Straw Management and Crop Rotation
Alternatives to Stubble Burning:
Assessing Economic and Environmental Trade-offs

Principle Investigators
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Project Objectives

• Identify and economically assess crop rotations and sequences that benefit from retaining winter wheat residues in direct-seed systems
• Document effects of wheat straw management on weed seed survival
• Convey project findings through electronic and print media, field days, conferences and research site tours.
Cook Agronomy Farm

- Fall burn, no burn (2013)
- No-till planted to:
  - winter wheat
  - spring wheat
  - garbanzos
  - spring barley
<table>
<thead>
<tr>
<th>Crop</th>
<th>Control 2012</th>
<th>Fall Burn 2012</th>
<th>Control 2014</th>
<th>Fall Burn 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter Wheat Yield following Winter Wheat, (bu/ac)</td>
<td>82a</td>
<td>82a</td>
<td>71a</td>
<td>73a</td>
</tr>
<tr>
<td>Spring Wheat Yield following Winter Wheat (bu/ac)</td>
<td>59a</td>
<td>57a</td>
<td>50a</td>
<td>48a</td>
</tr>
<tr>
<td>Garbanzo Bean Yield following Winter Wheat, (lbs/ac)</td>
<td>1624a</td>
<td>1634a</td>
<td>1381a</td>
<td>1343a</td>
</tr>
<tr>
<td>Spring Barley Yield following Winter Wheat, (lbs/ac)</td>
<td>4733b</td>
<td>5234a</td>
<td>3132a</td>
<td>3574a</td>
</tr>
</tbody>
</table>
Conservation Farming and Herbicide Resistance

• Direct-seed and reduced tillage systems depend on herbicides for weed control

• Herbicide resistance is a growing problem worldwide and in the Pacific Northwest
Weed Seeds at Harvest

Majority of weed seeds exit in the chaff fraction
Narrow Windrow Burning

Concentrate residues at harvest

Burn residues in autumn
Narrow Windrow Burning

99% control of *Lolium* and *Raphanus*

Most Western Australian growers use this technique
Harvest Weed Seed Control

- Biological attribute needed for system to work:
  - mature seed do not shatter before grain harvest, held above cutting bar height
Seed Retention at Harvest

- Downy brome: 80%
- Italian ryegrass: 60%
- Jointed goatgrass: 60%
- Rattail fescue: 40%
Weed Seed Tray Placement
Weed Seed Tray Prior to Burn
Thermocouple Wires & Data Logger
Burning All Crop Residue
Three Weeks After Burning
Collecting Crop Residues
Crop Residue After Burning Averaged Across Years

Dry weight (lb/acre)

- Spread/No Burn
- Spread/Burn
- Windrow/Burn

No Burn vs. Burn $P=0.003$
Spread vs. Windrow $P=0.943$
Germinating Italian Ryegrass After Burning
Italian Ryegrass Seed Survival

No Burn vs. Burn P=0.003
Spread vs. Windrow P=0.002

No Burn vs. Burn P<0.001
Spread vs. Windrow P<0.001

* Seconds above 392° F (200° C)
Alternatives to Field Burning
Chaff Collection

Up to 85% of *Lolium* and *Raphanus* seed collected and removed
Glenvar Bale Direct System

Up to 95% of *Lolium* seed collected and removed in baled harvest residues
Harrington Seed destructor

Based on a cagemill used in the coal industry
Harrington Seed Destructor

Cage mill

Chaff flow

Straw flow
**Lolium emergence - autumn 2012**

Averaged across 13 sites SE Aust.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Reduction in Lolium emergence (%)</th>
</tr>
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<tbody>
<tr>
<td>HSD</td>
<td>58</td>
</tr>
<tr>
<td>Chaff cart</td>
<td>55</td>
</tr>
<tr>
<td>Narrow windrow burn</td>
<td>55</td>
</tr>
<tr>
<td>LSD (P=0.05)</td>
<td>9</td>
</tr>
</tbody>
</table>
Weeds have the potential to evolve resistance to all forms of weed control.
Low weed densities are the best insurance against resistance evolution.