IHARF Soil and Crop Management Seminar

Malting and feed barley: disease management research

Acknowledgements

• AAFC, AAF, CGC, University colleagues and technical staff

• Barley Cluster
  – AAFC, Alberta Barley, Sask Barley Development Commission, Western Grains Research Foundation, Rahr Malting Inc., Atlantic Grains Council, BMBRI
Test 65, AB, 2013, Melfort, SK, Variety and % Leaf Area Diseased, Flag leaf – 1 & 2, Soft Dough Stage

% leaf area diseased with net-form net blotch

- Sundre (VS-S)
- Chigwell (MRMS)
- Vivar (MR-R)

Flag leaf -1
Flag leaf -2

Note: No seed treatment No foliar fungicide
Barley Test 65, Melfort, SK, 2013, Seed Treatment, Variety, Fungicide, Yield (kg/ha)

- Sundre (S)
- Chigwell (MRMS)
- Vivar (MR-R)

No seed trt No Twinline

27% yield reduction with Sundre
# Leaf Spot Reaction of Barley Varieties For Alberta

Based on Varieties of Cereal and Oilseed Crops For Alberta - 2013, AARD Agdex 100/32

**T.K. Turkington¹**, and **K. Xi²**

¹ Agriculture and Agri-Food Canada Lacombe, AB; ² Alberta Agriculture and Rural Development (AARD), Lacombe, AB

## Leaf Spot Reaction

<table>
<thead>
<tr>
<th>Barley (row type)</th>
<th>Scald</th>
<th>Net form (VP)</th>
<th>Spot form Net</th>
<th>Spot Blotch*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General purpose</strong></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>AC Harper (6)</td>
<td>P</td>
<td>F</td>
<td>F</td>
<td>xx</td>
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<tr>
<td>AC Lacombe (6)</td>
<td>F</td>
<td>P</td>
<td>G</td>
<td>xx</td>
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<tr>
<td>AC Ranger (6)</td>
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<tr>
<td>AC Rosser (6)</td>
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<td>F</td>
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<tr>
<td>Busby (2)</td>
<td>F</td>
<td>P</td>
<td>G</td>
<td>G</td>
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<tr>
<td>CDC Austenson (2)</td>
<td>VP</td>
<td>F</td>
<td>G</td>
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<tr>
<td>CDC Coalition (2)</td>
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<td>F</td>
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<tr>
<td>CDC Cowboy (2)</td>
<td>P</td>
<td>F</td>
<td>G</td>
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<tr>
<td>CDC Dolly (2)</td>
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<td>CDC Helgason (2)</td>
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<tr>
<td>CDC Maverick (2)</td>
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<td>G</td>
<td>xx</td>
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<tr>
<td>CDC Mindon (2)</td>
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<td>VP</td>
<td>G</td>
<td>F</td>
</tr>
<tr>
<td>CDC Trey (2)</td>
<td>P</td>
<td>F</td>
<td>VG</td>
<td>F</td>
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<tr>
<td>Champion (2)</td>
<td>VP</td>
<td>VP</td>
<td>F</td>
<td>P</td>
</tr>
<tr>
<td>Chigwell (6)</td>
<td>G</td>
<td>F</td>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>Conlon (2)</td>
<td>VP</td>
<td>F</td>
<td>G</td>
<td>P</td>
</tr>
<tr>
<td>Gadsby (2)</td>
<td>VG</td>
<td>P</td>
<td>G</td>
<td>VP</td>
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<td>Muskwa</td>
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<td>P</td>
<td>G</td>
<td>F</td>
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<td>Ponoka (2)</td>
<td>G</td>
<td>P</td>
<td>G</td>
<td>G</td>
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<tr>
<td>Seebe (2)</td>
<td>G</td>
<td>VP</td>
<td>P</td>
<td>xx</td>
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<tr>
<td>Sundre (6)</td>
<td>VG</td>
<td>P</td>
<td>F</td>
<td>F</td>
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<tr>
<td>TR07728 (2)</td>
<td>VP</td>
<td>F</td>
<td>P</td>
<td>VP</td>
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<tr>
<td>Trochu (6)</td>
<td>VP</td>
<td>F</td>
<td>G</td>
<td>xx</td>
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<tr>
<td>Xena (2)</td>
<td>VP</td>
<td>VP</td>
<td>F</td>
<td>VP</td>
</tr>
</tbody>
</table>
A single year between host crops (e.g. canola/barley/canola/barley) is not sufficient for adequate decomposition of infested crop residues.
Tight rotation, susceptible variety ... no worries, hit it good, hit it real good with fungicide! Problem solved ... ???

Boise Gun Club
Thanksgiving Turkey Shoot,
Boise, Idaho, 2014

Brother: Brent T.
Nephew: Kyle W. – Armoury
Kelly T.
Haul = 1 turkey and 1 ham

Photo by C. Fisher
(Brother-in-law)
### Percentage leaf area diseased, penultimate leaf, AC Metcalfe, herb./fungicide exp., 13 site yrs, 2010-2012

<table>
<thead>
<tr>
<th>Herbicide/Fungicide Treatment</th>
<th>% leaf area diseased</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hrb2-3 (early weed)</td>
<td></td>
</tr>
<tr>
<td>Hrb5-6 (late weed)</td>
<td></td>
</tr>
<tr>
<td>Hrb2-3 + HRFun</td>
<td></td>
</tr>
<tr>
<td>Hrb5-6 + HRFun</td>
<td></td>
</tr>
<tr>
<td>Hrb2-3/FRF-Flg</td>
<td></td>
</tr>
<tr>
<td>Hrb5-6/FRF-Flg</td>
<td></td>
</tr>
<tr>
<td>Hrb2-3 + HRFun/FRF-Flg</td>
<td></td>
</tr>
<tr>
<td>Hrb5-6 + HRFun/FRF-Flg</td>
<td></td>
</tr>
<tr>
<td>Hrb2-3 + HRFun/HRF-Flg</td>
<td></td>
</tr>
<tr>
<td>Hrb5-6 + HRFun/HRF-Flg</td>
<td></td>
</tr>
</tbody>
</table>

#### Fungicide at flag leaf stage

- **No fungicide at flag leaf stage**
- **Fungicide at flag leaf stage**

- **LSD = 4.0**
- **P <0.001**

### Notes
- Treatment comparisons:
  - **Herb only**
  - **Herb + ½ rate Tilt**
  - **Herb + Full rate Tilt at flag**
  - **Herb + ½ rate Tilt & Full rate Tilt at flag**
  - **Herb + ½ rate Tilt & 1/2 rate Tilt at flag**

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[Graph with data points and comparisons showing the effect of different herbicide/fungicide treatments on leaf area diseased.]
Yield (bu/ac) and herb./fungicide treatment, 13 site years, AC Metcalfe barley, 2010-2012

<table>
<thead>
<tr>
<th>Herbicide/Fungicide Treatment</th>
<th>No fungicide at flag leaf stage</th>
<th>Fungicide at flag leaf stage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hrb2-3 (early weed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hrb5-6 (late weed)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hrb2-3 + HRFun</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hrb5-6 + HRFun</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hrb2-3/FRF-Flg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hrb5-6/FRF-Flg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hrb2-3 + HRFun/FRF-Flg</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hrb5-6 + HRFun/FRF-Flg</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P < 0.001

LSD = 4.1
Trial 62, Seed treatment, PGR and fungicide timing, 2013-2016

- Seed treatment
  - Insure at 600 ml/100 kg seed (2x rate)

- PGR
  - Ethrel (ethephon) at 300-400 ml/ac (Cerone)

- Flag leaf
  - Twinline at 202 ml/ac

- Head emergence
  - Prosaro at 324 ml/ac

- Percentage leaf area diseased
  - Flag leaf – 1

- Grain yield
- Kernel characteristics
- AC Metcalfe barley
- Multiple locations across Canada
Test 62, Beaverlodge, AB, 2014, Grain Yield (kg/ha)

No to limited disease development (<2.0% for check)

Similar results in other years at Beaverlodge
Test 62, Indian Head, MB, 2013, Percentage Leaf Area Diseased

<table>
<thead>
<tr>
<th>Seed treatment</th>
<th>PGR</th>
<th>Flag fungicide</th>
<th>Head fungicide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check</td>
<td>Treated</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Seed treatment: P < 0.001
- PGR: P = NS
- Flag fungicide: P < 0.001
- Head fungicide: P < 0.001
Test 62, Indian Head, MB, 2013, Grain Yield (kg/ha)

Grain yield (kg/ha)

- Seed treatment: P = 0.03
- PGR: P = NS
- Flag fungicide: P = NS
- Head fungicide: P < 0.031
Indian Head 2014 and 2015

- Low disease levels in 2014
  - Limited influence on yield
- Low to moderate in 2015
  - Limited treatment effects
Test 62, Indian Head, SK, 2016, Grain Yield (kg/ha)

<table>
<thead>
<tr>
<th>Seed treatment</th>
<th>PGR</th>
<th>Flag fungicide</th>
<th>Head fungicide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Check</td>
<td>Treated</td>
<td>Check</td>
<td>Treated</td>
</tr>
<tr>
<td>NS</td>
<td>P&lt;0.0001</td>
<td>NS</td>
<td>P=0.0014</td>
</tr>
</tbody>
</table>

Final leaf disease ratings not available
Trial 65, Seed Treatment, Variety Resistance and Fungicide

- **Seed treatment**
  - Insure at 600 ml/100 kg seed (2x rate)
    - Triticonazole, pyraclostrobin, metalaxyl

- **Flag leaf**
  - Twinline at 202 ml/ac
    - Metconazole, pyraclostrobin

- **Variety resistance**
  - Lacombe (scald)
    - Xena (S)
    - Busby (MRMS)
    - Gadsby (MR-R)
  - Melfort/Charlottetown (net form net blotch)
    - Sundre (VS-S)
    - Chigwell (MRMS)
    - Vivar (MR-R)
  - Percentage leaf area diseased
    - Early and late
  - Grain yield/ kernel characteristics
Barley Test 65, AB, 2016, Charlottetown, PEI, Seed Treatment, Variety, Fungicide, % Leaf Area Diseased, Flag – 1, Soft Dough Stage

% leaf area diseased with net-form net blotch

No seed trt No Twinline vs Yes Seed trt No Twinline vs No seed trt Twinline applied vs Yes Seed trt Twinline applied

Sundre (VS-S) | Chigwell (MRMS) | Vivar (MR-R)

P<0.0211
Test 65, Charlottetown, PEI, 2016, Interaction of Variety and Fungicide, Grain Yield (bu/ac)

Grain yield (bu/ac)

<table>
<thead>
<tr>
<th>Sundre (VS-S)</th>
<th>Chigwell (MRMS)</th>
<th>Vivar (MR-R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>A</td>
<td>A</td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>AB</td>
</tr>
<tr>
<td>A</td>
<td>A</td>
<td>A</td>
</tr>
</tbody>
</table>

No Twinline

Twinline applied

P = 0.0484
Take home messages

• **Seed treatment**
  – May have some impact/benefit
    • When leaf disease risk is higher

• **PGR**
  – Perhaps when there is a risk of lodging

• **Flag/Head fungicide**
  – Most consistent impact
    • When leaf disease risk was moderate-high

• **Few interactions**
  – Single fungicide applications similar to split applications
Take home messages

• Resistant varieties generally not responsive to fungicide inputs
  – Resistance provides producers with peace of mind when disease risk is high, protecting yield, while limiting input costs

• No synergistic impact of using a seed treatment in combination with a foliar fungicide
  – May reflect the seed treatment that was used
  – If leaf disease is an issue then direct protection of the upper canopy leaves should be your focus
Cropping system management is more than just disease management.

“I’ve got it, too, Omar ... a strange feeling like we’ve just been going in circles.”
Use of Advanced Agronomic Practices in Malt Barley: Benefits and Risk to Yield and Quality

B.D. Tidemann
J.T. O’Donovan
Agriculture and Agri-Food Canada
Lacombe
Collaborating Scientists

- Neil Harker and Kelly Turkington – AAFC Lacombe
- Marta Izydorczyk – Canadian Grain Commission
- Lori Oatway – Alberta Agriculture and Forestry
- Brian Beres – AAFC Lethbridge
- Bill May – AAFC Indian Head
- Cecil Vera – AAFC Melfort
- Greg Semach – AAFC Beaverlodge
- Ramona Mohr – AAFC Brandon
- Jessica Weber – Western Applied Research Corporation
Acknowledgements

• Western Grains Research Foundation
• Alberta Barley Commission
• Brewing and Malting Barley Research Institute
• Rahr Malting

• National Barley Cluster – Growing Forward II
• Technical support and summer students at each site
Malt barley in western Canada

• ~2.5 million ha of total barley
• Top varieties: CDC Copeland, AC Metcalfe

Canadian Grain Commission 2016
Malt barley in western Canada

• Premium for malt barley vs. feed barley

• Difficulty achieving malt quality
  – 15 quality targets
  – Grain protein (11-12.5%)
  – Lodging
  – Uneven maturity
Potential Advanced Agronomics

• Use of varieties less responsive to nitrogen
  – Increased yield, maintained protein

• Use of plant growth regulators (PGRs) to prevent lodging

• Use of glyphosate as a pre-harvest aid for uneven maturity
Trial Locations

Alberta

- Beaverlodge
- Lacombe
- Melfort
- Scott
- Lethbridge
- Indian Head
- Brandon

Saskatchewan

- Canadian Shield

Manitoba

- 60° N Lat.

49° N Lat.
Trials

- Variety x Nitrogen
- PGR’s
The nitrogen conflict

- Producers goal is to increase yield
- Nitrogen effectively increases yield
- Nitrogen increases protein
  - Less chance of malt quality

- Are there varieties that show less response to nitrogen in quality?
Materials and Methods

- The trial was conducted over 4 years under direct seeding conditions
- 2 factor factorial, RCBD
  - 5 varieties
    - AC Metcalfe
    - AAC Synergy
    - CDC Kindersley
    - Voyager
    - Cerveza
  - 4 nitrogen rates (kg/ha)
    - 0
    - 25
    - 50
    - 100
- Results presented across site-years (Proc Mixed)
Contrasts with Metcalfe
Kindersley $p = 0.0016$
Cerveza $p < 0.0001$
Voyager $p < 0.0001$
Synergy $p < 0.0001$
Protein

% protein vs. Nitrogen rate (kg/ha)

- Kindersley
- Cerveza
- Voyager
- Synergy
- Metcalfe

Contrasts with Metcalfe:
- Kindersley $p = 0.4095$
- Cerveza $p = 0.0135$
- Voyager $p < 0.0001$
- Synergy $p < 0.0001$
Maturity

Days to maturity

Nitrogen Rate (kg/ha)

Contrasts with Metcalfe
Kindersley $p = 0.0758$
Cerveza $p = 0.0001$
Voyager $p < 0.0001$
Synergy $p = 0.0002$
Percent Plump

Contrasts with Metcalfe
Kindersley $p = 0.591$
Cerveza $p = 0.2496$
Voyager $p < 0.0001$
Synergy $p < 0.0001$
Kernel Weight

### Graph

- **Y-axis:** g/1000 seeds
- **X-axis:** Nitrogen rate (kg/ha)

#### Lines and Contrasts
- **Kindersley**
- **Cerveza**
- **Voyager**
- **Synergy**
- **Metcalfe**

#### Contrasts with Metcalfe
- **Kindersley**: $p < 0.0001$
- **Cerveza**: $p < 0.0001$
- **Voyager**: $p < 0.0001$
- **Synergy**: $p < 0.0001$
Conclusions

- All four of the new varieties were higher yielding than Metcalfe at all nitrogen rates
- **AAC Synergy** produced the highest yield regardless of nitrogen rate
- Synergy and Voyager performed well in quality, but are later maturing
- Synergy as a Canadian variety may be quite successful
Trials

- Variety × Nitrogen
- PGR’s
Materials and Methods

• 15 site-years, 2 factor factorial
• CDC Copeland
• PGR
  – None
  – Ethephon (Ethrel) (flag leaf – swollen boot)
  – Chlormequat (Manipulator) (<3\(^{rd}\) node)
  – Trinexapac (Moddus)(<3\(^{rd}\) node)
• Seeding rate – 200, 300 or 400 seed m\(^{-2}\)
Effects on Height

<table>
<thead>
<tr>
<th>Treatment</th>
<th>A</th>
<th>NS</th>
<th>D+</th>
<th>D-</th>
<th># of sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trinexapac</td>
<td>5</td>
<td>0</td>
<td>9</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Chlormequat</td>
<td>12</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>15</td>
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<tr>
<td>Ethephon</td>
<td>9</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>15</td>
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<tr>
<td>None</td>
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Effects on Lodging

<table>
<thead>
<tr>
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<th>A</th>
<th>NS</th>
<th>D+</th>
<th>D-</th>
<th># of sites</th>
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<td>3</td>
<td>12</td>
<td>0</td>
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<tr>
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<td>15</td>
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<tr>
<td>Ethephon</td>
<td>12</td>
<td>0</td>
<td>2</td>
<td>1</td>
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<tr>
<td>None</td>
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<td>15</td>
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</table>
Effects on Maturity

- **Trinexapac**: 11 A, 0 NS, 4 D+, 0 D-, 15 sites
- **Chlormequat**: 15 A, 0 NS, 0 D+, 0 D-, 15 sites
- **Ethephon**: 10 A, 5 NS, 0 D+, 0 D-, 15 sites
- **None**: Number of days to maturity ranges from 93 to 103.
Effects on % Plump

<table>
<thead>
<tr>
<th>Treatment</th>
<th>A</th>
<th>NS</th>
<th>D+</th>
<th>D-</th>
<th># of sites</th>
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<td>Chlormequat</td>
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<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Ethephon</td>
<td>9</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>None</td>
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</table>

Plump (%)
Effects on Yield

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>NS</th>
<th>D+</th>
<th>D-</th>
<th># of sites</th>
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<tr>
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<td>0</td>
<td>4</td>
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<tr>
<td>Chlormequat</td>
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<td>3</td>
<td>1</td>
<td>15</td>
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<tr>
<td>Ethephon</td>
<td>9</td>
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<td>5</td>
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<td>15</td>
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<tr>
<td>None</td>
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</table>

Yield (kg/ha)
Conclusions

• Inconsistent benefits of PGRs on height, lodging and yield
• More consistent risks to maturity, percent plump
• Little to no negative effect on malt quality
• Increased variability in malt quality
• Generally more consistent risks than benefits to use of PGRs in malt barley
Thank you