Effect of *Cercospora* Leaf Spot on Sugarbeet Root Storage Properties

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Introduction

- *Cercospora* leaf spot (CLS) is the most damaging foliar disease of sugarbeet
- CLS has become increasingly prevalent and severe due to the development of fungicide resistant strains of *Cercospora beticola*, the pathogen responsible for CLS
- CLS reduces root yield and sucrose content at harvest
- Effect of CLS on sugarbeet root storage properties is generally unknown
- Knowledge of CLS effects on storage would be useful to:
  - assist in predicting storage losses
  - determine if there is a threshold of disease severity that would preclude roots from being incorporated into storage piles
  - determine if it is advantageous to segregate diseased roots for early processing

Objective

Determine impact of CLS disease severity on sugarbeet root storage properties including respiration, sucrose loss, invert sugar accumulation, loss to molasses, and recoverable sugar per ton after different durations in storage.

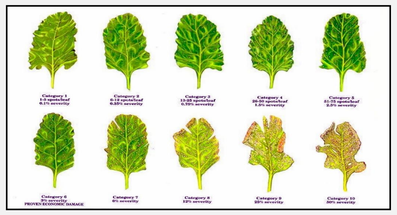
Materials & Methods

- Experiment was conducted in 2018, 2019, and 2020
- Field plots were established in first half of May in all years
- Plots were inoculated with dried, CLS-infected leaves around the beginning of July
- Field plots were treated with different fungicide regimes to obtain varying levels of disease
- CLS severity was rated prior to harvest using a 1 -10 scale
- Roots with four levels of disease severity were harvested by hand in mid – late September
- Roots were obtained from plots with the lowest CLS disease ratings, the highest disease ratings, and two intermediate CLS rating levels
- Roots were washed and stored at 5°C and 95% relative humidity for up to 120 days
- The 2020 storage study data is ongoing and not complete

Results

Cercospora Leaf Spot (CLS) Disease Ratings

Roots from plants with four levels of CLS disease severity were used for storage experiment in 2018, 2019, and 2020



Jones & Windels (1991). MN Ext Ser Pub AG-FO-5643-E

CLS class	2018	2019	2020
I	3.0 c	3.0 c	5.5 c
II	3.3 c	3.5 c	6.5 bc
III	6.0 b	5.8 b	8.0 b
IV	9.8 a	8.8 a	10.a

- CLS class I contained roots from plants with the lowest available CLS ratings
- CLS class IV contained roots from plants with the highest available CLS ratings
- CLS classes II and III contained roots from plants with intermediate levels of CLS
- CLS ratings for classes I – IV were similar in 2018 and 2019
- CLS ratings for classes I – IV were substantially higher in 2020 due to greater disease in the field

Storage Respiration Rate

Respiration rate (mg CO_2 kg^{-1} h^{-1}) after 30 and 120 days in storage in 2018, 2019, and 2020

CLS class	2018		2019		2020	
	30 d	120 d	30 d	120 d	30 d	120 d
I	2.5 a	2.4 a	2.2 a	4.2 a	2.9 a	4.7 a
II	2.7 a	2.9 a	2.6 a	3.7 a	2.9 a	3.9 a
III	2.4 a	2.7 a	2.7 a	3.6 a	2.8 a	4.7 a
IV	2.8 a	3.1 a	2.9 a	4..2 a	3.1 a	3.6 a

- Respiration rate was unaffected by CLS, regardless of disease severity

Change in Sucrose Content

Sucrose content, as percentage of fresh weight, at harvest and after 30 and 120 days in storage in 2018 and 2019

CLS class	2018			2019		
	0 d	30 d	120 d	0 d	30 d	120 d
I	16.0 a	15.8 a	15.7 a	14.5 a	14.4a	14.5 a
II	15.7 a	15.7 a	15.2 a	13.6 ab	14.0 ab	14.1 a
III	14.1 b	13.6 b	13.7 a	13.5 ab	13.6 b	13.8 ab
IV	13.7 b	14.0 b	13.5 b	12.5 b	13.1 b	13.2 c

- Sucrose content was reduced in roots obtained from plants with higher levels of CLS severity (CLS classes III and IV)
- Differences in sucrose content during storage reflect differences that were present at harvest
- CLS, at any severity, did not affect the rate of sucrose loss during storage

Invert Sugar Accumulation

Invert sugars (g per 100 g sucrose) at harvest and after 30 and 120 days in storage in 2018 and 2019

CLS class	2018			2019		
	0 d	30 d	120 d	0 d	30 d	120 d
I	1.28 a	0.60 c	3.51 a	0.77 a	0.88 a	2.14 a
II	0.79 a	0.65 bc	2.10 a	0.87 a	1.04 a	1.18 a
III	1.03 a	0.87 ab	4.42 a	0.80 a	0.84 a	1.30 a
IV	1.00 a	1.00 ab	4.59 a	0.84 a	0.88 a	1.22 a

- In 2018, invert sugars were elevated in roots with moderate – severe CLS, but only after 30 days in storage
- CLS had no effect on invert sugars in 2018 after 120 d storage or at any time point in 2019

Changes in Sucrose Loss to Molasses (SLM)

Sucrose loss to molasses (%) at harvest and after 30 and 120 days in storage in 2018 and 2019

CLS class	2018			2019		
	0 d	30 d	120 d	0 d	30 d	120 d
I	1.72 a	1.50 a	1.70 a	0.90 b	0.80 b	1.18 a
II	1.79 a	1.65 a	1.52 a	0.87 b	0.92 ab	1.20 a
III	1.58 a	1.57 a	1.47 a	1.17 a	0.86 ab	1.33 a
IV	1.58 a	1.62 a	1.47 a	1.16 a	1.04 a	1.37 a

- CLS had no effect on SLM in 2018
- In 2019, CLS affected SLM at harvest and after 30 days in storage
- SLM differences during storage for roots with differing CLS severities, reflect differences at harvest
- CSL does not affect accumulation of non-sugar impurities during storage

Changes in Recoverable Sugar per Ton (RST)

Recoverable sugar per ton (lbs ton^{-1}) at harvest and after 30 and 120 days in storage in 2018 and 2019

CLS class	2018			2019		
	0 d	30 d	120 d	0 d	30 d	120 d
I	285 a	286 a	279 a	271 a	271 a	267 a
II	278 ab	281 a	273 a	254 ab	262 ab	258 a
III	251 bc	241 b	246 a	247 b	255 b	250 ab
IV	243 c	248 b	241 b	232 b	241 c	237 b

- RST was reduced in roots from plants with severe CLS symptoms (class IV)
- Differences in RST during storage reflect differences that were present at harvest
- CLS, at any severity, did not affect the rate of recoverable sugar loss during storage

Conclusions

- CLS had no apparent effect on root storage properties including:
  - respiration rate
  - sucrose loss
  - invert sugar accumulation
  - changes in sucrose loss to molasses
  - loss of recoverable sugar per ton
- Results suggest that no special precautions are needed to store roots from *Cercospora beticola*-infected plants

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