



The effect root rots have on yield in wheat

Amelia Foster², Johnathan Antholz¹, Myron Bruce¹, Lawrence Tidakbi¹,
Dylan Mangel³, Nar Ranabhat⁴, Mark Davis¹, Nick Beyer¹, and Jessica Noller¹

Kansas State University, Department of Plant Pathology¹, Fort Hays State University² Department of Plant Pathology,
University of Nebraska, Lincoln³, Department of Plant Pathology and Entomology, University of Tennessee, Nashville Tennessee⁴



Objective

- The objective of this study is to quantify the yield that is lost due to infection of *Fusarium*, *Pythium*, and *Rhizoctonia* root rot pathogens under field conditions.

Background

- Annual wheat production is threatened by fungal and oomycete pathogens that reduce stand, root function, and grain yield.
- Common symptoms are seeding damping off, root discoloration, crown rot, reduced tillering, and premature plant senescence.
- Root Rots affecting wheat in Kansas and included in this study are *Fusarium graminearum*, *Fusarium pseudograminearum*, *Pythium ultimum*, *Pythium irregulare*, and *Rhizoctonia solani*
- Quantifying yield loss that these pathogens is vital to determining their economic impact.

Methods

- A root rot trial was established at Rocky Ford Experiment Station in the fall of 2019.
- The experiment was designed as a randomized complete block design with three replications.
- Four treatment strips were established by rep and each treatment strip contained ten experimental subplots (1.52m x 4.57m), resulting in 120 total (Figure 1., Figure 2.)

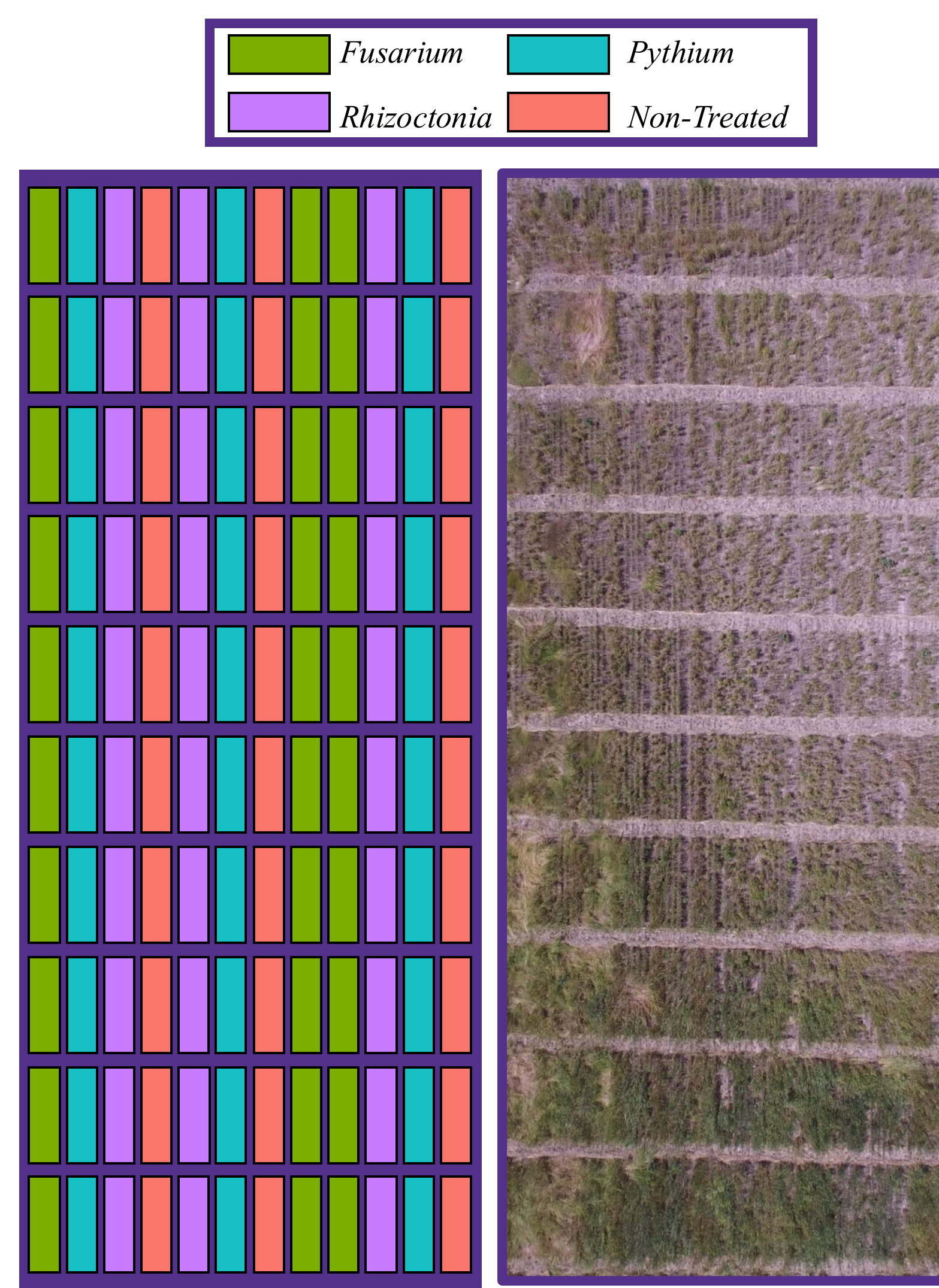


Figure 1: Diagram of Root Rot field map

Figure 2: Ortho mosaic of the Root Rot field in 2020

Methods Continued

- Each pathogen was cultured on a species appropriate media.
- Whole oats were sterilized and infested with a plug of each pathogen species and allowed to grow, then were dried.
- Wheat was planted every other year when the 2” soil depth temperature was below 15.5°C. Infested oat kernels were inoculated in-furrow.

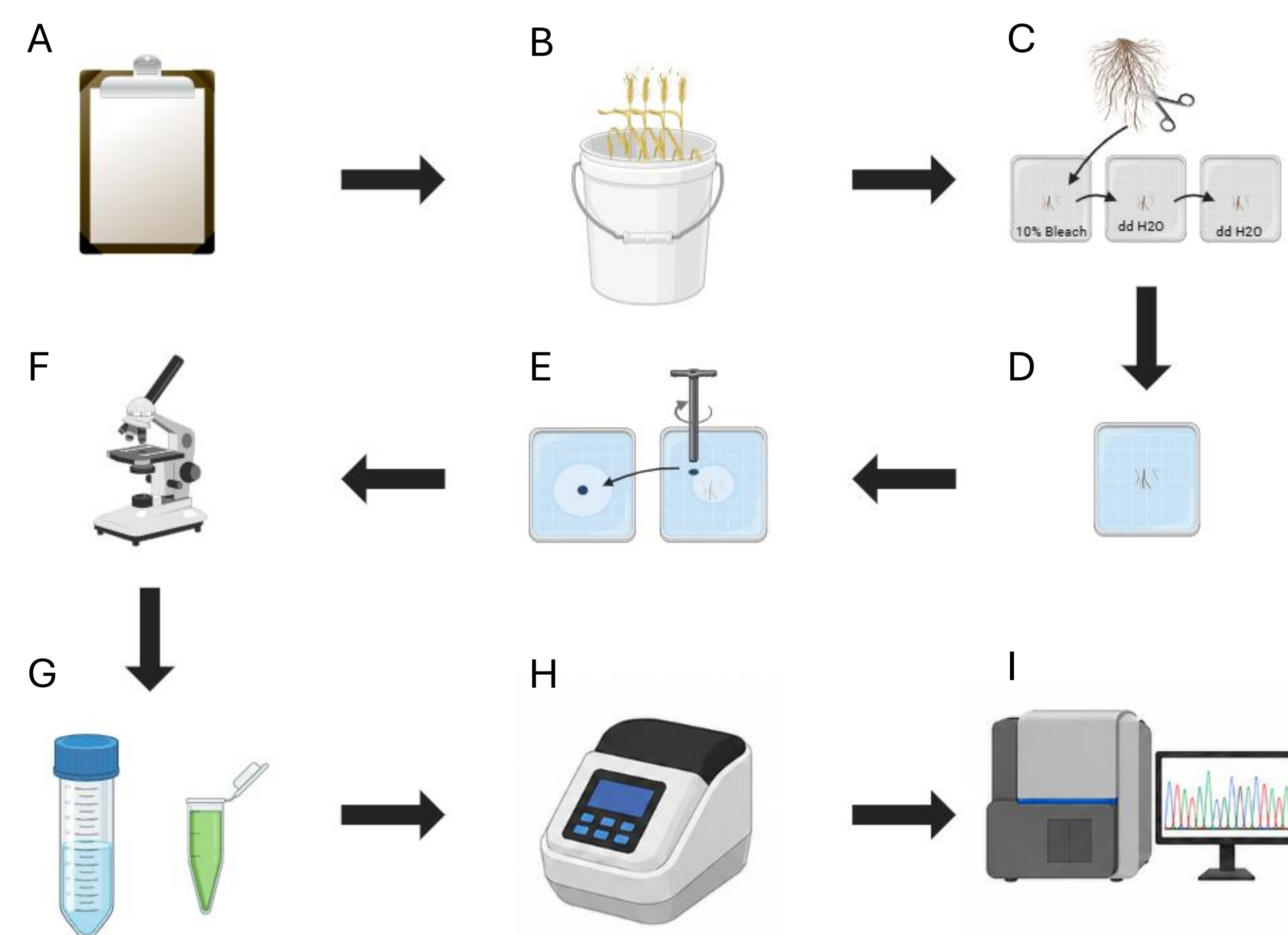


Figure 3: Flowchart of methodologies used in-season. **A.** Field notes were taken on vigor and indirect disease ratings. **B.** Two plants per strip were sampled to observe and confirm pathogen presence. **C.** Roots were cleaned, and root cuttings (2cm) were cut, underwent surface sterilization and rinsing **D.** plated on water agar. **E.** Following a growth period, pathogens were sub-cultured onto appropriate media. **F.** Morphological characteristics of the pathogens were observed. **G.** Each plate underwent DNA extraction, followed by **H.** PCR analysis of the ITS region, and were then sent for **I.** DNA sequencing at McLab.

- Pathogen identity was confirmed via morphological and molecular methods initially, and in each subsequent growing season.
- Plants were rated for vigor assessing plant growth, stand uniformity and leaf color.
- Indirect disease ratings were taken on a 1 to 9 scale.
- Force tests were done on each plot on a 1 to 9 scale.
- Two plants per strip were sampled for analysis.
- Yield was recorded by plot in kg.

Results

- Plants effected by root rots have a significantly smaller root zone (Figure 4).

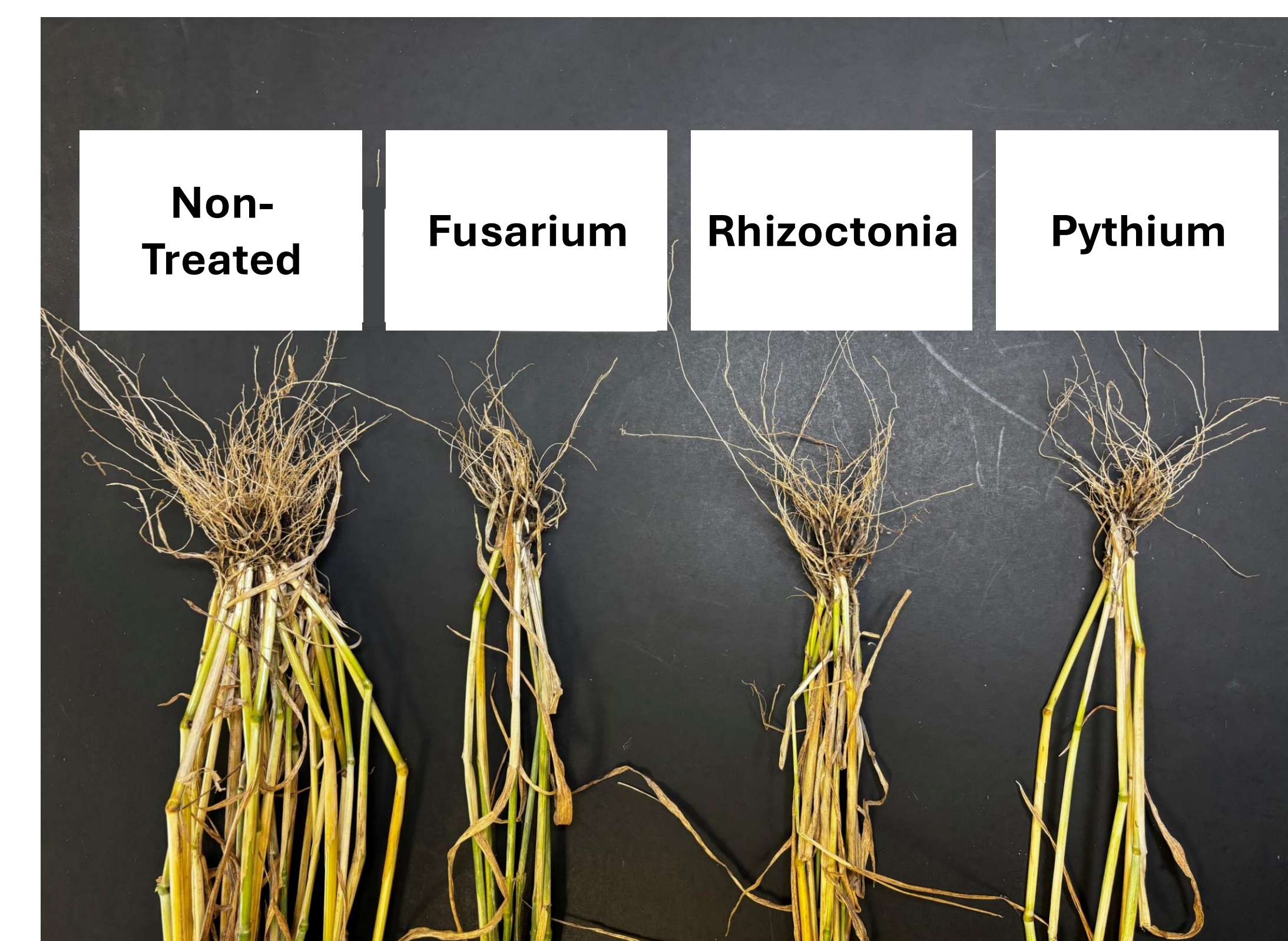


Figure 4: Wheat crowns and roots. From left to right: Non-treated control, Fusarium, Rhizoctonia, and Pythium. Wheat roots infected with root rot pathogens display compromised root structures. PC: Johnathan Antholz, 2026

- In 2020 and 2024 there was a statistical significance in yield loss when comparing *Fusarium*, *Pythium*, and *Rhizoctonia* to the non- treated plants.

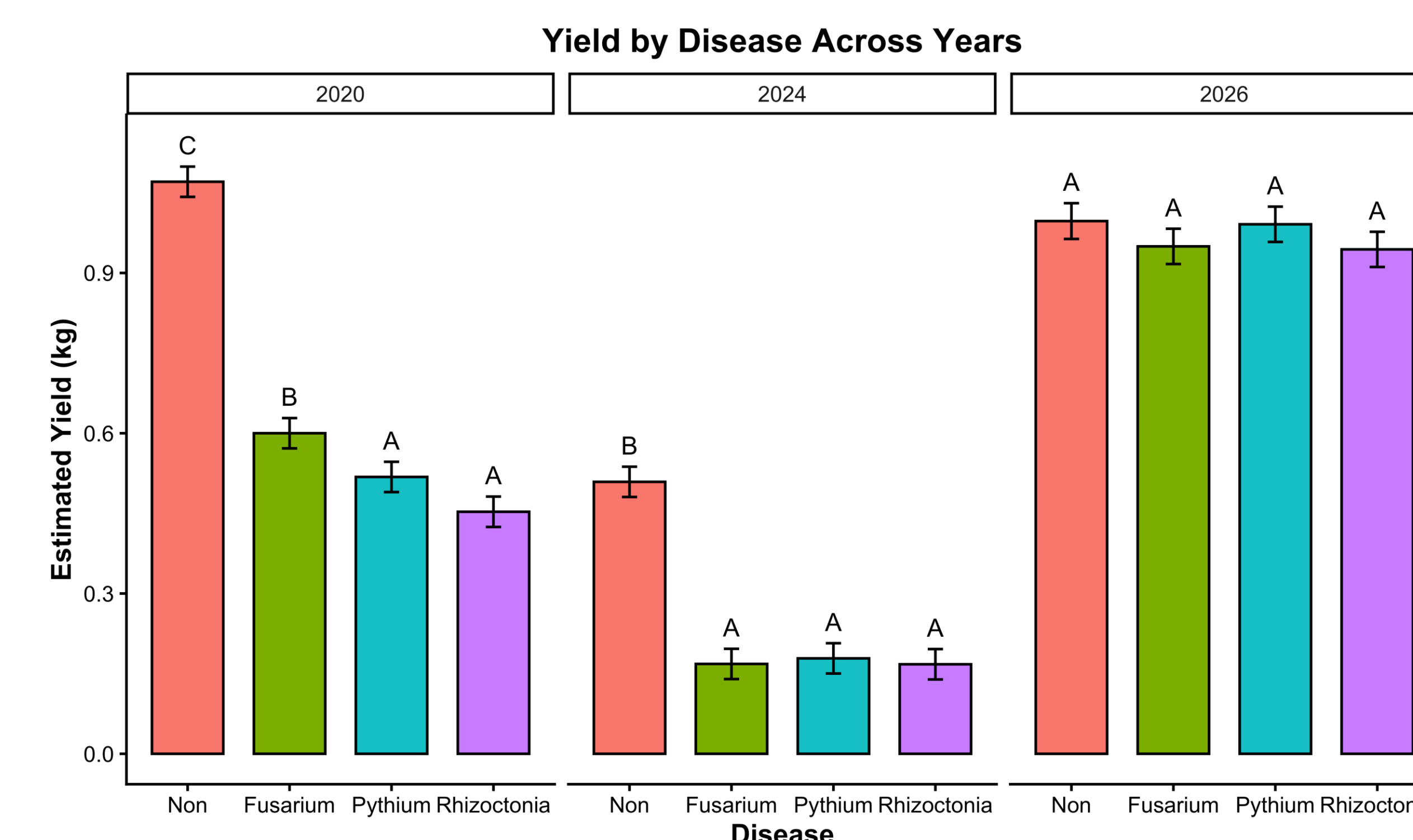


Figure 5: Yield by Disease across years. Linear mixed-effects models were used to evaluate the effects of disease treatment and year on wheat yield. Treatment means were separated using Fisher's protected LSD, and comparisons with the non-inoculated control were conducted using Dunnett's test ($\alpha = 0.05$) using R Studio Version 2026.06.0+242 (2026.06.0+242).

- In 2026 there in not a statistical difference in treated verses non-treated.

Conclusion

- Measurable yield loss can be attributed to root rot pathogens
- Producers should use a seed treatment to protect their crop yield