MANAGEMENT GUIDELINES FOR BLACKLEG AND TUBER SOFT ROT ON A POTATO FARMING OPERATION

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Background

- Blackleg and tuber soft rot are caused by bacteria in the genera *Pectobacterium* and *Dickeya*
- Facultative anaerobes, pectolytic
- Major concern in many potato growing regions around the world
- Varies between different grower operations, why?
Blackleg Project Outline

• 3 studies to evaluate blackleg and tuber soft rot
  • Seed Cutter Evaluation (spring 2014 & spring 2015)
  • Grower Seed Evaluation (2013-2015)
  • Evaluation of Rotational crops (2013-2014)
Evaluation of Two Seed Cutting Operations

- Several locations on a potato tuber can serve as reservoirs for bacteria (lenticels, wounds, rotten tubers, etc.)
- As a seed cutter is exposed to the bacteria, different surfaces in the cutter can also serve as reservoirs
- Cutting knives, belts, rollers, etc.
Evaluation of Two Seed Cutting Operations
(Materials & Methods)

• Two different certified seed growers (San Luis Valley, CO).
• Milestone seed cutter (grower #1) vs Hot cutter (grower #2)
• Milestone cutter circular blades were sanitized between seed lots (Hyamine @ 1% dilution, a.i. N-Alkyl dimethyl benzyl ammonium chloride).
• Hot cutter knives were heat sterilized using an electrical current (200-260°C).
Evaluation of Two Seed Cutting Operations
(Materials & Methods)

- Used autoclaved (sterile) Qtips
- Swabbed each cutter surface
- Sterile toothpicks, ten random colonies and inserted into Crystal Violet Pectate (CVP).
- Anaerobic environment for 96 hours
- Counted the number of pits.
- A LSD mean separation (p=0.10) and paired t-tests, five reps per surface.
Evaluation of Two Seed Cutting Operations
(Milestone Cutter - Grower #1)
Evaluation of Two Seed Cutting Operations
(Milestone Cutter - Grower #1)
Pic of Hot cutter (Grower #2)
Table of Summer Blackleg readings
Average 2009-2015

<table>
<thead>
<tr>
<th>Year</th>
<th># of seed lots evaluated</th>
<th># plants inspected</th>
<th># plants with blackleg</th>
<th># lots with blackleg</th>
<th>% plants with blackleg</th>
<th>% lots with blackleg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grower #1</td>
<td>27</td>
<td>61,471</td>
<td>444</td>
<td>9.4</td>
<td>0.73</td>
<td>35.6</td>
</tr>
<tr>
<td>Grower #2</td>
<td>163</td>
<td>94,443</td>
<td>3</td>
<td>2.0</td>
<td>0.0029</td>
<td>1.6</td>
</tr>
</tbody>
</table>
Comparison of Similar Cutting Surfaces at the Two Different Grower Operations (Grower 1 vs Grower 2). Mean Percent Pits Visually Observed on CVP Media, Canela Generation 3, 2014.

- Grower #1 (2014 Canela Russet G3)
- Grower #2 (2014 Canela Russet G3)

Surface Comparisons:

1. Circular vs Hot Knives
2. Stationary vs Hot Knives
3. Belt comparison (before seed treat)
4. Belt comparison (after seed trat)
Summary of Seed Cutter Evaluations

• Use of a liquid seed treatment provides a favorable environment for pectolytic bacteria
• The use of a hot cutter or routine disinfection results in a lower number of pectolytic bacteria
Differences in Blackleg Management Practices between Potato Growers
Differences in Blackleg Management Practices between Potato Growers

• Purpose: to determine whether or not a lab test could be used to evaluate a seed lot for blackleg causing bacteria

• Evaluated 62 seed lots (2013 crop) and 20 seed lots (2014 crop), four growers with varying blackleg.

• Collected 40 in the fall and 40 tubers in spring for each seed lot.

• Sterile toothpick, punctured stem end and 3 random lenticels.

• CVP, anaerobic chamber for 4-5 days
<table>
<thead>
<tr>
<th>Grower</th>
<th>Cultivar</th>
<th>Year</th>
<th>Field Year</th>
<th>Field Generation</th>
<th>Acres in Lot</th>
<th>% Blackleg&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Satina</td>
<td>2013</td>
<td>FY4</td>
<td>G4</td>
<td>22.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2</td>
<td>Satina</td>
<td>2014</td>
<td>FY5</td>
<td>G5</td>
<td>NA&lt;sup&gt;b&lt;/sup&gt;</td>
<td>NA&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>3</td>
<td>Satina</td>
<td>2013</td>
<td>FY4</td>
<td>G4</td>
<td>47.60</td>
<td>6.00</td>
</tr>
<tr>
<td>3</td>
<td>Satina</td>
<td>2014</td>
<td>FY5</td>
<td>G5</td>
<td>NA&lt;sup&gt;b&lt;/sup&gt;</td>
<td>NA&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

<sup>a</sup> Each lot is inspected by trained seed potato inspectors. Percent blackleg is based on the visual evaluation of 1% of the number of acres in each seed lot (or a minimum of 1,000 plants for seed lots with less than 10 acres). The total number of plants expressing blackleg symptoms are used to calculate the percentage of blackleg: (# blackleg plants/# plants evaluated)*100.

<sup>b</sup> NA = Information is Not Available because seed lot was not planted by the grower in 2014.
Figure 2. Evaluation of the Potato Cultivar Satina (Field Generation Four) Under Two Different Seed Operations to Determine the Percentage of Pitting caused by Pectolytic Bacteria - Stem Ends, 2013 Crop.

![Graph showing evaluation of potato cultivar Satina over two seasons. The graph compares percent pitting between Grower 2 and Grower 3 over the fall 2013 to spring 2014 evaluation season. The graph indicates a significant difference between the two growers, with P values of 0.0023 and 1.0000.](image)
Summary of Grower Evaluations

- When blackleg is present in a seed lot, a fall screening using this CVP technique can be used to confirm.
- Pectolytic bacterial numbers in the spring are not consistent.
- This screening technique could potentially be used to evaluate a seed operations effectiveness at managing blackleg.
Evaluation of Different Crop Rotations
Evaluation of Different Crop Rotations

- Seven crop rotations evaluated (data collected 2013 & 2014)
- Solid-set irrigation
- Potato cultivar (Colorado Rose)
- Potato, Potato-rye, Barley, Sudan (green manure), Canola, Camolina, 7 species mix
- Potato seed was inoculated with a slurry of *P. atrosepticum*
- Two potato rows (one inoculated and one uninoculated row)
Figure 3. Evaluation of Potato Quality at Harvest: % culls.

Crop Rotation

Culls are defined as any tuber not meeting grade standards (e.g. misshaped, green coloration, etc.). Percent culls are based on tuber weight at harvest. Data collected on one 10 foot row per treatment per replication, mean of 2013 and 2014 data. Means followed by the same letters are not significantly different at $P=0.05$. 

Aspen Barley
2. Potato-Rye/Sudan
3. Potato/Barley/Canola
4. Potato/Barley/Sudan
5. Potato/Barley/Camolina
6. Potato/Barley/Cocktail
7. Potato-Rye/Cocktail/Sudan
Table 3. Evaluation of potato seed challenge inoculated with *Pectobacterium atrosepticum* to determine effect on soft rot incidence, mean of 2013 & 2014 data.

<table>
<thead>
<tr>
<th>Trt #</th>
<th>Treatment</th>
<th>Number Rotten Tubers (UI)a</th>
<th>Number Rotten Tubers (I)b</th>
<th>Pairwise comparison between UI &amp; Ic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Potato/Barley</td>
<td>0.3</td>
<td>0.3</td>
<td>1.0000</td>
</tr>
<tr>
<td>2</td>
<td>Potato-Rye/Sudan GM</td>
<td>0.1</td>
<td>0.8</td>
<td>0.0605</td>
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<tr>
<td>3</td>
<td>Potato/Barley/Canola</td>
<td>0.0</td>
<td>0.9</td>
<td>0.0092</td>
</tr>
<tr>
<td>4</td>
<td>Potato/Barley/Sudan GM</td>
<td>0.3</td>
<td>0.3</td>
<td>1.0000</td>
</tr>
<tr>
<td>5</td>
<td>Potato/Barley/Camolina</td>
<td>0.3</td>
<td>0.4</td>
<td>0.7048</td>
</tr>
<tr>
<td>6</td>
<td>Potato/Barley/Cocktail GM</td>
<td>0.1</td>
<td>0.8</td>
<td>0.1115</td>
</tr>
<tr>
<td>7</td>
<td>Potato-Rye/Cocktail GM/Sudan GM</td>
<td>0.3</td>
<td>0.5</td>
<td>0.4492</td>
</tr>
<tr>
<td>LSD</td>
<td></td>
<td>NS</td>
<td>NS</td>
<td>-</td>
</tr>
<tr>
<td>CV</td>
<td></td>
<td>253.05</td>
<td>151.73</td>
<td>-</td>
</tr>
<tr>
<td>P value</td>
<td></td>
<td>0.90</td>
<td>0.57</td>
<td>-</td>
</tr>
</tbody>
</table>
Summary of Crop Rotation Evaluation

- Avoid using Canola or Camolina as a crop rotation the year before potatoes if you have a history of blackleg.
- The other rotational crops evaluated did not result in a significant change in tuber soft rot or % culls at harvest.
Management Strategies for Blackleg and Tuber Soft Rot

• 1. Plant certified seed with low blackleg levels
• 2. Plant resistant cultivars
• 3. Plant early generations (G3 or G4)
• 4. Use single drop seed, if possible
Management Strategies for Blackleg and Tuber Soft Rot

5. If using cut seed, dry your seed
6. Sterilize equipment (steam, disinfectants)
7. Crop rotations (promotes mycorrhizal growth)
8. Avoid surface irrigation water and excess irrigation
Questions?