Impact of a Polyethylene Liner on the Storage of Canola in Unaerated Steel Bins

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Canola Production and Use

• Canola is the second largest global oilseed crop after soybeans
• Primary uses
  ▫ Vegetable oil
  ▫ Meal for animal feed

Table 1. World production of major oilcrops

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<tbody>
<tr>
<td></td>
<td>million tonnes</td>
<td>%</td>
<td></td>
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<tr>
<td>Soybeans</td>
<td>320.0</td>
<td>314.4</td>
<td>329.5</td>
<td>4.8</td>
</tr>
<tr>
<td>Rapeseed</td>
<td>67.4</td>
<td>69.9</td>
<td>67.4</td>
<td>-3.5</td>
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<tr>
<td>Cottonseed</td>
<td>45.4</td>
<td>38.2</td>
<td>40.3</td>
<td>5.4</td>
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<tr>
<td>Groundnuts (unshelled)</td>
<td>38.1</td>
<td>37.6</td>
<td>40.5</td>
<td>7.7</td>
</tr>
<tr>
<td>Sunflower seed</td>
<td>41.1</td>
<td>42.2</td>
<td>45.9</td>
<td>8.7</td>
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<tr>
<td>Palm kernels</td>
<td>15.4</td>
<td>14.7</td>
<td>15.8</td>
<td>7.5</td>
</tr>
<tr>
<td>Copra</td>
<td>5.8</td>
<td>5.4</td>
<td>5.8</td>
<td>8.2</td>
</tr>
<tr>
<td>Total</td>
<td>537.0</td>
<td>522.5</td>
<td>545.3</td>
<td>4.4</td>
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(FAO Oilcrops, Oct. 2016)
U.S. Canola Production

- 2.9 billion pounds in 2015
  - About 2% of global production
- Dominated by North Dakota (87% in 2015)
- Oklahoma is the #2 producer (still only 5%)

U.S. Canola Production

- Potential rotation crop for cereal grains in Southern United States
  - Herbicide tolerant varieties
  - Wheat yields 10-20% higher in canola/wheat rotation vs. wheat alone
  - Address problematic weeds such as feral ryegrass
Canola Storage in Southern States

- Canola is stored where wheat is stored...
  - Primarily a secondary crop
  - Harvest of winter canola is generally just before wheat harvest

Question . . .

- “We want to use some of our old bins for canola storage...”
  - 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

First Challenge . . .
Test Plan

- 6 storage bins – 170 bushel
- Fairly low quality bins – no aeration
- Three bins lined, three unlined
  - Sealed as effectively as possible but not airtight
- Samples collected with a grain trier
- Temperature monitored with StorMax cable (1 per bin)
- Tested for free fatty acid (FFA) by NDSU (AOCS Ca 5a-40)

Test Plan - Comparison

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
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<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>
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<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>
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</tbody>
</table>
Year One - Issues with Water Intrusion

Year One Results - Temperature Trends
Year One - 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.
Year One Results - Free Fatty Acid

**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

Year Two Results - Temperature Trends
Year Two - Inspection at Unloading

**Lined Bins**
- **Bin 2** - Good condition. No evidence of mold. Standing water under the bag.
- **Bin 4** - Good condition. No evidence of mold. Red flour beetle on surface. Standing water under the bag.
- **Bin 6** - Good condition. No evidence of mold. Red flour beetle on surface. Standing water under the bag.

**Unlined Bins**
- **Bin 1** – Good condition. Small patch of moldy canola at bottom center
- **Bin 3** – Good condition. Small patch of moldy canola at bottom center
- **Bin 5** – Good condition. Slight clumping on the south side approximately halfway down.
Bin 1 – unlined - good condition

Bottom on Bin 3 – typical of unlined bins with layer of plastic at base

Year Two Results - Free Fatty Acid

Year 2 - FFA for Winter Canola in Lined vs. Unlined Steel Bins
Conclusions

- No significant difference observed in storage quality between lined and unlined bins
- Maintaining dry grain is critical!
  - Low moisture content canola seed (5.4%) stored without aeration for 11 months with no reduction in grade
  - High moisture canola seed (9.1%), 4 out of 6 bins were reduced to sample grade within 6 months
  - Moisture migration in sealed grain bags was problematic with high moisture canola seed
- Bag material was useful for excluding water from the bottom of a leaky bin
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