Cercospora Leaf Spot Control and Other Research Updates

Mohamed Khan
Extension Sugarbeet Specialist
Plant Pathology Department
North Dakota State University & University of Minnesota
Outline

- Using Fungicides without and with alternation to manage *Cercospora beticola*
- Impact of N on sugar beet yield and quality

Foxhome, MN
Planted – May 10
Inoculated – July 8
Fungicides – 7/28, 8/9, 22
Fungicide Rates/A - 2011

- Headline – 9 fl oz
- Eminent – 13 fl oz
- Inspire XT – 7 fl oz
- Proline + Premier NIS – 5 oz + 0.125% v/v
- SuperTin 4L – 8 fl oz
- (Topsin + Super Tin) – 7.6 fl oz + 6 fl oz
- Mixtures – each product used at 0.75 x labeled rate.
# Efficacy of Fungicide Mixtures in Controlling *Cercospora beticola*

<table>
<thead>
<tr>
<th>Treatments @ 14 d</th>
<th>CLS</th>
<th>RSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nontreated Check</td>
<td>10.0</td>
<td>3,328</td>
</tr>
<tr>
<td><strong>Inspire XT (7 fl oz)</strong></td>
<td>8.0</td>
<td>4,527</td>
</tr>
<tr>
<td><em>S-Tin (6 fl oz) + Inspire XT (5.25 fl oz)</em></td>
<td>6.5</td>
<td>6,113</td>
</tr>
<tr>
<td><em>Topsin (7.6 fl oz) + Inspire XT (5.25 fl oz)</em></td>
<td>7.0</td>
<td>6,588</td>
</tr>
<tr>
<td><strong>Proline (5 fl oz) + NIS</strong></td>
<td>9.0</td>
<td>5,152</td>
</tr>
<tr>
<td><em>S-Tin (6 fl oz) + Proline (3.75 fl oz)</em></td>
<td>6.3</td>
<td>5,697</td>
</tr>
<tr>
<td><em>Topsin (7.6 fl oz) + Proline (3.75 fl oz)</em></td>
<td>7.8</td>
<td>5,568</td>
</tr>
<tr>
<td><strong>Eminent (13 fl oz)</strong></td>
<td>8.8</td>
<td>5,118</td>
</tr>
<tr>
<td><em>S-Tin (6 fl oz) + Eminent (9.75 fl oz)</em></td>
<td>7.0</td>
<td>5,216</td>
</tr>
<tr>
<td><em>Topsin (7.6 fl oz) + Eminent (9.75 fl oz)</em></td>
<td>7.8</td>
<td>5,991</td>
</tr>
<tr>
<td><strong>Headline EC (9 fl oz)</strong></td>
<td>8.8</td>
<td>5,311</td>
</tr>
<tr>
<td><em>S-Tin (6 fl oz) + Headline (6.75 fl oz)</em></td>
<td>8.0</td>
<td>5,149</td>
</tr>
<tr>
<td><em>Topsin (7.6 fl oz) + Headline (6.75 fl oz)</em></td>
<td>6.3</td>
<td>5,503</td>
</tr>
<tr>
<td><strong>LSD P=0.05</strong></td>
<td>1.0</td>
<td>990</td>
</tr>
</tbody>
</table>
Non-Treated Check
# Efficacy of Fungicide Mixtures in Controlling *Cercospora beticola*

<table>
<thead>
<tr>
<th>Treatments @ 14 d</th>
<th>CLS</th>
<th>RSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nontreated Check</td>
<td>10.0</td>
<td>3,328</td>
</tr>
<tr>
<td><strong>Inspire XT (7 fl oz)</strong></td>
<td>8.0</td>
<td>4,527</td>
</tr>
<tr>
<td>S-Tin (6 fl oz) + Inspire XT (5.25 fl oz)</td>
<td>6.5</td>
<td>6,113</td>
</tr>
<tr>
<td>Topsin (7.6 fl oz) + Inspire XT (5.25 fl oz)</td>
<td>7.0</td>
<td>6,588</td>
</tr>
<tr>
<td><strong>Proline (5 fl oz) + NIS</strong></td>
<td>9.0</td>
<td>5,152</td>
</tr>
<tr>
<td>S-Tin (6 fl oz) + Proline (3.75 fl oz)</td>
<td>6.3</td>
<td>5,697</td>
</tr>
<tr>
<td>Topsin (7.6 fl oz) + Proline (3.75 fl oz)</td>
<td>7.8</td>
<td>5,568</td>
</tr>
<tr>
<td><strong>Eminent (13 fl oz)</strong></td>
<td>8.8</td>
<td>5,118</td>
</tr>
<tr>
<td>S-Tin (6 fl oz) + Eminent (9.75 fl oz)</td>
<td>7.0</td>
<td>5,216</td>
</tr>
<tr>
<td>Topsin (7.6 fl oz) + Eminent (9.75 fl oz)</td>
<td>7.8</td>
<td>5,991</td>
</tr>
<tr>
<td><strong>Headline EC (9 fl oz)</strong></td>
<td>8.8</td>
<td>5,311</td>
</tr>
<tr>
<td>S-Tin (6 fl oz) + Headline (6.75 fl oz)</td>
<td>8.0</td>
<td>5,149</td>
</tr>
<tr>
<td>Topsin (7.6 fl oz) + Headline (6.75 fl oz)</td>
<td>6.3</td>
<td>5,503</td>
</tr>
</tbody>
</table>

LSD *P*=0.05

| LSD          | 1.0 | 990  |

SuperTin 8 fl oz

Topsin 10 fl oz

SuperTin 6 fl oz
+ Topsin 7.6 fl oz
Inspire XT  7 fl oz

Inspire XT 5.25 fl oz + SuperTin 6 fl oz

Inspire XT 5.25 fl oz + Topsin 7.6 fl oz
Headline 9 fl oz

Headline 6.75 fl oz + SuperTin 6 fl oz

Headline 6.75 fl oz + Topsin 7.6 fl oz
Non-Treated
Check CLS 8.8; RSA 5460 lb

Eminent 4x
CLS 4.1; RSA 7130 lb

0.8 (Eminent + TPTH) 4x
CLS 1.8; RSA 8383 lb

2006
Foxhome, MN
Non-Treated Check
CLS 8.8; RSA 5460 lb

Headline 4x
CLS 2.0; RSA 8291 lb

0.8 (Headline + TPTH) 4x
CLS 1.5; RSA 9549 lb
Non-Treated
Check CLS 8.8;
RSA 5460 lb

[0.8 (Eminent + TPTH) / Headline]^2
CLS 1.5; RSA 8929 lb

[0.8 (Headline + TPTH) / Eminent]^2
CLS 1.5; RSA 9278 lb
# Efficacy of Fungicides in Alternation at Controlling *Cercospora beticola* ‘11

<table>
<thead>
<tr>
<th>Treatments @ 14 d</th>
<th>CLS</th>
<th>RSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nontreated Check</td>
<td>10.0</td>
<td>3,636</td>
</tr>
<tr>
<td>Proline /</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S-Tin+Topsin/H-line/S-Tin</td>
<td>6.9</td>
<td>6,059</td>
</tr>
<tr>
<td>S-Tin+T-sin/ T-sin+Inspire/H-line</td>
<td>6.5</td>
<td>5,890</td>
</tr>
<tr>
<td>S-Tin+T-sin/Inspire/H-line</td>
<td>7.3</td>
<td>5,494</td>
</tr>
<tr>
<td>S-Tin+T-sin/ T-sin+Proline/H-line</td>
<td>7.0</td>
<td>5,453</td>
</tr>
<tr>
<td>S-Tin+T-sin/ S-Tin+Proline/H-line</td>
<td>7.3</td>
<td>5,370</td>
</tr>
<tr>
<td>LSD <em>P</em>=0.05</td>
<td>1.2</td>
<td>1,387</td>
</tr>
</tbody>
</table>
Efficacy of Fungicides in a Rotation Program at Controlling *Cercospora beticola* Nontreated Check
Proline/S-Tin+T-sin/Headline/SuperTin
S-Tin+T-sin/Inspire/Headline
S-Tin+T-sin/S-Tin+Proline/Headline
Summary

- Conditions were favorable for CLS starting early in the season.
- Multiple applications of fungicide in mixtures provided more effective CLS control compared to fungicides used alone.
- The use of fungicide mixtures with different modes of action rotated with other mixtures or effective fungicides provided significantly higher level of CLS control and higher recoverable sucrose compared to the nontreated check.
Recommendations

1 Application:
- Mixture of TPTH and Topsin at 0.75x labeled rates
- or mixture of Headline and TPTH
- or mixture of Triazole and TPTH

2 Applications:
Option 1
a. Mixture of TPTH and Topsin at 0.75x labeled rates
b. Inspire XT or Proline or mixture of Eminent and TPTH

Option 2
a. Mixture of TPTH and Topsin at 0.75x labeled rates
b. Headline

Use products in mixture at least at 0.75 times labeled rate!!!
Recommendations

3 Applications:

Option 1
a. Mixture of TPTH and Topsin at 0.75x labeled rates
b. Inspire XT or Proline or mixture of Eminent and TPTH
c. Headline

Option 2
a. Mixture of TPTH and Topsin at 0.75x labeled rates
b. Headline
c. Inspire XT or Proline or mixture of Eminent and TPTH
Recommendations

4 Applications:

Option 1
a. Mixture of TPTH and Topsin at 0.75x labeled rates
b. Inspire XT or Proline or mixture of Eminent and TPTH
c. Headline
d. TPTH

Option 2
a. Mixture of TPTH and Topsin at 0.75x labeled rates
b. Headline
c. Inspire XT or Proline or mixture of Eminent and TPTH
d. TPTH

Check with your Agriculturist for area specific information.
Fungicide Resistance
And
Management
# Efficacy of Individual Fungicides at Controlling *Cercospora beticola* (C.b)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Susceptible C.b</th>
<th>Resistant C.b</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CLS</td>
<td>RSA</td>
</tr>
<tr>
<td>Control</td>
<td>10</td>
<td>4789</td>
</tr>
<tr>
<td>Eminent</td>
<td>8.3</td>
<td>6670</td>
</tr>
<tr>
<td>Proline + NIS</td>
<td>5.0</td>
<td>8094</td>
</tr>
<tr>
<td>Inspire XT</td>
<td>5.8</td>
<td>8269</td>
</tr>
<tr>
<td>SuperTin 4L</td>
<td>7.3</td>
<td>7089</td>
</tr>
<tr>
<td>Headline</td>
<td>6.3</td>
<td>8094</td>
</tr>
<tr>
<td>LSD P=0.05</td>
<td>0.8</td>
<td>932</td>
</tr>
</tbody>
</table>
Susceptible *C. beticola* isolates

Eminent  Inspire XT  Proline

Resistant *C. beticola* isolates
Resistance

- Resistance – the inherent ability of a fungus to overcome the effect of a fungicide at a concentration that was previously lethal to that fungal population.

- Resistance is heritable – it passes on to succeeding generations.
Resistance

A fungus can acquire resistance either in
-one step, due to mutation of a
single gene, or in
-multi-steps, by the interaction of
several mutant genes, each with a
small individual effect.
Resistance

- A resistant mutant might exist at an initial frequency of 1 in 1000 M spores.
- Disease control is affected when there are 1 in 100 or 1 in 10 mutant in the population.
Resistance Mechanisms

1. Decreased permeability of pathogen cell membrane to the chemical.
2. Detoxification through modification of structure or through binding to a cell constituent
3. Decreased conversion of the toxic compound
4. Decreased affinity at the reactive site
5. Shift in metabolism (bypassing a blocked reaction)
6. Producing more of inhibited product
Chemical Classes

- Super Tin, Agri Tin - Triphenyltin hydroxide
- Penncozeb, Mancozeb – Ethylenebisdithiocarbamates (EBDC).
- Topsin M, Benomyl – Benzimidazoles.
- Eminent, Proline, Inspire XT - (Triazoles) – Sterol Biosynthesis Inhibitors.
- Quadris, Gem, Headline – (Strobilurins) – Quinone outside inhibitors.
Chemical Classes - Toxicity

- Triphenyltin hydroxide – uncouples oxidative phosphorylation (energy)
- Benzimidazoles interferes with nuclear division (tubulin production) of sensitive fungi.
- Triazoles - Sterol Biosynthesis Inhibitor (SBI) - inhibit targets within the fungal sterol biosynthesis (membrane)
- Strobilurins – interfere with cell respiration and the production of energy, causing the fungus to stop growing and die.
Recommendations for use of Triazoles & Strobilurins

- Repeated application of triazoles and strobilurins should not be used on the same crop in one season against a high risk pathogen in areas of high disease pressure.
- Do not reduce rates when applying products alone.
- Alternate or mix with an effective non-resistant fungicide.
- Alternation should continue between successive crops.
Nitrogen Rates, Varieties, and Fungicides Impact on Sugarbeet Yield and Quality - 2011

<table>
<thead>
<tr>
<th>N rates: lb/A</th>
<th>Varieties</th>
<th>Fungicides</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>A - Prostrate</td>
<td>Non-treated</td>
</tr>
<tr>
<td>100</td>
<td>B – Erect</td>
<td>Inspire XT</td>
</tr>
<tr>
<td>130</td>
<td></td>
<td>Headline</td>
</tr>
<tr>
<td>160</td>
<td></td>
<td>Eminent</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Proline + NIS</td>
</tr>
</tbody>
</table>
70 lb/A N, Variety B

100 lb/A N, Variety B

130 lb/A N, Variety B

160 lb/A N, Variety B
# Impact of Nitrogen Rates on Sugarbeet Yield and Quality

<table>
<thead>
<tr>
<th>Treatments / A</th>
<th>T/A</th>
<th>% S</th>
<th>RSA(lb/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 lb N</td>
<td>21.7*</td>
<td>16.7</td>
<td>6778*</td>
</tr>
<tr>
<td>100 lb N</td>
<td>23.5</td>
<td>17.0</td>
<td>7479</td>
</tr>
<tr>
<td>130 lb N</td>
<td>23.8</td>
<td>16.5</td>
<td>7314</td>
</tr>
<tr>
<td>160 lb N</td>
<td>25.3</td>
<td>16.4</td>
<td>7672</td>
</tr>
<tr>
<td>LSD P=0.10</td>
<td>1.0</td>
<td>0.3</td>
<td>396</td>
</tr>
</tbody>
</table>

At Foxhome, 100 to 160 lb/A N (applied in Spring) resulted in significantly higher tonnage and recoverable sucrose compared to 70 lb N/A.
## Impact of Varieties on Sugarbeet Yield and Quality

<table>
<thead>
<tr>
<th>Treatments</th>
<th>T/A</th>
<th>% S</th>
<th>RSA(lb/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variety A</td>
<td>24.4</td>
<td>17.0</td>
<td>7741</td>
</tr>
<tr>
<td>Variety B</td>
<td>22.8</td>
<td>16.2</td>
<td>6880</td>
</tr>
<tr>
<td><strong>LSD P=0.05</strong></td>
<td><strong>0.7</strong></td>
<td><strong>0.2</strong></td>
<td><strong>280</strong></td>
</tr>
</tbody>
</table>

- **Variety A had significantly higher tonnage and higher quality which resulted in significantly higher recoverable sucrose than Variety B.**
# Impact of Fungicides on Sugarbeet Yield and Quality

<table>
<thead>
<tr>
<th>Treatments / A</th>
<th>T/A</th>
<th>% S</th>
<th>RSA (lb/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nontreated check</td>
<td>22.8</td>
<td>16.5</td>
<td>7001</td>
</tr>
<tr>
<td>Inspire XT</td>
<td>23.7</td>
<td>16.6</td>
<td>7319</td>
</tr>
<tr>
<td>Headline</td>
<td>23.7</td>
<td>16.7</td>
<td>7382</td>
</tr>
<tr>
<td>Eminent</td>
<td>23.7</td>
<td>16.7</td>
<td>7408</td>
</tr>
<tr>
<td>Proline +NIS</td>
<td>23.9</td>
<td>16.7</td>
<td>7444</td>
</tr>
</tbody>
</table>

*LSD P=0.05 NS NS NS*

- Topsin was applied early across all plots to control Cercospora beticola. In the absence of CLS, fungicides did not have a significant impact on tonnage, sucrose concentration and recoverable sucrose compared to the nontreated check.
Summary

- 100, 130 and 160 lb N/A, Spring applied, resulted in significantly higher recoverable sucrose compared to 70 lb N/A.

  N recommendation of 130 lb/A still effective.

- Variety A provided significantly higher yield, quality, and recoverable sucrose compared to Variety B. Variety selection is very important!

- In the absence of significant Cercospora leaf spot, fungicides did not significantly increase yield, quality or recoverable sucrose compared to the non-treated check.

  CLS can be effectively controlled.
Concluding Remarks

- Recommendations for using fungicides are based on field and laboratory research.
- Currently, because of your practices, we do not have any serious resistance issues with fungicides – congratulations and keep up the good work.
- Growers in ND and MN should continue to follow research based recommendations so that we can prolong the efficacy of our fungicides.
2011 Sugarbeet Growing Tips Schedule – Sugarbeet Radio Program

Projections for 2011 SB Season Mohamed Khan 231-8596 April 21
Nutrient Requirement Dave Franzen 231-8884 April 28
Field Preparation Dave Franzen 231-8884 May 5
Planning for Weed Control Jeff Stachler 231-8131 May 12
Plant Populations, Yield & Quality Mohamed Khan 236-8596 May 19
Root Rot Problems Carol Windels 218-281-8608 May 26
Early Postemergence Herbicides Jeff Stachler 231-8131 June 2
Root Maggot Alert Mark Boetel 231-7901 June 9
Root Rot Problems Carol Windels 218-281-8608 June 16
Root Maggot Control Mark Boetel 231-7901 June 23
Postemergence Weed Control Jeff Stachler 231-8131 June 30
Crop Progress Tom Knudsen 701-671-1351 July 7
Crop Progress Todd Geselius 320-329-4149 July 14
Crop Progress Allan Cattanach 218-236-4487 July 21
The Trade & Politics Scene Nick Sinner 701-239-4151 July 28
Crop Progress Mohamed Khan 231-8596 August 4
Cercospora Alert Mohamed Khan 231-8596 August 11
Fall Tillage for 2012 Crop Dave Franzen 231-8884 August 18
Update on Sugarbeet Diseases Mohamed Khan 231-8596 August 25
Soil Testing & Sampling Problems Dave Franzen 231-8884 * All topics are subject to change.
Back to Tips
Acknowledgements – Thank You

- Growers through the SBREB for funding my research and educational programs.
- Seed, chemical and allied industries, and agriculturists and consultants for assistance.
- Kevin Ekzler, Vince Ulstad, and Kevin Nelson for research conducted on their farms.
- Personnel at ACSC tare laboratory, East Grand Forks.
- Colleagues at NDSU for assistance in harvesting.
- Aaron Carlson – conducting trials.