Management of Rhizoctonia, Aphanomyces and Fusarium Diseases in Sugarbeet

2020 ACSC Growers’ Seminar

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# Summary of Field Samples 2016 - 2019

<table>
<thead>
<tr>
<th>Cause of Problem</th>
<th>No. of Fields</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rhizoctonia</td>
<td>63</td>
</tr>
<tr>
<td>Aphanomyces</td>
<td>44</td>
</tr>
<tr>
<td>Rhizoctonia + Aphanomyces</td>
<td>45</td>
</tr>
<tr>
<td>Fusarium</td>
<td>37</td>
</tr>
<tr>
<td>Chemical</td>
<td>36</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Rhizoctonia</th>
<th>Aphanomyces</th>
<th>Rhizoctonia + Aphanomyces</th>
<th>Fusarium</th>
<th>Chemical</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>36</td>
<td>23</td>
<td>2</td>
<td>11</td>
<td>7</td>
</tr>
<tr>
<td>2017</td>
<td>3</td>
<td>9</td>
<td>5</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2018</td>
<td>2</td>
<td>1</td>
<td>11</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2019</td>
<td>2</td>
<td>1</td>
<td>11</td>
<td>7</td>
<td>16</td>
</tr>
</tbody>
</table>
Accurate Diagnosis is critical!

Fusarium

Susceptible

Resistant
Uninvited Guests!

Rhizoctonia + Aphanomyces

July 21, 2015
Damping-off
Crown and Root Rot
Crown and Root Rot
Crown and Root Rot
Rhizoctonia rating scale

Photo Credit: Greg Reynolds
Rhizoctonia affects Yield

Resistant and Moderately Susceptible Varieties

$y = -3.2117x + 34.468$

$R^2 = 0.7703$

$r = -0.88$
Rhizoctonia

- Fungus – *Rhizoctonia solani*
- 13 Anastomosis groups
- Sugarbeet: Anastomosis groups AG 2-2 (seedling and adult) and AG 4 (seedling)
- AG 2-2 has intraspecific groups (ISGs)
  - AG 2-2 IIIB and AG 2-2 IV
- Both ISGs cause same symptoms on sugarbeet
- Both occur in MN/ND (Windels, 2009)
AG 2-2 IV vs AG 2-2 IIIB

RRV (460 cultures): AG 2-2 IV most common (66%)

So. MN (504 cultures): AG 2-2 IIIB most common (56%)

(Windels, 2010)
Management of Rhizoctonia

• Early planting
Management of Rhizoctonia

- Early planting
- Crop Rotation
  - Length of rotation
  - Weed control
  - Crop choice
Soybeans
Navy beans
Navy beans
Corn

https://cropwatch.unl.edu/corn-seedling-diseases-2015

Amber Buzzard, Corteva agriscience
https://www.youtube.com/watch?v=DPvfnQVaKCI
Management of Rhizoctonia

- Early planting
- Crop Rotation
  - Crop choice
  - Length of rotation
  - Weed control
- Resistant varieties
Rhizoctonia varieties

Photo Credit: Greg Reynolds
Rhizoctonia & Varietal Selection

PR – Specialty
M - Moderate
S - Weak

Normalized plant stand

Days after planting

Soil temp. (°C)

100
90
80
70
60
50
40
30
20
10
0

110
100
90
80
70
60
50
40
30
20
10
0

16°C
10 cm ST

2015
Management of Rhizoctonia

• Early planting

• Crop Rotation
  – Crop choice
  – Length of rotation
  – Weed control

• Resistant varieties

• At-planting fungicides
  – Seed treatment
Seed treatments

- SDHI class of fungicides
- Single site of action (Succinate DeHydrogenase Inhibitor)
- Inhibit fungal respiration
<table>
<thead>
<tr>
<th>MOA</th>
<th>TARGET SITE AND CODE</th>
<th>GROUP NAME</th>
<th>CHEMICAL OR BIOLOGICAL GROUP</th>
<th>COMMON NAME</th>
<th>COMMENTS</th>
<th>FRAC CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>complex I NADH Oxido-reductase</td>
<td>pyrimidinamines</td>
<td>pyrimidinamines</td>
<td>diflumetorim</td>
<td>Resistance not known.</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pyrazole-MET1</td>
<td>pyrazole-5-carboxamides</td>
<td>tolenpyrad</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>quinazoline</td>
<td>quinazoline</td>
<td>fenazaquin</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>phenyl-benzamides</td>
<td>benodanil</td>
<td>fluotolenil</td>
<td>mepronil</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>phenyl-oxo-ethyl thiophene amide</td>
<td>isofetamid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>pyridinyl-ethyl-benzamides</td>
<td>fluopyram</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>furan-carboxamides</td>
<td>fenfuram</td>
<td></td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td>oxathiin-carboxamides</td>
<td>carboxin</td>
<td>oxycarboxin</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>thiazole-carboxamides</td>
<td>thifluzamide</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>complex II; succinate-dehydrogenase</td>
<td>SDHI (Succinate-dehydrogenase inhibitors)</td>
<td>benzovindiflupyr bixafen fluidapyr luxapyroxad</td>
<td>resistance management required.</td>
<td>Medium to high risk.</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pyrazole-4-carboxamides</td>
<td></td>
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</tr>
<tr>
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<td></td>
<td>N-cyclopropyl-N-benzyl-pyrazole-carboxamides</td>
<td>isoflucypram</td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>N-methoxy-(phenyl-ethyl)-pyrazole-carboxamides</td>
<td>pydilflumetofen</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>pyridine-carboxamides</td>
<td>bosalid</td>
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<tr>
<td></td>
<td></td>
<td>pyrazine-carboxamides</td>
<td>pyraziflumid</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See FRAC SDHI Guidelines for resistance management.

SDHI Fungicide Overview

- **SDHI fungicides**: Respiration inhibitors: Target succinate dehydrogenase reductase enzyme
  - 4 subunits

Seed treatments

- Kabina 14 g (Penthiopyrad, 2014)
- Vibrance 1.5 g (Sedaxane, 2016)
- Systiva 5 g (Fluxapyroxad, 2017)
- **Metlock Suite [Metconazole + Rizolex] + Kabina 7g (Penthiopyrad), 2014**
- From 2017, 100% seed is treated for Rhizoctonia and treatment depends on the seed companies’ choice

Metconazole and Rizolex are not SDHI
Seed treatments - 2015

Planting date: May 04

- Non-inoculated
- Systiva + 15 g Stamina
- Met. Suite + 7 g Kabina
- 14 g Kabina ST
- 2 g Vibrance

No. plants per 100 ft of row

Days after planting

Seed treatments - 2015

Planting date: May 04
Seed treatments – 2016

Planting date: June 24

No. plants per 100 ft of row

Days after planting

- Kabina 14 g
- Metlock Suite + Kabina 7 g
- Systiva 5 g
- Vibrance 1.5 g
- Untreated control

University of Minnesota
Driven to Discover
2019 Seed Treatments – Susceptible Variety (4.5 rating)

Planting date: May 15

No. plants/100 ft of row
0 7 14 21 28 35 42 49 56
0 100 120 140 160 180 200 220 240
Days after planting

- Untreated
- Kabina 14
- MS + Kab
- MS + Vib
- Systiva
- Vibrance

University of Minnesota
Driven to Discover
Benefits of seed treatments

- Sugarbeet seedlings are very susceptible to Rhizoctonia early on
- Genetic resistance is not expressed until 6-8 leaf stage
- Effective protection of seedling (4-5 weeks)
- Ease of use - It comes with seed
- Safety
- No plugged nozzles
Management of Rhizoctonia

- Early planting
- Crop Rotation
  - Crop choice
  - Length of rotation
  - Weed control
- Resistant varieties
- At-planting fungicides
  - Seed treatment
  - In-furrow application
In-furrow application

Fungicide in 3 gal water + 10-34-0
3 gal. applied via drip tube
10-34-0 + azoxystrobin
10-34-0 + azoxystrobin

2 hours after mixing

Quadris  Satori  Equation  10-34-0 Starter

University of Minnesota
Driven to Discover
10-34-0 + Fungicides: 0 minutes (shaken and poured in to a jar after sitting for 6 hours after mixing and application in the field)
10-34-0 + Fungicides: 10 minutes
In-furrow treatments – 2016

Planting date: June 24

- Quadris I-F 10 fl oz
- Satori I-F 10 fl oz
- Xanthion I-F 9 + 1.8 fl oz
- Headline I-F 9 fl oz
- Untreated control

In-furrow fungicide applied via drip
In-furrow treatments – 2018

Planting date: May 11

No. plants/100 ft of row vs. Days after planting

- Xanthion I-F 9 + 1.8 fl oz/A
- AZteroid I-F 11.9 fl oz/A
- Untreated control
- Quadris I-F 9.5 fl oz/A
In-furrow treatments – 2019

Planting date: May 15

Susceptible Variety (4.5 rating)
Seed vs In-furrow fungicides - 2016

2016

Planted late June
Seed vs In-furrow fungicides - 2019

Planting date:

- Untreated
- Seed treatments
- In-furrow treatments

Graph showing the number of plants per 100 ft of row over days after planting for untreated and treated seed and in-furrow treatments.
# Seed vs In-furrow fungicides - 2015

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. harv. Roots/100 ft.</th>
<th>RCRR (0-7)</th>
<th>Yield</th>
<th>RSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed treatments</td>
<td>98</td>
<td>3.9</td>
<td>20.1</td>
<td>6181</td>
</tr>
<tr>
<td>In-furrow treatments</td>
<td>127</td>
<td>2.7</td>
<td>25.5</td>
<td>7772</td>
</tr>
<tr>
<td><strong>Contrast analysis p-value</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.001</td>
<td>0.006</td>
<td>0.0032</td>
<td>0.0148</td>
</tr>
</tbody>
</table>

**Seed Treatments**
- 14 g Kabina ST
- Metlock Suite
- Met. Suite + 7 g Kabina
- 7 g Kabina ST
- 2 g Vibrance

**In-furrow**
- 12 fl oz Headline IF
- 10 fl oz Quadris IF
- 10 fl oz Equation IF
- 10 fl oz Satori IF

RSA = ESA
## Seed vs In-furrow fungicides - 2018

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. harv. roots/100 ft</th>
<th>RCRR (0-7)</th>
<th>Yield ton A⁻¹</th>
<th>RSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed treatments</td>
<td>151</td>
<td>0.7</td>
<td>32.8</td>
<td>10440</td>
</tr>
<tr>
<td>In-furrow treatments</td>
<td>141</td>
<td>0.4</td>
<td>32.2</td>
<td>10528</td>
</tr>
<tr>
<td><strong>Contrast analysis P-value</strong></td>
<td>0.01</td>
<td>0.01</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>NS</strong></td>
<td><strong>NS</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Seed Treatments
- 14 g Kabina ST
- Met. Suite + 1 g Vibrance
- Met. Suite + 7 g Kabina
- 5 g Systiva
- 1.5 g Vibrance

### In-furrow
- 9.5 fl oz Quadris
- 11.9 fl oz AZteroid
- Xanthion (Headline + Integral, 9 + 1.8 fl oz/A)
- Elatus 9.5 fl oz (* not registered for sugarbeet)

RSA = ESA

NS = not significantly different
Plant Stand – MDFC, 2019

No. of plants per 100 ft of row

Days after planting
Renville, MN - 2019

No. of plants per 100 ft of row

Days after planting

- Quadris I-F + Systiva
- Systiva
- Untreated

a b
In-furrow treatments

• Benefits
  – Sanitizing the furrow (seedling + soil)
  – More effective than seed treatments – longevity up to 8-10 weeks (Windels, 2010)

• Risks
  – Phytotoxicity
    • cool weather and light soils
    • Mixing with starter fertilizer and other chemicals
  – Plugged nozzles
Management of Rhizoctonia

- Early planting
- Crop Rotation
  - Crop choice
  - Length of rotation
  - Weed control
- Resistant varieties
- At-planting fungicides
  - Seed treatment
  - In-furrow application
- Postemergence fungicides
Postemergence Application – SMBSC 2019

Planting date: May 14

4-leaf stage
June 10

8-leaf stage
June 19
SMBSC - Variety x Post

Root Rot Severity

- No PE
- 4-leaf
- 8-leaf

Res = 3.9 variety
Suc = 4.5 variety

Root Rot Incidence (Rating > 2.0)

- Planting date: May 14
- 4-leaf POST: June 10
- 8-leaf POST: June 19
Variety x Post

SMBSC

Planting date: May 14
4-leaf POST: June 10
8-leaf POST: June 19

Res = 3.9 variety
Suc = 4.5 variety
## Postemergence Treatments (2019)
### Susceptible Variety (4.5 rating)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Day 36</th>
<th>Harvested roots</th>
<th>Harv. loss</th>
<th>Rating</th>
<th>Incidence</th>
<th>Yield</th>
<th>Sugar</th>
<th>SLM</th>
<th>RST</th>
<th>RSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadris 14.5 fl oz</td>
<td>193</td>
<td>179</td>
<td>14</td>
<td>0.2</td>
<td>3</td>
<td>24.8</td>
<td>17.5</td>
<td>1.04</td>
<td>330</td>
<td>8184 a</td>
</tr>
<tr>
<td>Elatus 7.1 oz</td>
<td>180</td>
<td>170</td>
<td>10</td>
<td>0.2</td>
<td>3</td>
<td>24.1</td>
<td>17.6</td>
<td>1.01</td>
<td>332</td>
<td>8021 a</td>
</tr>
<tr>
<td>Azteroid 9.2 fl oz</td>
<td>196</td>
<td>184</td>
<td>12</td>
<td>0.3</td>
<td>5</td>
<td>23.9</td>
<td>17.6</td>
<td>1.0</td>
<td>331</td>
<td>7912 a</td>
</tr>
<tr>
<td>Quadris 10 fl oz</td>
<td>196</td>
<td>178</td>
<td>18</td>
<td>0.5</td>
<td>8</td>
<td>23.5</td>
<td>17.7</td>
<td>0.98</td>
<td>333</td>
<td>7846 a</td>
</tr>
<tr>
<td>Propulse 13.6 fl oz</td>
<td>187</td>
<td>174</td>
<td>13</td>
<td>0.9</td>
<td>19</td>
<td>23.3</td>
<td>17.5</td>
<td>1.02</td>
<td>329</td>
<td>7676 ab</td>
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<tr>
<td>Proline 5.7 fl oz</td>
<td>197</td>
<td>174</td>
<td>23</td>
<td>0.8</td>
<td>14</td>
<td>23.2</td>
<td>17.6</td>
<td>1.03</td>
<td>330</td>
<td>7651 ab</td>
</tr>
<tr>
<td>Quadris broadcast 14.5 fl oz</td>
<td>191</td>
<td>173</td>
<td>18</td>
<td>0.4</td>
<td>5</td>
<td>23.2</td>
<td>17.4</td>
<td>1.02</td>
<td>328</td>
<td>7617 ab</td>
</tr>
<tr>
<td>Priaxor 6.7 fl oz</td>
<td>176</td>
<td>151</td>
<td>25</td>
<td>1.2</td>
<td>20</td>
<td>20.6</td>
<td>17.0</td>
<td>1.06</td>
<td>319</td>
<td>6582 b</td>
</tr>
<tr>
<td>Untreated</td>
<td>195</td>
<td>104</td>
<td>91</td>
<td>4.6</td>
<td>74</td>
<td>12.2</td>
<td>16.7</td>
<td>1.16</td>
<td>310</td>
<td>3867 c</td>
</tr>
</tbody>
</table>

| ANOVA P-value | <0.0001 | 1 | <0.0001 | <0.0001 | <0.0001 | 0.121 | 0.2291 | 0.1077 | <0.0001 |
| LSD (P = 0.05) | 23.4 | 16.4 | 0.61 | 10.8 | 2.98 | NS | NS | NS | 1105 |
## Postemergence Fungicides – 2015

### Quadris vs Generics

<table>
<thead>
<tr>
<th>Treatment</th>
<th>RCRR (0-7)</th>
<th>Yield T/A</th>
<th>RSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-inoculated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No-fungicide control</td>
<td>3.4</td>
<td>24.3</td>
<td>6263</td>
</tr>
<tr>
<td>R. solani-inoculated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equation @ 14 fl oz/A</td>
<td>1.9 d</td>
<td>31.0 a</td>
<td>8066 a</td>
</tr>
<tr>
<td>Quadris @ 14 fl oz/A</td>
<td>2.4 d</td>
<td>29.9 a</td>
<td>7908 a</td>
</tr>
<tr>
<td>Satori @ 14 fl oz/A</td>
<td>2.4 d</td>
<td>29.6 a</td>
<td>7790 a</td>
</tr>
<tr>
<td>No-fungicide control</td>
<td>5.5 a</td>
<td>14.0 c</td>
<td>3411 c</td>
</tr>
</tbody>
</table>

**ANOVA P-value**
- 0.0001
- 0.004
- 0.002

**LSD (P = 0.05)**
- 1.4
- 8.3
- 2284
## Postemergence fungicides – 2015 azoxystrobin Band vs Broadcast

<table>
<thead>
<tr>
<th>Treatment (Rates per Acre)</th>
<th>RCRR (0-7)</th>
<th>RCRR % Incidence</th>
<th>Yield T/A</th>
<th>RSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>No fungicide control</td>
<td>3.7 a</td>
<td>75 a</td>
<td>23.2 c</td>
<td>7324 c</td>
</tr>
<tr>
<td>AZteroid @ 17.6 fl oz, band</td>
<td>0.7 b</td>
<td>15 b</td>
<td>33.6 ab</td>
<td>11084 ab</td>
</tr>
<tr>
<td>Quadris @ 10 fl oz, band</td>
<td>0.9 b</td>
<td>16 b</td>
<td>33.5 ab</td>
<td>11272 a</td>
</tr>
<tr>
<td>Quadris @ 14 fl oz, band</td>
<td>1.2 b</td>
<td>25 b</td>
<td>31.9 ab</td>
<td>10659 ab</td>
</tr>
<tr>
<td>Quadris @ 14 fl oz broadcast</td>
<td>1.1 b</td>
<td>21 b</td>
<td>33.4 ab</td>
<td>10944 ab</td>
</tr>
</tbody>
</table>

ANOVA $P$-value

- $<0.0001$
- $<0.0001$
- $<0.0001$
- 0.0001

LSD ($P = 0.05)^W$

- 0.92
- 18.4
- 3.86
- 1451
Postemergence fungicides

• Benefits
  – If you are doing a row cultivation--throwing soil onto crowns
  – Late season disease control (rain Aug-Sept)
  – If sugarbeets are following Rhizoctonia-susceptible crops in a rotation
  – Band application (preferred) – severe disease pressure
  – Broadcast application – low disease pressure

• Risks
  – Work better if applied before infection
Summary

• Varietal Selection
  – Can make a difference under moderate to high disease pressure
• Seed treatments
  – Provide excellent early-season protection
• In-furrow applications
  – can reduce stands under dry and cool conditions
  – early to mid-season protection
• Postemergence fungicide application
  – 4-8 leaf stage window for application
  – Important for susceptible varieties
    • Seed treatment – beneficial postemergence
    • Seed treatment + in-furrow fungicide – may not be needed unless very severe field history
Management of Aphanomyces
Aphanomyces can be a full-season pathogen

Aphanomyces damping-off  Aphanomyces root rot
Life Cycle of *Aphanomyces cochlioides*

Zoospore swim in water
Correlation of sugar yield with Aphanomyces root rot

Recoverable sucrose (lb/A)

Aphanomyces root rot rating (0-7)

r = -0.911  38 df
Significant at P = 0.01
Management of Aphanomyces

Seed Treatment
Tachigaren (Hymexazol)

Early planting
Management of Aphanomyces

Resistant variety < 4.4

Varietal Selection

Aphanomyces Root Rot
Management of Aphanomyces Root Rot
2016 - No lime
2016 - 10 ton/A lime
2016 - 20 ton/A lime
Original lime still reduced Aphanomyces in sugarbeet after 12 years (2016)

- The relationship is described by the equation: \( y = -0.2099x + 5.5948 \)
- The coefficient \( R^2 = 0.9949 \)
- Significant at \( P = 0.0001 \)
Original lime still improved sugar yield after 12 years

\[ y = 137.2x + 3135.1 \]

\[ R^2 = 0.9576 \]

Significant at \( P = 0.0001 \)
### Effect of supplemental lime – across all original lime rates

<table>
<thead>
<tr>
<th>Supplemental lime</th>
<th>Soil Ca (ppm)</th>
<th>Stand at 7 weeks (per 100 ft)</th>
<th>Harvested roots (per 100 ft)</th>
<th>Aph RRR (0-7)</th>
<th>Yield (ton/A)</th>
<th>Sucrose (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>4132</td>
<td>115</td>
<td>101</td>
<td>3.5</td>
<td>20.3</td>
<td>12.6</td>
</tr>
<tr>
<td>5 ton/A</td>
<td>4696</td>
<td>133</td>
<td>122</td>
<td>2.6</td>
<td>22.9</td>
<td>12.8</td>
</tr>
</tbody>
</table>

| Significance     | ***           | **                           | **                            | **           | **           | NS          |

* = Significant at $P = 0.05$
** = Significant at $P = 0.01$
*** = Significant at $P = 0.001$
Correlation of *Aphanomyces* root rot with soil extractable calcium

$r = -0.826$  
38 df  
Significant at $P = 0.01$
Correlation of sugar yield with soil extractable calcium

Recoverable sucrose (lb/A) vs. Soil Ca concentration (ppm)

- Correlation coefficient: \( r = 0.840 \)
- Degrees of freedom: 38
- Significant at \( P = 0.01 \)
For fields with Aphanomyces:

- **No lime**: Add 5-10 ton/A spent lime
- **5 ton/A**: Add 5 ton/A spent lime
- **10+ ton/A**: Apply based on field history
Integrated Management of Aphanomyces

- Varietal Selection
- Seed Treatment
- Tachigaren (Hymexazol)
- Spent Lime
- Weed Management
- Manage Soil Moisture
- Early planting
- Resistant variety < 4.4
Management of Fusarium Yellows
Fusarium Yellows

- Moorhead, late 1990’s
- 2004, 5 to 10% of fields
- 2018, ACSC

<table>
<thead>
<tr>
<th># Townships</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>174</td>
</tr>
<tr>
<td>Slight</td>
<td>89</td>
</tr>
<tr>
<td>Moderate</td>
<td>20</td>
</tr>
<tr>
<td>Severe</td>
<td>16</td>
</tr>
</tbody>
</table>
Fusarium on Seedlings
Fusarium Yellows

5.7 variety (06/17/2019)

5.7 variety (06/17/2019)
Fusarium Yellows

4.3 variety
(06/28/2019)
Fusarium Yellows

4.3 variety (08/06/2019)

2.5 variety
08/14/2019
Fusarium Yellows

Another F. spp recovered in 2019
Integrated Management of Fusarium

- Resistant variety
- Varietal Selection
- Avoid Stress?
- Clean Machinery
- Manage Tare piles
- Fusarium Yellows
- Weed Management

No effective fungicides
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• Minn-Dak Farmers Cooperative
• Southern Minnesota Beet Sugar Cooperative
Thank you!

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