Impact of a Polyethylene Liner on Storage of Canola in Unaerated Steel Bins - Year 2 Update

Kevin Moore
Carol Jones, Ph.D., P.E.
Acknowledgements

- NC-213 The U.S. Quality Grains Research Consortium
- The Andersons
- Delta Grain Bag Systems, Inc.
Where is Canola Stored in Oklahoma?

- Where wheat is stored . . .
- Primarily commercial storage – limited on farm
- Concrete and steel grain bins, flat storage
- Some limited use of grain bags
Question . . .

- Can you place grain bag material inside a storage bin?
- Would this improve storage quality?
First Challenge . . .

9 foot diameter grain bag

6 foot diameter grain bin
A Solution?

Test Plan - Year One

- 6 storage bins – 170 bushel
- Fairly low quality bins – no aeration
- Bins 1, 2, and 5 received liner
  - Sealed as effectively as possible but not airtight
- Canola placed in storage immediately (early June)
Test Plan - Year One

- 35.1% oil content and 9.1% moisture content
- Samples collected with a long grain trier
  - Weekly for two months
  - Every two weeks for two months
  - Monthly for six months
- Tested for free fatty acid (FFA) by NDSU
  - According to AOCS Ca 5a-40
- Temperatures monitored with StorMax cable
Issues with water intrusion
Year One Results - Temperature Trends

Days in Storage Vs. Average Bin Temperature

- Lined
- Unlined
- Air Temp - High
Visual Inspection at Unloading

**Lined Bins**
- Bin 1 - Heavy mold at top of bag, 4-6 inches thick. After this, some light clumping but generally in good condition.
- Bin 2 - Good condition. Some very light clumping but no heavy mold. No mold at bottom of the bag.
- Bin 5 – Heavy mold at top of bag, 4-6 inches. Sides and bottom did not appear moldy.

**Unlined Bins**
- Bin 3 – Good condition. Light surface mold at the top. Bottom had mold at 45 degree angle around the perimeter.
- Bin 4 – Very poor condition. 6-12 inches mold on south side. Bottom was 6-8 inches of mold and wet grain. Soldier fly infestation.
- Bin 6 – Light surface mold at top. 3-6 inch mold south and east walls.
Bin 1 – heavy mold at top

Bin 2 – good condition

Bin 3 – good condition, some mold at bottom

Bin 4 – heavy mold throughout
Year One Results - Free Fatty Acid

FFA for Winter Canola in Lined vs. Unlined Steel Storage Bins

\[ \text{FFA} = -1.3 \times 10^{-5} d^2 + 0.00547 d + 0.2237 \]
## Year One Results - Germination*

<table>
<thead>
<tr>
<th></th>
<th>Initial (6/3/14)</th>
<th>8/8/14</th>
<th>8/22/14</th>
<th>9/5/14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bin 1 - lined</td>
<td>94%</td>
<td>44%</td>
<td>16%</td>
<td>2%</td>
</tr>
<tr>
<td>Bin 2 - lined</td>
<td></td>
<td>66%</td>
<td>38%</td>
<td>4%</td>
</tr>
<tr>
<td>Bin 3 - unlined</td>
<td></td>
<td>66%</td>
<td>56%</td>
<td>34%</td>
</tr>
<tr>
<td>Bin 4 - unlined</td>
<td></td>
<td>10%</td>
<td>2%</td>
<td>0%</td>
</tr>
<tr>
<td>Bin 5 - lined</td>
<td></td>
<td>32%</td>
<td>14%</td>
<td>8%</td>
</tr>
<tr>
<td>Bin 6 - unlined</td>
<td></td>
<td>20%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

* Post hoc test completed on samples stored at ~2°C
Year One Results - Grade

- Enid Grain Inspection at binning, 6 weeks, 6 months, 10 months
  - All bins grade 1 at 6 weeks
  - At 6 months, only bins 2 and 3 still grade 1
    - Bins 1, 4, 5, 6 sample grade due to musty or sour smell
  - At 10 months all sample grade
Year Two Changes

- Considerable effort made to seal the bottom of the bins and prevent moisture intrusion
- Small vent added to the top of grain bins
- Modified sampling and testing schedule
# Test Plan - Comparison

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Bins 1, 2, and 5 received liner</td>
<td>• Bins 2, 4, and 6 received liner</td>
</tr>
<tr>
<td>• Canola placed in storage immediately (early June)</td>
<td>• Storage delayed 2 weeks due to heavy rain (late June)</td>
</tr>
<tr>
<td>• 35.1% oil content and 9.1% moisture content</td>
<td>• 38.4% oil content and 5.3% moisture content</td>
</tr>
<tr>
<td>• Monthly samples for FFA</td>
<td>• Monthly samples for FFA</td>
</tr>
<tr>
<td>• Grade at binning, 6 weeks, 6 months, 10 months</td>
<td>• Grade at binning and monthly</td>
</tr>
<tr>
<td></td>
<td>• Monthly germination tests</td>
</tr>
</tbody>
</table>
Year Two Results - Temperature Trends
Year Two Results - Germination

Germination Rates - Year Two

- Bin 1
- Bin 2
- Bin 3
- Bin 4
- Bin 5
- Bin 6
- Control

Days in Storage

Germination %
Year Two Results - Free Fatty Acid

**FFA for Winter Canola in Lined vs. Unlined Steel Storage Bins**

- **Yr 2 - Liner**
- **Yr 2 - No Liner**
- **Year 1 Trend**
- **Linear (Control)**

**Axes:**
- **% FFA** on the y-axis
- **Days in Storage** on the x-axis

**Graph Description:**
- The graph compares the free fatty acid (FFA) content in winter canola stored in lined and unlined steel storage bins over a period of 180 days.
- The line graph shows a clear upward trend for both lined and unlined bins, indicating an increase in FFA content over time.
- The points represent the FFA levels at different storage intervals for each condition.
Summary

• Impact of bin liner is questionable
• Maintaining dry grain is critical!
• Bag material may be useful for excluding water from the bottom of a leaky bin – time will tell
Questions?