Inoculum reduction strategies tested in the field for improved management of Cercospora leaf spot on sugar beets, 2021-22

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Background: This research aims to identify, develop, and deploy novel, long-term CLS management strategies. Observations of *C. beticola* survival over the winter, early-season inoculum and spore presence, and disease pressure overtime have helped us to identify opportunities for further improvement in CLS management. End-of-season management strategies were assessed to reduce *C. beticola* inoculum levels and CLS disease pressure in the field.

Location: Saginaw (SVREC)	**Treatments:** described below
Planting Date: May 7, 2022	**Variety:** C-G932NT (Inoculated July 12, 2021)
Harvest: September 23, 2022	**Replicates:** 4

Methods: From 2021-22, experiments were conducted to evaluate the following fall treatments: **1)** nontreated control, **2)** Wheeler rye cover crop at 67 kg/ha planted immediately post-harvest, **3)** factory lime at 3 and **4)** 6 tons/acre applied immediately post-harvest, and **5)** propane-fueled heat treatment at 3 mph prior to defoliation. In 2021, treatments were applied to 10 x 60 ft plots, surrounded by a 10-ft buffer of soybean followed by winter wheat, and replicated four times in a randomized complete block design. Leaf samples were collected from each plot at harvest before topping and evaluated 0-, 35-, 70-, and 168-days post-harvest (DPH) to assess *C. beticola* survival over the winter, determined using the percentage of lesion sporulation and isolation frequency from treated leaves. Leaf degradation over time was also evaluated.

In 2022, highly susceptible sentinel beets (germplasm F1042) and bi-weekly CLS ratings in re-planted plots were used to assess the efficacy of inoculum reduction strategies. Yield and sugar data were collected to assess the long-term efficacy of inoculum reduction strategies. Statistical analyses (mixed model ANOVA) were conducted in SAS v. 9.4 and evaluated at the α=0.05 significance level. Fisher's protected Least Significance Difference was used for mean comparisons.

Summary: In 2021 (following treatment application), significant reductions in percent lesion sporulation were detected for 3 mph heat treated at-harvest ($P < 0.0001$, Fig. 1A) samples (N=160 leaves and 200 lesions per timepoint). No differences were detected in sporulation for 35-, 70-, and 168-DPH or isolation frequencies of *C. beticola* from leaf samples evaluated at-harvest, 35-, 70-, and 168-DPH. Additionally, no differences were observed in percent sugar or RWST following fall treatments. Significant differences in percent leaf degradation, calculated using initial leaf weight at-harvest and final weight post-harvest, were detected in 70-DPH ($P < 0.05$, Fig. 1B) leaf samples. In 2022 (the year following treatment application), significant differences were seen in number of lesions on sentinel beets. Numerical reductions in sentinel beet CLS lesions were seen in Week 1 (May 17-24), Week 2 (May 24-31), and Week 4 (June 15-22) in the cover crop treated plots and Week 1 and 2 for the 3-mph heat treated plots compared to the non-treated control (Fig. 2A, N = 60 beets per timepoint). Area under the disease progress curve (AUDPC) values were significantly different among treatments ($P < 0.001$, Fig. 2B & C); the cover crop and 3 mph heat treatment resulted in significantly lower CLS than the non-treated control. Results from experiments suggest the use of a foliar heat treatment at 3 mph and a rye cover crop treatment at-harvest could have some potential to significantly reduce CLS disease pressure the following year.

Acknowledgements: This work is supported by the Michigan Sugar Company, USDA-ARS, Project GREEEN, Sugarbeet Advancement, and the USDA National Institute of Food and Agriculture, Hatch project 1020281.

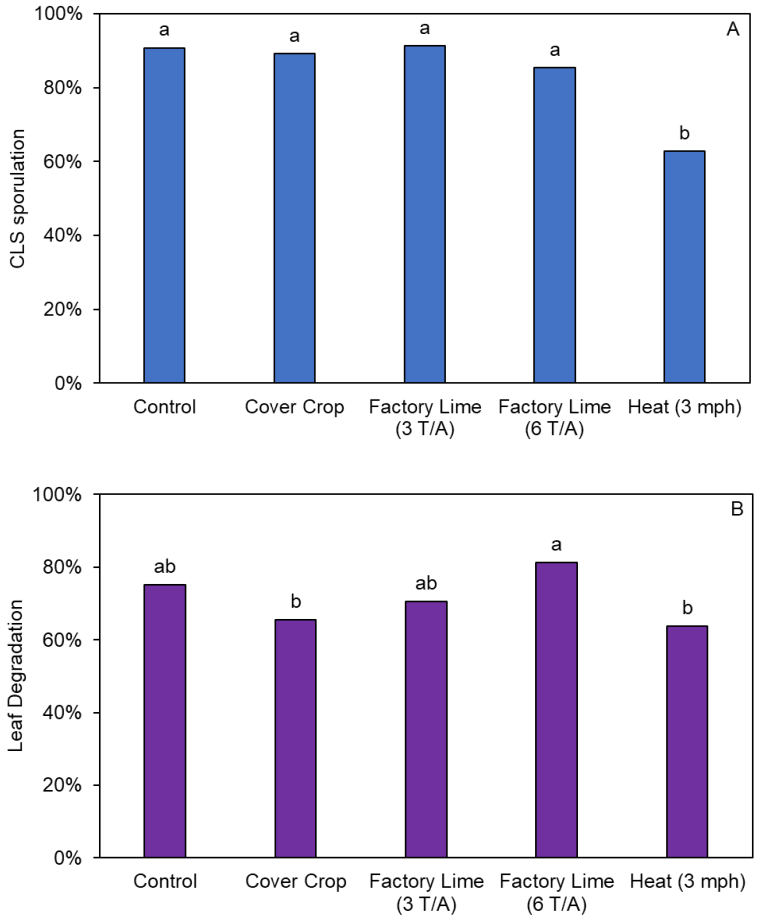
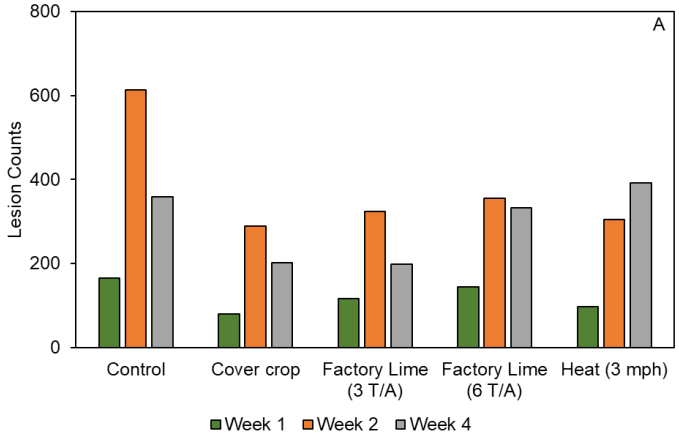


Figure 1. A) *90-day post-harvest lesion sporulation and* ***B)*** *leaf degradation following fall treatments applied in 2020. Leaf samples were weighed at initial and final collection from each treated plot, then placed in a moist chamber for three days. Then CLS lesions were assessed by observing characteristic C. beticola sporulation under a stereomicroscope (X7-X30 magnification). Means of bars with the same letters were not different based on Fisher's protected LSD at α=0.05.*

The 3-mph heat treatment significantly reduced sporulation over the winter. Leaf degradation for all treatments were not different from the control.



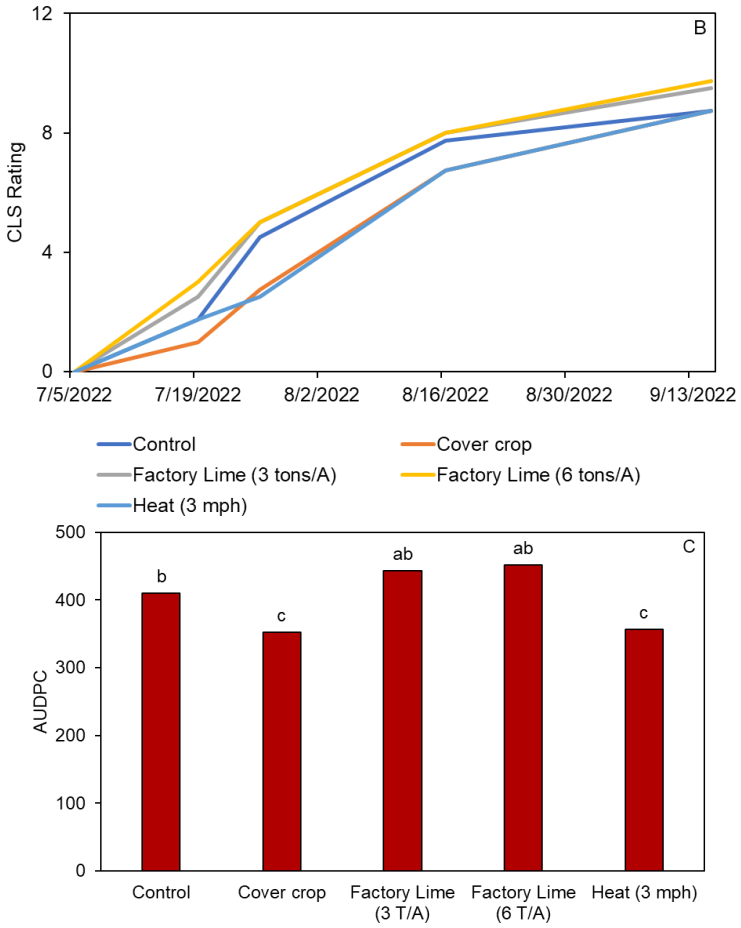


Figure 2. *Early-season inoculum and subsequent CLS observations in 2021 following end-of-season treatments applied in 2020.* ***A)*** *Spot counts were collected from four sentinel beets placed in the center of each treated plot, left for seven days, and quantified after 21 days.* ***B)*** *Progression of mean CLS severity ratings collected 7 July to 15 Sept.* ***C)*** *Area under the disease progress curve (AUDPC) generated from biweekly CLS ratings (0-10 scale). Means of bars with the same letters were not different based on Fisher's protected LSD at α=0.05.*

Decreased lesion counts were observed from mid-May to late June for the cover crop treatment. The cover crop and heat treatment reduced AUDPC and CLS ratings from late July to mid-August.