

Investigation of cover crops for *Cercospora* leaf spot control in sugarbeet

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Investigating the interactions between various cover crops and *C. beticola* could inform the potential use of these practices in CLS management. This study aims to determine the impact of common cover crops on *C. beticola* growth and CLS on sugarbeet in Michigan. This research will provide valuable insights for sustainable management strategies for CLS on sugarbeet.

Objective 1: Assess *in vitro* germling-induced inhibition of *C. beticola* for several cover crops

Methods: Seeds were surface disinfested, germinated, and plated adjacent to *C. beticola* isolates to assess inhibitory properties of five cover crop types compared to a no seed control. ‘Wheeler’ rye (*Secale cereale*), crimson clover (*Trifolium incarnatum*), yellow mustard (*Sinapis alba*), common oat (*Avena sativa*), and oilseed radish seeds (*Raphanus sativus*) (Johnny’s Selected Seeds, Winslow, ME) were placed on the opposite side of the media plate as a 5-mm plug from a pure culture of *C. beticola* isolate, ‘Blum 1-2’ or ‘RangeA’, 3 cm from the edge. Treatments were replicated four times. Isolate radial growth on the seed-bearing and seedless sides were measured using a digital caliper at one- and two-weeks after initiation of the experiment. Percent growth of *C. beticola* was calculated for each seed treatment, as well as the control plates without seeds, by dividing the seed side radius by the no-seed side radius.

Results: *In the absence of antibiotics*, only Crimson clover reduced the growth of *C. beticola* on sugarbeet leaf extract agar (SBLEA) after two weeks ($P < 0.01$; Table 1).

In the presence of antibiotics, Wheeler rye germlings significantly reduced *C. beticola* growth in both media types at two weeks ($P < 0.01$; Table 2). Common oat germlings significantly increased growth of *C. beticola* on soil extract agar (EA) with antibiotics after one week but not at two weeks or on SBLEA ($P < 0.05$; Table 3). Crimson clover, Defender oilseed radish, and yellow mustard did not significantly impact *C. beticola* growth ($P > 0.05$).

Table 1. Percent growth of *C. beticola* at 1 week and 2 weeks after placement adjacent to germinated seed of Crimson clover and Defender oilseed radish on SBLEA and soil extract agar (EA) without antibiotics.

Treatment	Percent growth (%)			
	SBLEA		Soil EA	
	Week 1	Week 2	Week 1	Week 2
Control	98.1	98.1 a	-	-
Crimson clover	97.3	76.3 b	-	-
Defender oilseed radish	100.5	95.8 a	-	-
<i>SE</i>	4.2	3.0	-	-
<i>P-value</i>	0.8619	0.0069 **	-	-
<i>LSD</i>	-	11.6	-	-

Table 2. Percent growth of *C. beticola* at 1 week and 2 weeks after placement adjacent to germinated seed of Wheeler rye on SBLEA and soil extract agar (EA) amended with antibiotics streptomycin (0.5 ug/ml) and ampicillin (0.25 ug/ml).

Treatment	Percent growth (%)			
	SBLEA		Soil EA	
	Week 1	Week 2	Week 1	Week 2
Control	95.2	103.7 a	113.7	99.1 a
Wheeler rye	98.1	81.4 b	89.6	88.2 b
SE	5.6	3.1	4.3	3.0
P-value	0.793	0.002 **	0.0778	0.0071 **
LSD	-	7.0	-	5.2

Table 3. Percent growth of *C. beticola* at 1 week and 2 weeks after placement adjacent to germinated seed of common oat on SBLEA and soil extract agar (EA) amended with antibiotics streptomycin (0.5 ug/ml) and ampicillin (0.25 ug/ml).

Treatment	Percent growth (%)			
	SBLEA		Soil EA	
	Week 1	Week 2	Week 1	Week 2
Control	96.3	103.7	84.6 b	110.4
Common oat	92.3	104.4	122.5 a	155.8
SE	1.6	3.1	4.4	22.3
P-value	0.1682	0.893	0.0177 *	0.2183
LSD	-	-	25.4	-

Objective 2: Evaluated fall-planted cover crops for CLS control in sugarbeet field studies

Methods: In 2021-22 and 2023-24, fall-planted cover crop treatments were tested in field trials at the Saginaw Valley Research and Extension Center (SVREC). Treatments were replicated four times in 3 m by 18 m plots using a randomized complete block design with 1.5 m wheat buffers. Cover crops treatments, including rye, radish, and a combination of oat and clover, were planted after sugarbeet harvest with the aim to decrease *C. beticola* inoculum survival. The seeding rates for Wheeler rye (Moore Seed Farm, Elsie, MI), Defender oilseed radish (P. H. PETERSEN, Lundsgaard, Schleswig-Holstein, Germany), common oats (Johnny’s Selected Seeds, Winslow, ME), and Crimson clover (Johnny’s Selected Seeds, Winslow, ME) were 100, 35, 8, and 9 pounds per acre, respectively. In the spring, highly CLS-susceptible sentinel beets were placed biweekly into the plots to measure CLS pressure from April to June. One week of data was collected before the termination of the cover crops, and subsequent sampling took place after chemical termination using Roundup (Bayer, Leverkusen, Germany).

Results: In 2021-22 no significant differences in leaf degradation, *C. beticola* sporulation or viability, sentinel beet lesions, yield, percent sugar, RWSH, and RWS were observed for the Wheeler rye (or factory lime) treatments compared to the non-treated control ($P > 0.05$). However, the Wheeler rye cover crop significantly reduced area under the disease progress curve

(AUDPC) the following season compared to the non-treated control ($P < 0.0001$; Figure 2). No significant difference between the CLS ratings on sentinel beets was observed for treatments in the 2023-24 study (Figure 3).

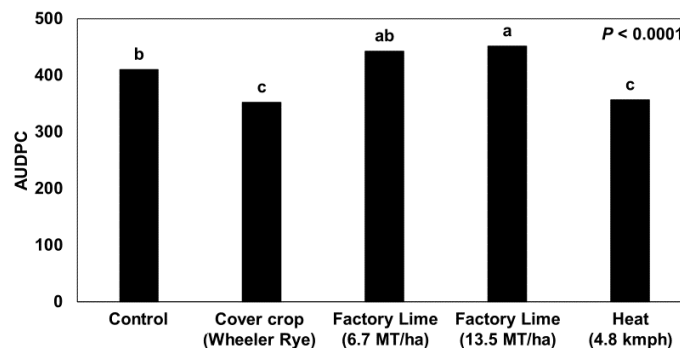


Figure 2. From 2021-22 field studies, area under the disease progress curve (AUDPC) following fall-applied treatments of a Wheeler rye cover crop, two factory lime rates, and the 4.8-kmph heat treatment compared to a non-treated control.

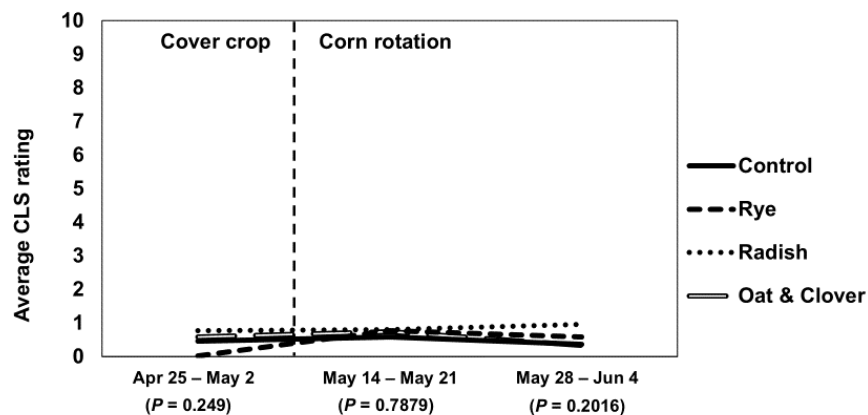


Figure 3. From 2023-24 field studies, average bi-weekly severity ratings (0-10) on highly-CLS susceptible sentinel beets exposed for one week in field plots then incubated in a humidity chamber for 3 days and monitored at ambient conditions for 3 weeks. Lines represent Wheeler rye, Defender oilseed radish, and common oats mixed with Crimson clover treatments compared to a non-treated control.

Overall Summary:

- Based on laboratory assays, Crimson clover and Wheeler rye showed potentially useful inhibitory effects on *C. beticola* growth in culture.
- In field studies, suppression of CLS development was also observed following a fall-planted rye cover crop. However, this did not correspond to a significant reduction in early-season inoculum levels. Further field tests are needed to understand these impacts.

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