Evaluation of Cercospora leaf spot and postharvest rot pathogen impacts on sugarbeet storage

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Background: In 2020, storage studies were initiated to investigate: (1) the impacts of variety and Cercospora leaf spot (CLS) field infection on rate of storage rot symptom development, (2) the effect of CLS infection on beet respiration rate in storage, and (3) monitor and characterize storage pathogens affecting sugarbeets postharvest. In the following trials, sugarbeet varieties C-G333NT and F1042 [1] were selected as CLS-susceptible materials and HIL-9865 and EL50/2 [2] were selected as CLS-resistant materials. Both C-G333NT and HIL-9865 have been evaluated in Michigan Sugar Company storage trials for the past 3 years; C-G333NT consistently resulted in lower storage rot ratings than HIL-9865. High and low CLS levels were established using combinations of fungicide treatments and field inoculation. After 60 days of storage at 42°F, beet slices were inoculated with *Botrytis cinerea, Penicillium vulpinum, Fusarium graminearum* and *Geotrichum* sp. Fungal growth was measured one-week post-inoculation. At least three timepoints are planned.

Trial 1: CLS infection impact on susceptibility of sugarbeet to four postharvest diseases

Location: Saginaw (SVREC)	**Treatments:** Non-treated (high CLS), grower standard (low CLS)
Planting Date: April 7, 2020	**Variety:** C-G333NT (Inoculated July 9 and July 23, 2020)
Harvest: September 18, 2020	**Replicates:** 4 plots/treatment in field, 3 roots/plot in storage
Storage Trial Timepoint 1: November 24, 2020	**Days Postharvest Timepoint 1:** 67

Trial 2: CLS inoculation and variety impacts on susceptibility of sugarbeet to four postharvest diseases

Location: Saginaw (SVREC)	**Treatments:** Inoculated (high CLS), non-inoculated (low CLS)
Planting Date: May 22, 2020	**Varieties:** F1042, EL50/2, C-G333NT, HIL-9865
Harvest: October 15, 2020	**Inoculated:** July 9 and July 23, 2020
Storage Trial Timepoint 1: December 15, 2020	**Days Postharvest Timepoint 1:** 61

Summary (1): Results from Trial 1 showed no significant differences between storage rot susceptibility in beets with high or low CLS levels in the field ($P > 0.05$; Fig. 1). Both length and depth of lesions caused by *P. vulpinum* and *B. cinerea* were similar, *F. graminearum* caused slightly less severe symptoms, and *Geotrichum* sp. did not cause symptoms statistically different from the control. In Trial 2, however, our results suggest that the interaction between CLS level, pathogen, and variety may have an effect on sugarbeet rot depth ($P < 0.05$; Table 1). There will be another timepoint at the end of the storage season, as well as a minimum of one mid-winter sample.

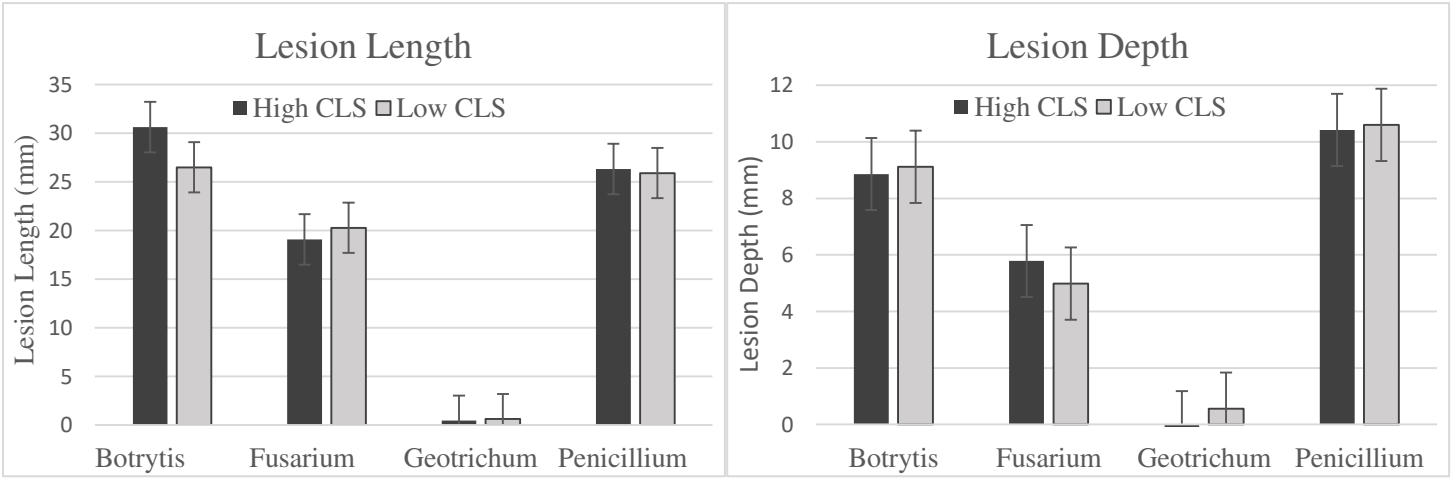

Figure 1. Mean lesion lengths and depths measured from sugarbeet roots inoculated with postharvest pathogens. Beet roots originated from plots with high or low levels of CLS in field studies, achieved from either a non-treated or grower standard treated check. Least Squares Difference showed difference of 6.6 mm is considered significant for length, and 3.5 mm for depth at $\alpha = 0.05$.

Table 1. Mean lesion lengths and depths measured from sugarbeet roots inoculated postharvest pathogens. C-G333NT and F1042 were selected as CLS-susceptible and HIL-9865 and EL50/2 were selected as CLS-resistant varieties. These varieties were subjected to high and low CLS pressure following inoculation or no inoculation. Statistics indicate that the interaction between CLS level, pathogen, and variety influences rot depth.

Type III Tests of Fixed Effects						
			Lesion Length		Lesion Depth	
Effect	**Num DF**	**Den DF**	**F Value**	**Pr > F**	**F Value**	**Pr > F**
CLS Level	1	2	3.52	0.2015	4.37	0.1717
Pathogen	3	48	24.49	<.0001	50.20	<.0001
CLS*Pathogen	3	48	0.05	0.9832	0.53	0.6654
Variety	3	12	0.77	0.5350	0.36	0.7809
CLS*Variety	3	12	0.19	0.9008	0.51	0.6836
Pathogen*Variety	9	48	2.09	0.0492	0.90	0.5351
CLS*Pathogen*Variety	9	48	2.02	0.0569	2.17	0.0415

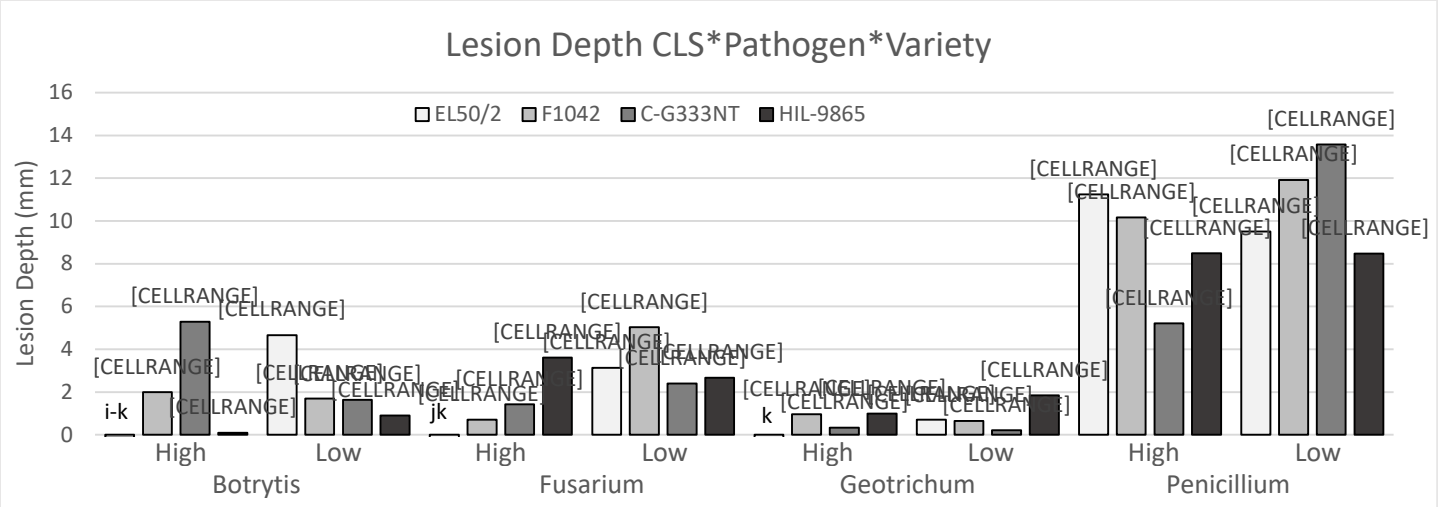

Figure 2. Mean lesion depths measured from sugarbeet roots inoculated with postharvest pathogens. Beet roots originated from plots with high or low levels of CLS in field studies, achieved from either inoculation or no inoculation. Least Squares Difference showed difference of 4.87 mm is considered significant at $\alpha = 0.05$.

Summary (2): Roots of C-G333NT and HIL-9865 with high and low CLS ratings from Trial 2 are being stored in vented respirometry chambers at 42 °F. These beets will not be inoculated with storage pathogens. Samples will be taken periodically throughout the storage season to measure the beet respiration rate/lb. The effect of CLS infection in the field on the respiration rate of beets in storage will be determined.

Summary (3): 2019-20 samples show different pathogens are colonizing the beets in storage compared to the field. The main organisms isolated from SVREC field were *Fusarium* spp., *Geotrichum* spp., *Rhizoctonia solani,* and *Trichoderma* spp. *Trichoderma* spp. have been used for biocontrol control and are commonly found in the environment. *Geotrichum* spp. were not previously reported on sugarbeet in Michigan but were detected in fall of 2019 (REACh, 2020). Prominent organisms isolated from a Michigan Sugar Co. piling facility in spring 2019 include *Botrytis cinerea, Penicillium* spp., and *Fusarium* spp. In addition to the pathogens found in the spring, December 2020 samples from Michigan Sugar Co. storage piles were also infected with *Geotrichum* spp. Future goals include determining the pathogenicity, virulence, and spore dispersal mechanisms of storage pathogens to help reduce infection.

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[1] Campbell, L. G. 2015. PI 674103, *Beta vulgaris* L. subsp. *vulgaris*. U.S. National Plant Germplasm System. https://npgsweb.ars-grin.gov/gringlobal/accessiondetail?id=1923721 ; [2] McGrath, J.M. 2012. Germplasm releases: EL50/2; EL58 through EL66; SR99 through SR101 [CD-ROM]. 2012 Annual Beet Sugar Development Foundation Research Report. Denver, Colorado: Beet Sugar Development Foundation