

## Introduction

- Previous research suggests *Cercospora* leaf spot (CLS) may predispose sugarbeet roots to storage rot [1]. Commercial storage observations also support CLS may impact storage.
- Predisposing CLS infection was not found to significantly or repeatedly impact sugarbeet storage properties [2] or storage rot in hand harvested beets [3].
- Substantial damage to beet roots can occur during harvest [4] but was minimized in initial research. However, damage may improve our understanding of pre- and postharvest disease dynamics.

## Objectives

- Determine effects of CLS field infection on storage rot in bruised beets.
- Research effects of CLS, bruising, and storage rot on root physiology.

## Methods

### Cercospora leaf spot

- Designated 'high' and 'low' CLS levels were achieved using fungicide treatments and field inoculation (Table 1). Beets were hand-harvested in 2022 and machine harvested in 2023, washed with water, and stored at 42°F/5°C.

**Table 1.** Range of at-harvest KWS ratings and area under disease progress curve (AUDPC) for high and low designated sugarbeets.

Year	CLS	KWS Range (0-10)	AUDPC
2022	Low	2	34.6 b Std. error 12.8
	High	7-9	199.6 a P-value 0.0048
2023 Trial 1	Low	5-7	120.8 b Std. error 11.2
	High	8-9	194.5 a P-value 0.0004
2023 Trial 2	Low	2-3	12.7 b Std. error 5.08
	High	5-8	52.0 a P-value 0.0053

### Beet bruise

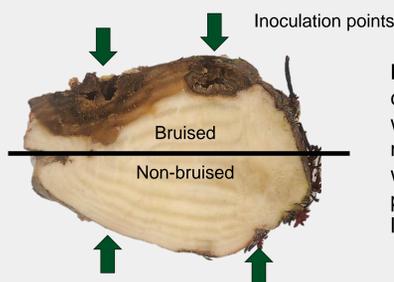
- After washing, roots were damaged at the mid-beet and crown with a 1.5-kg metal weight dropped from 1-m height simulating commercial harvest damage.

### Storage pathogen inoculation

- For each timepoint, roots were inoculated with a 4-mm plug of *Botrytis cinerea*, *Penicillium vulpinum*, or *Fusarium graminearum* at four points: the two impact zones and two control zones on undamaged tissue (Figure 1).
- Symptoms were measured after 4 weeks (2022) or 8 weeks (2023) in a moist chamber at 68°F/20°C and compared to clarified V8 media control.
- In 2022, timepoints were completed at 50- and 90-days postharvest. In 2023, two repeated trials were completed, one with variety SX-1278 at 90- and 180-days postharvest and one with variety HIL-2238 at 100- and 200-days postharvest.

### Relative electrolyte leakage

- Two 1-cm<sup>2</sup> cores were removed from inoculation points at time of rot measurement and incubated in 0.3M mannitol solution overnight before measuring initial conductivity.
- Cores were autoclaved and cooled before measuring final conductivity.



**Figure 1.** Sugarbeet damaged at the crown and mid-beet, then inoculated with *Botrytis cinerea* at bruised and non-bruised control points indicated with arrows. Inoculated at 50-days postharvest and measured 4 weeks later in 2022.

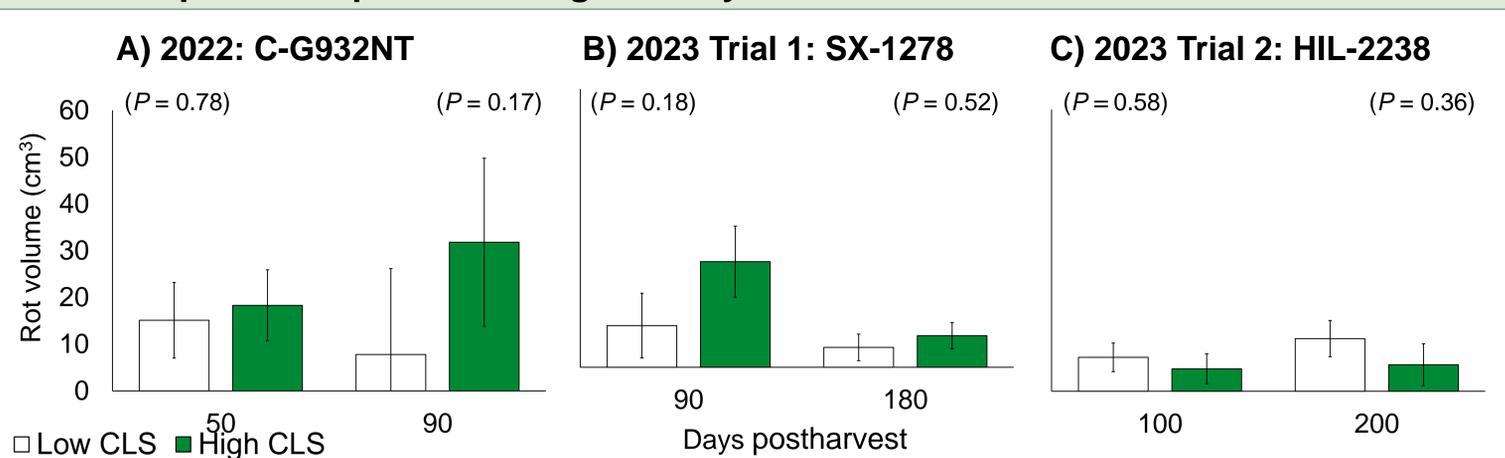
Statistics completed via ANOVA in GLIMMIX procedure SAS v.9.4 using  $\alpha=0.05$  significance level. Mean separation based on Fisher's protected LSD.

## References

- [1] Smith, G.A., and Ruppel, E.G. 1971. *Phytopathology* 61:1485-1487
- [2] Fugate, K. et al. 2023. *Plant Disease* 107:1816-1821
- [3] Hendershot, C. et al. 2024. *Plant Disease First Look* e-ISSN:1943-7692
- [4] Wyse, R. 1978. *Journal of the ASSBT* 20:193-202

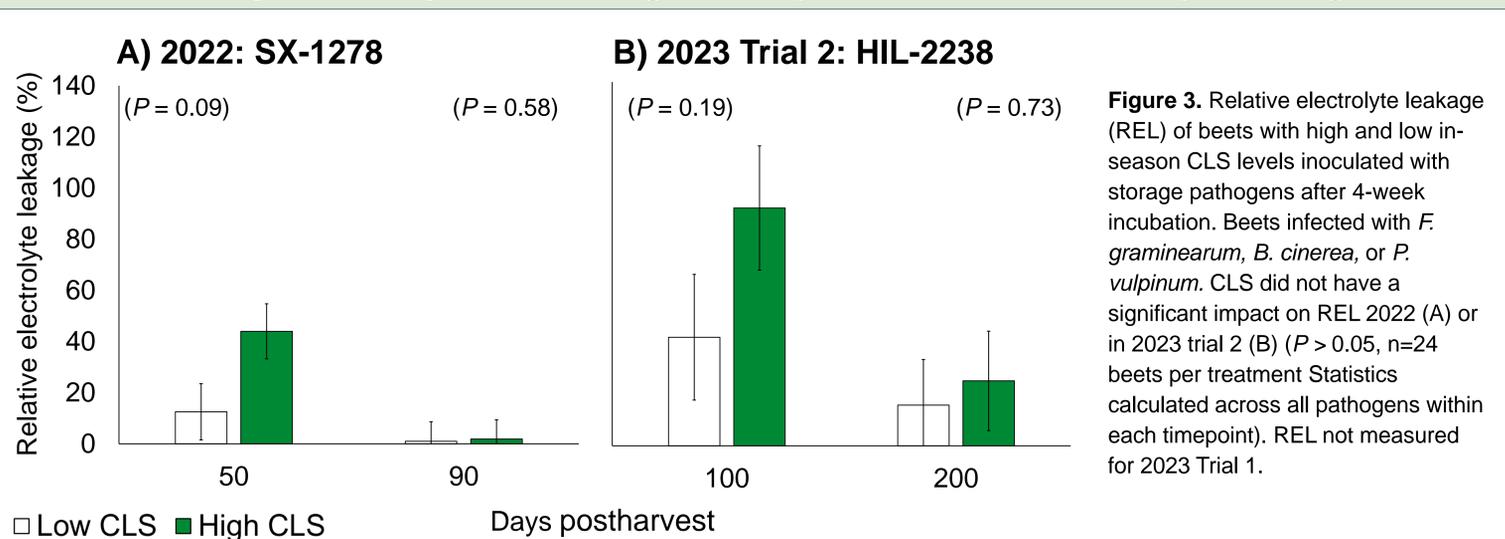
## Results

### Cercospora leaf spot did not significantly increase root rot volume in bruised tissue



**Figure 2.** Volume of rotted tissue in beets bruised mid-beet with high or low in-season CLS levels inoculated with *F. graminearum*, *B. cinerea*, or *P. vulpinum*. CLS did not have a significant impact on rate of rot development in 2022 (A) or in 2023 trial 1 (B) or trial 2 (C) ( $P > 0.05$ ,  $n=12$  beets per treatment.) Statistics calculated across all pathogens within each timepoint.

### Cercospora leaf spot did not significantly affect relative electrolyte leakage



**Figure 3.** Relative electrolyte leakage (REL) of beets with high and low in-season CLS levels inoculated with storage pathogens after 4-week incubation. Beets infected with *F. graminearum*, *B. cinerea*, or *P. vulpinum*. CLS did not have a significant impact on REL 2022 (A) or in 2023 trial 2 (B) ( $P > 0.05$ ,  $n=24$  beets per treatment. Statistics calculated across all pathogens within each timepoint). REL not measured for 2023 Trial 1.

## Conclusions

- Over two years and six timepoints, CLS level did not significantly impact rot length, width, depth, and volume in bruised beets for the tested pathogens and varieties ( $P > 0.05$ ).
- Despite numerically elevated electrolyte leakage, CLS did not significantly impact relative electrolyte leakage in the two years and four timepoints measured ( $P > 0.05$ ); results indicate CLS did not predispose beets to harvest damage.
- Correlation analyses within symptomatic bruised tissues indicated area under the disease progress curve (AUDPC) calculated from in-season CLS severities was significantly associated with volume of storage rot symptoms ( $r = 0.26$ ,  $P < 0.05$ , data not shown).
- Bruise significantly increased total rot volume at all six timepoints across crown and mid-beet impact sites ( $P < 0.05$ ). Bruising caused a significant increase in rot depth at five timepoints, width at three timepoints, and length at two timepoints ( $P < 0.05$ , data not shown).
- Botrytis cinerea* and *Penicillium vulpinum* tended to cause a higher rot volume than *Fusarium graminearum*. There was no difference in relative electrolyte leakage between pathogens at any time ( $P > 0.05$ ).

## Future Directions

- Based on continued industry reports of high CLS beets rotting faster in storage, this research will continue looking at other factors that may be affecting beet storability.
- We are currently implementing scanning electron microscopy to investigate differences in damage at a cellular level between beets with high and low CLS, as well as differences in water loss throughout storage and varietal susceptibility to damage.

## Acknowledgements

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