The effect of low levels of CIPC on Seed Potato Performance

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Introduction

Is it OK to cut seed in a storage that has been treated with CIPC?

Common grower question
Introduction

I don’t recommend it ...

... BUT
DO NOT BRING SEED INTO A STORAGE AREA which has been treated until four to six months have passed and the building as been cleaned, disinfected and continuously aired for that period. If seed is stored after these conditions have been met, do not seal the storage or apply heat, but keep well aired and at as low a temperature as possible during the period seed is stored there.
Introduction

But we kept seeing things that concerned us, especially since 2000
Grower samples: From field in 2014

We’ve always been concerned about the effect on seed performance
And when we checked CIPC residues?

< 0.005 ppm  ~ 0.100 ppm or more
What we did...

A 3-year study looking at the effect of low levels of CIPC on seed performance...
Trial Setup: 2014
Storage was steam cleaned and disinfected before being used to cut seed. Chipping bins were sealed off to prevent contamination.
Trial Setup: 2014

- 3 Storages
  - No CIPC: Wicklow res. storage
  - Exposed but clean: Treated storage washed and disinfected
  - Exposed but dirty: Treated storage with potatoes still in it, not cleaned
Trial Setup: 2014

- **Two varieties:**
  - Russet Burbank
  - Innovator

- **Four exposure times**
  - 1, 2, 3, & 4 weeks
Residue Results: 2014
Residue Results: 2014

- Could detect low levels
- But treatment results were unexpected

Note: couldn’t detect it in the air
Residue Results: 2014

- Went back and re-tested results
- Samples in storages 1 week
- Results confirmed!
Residue Results: 2014

- **Exposure time**
  - Relatively little effect
  - CIPC there from the beginning

![Graph showing PPM CIPC in Tubers over 1, 2, 3, and 4 weeks. The graph shows an increase in PPM CIPC over time.](image-url)
Field Results: 2014
**Field Results: 2014**

- **Emergence**
  - Was delayed by higher levels of CIPC
  - Counted all plants in plots
  - Note: final emergence was not significantly different

<table>
<thead>
<tr>
<th>Date</th>
<th>Innovator</th>
<th>RB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jun 17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun 24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun 27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun 17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun 24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jun 27</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Field Results: 2014

Yield
- Also affected!!!
- 8% yield loss
- Statistically significant
  - Cleaned storage from other two storages
  - Averaged over both varieties

<table>
<thead>
<tr>
<th>Variety</th>
<th>Total Yield (cwt/A) Uncleaned</th>
<th>Total Yield (cwt/A) Cleaned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wicklow</td>
<td>330.5</td>
<td>331.0</td>
</tr>
<tr>
<td></td>
<td>309.2</td>
<td>300.7</td>
</tr>
<tr>
<td></td>
<td>348.5</td>
<td>312.8</td>
</tr>
<tr>
<td>Innovator</td>
<td>331.0</td>
<td>300.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>312.8</td>
</tr>
<tr>
<td>RB</td>
<td>331.0</td>
<td>300.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>312.8</td>
</tr>
</tbody>
</table>
For 2015 Season
2015 Trial

Two-step approach:

- Dip seed tubers in CIPC to achieve 0 - .4 ppm in residues
2015 Trial

Two-step approach:

- Dip seed tubers in CIPC to achieve 0 - .4 ppm in residues
- Measure seed tuber levels in grower storages.
Trial Setup in 2015
Trial Setup in 2015

- Two varieties: RB & Innovator
  - But Innovator results discarded

- 6 Target rates:
  - 0, 0.025, 0.050, 0.100, 0.200, & 0.400 ppm
  - Control tubers were left at McCain research farm
  - Rest were sent to RPC in Fredericton for dipping
# Intended vs. Actual Rates

<table>
<thead>
<tr>
<th>Intended Rate</th>
<th>Actual Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RB</td>
</tr>
<tr>
<td>0.000</td>
<td>0.000</td>
</tr>
<tr>
<td>0.025</td>
<td>0.021</td>
</tr>
<tr>
<td>0.050</td>
<td>0.033</td>
</tr>
<tr>
<td>0.100</td>
<td>0.043</td>
</tr>
<tr>
<td>0.200</td>
<td>0.065</td>
</tr>
<tr>
<td>0.400</td>
<td>0.135</td>
</tr>
</tbody>
</table>
Emergence and early growth
Emergence and early growth

RB “0”

RB “400”
Emergence Numbers: Russet Burbank

Emergence of RB potatoes in CIPC on Seed Trial

% Emergence

Jun 25 | Jun 29 | Jul 6 | Jul 13 | Jul 17 | Jul 28

- 0 ppm
- 0.025 ppm (0.021)
- 0.050 ppm (0.033)
- 0.100 ppm (0.043)
- 0.200 ppm (0.065)
- 0.400 ppm (0.135)
Total Yield Results
Total Yield Results: Russet Burbank

No other significant effects of note.
Grower samples
Grower Samples: New Brunswick (2015)

- 11 growers, 22 samples
- Different parts of storage
  - Along walls
  - Above ducts
- All the growers washed and disinfected the bins, trucks, and handling equipment
- At least one grower washed duct

<table>
<thead>
<tr>
<th>Client</th>
<th>Location in Bin</th>
<th>Cut or Whole</th>
<th>CIPC Found (PPM)</th>
<th>Variety</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Near duct</td>
<td>Cut</td>
<td>0.055</td>
<td>Shepody</td>
</tr>
<tr>
<td>1</td>
<td>Along wall</td>
<td>Cut</td>
<td>&lt;0.005</td>
<td>Shepody</td>
</tr>
<tr>
<td>1</td>
<td>Near duct</td>
<td>Cut</td>
<td>0.240</td>
<td>Innovator</td>
</tr>
<tr>
<td>1</td>
<td>Along wall</td>
<td>Cut</td>
<td>0.008</td>
<td>Innovator</td>
</tr>
<tr>
<td>1</td>
<td>Middle of pile</td>
<td>Cut</td>
<td>0.012</td>
<td>Innovator</td>
</tr>
<tr>
<td>2</td>
<td>Along back wall</td>
<td>Cut</td>
<td>0.075</td>
<td>RB</td>
</tr>
<tr>
<td>2</td>
<td>Back centre of pile</td>
<td>Cut</td>
<td>0.072</td>
<td>RB</td>
</tr>
<tr>
<td>3</td>
<td>Along wall</td>
<td>Whole</td>
<td>&lt;0.005</td>
<td>RB</td>
</tr>
<tr>
<td>3</td>
<td>Above duct</td>
<td>Whole</td>
<td>&lt;0.005</td>
<td>RB</td>
</tr>
<tr>
<td>4</td>
<td>Along front wall</td>
<td>Whole</td>
<td>&lt;0.005</td>
<td>Innovator</td>
</tr>
<tr>
<td>4</td>
<td>Above front duct</td>
<td>Whole</td>
<td>&lt;0.005</td>
<td>Innovator</td>
</tr>
<tr>
<td>5</td>
<td>Along back wall</td>
<td>Cut</td>
<td>0.018</td>
<td>Monticello</td>
</tr>
<tr>
<td>5</td>
<td>Above back duct</td>
<td>Cut</td>
<td>0.083</td>
<td>Monticello</td>
</tr>
<tr>
<td>6</td>
<td>Along wall</td>
<td>Cut</td>
<td>0.007</td>
<td>RB</td>
</tr>
<tr>
<td>6</td>
<td>Above duct</td>
<td>Cut</td>
<td>0.012</td>
<td>RB</td>
</tr>
<tr>
<td>7</td>
<td>Next to wall</td>
<td>Whole</td>
<td>0.054</td>
<td>RB</td>
</tr>
<tr>
<td>7</td>
<td>Next to duct</td>
<td>Cut</td>
<td>&lt;0.005</td>
<td>RB</td>
</tr>
<tr>
<td>8</td>
<td>Next to wall</td>
<td>Whole</td>
<td>&lt;0.005</td>
<td>RB</td>
</tr>
<tr>
<td>8</td>
<td>Next to wall</td>
<td>Cut</td>
<td>&lt;0.005</td>
<td>RB</td>
</tr>
<tr>
<td>9</td>
<td>Next to wall</td>
<td>Whole</td>
<td>0.014</td>
<td>Blazer</td>
</tr>
<tr>
<td>9</td>
<td>Next to wall &amp; duct</td>
<td>Whole</td>
<td>0.011</td>
<td>Shepody</td>
</tr>
<tr>
<td>11</td>
<td>Next to wall</td>
<td>Whole</td>
<td>0.012</td>
<td>Innovator</td>
</tr>
</tbody>
</table>
Grower Samples: Maine (2015)

- Nine grower samples from Maine
- Similar results
- No information on whether storages were cleaned and disinfected prior to seed
- Also no information on equipment

<table>
<thead>
<tr>
<th>No.</th>
<th>Variety</th>
<th>Seed Type</th>
<th>mg/kg</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Innovator</td>
<td>Cut - not treated</td>
<td>0.036</td>
<td>Stored in mesh bags in plenum</td>
</tr>
<tr>
<td>2</td>
<td>Burbank</td>
<td>Whole</td>
<td>0.010</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Burbank</td>
<td>Whole</td>
<td>Trace</td>
<td>Runs Ventilation</td>
</tr>
<tr>
<td>4</td>
<td>Burbank</td>
<td>Whole</td>
<td>Trace</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Burbank</td>
<td>Whole</td>
<td>0.042</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Innovator</td>
<td>Whole</td>
<td>0.210</td>
<td>1st time treated was 2014</td>
</tr>
<tr>
<td>7</td>
<td>Burbank</td>
<td>Cut - treated</td>
<td>Trace</td>
<td>Runs ventilation after dumps seed. Last treated in '14</td>
</tr>
<tr>
<td>8</td>
<td>Burbank</td>
<td>Whole</td>
<td>0.160</td>
<td>Samples in mesh bags on top of pile</td>
</tr>
<tr>
<td>9</td>
<td>Innovator</td>
<td>Whole</td>
<td>0.092</td>
<td>Samples in mesh bags on top of pile</td>
</tr>
</tbody>
</table>
Design of 2016 Trial
Design of 2016 Trial

- Dipped seed potatoes in solutions of CIPC and water
  - 0 ppm (0)
  - 0.025 ppm (0.021)
  - 0.050 ppm (0.128)
  - 0.100 ppm (0.143)
  - 0.200 ppm (0.230)
What we saw... delayed emergence

Russet Burbank
What we saw... delayed emergence
What we saw... delayed emergence

Innovator

June 28, 2016

Control  0.025 ppm  0.050 ppm  0.100 ppm  0.200 ppm

July 8, 2016

Control  0.025 ppm  0.050 ppm  0.100 ppm  0.200 ppm
What we saw... delayed emergence

![Graph showing Innovator Emergence with percent emergence on the y-axis and days after planting on the x-axis. The graph includes lines for 0 (RPC), 0.025 ppm, 0.050 ppm, 0.100 ppm, and 0.200 ppm.]
What we saw ... Lower yields

Russet Burbank Total Yield (cwt/A)

- **A**: 537
- **AB**: 479
- **AB**: 487
- **B**: 463
- **B**: 447

15.9% yield decrease
What we saw ... Lower yields

![Bar Chart: Innovator Total Yield (cwt/A)]

- 592 A (0 ppm)
- 582 A (0.025 ppm (0.062))
- 546 AB (0.050 ppm (0.153))
- 563 AB (0.100 ppm (0.153))
- 523 B (0.200 ppm (0.303))

11.7% yield decrease
Bottom Line

Even tiny amounts of CIPC, 0.025 ppm or less (?), can adversely affect emergence and yields!
What can you do about it?
What can you do about it?

- One grower stopped using CIPC and steam-cleaned all the bins for 2 years.
- We put samples in the empty storage.
  - No CIPC detected.
  - We also sampled the bins in December...
What can you do about it?

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0.007 ppm</td>
<td>&lt;0.005 ppm</td>
<td>0.011 ppm</td>
<td>&lt;0.005 ppm</td>
<td>0.010 ppm</td>
<td>0.007 ppm</td>
</tr>
</tbody>
</table>

Recommendations

1. Cut seed in a CIPC-free building if possible
   - Build new?
Recommendations

2. Select a storage for short-term storage, and steam clean every year
   • Don’t even store treated samples there
   • NO CIPC!!!!!!!
     • Ever!
Recommendations

3. Select a separately ventilated bin, keep it CIPC free and steam-clean every year
   • Make sure ventilation is off when gassing other bins
Recommendations

4. Don’t forget about trucks, conveyors and bin pilers
   • Steam-clean
Acknowledgements

- NB Growing Forward Fund II
- McCain Foods Limited
- Manphool Fageria and Research Farm staff
- RPC
- Loretta Mikitzel
- Gary Hawkins
Questions?