Project: "Mitigating soybean root and seedling diseases in Kansas." (C.R. Little, PI, KSU)
Spring 2024 Progress report:

1. Discover resistance to *Fusarium* seedling diseases, sudden death syndrome (SDS), and charcoal rot in germplasm with abiotic stress resistance traits.
2. Evaluate management strategies for soybean seedling and root diseases.
3. Assess the impact of re-emerging root pathogens: *Phytophthora sojae* in Kansas.
4. Develop and communicate management considerations based on objectives 1, 2, and 3.

OBJ 1.

The primary activities associated with this objective have been on the pathogen side. We have screened multiple isolates of root and seedling-associated *Fusarium* spp. against soybeans ('AG3403') in a rolled-towel pathogenicity assay and obtained germination and root length data. On average, *Fusarium proliferatum* and *F. reticulatum* isolates from Kansas soybeans showed the greatest negative impact on seed germination in the pathogenicity assay (Figure 1). Analysis of root length is currently underway. Focus was placed on completing this data set for an upcoming journal publication, which is in preparation.

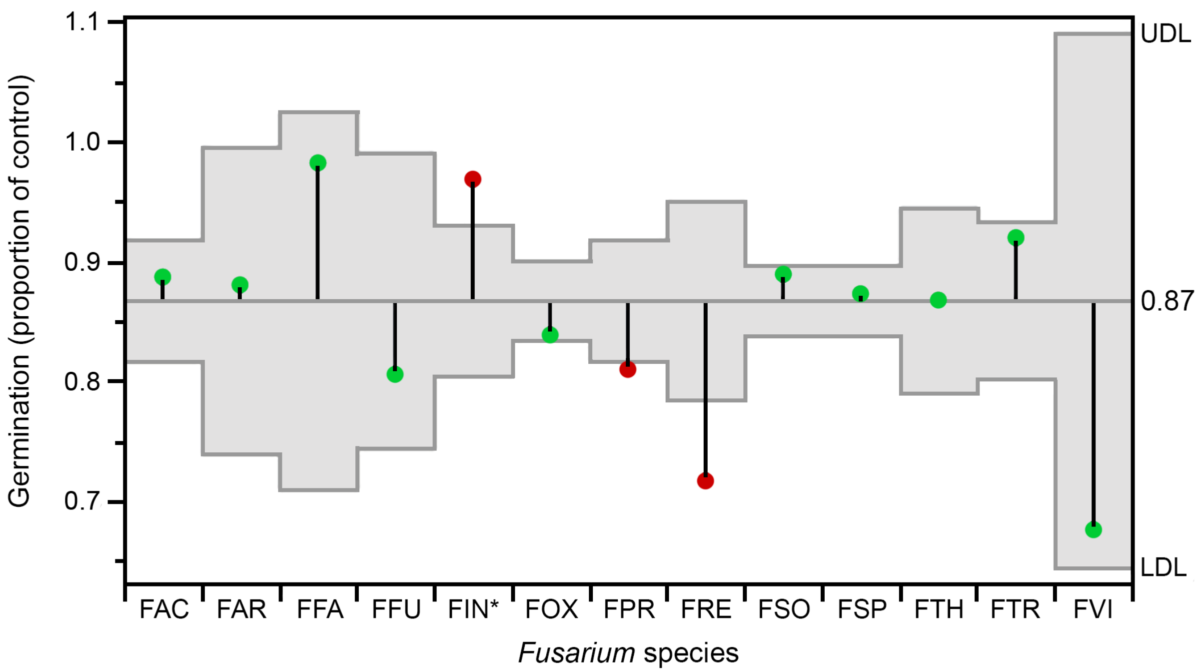


Figure 1. Relative germination (proportion of control) of Fusarium spp. comparred to the overaall mean. Red dots indicate species averages that are significantly different than the overall mean germination across *Fusarium* species compared. *Abbreviations:* FAC = *Fusarium acuminatum*, FAR = *F. armeniacum*, FFA = *F. falciforme*, FFU = *F. fujikuroi*, FIN = *F. incarnatum*, FOX = *F. oxysporum*, FPR = *F. proliferatum*, FRE = *F. reticulatum*, FSO = *F. solani*, FSP = *Fusarium* spp. (unidentified), FTH = *F. thapsinum*, FTR = *F. tricinctum*, and FVI = *F. virguliforme*; UDL = upper decision limit, LDL = lower decision limit.

Abiotic stress resistance traits:

In addition, 47 plant introductions (PIs) with heat tolerance, 151 PIs with halotolerance, and 360 PIs with chlorosis scores of '1' have been identified from the GRIN database that may have the potential for pathogen screening to integrate abiotic stress tolerance with root and seedling *Fusarium* disease resistance. Integrating these with charcoal rot resistance, to the extent that it exists, is also of interest. For example, Figure 2 shows a range of PIs that are rated to have "high germinability" under heat stress and their corresponding yield. Selection of PIs that have higher yield backgrounds, heat stress tolerance, and resistance to *Fusarium* spp. and charcoal rot would be of interest.

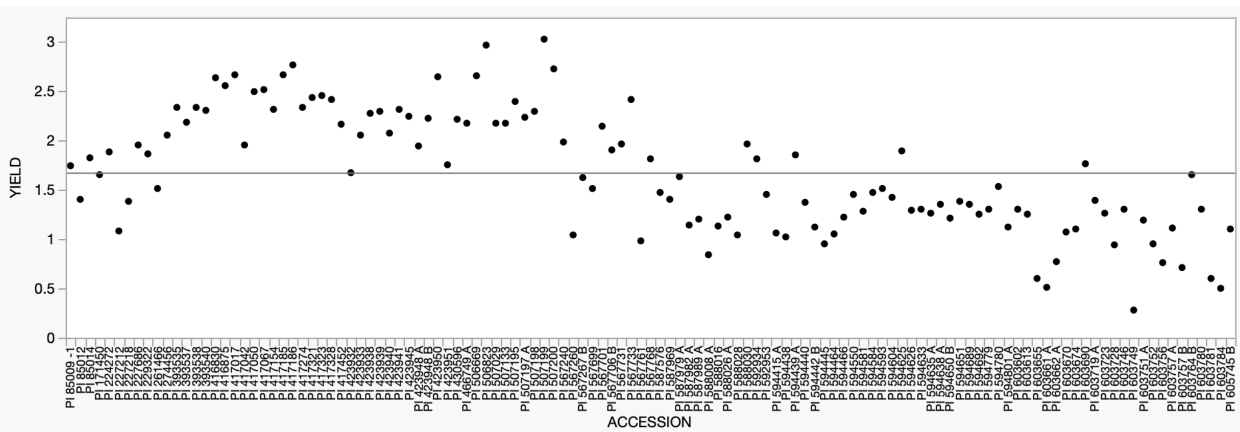


Figure 2. Heat tolerant soybean PIs (x-axis) and yield (y-axis; Mg/ha). The central gray line is the average yield across all the heat tolerant soybean PIs.

OBJ 2.

The primary activities associated with this objective have been testing *Fusarium proliferatum* isolates against strobilurin fungicides. An undergraduate, Hutch Turner, is working on this and has completed a set of 30+ *F. proliferatum* isolates and their growth on azoxystrobin (Figure 3). This data is still being analyzed and EC_{50} calculations need to be performed. However, there are differential levels of sensitivity to this common seed treatment active ingredient by the various *F. proliferatum* isolates. Hutch will also extract DNA and perform PCR on all isolates using species-specific primers to ensure the proper identification of these pathogens.

OBJ 3.

Numerous soil and plant samples have been obtained from southeast Kansas at both experiment station sites and cooperator farmers' fields. These samples have been collected a pre-, mid-, and post-season time points. *Phytophthora*-specific primers are being used to amplify whole soil DNA and seedling/root DNA to detect the presence of *P. sojae*. In addition, traditional culturing approaches are being used. Also, other pathogens, such as *Diaporthe* spp. are quite common in this production area and co-exist with *Macrophomina*, *Fusarium*, and other root pathogens of interest. An undergraduate student, Timothy Pearce, has worked on isolations from southeast Kansas soybean roots and has obtained numerous isolates (Figure 4). He will isolate DNA from all samples and conduct pathogen-specific PCR to determine pathogens present. In his and other ongoing work, we have observed (and detected) *Diaporthe* spp., *Fusarium* spp., *Didymella* spp., *Rhizoctonia, Phoma*, and *Epicoccum* spp. from mixed infections. So far, Phytophthora isolations have remained a challenge because of the preponderance of some of these other pathogens. We have been able to detect *Phytophthora sojae* in whole soil DNA from several field sites around the state (Figure 5).

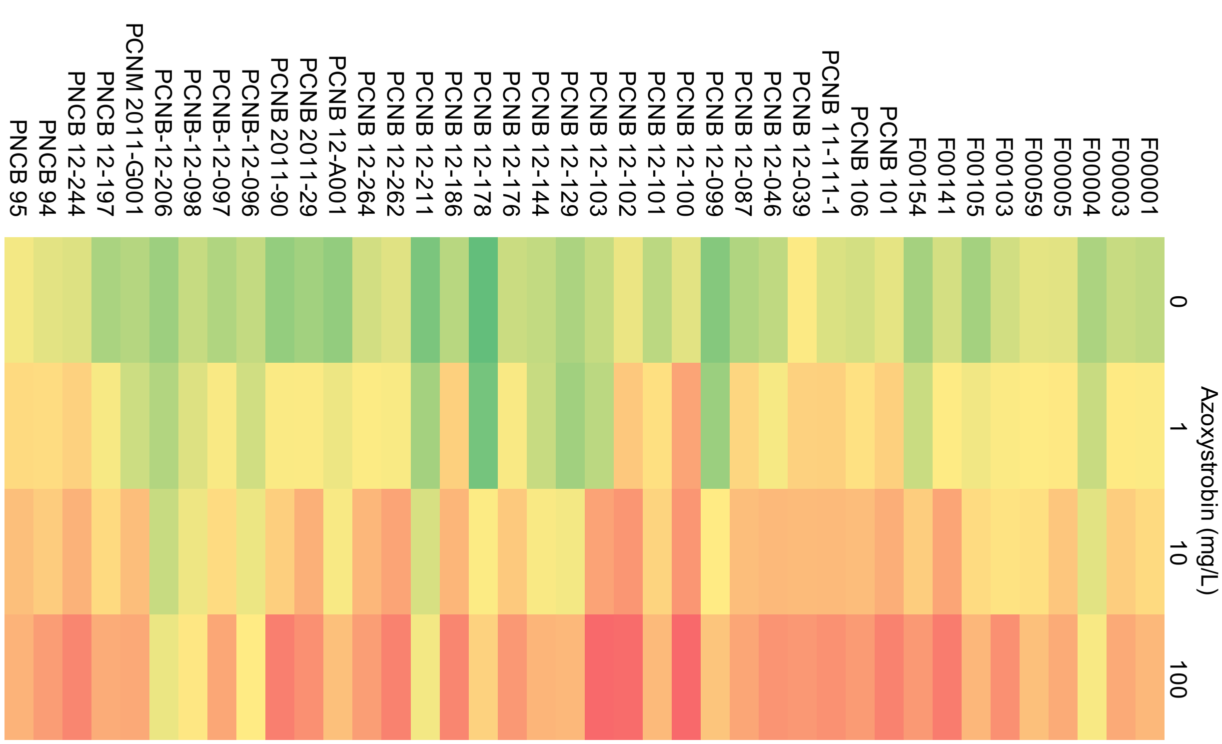


Figure 3. Growth of *Fusarium proliferatum* isolates (top) on increasing concentrations of the seed treatment active ingredient azoxystrobin (side). Green shading indicates increased growth, whereas red shading indicates decreased colony growth.

OBJ 4.

Information and updates that come from these studies are communicated by the Row Crops Extension Pathologist, Rodrigo Onofre, at grower meetings, radio interviews, field days, and other opportunities for interaction. A potential goal would be to develop a soybean seedling and root disease extension publication for Kansas in the future.

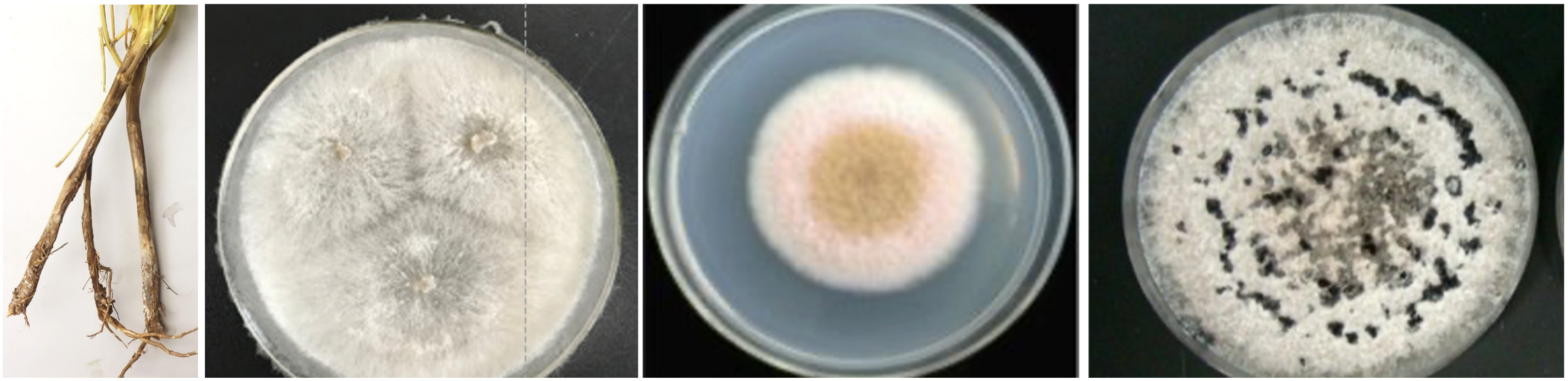
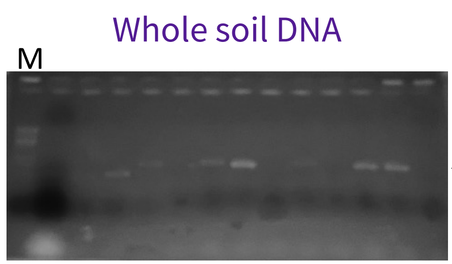


Figure 4. Typical root symptoms observed from soybeans collected in many southeastern Kansas fields (top). Examples of potential root pathogens isolated from soybean root tissues.



◄ *Phytophthora sojae*-specific primers

PSOJF1 5'-GCCTGCTCTGTGTGGCTGT-3'
PSOJR1 5'-GGTTTAAAAAGTGGGCTCATGATC-3'
(Bienapfl et al., 2011)

Sample locations

M = Size marker
1 = Blank
2,3 = Girard, Crawford county
4,5 = Fort Scott, Bourbon county
6,7 = Labette, Bartlett county
8,9 = Piqua, Woodson county
10,11 = Franklin, Ottawa county
12 = Blank

Figure 5. Potential detection of *Phytophthora sojae* in Kansas production fields using whole soil DNA and *P. sojae*-specific primers.