Mechanical Weed Control in Organic Crops

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Hand weeding intra-row weeds:
200-500 hours per hectare in carrot and direct sown onion and leek

Mechanical Weed Control Research in Saskatchewan

• Pre-seeding tillage
  • Pre-emergence tillage
    – Rod-weeder, harrow, rotary hoe, small shovels on heavy harrow
  • Post-emergence
    – Harrows, rotary hoe
    – Inter-row cultivation
    – Mowing, rolling, weed clipping
    – Alternative cropping study – long-term study

Pre-seeding tillage
Interaction of Seed Date and Flax Cultivar on Yield. Mean of 2 sites (Saskatoon, Scott), 2003

Effect of seeding date and weed management on weed biomass in flax. Scott and Saskatoon, SK 2003-2005.


MECHANICAL WEED CONTROL RESEARCH IN SASKATCHEWAN

Post-seeding / Pre-emergence Tillage in field pea


Questions

- Seed shallow and compete ??
- Seed deep / pre-emerge till ??
- Seed early?? Seed late ??

- **Check**
- **Harrow**
- **Rod Wd**

[Graph showing yield (kg/ha) over different seed dates and depths.]

If timed properly, pre-emergence tillage can be effective in large seeded crops.

- Field pea seeded May 4
- 3" depth - Herbicide

Field pea seeded May 18
3" depth - Pre-emergence rod-weed

If timed properly, pre-emergence tillage can be effective in large seeded crops.

- The best seed date X seed depth/pre-emergence tillage combination resulted in 80% of the yield obtained with the best seed date/seed depth/herbicide combination.

Maintenance of Crop Residues

- No Rotary Hoe
- 6 passes - Rotary Hoe

Rotary hoeing done after seeding but prior to field pea emergence.

Effect of rotary hoe passes on the maintenance of cereal stubble residue, Scott, SK. 2004 - 06.

<table>
<thead>
<tr>
<th>No. of passes</th>
<th>% surface residue</th>
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<tbody>
<tr>
<td>0</td>
<td>64</td>
</tr>
<tr>
<td>1</td>
<td>61</td>
</tr>
<tr>
<td>2</td>
<td>58</td>
</tr>
<tr>
<td>4</td>
<td>61</td>
</tr>
<tr>
<td>5</td>
<td>56</td>
</tr>
<tr>
<td>6</td>
<td>55</td>
</tr>
</tbody>
</table>

LSD$_{0.05}$ 12
CV 13

Maintenance of Crop Residues

Rotary hoeing done after seeding but prior to field pea emergence.
Effect of number of passes from rotary hoeing on field pea and lentil density at two growth stages. Weed-free conditions. Scott 2004-06

Pre-emergence Rotary hoe

Check
1 pass
2 pass
3 pass
4 pass
5 pass

Heavy harrow shovel – Proof of Concept Study

Heavy Harrow / Small Shovels Proof of Concept

- Unreplicated strip trials in fallow and stubble
- Stubble had moderate amounts of trash
- Seeded to field pea
- Treatments
  - Untreated
  - Single Pass Till 5 DAS
  - Double Pass Till 5 DAS
  - Single Pass Till + Single Pass Rotary Hoe 5 DAS
  - Double Pass Rotary Hoe 5 DAS
  - Single Pass Till Ground Crack
  - Single Pass Till 3-node

Pre-emergence Tillage With Small Shovels – Field Pea Density Scott 2008

Stubble
Fallow
Pre-emergence Tillage With Small Shovels – Field Pea Yield Scott 2008

Tilling at 3-node stage

Post-emergence Tillage

Flex-Tine Lely

Flex-Tine Einbock

Selectivity of Harrow Types

Tine

Rotary

Mechanical In-Crop Weed Control Selectivity

• Selectivity
  – differential tolerance in plant species.
  – Ratio between weed control and crop damage

• Selectivity dependent on:
  – How closely weeds resemble the crop
  – length of seed germination period
  – ineffective - perennial weeds
Relationship between crop burial and yield of field pea from post-emergence harrowing at 3 above-ground node stage. Weedy conditions. Scott 2004 & 2006.

\[ y = -3.8378x^3 + 4.6535x^2 - 0.7566x + 1.0213 \]

\[ R^2 = 0.6236 \]

Effect of harrow type and disturbance level on wild oat fresh weight (g m\(^{-2}\)), Scott, 1999

- Crop tolerance is composed of two factors:
  - Resistance: the ability of the crop to resist soil covering;
  - Recovery: the ability of the crop to recover from soil covering.

Later growth stages had higher resistance to crop burial than wheat.

Crop burial of barley, oat and wheat (from left to right) after four passes at the two leaf stage. Averaged over all treatments, crop burial of wheat (57%) was significantly greater (P<0.05) than barley (44%) and oat (38%).

Effect of timing of post-emergence harrowing on crop burial – mean of oats, barley, and wheat. Scott/ Saskatoon

\[ y = 5.8834x + 59.129 \]

\[ R^2 = 0.9318 \]

\[ y = 6.4145x + 17.746 \]

\[ R^2 = 0.9989 \]

\[ y = 2.1129x + 5.8 \]

\[ R^2 = 0.8764 \]
Effect of post-emergence harrowing on yields of oats, barley, and wheat relative to untreated checks. Weed-free conditions.

Scott/ Saskatoon

Wheat had poorer recovery than oat and barley (as well as resistance).
Later growth stages had better resistance but poorer recovery (oats and barley).

2-year study at Scott

- Field pea
- Treatments
  - Untreated
  - Single Pass - Ground Crack stage (1)
  - Double Pass - Ground Crack stage (2)
  - Triple Pass - Group Crack stage (3)
  - Single Pass - Ground Crack + 3-node stage (2)
  - Double Pass - Ground Crack + 3-node stage (4)
  - Triple Pass - Ground Crack + 3-node stage (6)
  - Single Pass - Ground Crack + 3-node + 5-node stage (5)
  - Double Pass - Ground Crack + 3-node + 5-node stage (6)
  - Triple Pass - Ground Crack + 3-node + 5-node stage (9)
  ( ) Total passes

Rotary Hoeing – Effect on Field Pea Density Scott 2007 + 2008

Rotary Hoeing – Effect on Weed Biomass

Rotary Hoeing – Effect on Field Pea Yield
Rotary Hoeing

- 4 – 6 passes is a lot!
- Only done by crazy scientists!

Pre-emerge + Post-emerge = ??

Inter-row Cultivation

Inter-row cultivation - benefits limited by in-row weed competition

Integration of Mechanical Weed Control Methods

Pre-emerge rod-weed X post-emerge harrow X inter-row cultivation

Yield Response from Pre-Emergence Rod-Weed, Post-emergence Harrow, and Inter-row Cultivation. Mean of 3 years, Scott (2000, 2001 and 2003)

<table>
<thead>
<tr>
<th>Method</th>
<th>Bu/acre</th>
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<tbody>
<tr>
<td>Pre-Emergence Rod-Weed</td>
<td>5.9</td>
</tr>
<tr>
<td>Post-Emergence Harrowing</td>
<td>2.0</td>
</tr>
<tr>
<td>Inter-row Cultivation</td>
<td>NS</td>
</tr>
</tbody>
</table>

Interaction of Pre-Emergence Rod-Weed and Inter-row Cultivation on Yield of Field Pea, Scott, Mean of 3 years (2000, 2001, 2003)
Effect of clipping on wild oat seedling recruitment. Mean of 2 years. Scott 2007


* Statistically lower than the herbicide check at P<0.05

Numbers represent p values for contrasts vs. check
Rotary Harrow – Soil Disturbance Settings

<table>
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<tr>
<th>Setting</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Low</td>
<td>15°</td>
</tr>
<tr>
<td>High</td>
<td>45°</td>
</tr>
</tbody>
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Untreated  Single Harrow 3X emg, 3 & 5 if  Double Harrow 3X emg, 3 & 5 if  Herbicide