EPIDEMIOLOGICAL STUDIES OF CERCOSPORA LEAF SPOT OF SUGAR BEET FOR IMPROVED MANAGEMENT

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Cercospora leaf spot (CLS), caused by the fungal pathogen *Cercospora beticola*, is a major foliar disease of sugar beet in the Great Lakes region. In Michigan and Ontario, Canada, CLS management has proved difficult with increased *C. beticola* inoculum survival following high disease pressure in the field. Recent studies have indicated a potential for underprediction in certain disease models, suggesting that recommended spray timing may need revision for current fungicide usage. In this research, methods to reduce inoculum survival and ways to incorporate spore presence into prediction models were investigated.

Spore abundance and environmental factors were monitored in two locations in 2019 for use in model development. Using this data, a preliminary model ($R^2 = 0.23$, $P < 0.0001$) was developed to predict daily *C. beticola* spore abundance using daily precipitation ($r = 0.22$, $P = 0.05$), minimum daily relative humidity ($r = 0.24$, $P < 0.01$), maximum daily soil temperature ($r = -0.24$, $P < 0.01$), and maximum daily wind speed ($r = 0.38$, $P < 0.0001$). *Cercospora beticola* spore presence and abundance were monitored using mechanical and live spore traps in multiple locations in Michigan and Ontario, Canada over two years. Environmental factors were tested for correlations to spore abundance and used to model spore counts. Environmental variables with notable correlations to spore abundance include maximum and minimum air temperature (r = 0.35, $P < 0.0001$; r = 0.33, $P < 0.0001$), minimum and maximum soil moisture (r = 0.22, $P = 0.0132$; r = 0.22, $P = 0.0136$), maximum wind speed (r = 0.17, $P = 0.0630$), and precipitation (r = 0.12, $P = 0.1099$). Additional locations and years will be added to these observations for further model refinement and validation. A preliminary model will be used in field validations conducted in 2021.

Along with developing a preliminary model to predict *C. beticola* spore abundance, reducing the amount of inoculum before the growing season could improve CLS management. In this study, three fall treatments aimed at inoculum reduction, including plowing, foliar heat treatment, and foliar desiccation, were compared to a non-treated control. After end-of-season treatments, leaf samples taken at harvest were evaluated and leaf samples left in the field were assessed 45-, 90, and 135-days to determine *C. beticola* viability. During the following season, susceptible beets were planted in the same plots, and disease ratings were recorded and lesions on sentinel beets were evaluated to determine inoculum levels present. In 2019, significant treatment differences were detected in percentages of lesion sporulation ($P < 0.0001$) and lesion viability ($P < 0.05$) in at harvest samples (N=133 leaves and 240 lesions) with notable reduction in the heat-treated samples. The heat-treated samples had a 71% reduction in mean sporulation and a 35% reduction in lesion viability compared to the nontreated control. In 2020, reduced numbers of CLS lesions were observed on sentinel beets (N = 1 box of 4 sugar beets per plot) collected in 2019 heat treated plots from May 26-June 1 ($P < 0.05$) and June 2-9 ($P < 0.01$). The heat treatment also significantly reduced the area under the disease progress curve (AUDPC), calculated from severity ratings collected from 16 June to 28 July the following season after treatment application ($P < 0.01$). Mean AUDPC was 8.5 for heat treated plots compared to 19.9 for the nontreated control. In the repeated trial initiated in 2020, lesion sporulation was reduced in at harvest ($P < 0.0001$), 45-days post-harvest ($P < 0.01$), and 90-days post-harvest samples ($P < 0.05$) with significant reductions in heat treated plots. The at-harvest samples for the 1 mph and 3 mph heat treatment showed a 78% and 70% reduction in sporulation, respectively, compared to the nontreated control. Both heat treatments and the plow treatment all had 0% mean sporulation compared to 22% and 7% mean sporulation in the nontreated control for the 45- and 90-days post-harvest samples, respectively. Percent leaf degradation was calculated using initial and final leaf weights for overwintering samples (N = 160 leaves for each timepoint). No significant differences were detected between treatments for percent leaf degradation of at harvest or 45-day post-harvest leaf samples ($P > 0.05$). Significant treatment differences were detected for percent leaf degradation in 90-days post-harvest samples ($P < 0.02$). The plow treatment (83% leaf degradation) and the 1 mph heat treatment (82% leaf degradation) had the highest numerical percentages of leaf degradation for 90-days post-harvest samples. Remaining leaf samples from inoculum overwintering studies will continue to be evaluated. In 2021, early-season spore presence and abundance, weekly disease ratings, and final yield and sugar data will be collected to validate the efficacy of inoculum reduction strategies. The overwintering study has shown that the heat treatment, applied with a foliar burner at harvest, significantly reduced *C. beticola* sporulation, lesion viability, and the amount of disease the following season as compared to the other treatments. Therefore, heat treatment using a tractor-mounted foliar burner has the potential to significantly reduce inoculum levels and aid in CLS management in the field. These novel management practices will be further validated and could aid in sustainable management of CLS.