Disease Control Strategies for Stored Potatoes

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Disease identification

Disease Management in Storage

- Integrated two-pronged approach:
  - Deal with field-infected tubers
  - Minimize spread from diseased to healthy in storage

- Variety
- Exclusion
- Pulp temperatures
- Wounding
- Ventilation
- Temperature
- Humidity
- Post-harvest products
Late Blight, Pythium Leak and Pink Rot in Storage

• Know cultivar susceptibility
• Control in field
• Avoid warm pulp temperatures and wounding; wet conditions
• Eliminate when loading
• Remove field heat quickly; 10°C curing temperatures
• Immediate air
• High ventilation rates
• Lower holding temperatures
• Post harvest products
Avoid harvest with pulp temperatures above 18.3°C and below 7.2°C

Maturity and Wounding

- Lack of skin set
- Entry points and more prone to disease invasion – Pythium leak, pink rot, late blight, Fusarium dry rot
- Potential for greater weight loss in early storage
Pink rot

![Image of pink rot on potato]

![Image of infected potato slice]

<table>
<thead>
<tr>
<th>% Infection</th>
<th>15.6°C</th>
<th>21.1°C</th>
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</thead>
<tbody>
<tr>
<td>Unwounded</td>
<td>3</td>
<td>65</td>
</tr>
<tr>
<td>Wounded</td>
<td>53</td>
<td>93</td>
</tr>
</tbody>
</table>
Pythium leak
Air, Temperature and Humidity

- Maximize run time
- Immediate air and aggressive ventilation program
- Set point -- Watch temperatures
- Refrigeration
- Humidification – use evaporative cooling pads to extend cooling time
- Watch storage closely; know disease and level
- Use low storage temperatures to advantage
- Minimize free moisture (condensation)

Heat load in Storage

- For a 100,000 cwt storage
- Mature “normal” respiration = 3,300,000 BTU/storage/day
- Immature respiration = 10 times greater = 33,000,000 BTU/storage/day
- Disease – significantly increases respiration

REMOVE HEAT… fan capacity and run time
Bacterial Soft Rot

• Decrease ability for Bacterial Soft rot to multiply as decrease temperature
  – Above 15.6°C = same – high level
  – Below 15.6°C dramatic decrease in multiplication
• Cool down ASAP - maximize run time
Pathogen Exposure to Air – Viability (%) on Tuber Surface

Time 0

- Late blight: 100%
- Dry rot: 100%
- Soft rot: 100%
- Silver scurf: 100%
Pathogen Exposure to Air – Viability (%) on Tuber Surface

**Time ½ hour**

- **Late blight**
  - 100%

- **Dry rot**
  - 100%

- **Soft rot**
  - 30%

- **Silver scurf**
  - 100%

**Time 1 hour**

- **Late blight**
  - 95%

- **Dry rot**
  - 100%

- **Soft rot**
  - 10%

- **Silver scurf**
  - 100%
Pathogen Exposure to Air – Viability (%) on Tuber Surface

**Time 2 hours**

- **Late blight**: 60%
- **Dry rot**: 100%
- **Soft rot**: 0%
- **Silver scurf**: 100%
Sprinkler hose without endcap

Sprinkler hose - too many holes / too large

Sprinkler hose - correct holes / uniform distribution

From Roger Brook, MSU
Additional options in storage

• Humidity reduction
• Ventilation
  – Supplemental fans (e.g., grain fan at entry to duct)
• Spot treating with post-harvest product

Early Storage Management Study:
Impact on Soft Rot

Less development of **SOFT ROT** from **late blight** or **pink rot** infected tubers when
  – Reduce humidity to 80%RH
  – Reduce curing temperatures to 10°C
Storage Management: Ventilation, Temperature and Humidity
Disease Spread from Infected to Healthy Tubers
Post-harvest spray application volumes

- Dry and 0.25 gal/T
- Dry and 0.50 gal/T
- Dry and 1.0 gal/T
- Dry and 2.0 gal/T
Large-scale study: Effect of Post Harvest Applications on PINK ROT

Effect of Post Harvest Applications on LATE BLIGHT

HPPA = Oxidate
PA = Phosphorous acid (Phostrol)
Effect of Post-harvest Treatment on LATE BLIGHT Incidence

- Phos Acid 2 (1:5)
- Phos Acid 1 (1:5)
- Azoxystrobin
- Hydrogen peroxide
- Peracetic acid
- Serenade ASO
- Untreated control

Effect of Post-harvest Treatment on PINK ROT Incidence

- Phos acid
- Azoxystrobin
- HPPA
- Ca hypochlorite
- Untreated control
Pythium leak

On-line spray vs. in-storage application
Effect of Post-inoculation Interval on Incidence of Late Blight

![Graph showing the effect of post-inoculation interval on incidence of late blight.](image)

- **HPPA**: Oxidate
- **PA**: Phostrol

**Legend**
- Red line: Untreated
- Green line: HPPA
- Blue line: PA

**Axes**
- Y-axis: Incidence
- X-axis: Post-inoculation Interval (Hours)
Dry rot management

- Function of
  - Variety
  - Inoculum level
  - Damage or entry points
  - Wound healing conditions
    - Race between healing and disease infection
  - Overall storage management

Mean percent Fusarium decay in bruised and inoculated potatoes from 4 clones at 4 nitrogen fertilization regimes

Var is significant, N treatment is not

- R Burbank
- Clearwater R
- AF4296-3
- Dakota R
Stadium® (Difenconazole, Fludioxonil, Azoxystrobin) post-harvest product application labeled for Fusarium dry rot and silver scurf

Commercial Storage Study

Collected before Stadium application
No Stadium
25 % incidence (>5%)

Collected after Stadium application
Stadium (1 fl oz/ton)
11 % incidence (>5%)
Fusarium Dry Rot Management

- Fusarium dry rot susceptibility
- Management Options
  - Pulp temperatures
  - Minimize wounding (avoid rocky fields, watch drops)
  - Early storage management
    - Encourage wound healing, balance with other diseases/weight loss
  - Stadium® typically can reduce Fusarium dry rot decay by half
  - Biological control may be option for low disease pressure
    - Situation dependent
  - Lower storage temperatures may retard severity
Silver Scurf Biology in Storage

- Primary infection occurs in field
- Secondary spread occurs in storage
  - Conidia spread in storage by ventilation
  - Infection occurs when warm, moist (e.g., condensation) conditions favor germination of the conidia
- Free moisture significantly increases the disease
- Temperature and %RH can affect spread
- Infection increases shrinkage in storage
Silver scurf management

1. Low level on seed
2. Use an effective seed treatment
3. Minimize time between vine-kill and harvest
4. Proper storage conditions
5. Sanitize storage facilities
6. Post-harvest products
Storage Conditions and Silver Scurf

- Avoid free moisture on the surface and within pile
- Lower holding temperatures
- Lower relative humidity

Free moisture and silver scurf

<table>
<thead>
<tr>
<th>silver scurf rating</th>
<th>Free moisture</th>
<th>none</th>
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<tbody>
<tr>
<td>B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td></td>
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</table>

Silver scurf rating, 1 to 10, 1 = 10%, 10 = 100% coverage

Frazier et al.
Holding Temperature and Silver Scurf

<table>
<thead>
<tr>
<th>Temp (°C)</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
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<tbody>
<tr>
<td>4.4</td>
<td>Yellow</td>
<td>68</td>
<td>83</td>
</tr>
<tr>
<td>5.6</td>
<td>Yellow</td>
<td>65</td>
<td>80</td>
</tr>
<tr>
<td>7.2</td>
<td>Yellow</td>
<td>70</td>
<td>82</td>
</tr>
<tr>
<td>8.9</td>
<td>Yellow</td>
<td>57</td>
<td>88</td>
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</tbody>
</table>

No considerable impact on % silver scurf or severity with temperature

Silver Scurf and %RH

Research shows need to be below 85% RH to affect silver scurf spread
Silver scurf management

1. Low level on seed
2. Use an effective seed treatment
3. Minimize time between vine-kill and harvest
4. Proper storage conditions
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Silver Scurf Post-harvest Applications

- **Phosphorous acid (phosphite)**
  - Late blight, pink rot, silver scurf
- **Stadium™ (Azoxystrobin, Difenoconazole, Fludioxonil)**
  - Silver scurf and Fusarium dry rot
- **Disinfectants**
  - Old and new application methods
- **Clove Oil**
  - Sprout suppression

### Phosphorous acid

<table>
<thead>
<tr>
<th>Year</th>
<th>Water-treated control</th>
<th>Phosphorous Acid</th>
<th>Water-treated control</th>
<th>Phosphorous Acid</th>
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<tr>
<td>2006</td>
<td>8</td>
<td>3</td>
<td>18</td>
<td>0</td>
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<tr>
<td>2007</td>
<td>67</td>
<td>5</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2008</td>
<td>22</td>
<td>5</td>
<td>15</td>
<td>5</td>
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<tr>
<td>2009</td>
<td>41</td>
<td>24</td>
<td>24</td>
<td>21</td>
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<tr>
<td>2010</td>
<td>77</td>
<td>40</td>
<td>75</td>
<td>60</td>
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<tr>
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<tr>
<td>2013</td>
<td>67</td>
<td>7</td>
<td>31</td>
<td>5</td>
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**Average**

- 3 months in storage: 45, 13
- 6 months in storage: 30, 16
Silver scurf and Phosphorous Acid

- Evaluated 2 products (Phostrol/Resist 57)
- 3 volumes
- 3 rates
- Apply at 12.8 fl oz/ton
- Volume of 0.5+ gal/ton
- No difference in products used (Phostrol and Resist 57)

<table>
<thead>
<tr>
<th>Year</th>
<th>Water-treated control</th>
<th>Azoxyystrobin</th>
<th>Azoxyystrobin</th>
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<tbody>
<tr>
<td></td>
<td>~3 months in storage</td>
<td>~6 months in storage</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>18</td>
<td>16</td>
<td>35</td>
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<tr>
<td>2003</td>
<td>16</td>
<td>3</td>
<td>26</td>
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<td>2004</td>
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<td>5</td>
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<td>67</td>
<td>32</td>
<td>90</td>
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</tr>
<tr>
<td>2013</td>
<td>35</td>
<td>18</td>
<td>31</td>
</tr>
<tr>
<td>average</td>
<td>36</td>
<td>11</td>
<td>42</td>
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* Applied as Stadium product
Silver scurf management

1. Low level on seed
2. Use an effective seed treatment
3. Minimize time between vine-kill and harvest
4. Proper storage conditions
5. Sanitize storage facilities
6. Post-harvest products

Efficacy of premium program on Silver scurf

<table>
<thead>
<tr>
<th>Incidence</th>
<th>Standard Program</th>
<th>Premium Program</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stadium</td>
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<td></td>
<td>14</td>
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Field Pesticide Program

Inoculated seed with *H. solani*
- Standard Seed and Field Treatment
  - MZ seed treat
- Premium Program
  - Cruiser Maxx Potato (Ext)
  - Quadris in furrow
  - Quadris Top

No other application differences
Integrated approach to minimize silver scurf in storage

• Field
  – Low level on seed planted
  – Use of effective seed treatment
  – Avoid delays in harvest after vine kill

• Storage
  – Clean and disinfect storages
  – Storage temperature and %RH
    • Other impacts
  – Avoid condensation

• Post harvest products

Disease Management in Storage

• Integrated two-pronged approach:
  – Deal with field-infected tubers
  – Minimize spread from diseased to healthy in storage

• Variety
• Exclusion
• Pulp temperatures
• Wounding
• Ventilation
• Temperature
• Humidity
• Post-harvest products