SUGARBEET PATHOLOGY LABORATORY: SUMMARY OF 2024-2025 FIELD SAMPLES

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INTRODUCTION AND OBJECTIVES

Each growing season, the Sugarbeet Plant Pathology Laboratory at the University of Minnesota, Northwest Research and Outreach Center in Crookston, MN, receives sugarbeet samples exhibiting disease, insect, or abiotic injury symptoms for diagnostic evaluation. The 2024 and 2025 seasons continued to reflect the dynamic nature of sugarbeet diseases in the American Crystal Sugar Company and Minn-Dak Farmers Cooperative growing districts in the Red River Valley of Minnesota and North Dakota, as well as the Southern Minnesota Beet Sugar Cooperative growing district. Variation in disease prevalence was influenced by fluctuating weather conditions and changing field environments. Notably, these years included expanded analysis of foliar diseases, in addition to the continued monitoring of major root pathogens such as *Rhizoctonia solani*, *Aphanomyces cochlioides*, and *Fusarium* spp. The following sections summarize diagnostic results and the observed trends for root and foliar diseases during 2024 and 2025.

MATERIALS AND METHODS

Accurate disease diagnosis depends heavily on the quality and condition of submitted samples. For root samples, plants exhibiting clear symptoms should be collected but those that are extensively decayed should be avoided, as secondary fungi can obscure primary pathogens. Roots should be placed in a resealable plastic (ziplock) bag containing a moist paper towel to maintain humidity without excessive free water. The likelihood of pathogen recovery is highest when samples are submitted the same day they are collected.

For leaf samples, place leaves in a resealable plastic bag with a dry paper towel to regulate humidity. Avoid leaving samples in vehicles or exposed to temperature extremes, as large fluctuations can accelerate tissue breakdown and reduce diagnostic quality.

Field sample submission forms are available on the Northwest Research and Outreach Center website: https://nwroc.umn.edu/research/sugar-beet-pathology

Upon receiving root samples, diseased sugarbeet roots were washed and photographed prior to sample preparation. Symptomatic tissue was excised, surface-sterilized in 0.5% sodium hypochlorite (NaOCl) for 30 s, rinsed twice with sterile deionized water, and placed into ultrafiltered deionized water. Following 24 to 48 h incubation at 21 ± 2 °C, roots were examined microscopically to confirm the presence of zoospore clusters characteristic of *Aphanomyces cochlioides* or right-angled hyphae typical of *Rhizoctonia solani*. Roots exhibiting symptoms consistent with *Fusarium* spp. infection were washed using the same procedure and plated onto acidified potato dextrose agar (APDA). After 5 to 7 days of incubation, colony morphology was used for preliminary identification. Single-spored *Fusarium* cultures were obtained for species-level identification by DNA extraction using a modified protocol using Wizard Genomic DNA purification kit (Promega) components and targeted sequencing of the translation elongation factor 1-α loci (EF1/EF2; O'Donnell et al. 1998). Species-level identification of *Colletotrichum* spp. isolates was conducted by using ITS1-F/ITS4 (Gardes and Bruns 1993; White et al. 1990), actin (ACT; Carbone and Kohn 1999), and β-tubulin (Btub; Woudenberg et al. 2009) primer sets.

Upon receiving leaf samples, representative leaves were chosen and photographed. Representative leaf spots or lesions were excised and placed in bi-plate Petri dishes lined with absorbent paper saturated with sterile deionized water. One side of the paper was coated with an impermeable polyethylene and positioned face-up to maintain contact with the leaf tissue; plates were sealed with Parafilm. After 24 to 48 h incubation at 21 ± 2 °C under combined UV and fluorescent light with a 12 h light/dark cycle, conidia produced within lesions were examined

microscopically. Single-spore cultures of *Alternaria* spp. and *Stemphylium* spp. grown on clarified V8 agar (CV8) were subjected to same DNA extraction protocol stated above, followed by PCR amplification and sequencing gene fragments of the internal transcribed spacer region (ITS1-F/ITS4; Gardes and Bruns 1993; White et al. 1990), calmodulin (CALD; Lawrence et al. 2013) and plasma membrane ATPase (Lawrence et al. 2013) loci.

Leaf spots that lacked visible fungal sporulation were tested for bacterial streaming by submerging symptomatic tissue in ultrafiltered deionized water and observing for exudate under a stereomicroscope. Suspect lesions were then excised and homogenized in potassium phosphate buffer (0.05 M) within 2 mL microcentrifuge tubes. After a 10-min incubation at room temperature, the suspension was diluted 1:10 and streaked onto nutrient broth yeast extract (NBY) agar to obtain single bacterial colonies. Single-colony cultures were grown in nutrient broth at 28°C on a shaker overnight prior to DNA extraction using the Wizard Genomic DNA purification kit (Promega). Representative isolates were subjected to targeted sequencing of the 16S-23S rRNA intergenic region (Guasp et al. 2000; Jensen et al. 1993) and housekeeping genes sigma factor 70 (*rpoD;* Sarkar and Guttman 2004), and gyrase B (*gyrB;* Sarkar and Guttman 2004) for species-level characterization.

RESULTS AND DISCUSSION

In 2024, sugarbeet root samples were received from 38 fields (254 individual roots). Of those fields, *R. solani* was identified from 25 fields (65.8%), *A. cochlioides* was identified from 4 fields (10.5%), and *Fusarium* spp. were identified from 6 fields (15.8%). Both *Fusarium oxysporum* and *Fusarium secorum* are typically isolated from sugarbeet roots with symptoms of Fusarium Yellows. There were 6 fields (15.8%) affected by possible environmental causes as no plant pathogens were detected, and 1 field (2.6%) had suspected sugarbeet root maggot injury (Fig. 1). In contrast, there was a lower number of submissions in 2025 (14 fields; 113 roots), but *R. solani* remained the dominant pathogen, detected in 10 fields (76.9%). *Aphanomyces cochlioides* was identified from 2 fields (15.4%), and *Fusarium* spp. were identified in 3 fields (23.1%) (Fig. 1). Wind damage affected 2 fields (15.4%) and unknown environmental issues affected 1 field (Fig. 1). *Colletotrichum* spp. were also identified in 2 fields (3.3%) in 2024, affecting the petioles of sugar beets and were associated with *R. solani* infections; a majority of isolates were identified as *Colletotrichum incanum*. In 2025, several fields had multiple issues; from the list above, 2 fields were affected by both *Rhizoctonia* and *Aphanomyces*, 2 fields were affected by both *Rhizoctonia* and *Fusarium*, and 1 field was affected by both *Rhizoctonia* and wind damage.

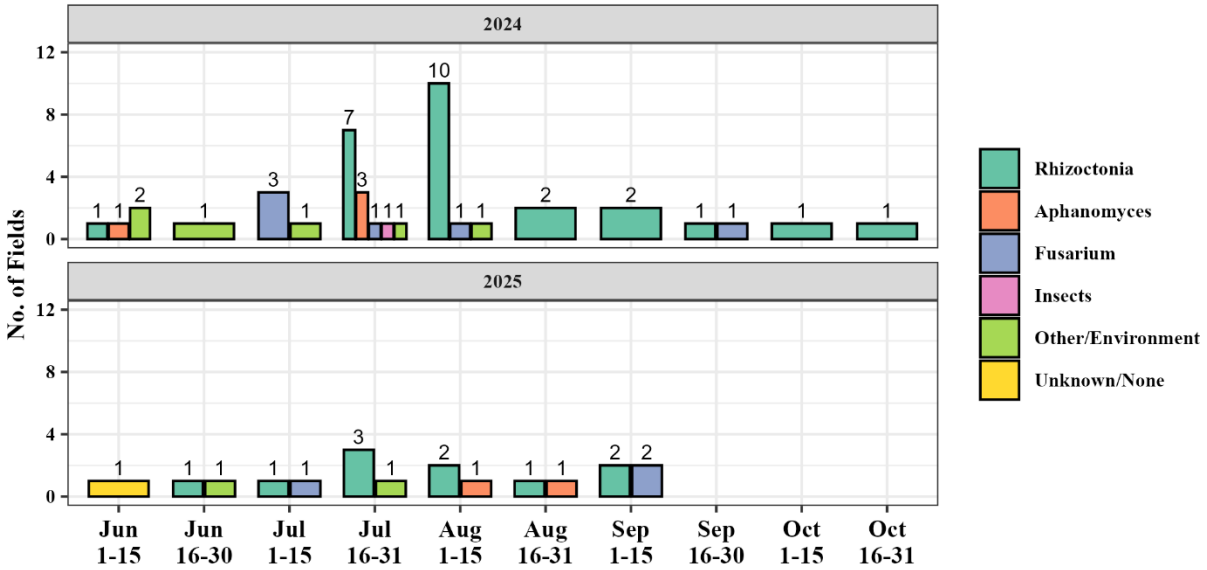

Fig. 1. Summary of sugarbeet root disease samples received by the Sugarbeet Plant Pathology Laboratory, University of Minnesota Northwest Research and Outreach Center, Crookston, MN in 2024 (top) and 2025 (bottom). Bars represent the number of fields diagnosed with each causal agent by the date range when samples were received.

The co-occurrence of *Rhizoctonia* with either *Aphanomyces* or *Fusarium* observed in several fields suggests overlapping environmental favorability for these pathogens. Rainfall patterns were notably different between 2024 and 2025 (Fig. 3). Spring and early-summer rainfall in 2024 was near or above the five-year average, while 2025 was drier with more localized precipitation (Fig. 3). The onset of *Aphanomyces* symptoms in early June corresponded with periods of saturated soils, whereas *Rhizoctonia* incidence peaked later in the season (July–August) under warmer, drier conditions following periods of saturated soil. *Fusarium* spp. were recovered sporadically from late June through September, often in fields planted with sugarbeet varieties susceptible to *Fusarium* spp.

Leaf diseases were increasingly prevalent in 2024 and 2025, marking a broader diagnostic focus compared to previous years. In 2024, leaf samples were received from 61 fields (454 leaves for a total of 3900 individual spots), and in 2025 from 21 fields (131 individual leaves; 1050 individual spots). *Cercospora beticola* remained the most common foliar pathogen, detected in 51 fields (83.6%) and 16 fields (76.2%) in 2024 and 2025, respectively (Fig. 2). However, the increasing frequency of *Alternaria* spp. and *Stemphylium vesicarium* was notable. In 2024, *Alternaria* spp. were present in 46 fields (75.4%), and *S. vesicarium* was present in 22 fields (36.1%), whereas *Alternaria* spp. were present in only 10 fields (47.6%) and *S. vesicarium* was not present in any field sample in 2025 (Fig. 2). *Alternaria* spp. and *S. vesicarium* were frequently observed within the same leaf spot.

In 2024, mean temperatures during June were notably cooler than normal, especially in the northern growing districts (Fig. 4), with frequent periods of moderate rainfall. These conditions likely favored the increased incidence of Alternaria and Stemphylium leaf spots, which are commonly associated with cooler, moist environments and physical injury to foliage caused by wind, hail, or other environmental stressors that compromise leaf tissue integrity. Two years of inoculated field trials (2024 and 2025) with *A. alternata* and *S. vesicarium* collected from Minnesota in the 2022 growing season have been conducted to better understand their pathogenicity, their interaction with sugarbeet varieties, and the efficacy of standard fungicide spray programs for management of leaf spot diseases caused by these pathogens. Results from these field trials will be summarized in a future manuscript.

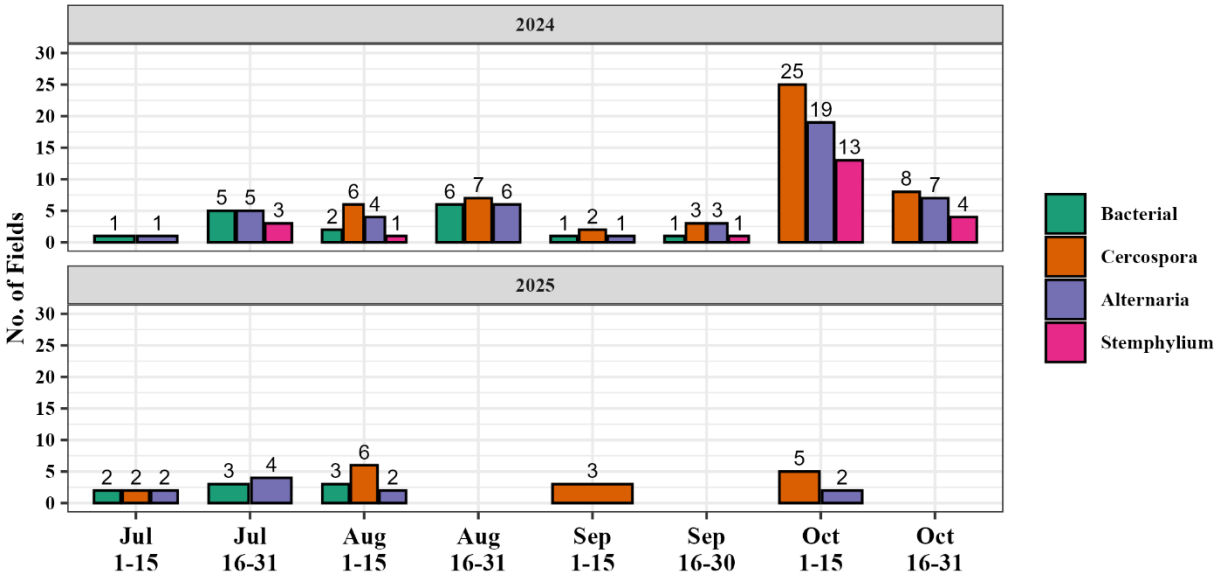

Fig. 2. Summary of sugarbeet foliar disease samples received by the Sugarbeet Plant Pathology Laboratory, University of Minnesota Northwest Research and Outreach Center, Crookston, MN in 2024 (top) and 2025 (bottom). Bars represent the number of fields diagnosed with each causal agent by the date range when samples were received.

Additionally, samples from 16 fields (26.2%) in 2024 and samples from 8 fields (38.1%) in 2025 were inconsistent with typical leaf spot symptoms, lacked fungal sporulation, and aligned with bacterial leaf spot symptoms. Cultures from these lesions yielded bacterial isolates currently being characterized through targeted gene sequencing as well as whole-genome sequencing to improve species-level identification. In addition, controlled growth chamber trials have been conducted to evaluate the pathogenicity of the bacterial strains collected in 2024. Results from these

studies are summarized in a separate report. Weather patterns during 2024 and 2025 appeared to strongly influence the type and severity of foliar diseases observed. Wind events and canopy injury observed in both seasons may have further facilitated infection by opportunistic bacterial pathogens.

Diagnostic results from 2024 and 2025 highlight the continued dominance of *Rhizoctonia solani* among root pathogens and the growing importance of leaf diseases in regional sugarbeet production. The increasing occurrence of opportunistic fungi and bacterial leaf spots underscores the influence of weather-related stress and canopy injury on disease development. Ongoing molecular and pathogenicity studies will refine species identification and improve understanding of emerging foliar and bacterial pathogens affecting sugarbeet in Minnesota and North Dakota.

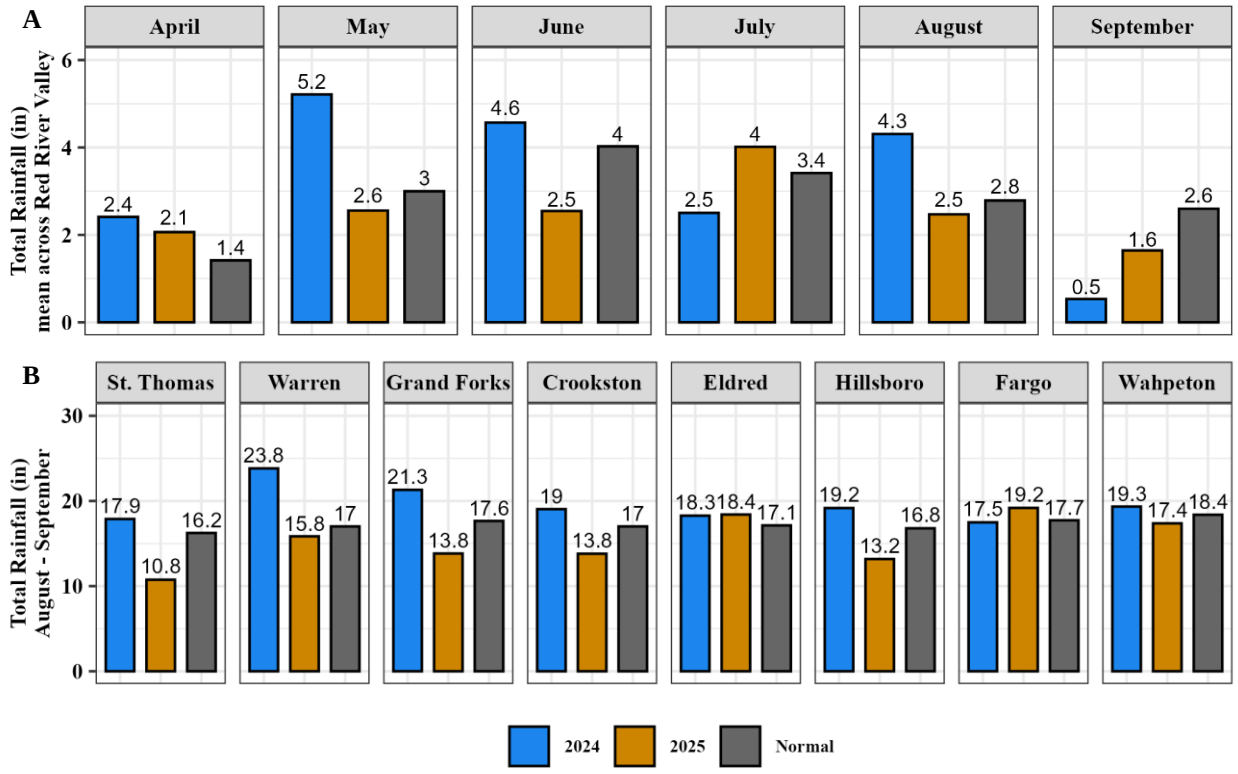

Fig. 3. Total rainfall recorded by the North Dakota Agricultural Weather Network (NDAWN) at eight locations in the Red River Valley (St. Thomas, Warren, Grand Forks, Crookston, Eldred, Hillsboro, Fargo, and Wahpeton). Rainfall is reported in inches for the growing season months of April through September in 2024 and 2025 compared to the 30-year average (normal). Rainfall is reported by **A.**) month (mean of all eight locations) and **B.**) location (total from April through September).

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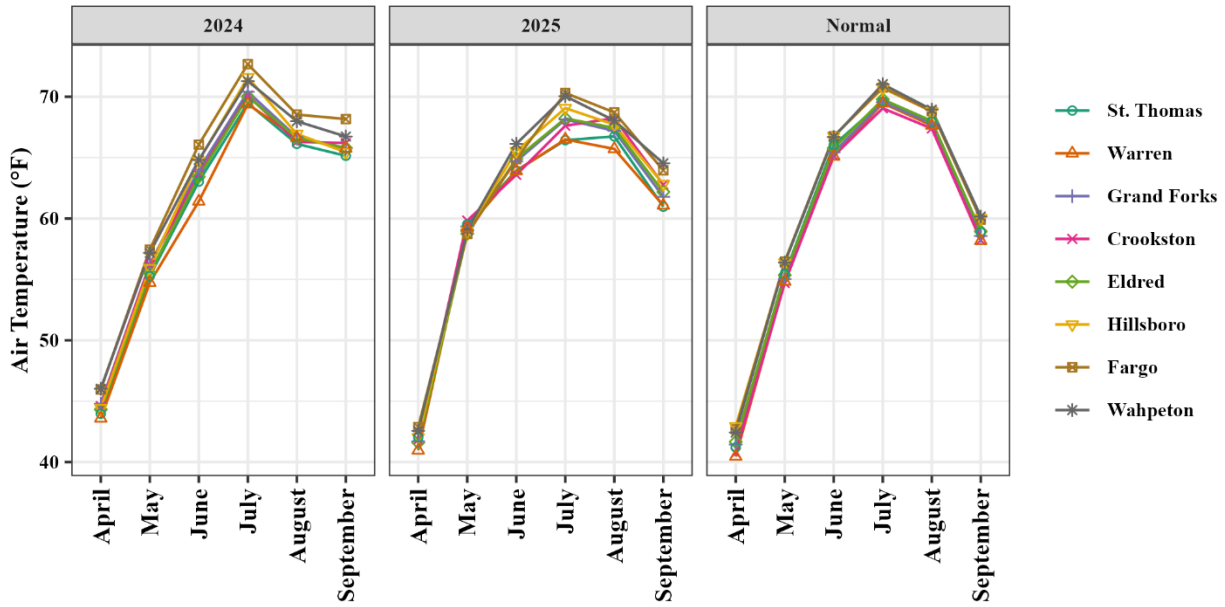

Fig. 4. Mean monthly air temperature recorded by the North Dakota Agricultural Weather Network (NDAWN) at eight locations in the Red River Valley (St. Thomas, Warren, Grand Forks, Crookston, Eldred, Hillsboro, Fargo, and Wahpeton). Temperature is reported in Fahrenheit for the growing season months of April through September in 2024 and 2025 compared to the 30-year average (normal).

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