Cover Crops

PFI Conference – Cover Crops 101
Saturday Jan. 12, 2013
Ames, IA

USDA-ARS
National Laboratory for Agriculture and the Environment
Ames, Iowa

Tom Kaspar
Ben Knutson
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Kent Heikens
Dan Jaynes
Tim Parkin
Tom Moorman
Rye after Corn Silage
Oats after Soybean
Corn and Soybeans have a 7 Month “BROWN” Gap

Corn or Soybean Crop at Maturity approx. Oct. 1

Phosphorus

Soil OM

Winter Cover Crops “Catch” Losses

Topsoil

Soil productivity is lost during the “BROWN” gap because there are no “GREEN” plants to protect soil and recycle nutrients.

Nitrogen

Corn or Soybean Crop at Emergence approx. May 1

Cover Crops Fill the “BROWN” Gap with “GREEN” Plants
Benefits of Using Cover Crops

- Reduced erosion
- Reduced nitrate leaching
- Reduced phosphorus losses
- Increased soil organic matter
- Improved weed control
- Support and maintain soil organisms
- Improve soil structure – especially no-till
- Grazing and forage potential
Erosion Measurements with Simulated Rainfall

NO COVER CROP

OAT COVER

RYE COVER
Nitrate Loss in Tile Drainage
## Total Nitrate-N Lost 2002-2010

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Nitrate-N lost</th>
<th>9-yr total</th>
<th>9-yr avg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>lbs/acre</td>
<td>lbs/acre</td>
</tr>
<tr>
<td>Corn-soybean</td>
<td>386</td>
<td>43</td>
<td></td>
</tr>
<tr>
<td>Corn-Soyb w. Rye</td>
<td>181</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>Reduction</td>
<td>205</td>
<td>23</td>
<td></td>
</tr>
<tr>
<td>% Reduction</td>
<td>53%</td>
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</table>
Cover Crops and No-Till
Soil Structure and Health
Rye Cover Crop Effect on Soil Quality in a Corn Silage System

- 17% more total soil organic matter
- 47% more Particulate Organic Matter (POM)
- 48% greater Potential N mineralization
- It is easier to see changes in these measurements in a corn silage system after 8 years, but they indicate that even in a corn grain system the trends are in the right direction.
Cereal Rye Cover Crop Root Weight and Rooting Depth in the Spring

<table>
<thead>
<tr>
<th>Year</th>
<th>Root Dry Weight (lbs/acre)</th>
<th>Rooting Depth (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004</td>
<td>294.4</td>
<td>38.0</td>
</tr>
<tr>
<td>2005</td>
<td>642.3</td>
<td>32.7</td>
</tr>
<tr>
<td>2006</td>
<td>606.7</td>
<td>45.8</td>
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<tr>
<td>2007</td>
<td>458.3</td>
<td>36.4</td>
</tr>
<tr>
<td>2008</td>
<td>388.1</td>
<td>38.8</td>
</tr>
<tr>
<td>Avg</td>
<td>478.0</td>
<td>38.2</td>
</tr>
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</table>
Selecting a Cover Crop for Iowa

• What is your cash crop rotation?
• Where are you in the state?
• Does the cover crop overwinter in Iowa?
• How are you going to establish the cover crop?
• What is the seed cost/acre?
• Bottom line! How much will it grow?
Possible Cover Crops for Iowa

- Small grains – oats, cereal rye, wheat
- Brassicas – radishes, turnips, mustard
- Forage grasses - ryegrass
- Legumes – hairy vetch, red clover
- Others – sorghum-sudangrass, buckwheat, millet
- Mixtures ????
Approximate Cost of cover crop seed per acre - 2012

- Winter Cereal Rye (1 bu/a) $14-17
- Oats (1 ½ bu/a) $14-17
- Annual Ryegrass (20-25#/a) $14-17
- Cover Crop Radish (5-8#/a) $15-24
- Pea + Radish Mix (35#/a) $40-44
- Crimson Clover + Radish (20#/a) $43-46
- Oats + Rye + Turnips (60#/a) $32-35
- Ryegrass + Crimson + Radish (21#/a) $30-35
- Hairy Vetch (30#/a) $55-70
Guesses for Planting Dates before Average 28°F Frost Date in Iowa

- Winter Hardy Small grains – 0 d
- Non-winter Hardy Small grains – 35 d
- Brassicas – 35 - 42 d
- Annual ryegrass – 35 – 42 d
- Legumes – 35 – 49 d

Story Co. Frost Dates 28°F
Oct. 14 - 50%  Oct. 28 - 90%
### Midwest Cover Crops Council - Cover Crop Decision Tool

**Iowa: Story County Seeding Dates**

<table>
<thead>
<tr>
<th>Location Information</th>
<th>Cash Crop Information</th>
<th>Soil Information</th>
<th>Attribute Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location Information</td>
<td>Iowa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash Crop</td>
<td>None or Prevented</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plant Date</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Harvest Date</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drainage Information</td>
<td>Select a Drainage Class</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flooding</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goal #1</td>
<td>Select an attribute</td>
<td>Goal #2</td>
<td>Goal #3</td>
</tr>
<tr>
<td></td>
<td>Select an attribute</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Select an attribute</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Select cover crop to create information sheet:**

- **50% HV/50% WC Rye**
- **Submit**

#### Nonlegumes
- Barley, Winter
- Buckwheat
- Millet, Japanese
- Millet, Pearl
- Oats
- Rye, Winter Cereal
- Ryegrass, Annual
- Sorghum-sudangrass
- Sudangrass
- Triticale, Winter
- Wheat, Winter

#### Brassicas
- Mustard, Oriental
- Radish, Oilseed
- Rapeseed/Canola
- Turnip/Rape, Forage type

#### Legumes
- Alfalfa - Dormant
- Alfalfa - Non-dormant
- Clover, Crimson
- Clover, Red
- Clover, White
- Crowned

**Reliable Establishment**

**Freeze Risk to Establishment**

**Frost Seeding**

**Cash Crop Growing Period:** Requires Aerial Seeding or Interseeding of Cover Crop
Rye Cover Crop Spring Shoot Biomass vs Fall Planting Date

- 2006
- 2004
- 2005

Sept 1 = 244
Sept 15 = 258
Oct 1 = 274
Oct 15 = 288
Nov 1 = 305
Nov 15 = 319
Overseeding Cover Crops into Soybean with an Airplane
Managing Cover Crops in the Spring?

- Only winter-hardy cover crops need to be killed in spring with herbicide or tillage.
- Watch soil water, rainfall, and cover crop growth.
- Before corn kill grass cover crops 14 days prior to planting or before cover crop is 6-8 inches tall.
- Before soybean, the biggest concern is dry conditions; otherwise, cover crop can be sprayed 3 days before planting.
Methods of Terminating Cover Crops in the Spring

- Herbicide – Glyphosate is the most commonly used; Follow BMPs; can take a while.
- Tillage – Usually takes two or more passes; weather dependent.
- Rolling or mowing – can work for some cover crop species after they have flowered or headed; don’t let any seeds mature; usually later than desirable.
Rye Cover Crop Shoot Biomass vs Kill Date
Planted Sept. 30, 2005

<table>
<thead>
<tr>
<th>DOY</th>
<th>Shoot Biomass (Mg/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>0</td>
</tr>
<tr>
<td>85</td>
<td>0.5</td>
</tr>
<tr>
<td>90</td>
<td>1</td>
</tr>
<tr>
<td>95</td>
<td>1.5</td>
</tr>
<tr>
<td>100</td>
<td>2</td>
</tr>
<tr>
<td>105</td>
<td>2.5</td>
</tr>
<tr>
<td>110</td>
<td>3</td>
</tr>
</tbody>
</table>

- Mar 1 = 60
- Mar 15 = 74
- Mar 30 = 89
- Apr 15 = 105
- Apr 20 = 110

Cover Crop Kill Date
Apr. 1
May 1
Apr. 15
Some Risk to Main Crop Yields

- Soybean yields no change.
- Corn silage yields no change.
- Corn grain yields on average 4 to 6 bu/acre lower following winter rye cover crop in our experiments. Similar risk with other winter cereals or grasses. No decrease with oats, which winterkill. Can be managed.
What does 6 to 8 in. of rye shoot growth look like?
What does 6-8 in of rye shoot growth look like?
Midwest Cover Crops Council Website
http://www.mccc.msu.edu/

WELCOME TO THE MIDWEST COVER CROPS COUNCIL WEBSITE

The goal of the Midwest Cover Crops Council (MCCC) is to facilitate widespread adoption of cover crops throughout the Midwest, to improve ecological, economic, and social sustainability.

WHO WE ARE?
The MCCC is a diverse group from academia, production agriculture, non-governmental organizations, commodity interests, private sector, and representatives from federal and state agencies collaborating to address soil, water, air, and agricultural quality concerns in the Great Lakes and Mississippi river basins (including Indiana, Michigan, Ohio, Manitoba, Ontario, Illinois, Wisconsin, Minnesota, Iowa, and North Dakota).

WHY COVER CROPS?
Cover crops are an effective tool to reduce soil erosion and increase nutrient recycling on farmlands, thereby also decreasing the soil and nutrient loads entering lakes and waterways. Cover crops can have numerous other benefits including improvement of soil quality, pest management, fertility management, water availability, landscape diversification, and wildlife habitat.

NEWS

Mark your calendars for the next MCCC meeting in Windsor, Ontario February 10-11, 2009.

Reflect on 2008 and get ready for 2009 by viewing the newly added 2008 MCCC Meeting reports.

View the MCCC plans for the Cover Crop Selector Tool from the 2008 ASA Posters.
Questions?

Tom.Kaspar@ars.usda.gov
BMPs for Killing a Rye Cover Crop with Glyphosate

- Apply acid equivalent (a.e.) of 1 lb/acre (28 oz WeatherMax or 43 oz of generic; I normally use less)
- Low spray volume – check label (e.g. 5-10 gal/acre would be reasonable) – use right nozzles and height
- Add AMS (ammonium sulfate; 4-6 lbs/100 gal). No UAN.
- Add Non-ionic Surfactant if not included in formulation (NIS is in WeatherMax already). No crop oil.
- Don’t mix triazine or contact herbicides with glyphosate.
- It is usually better to spray when you can than wait for perfect conditions with bigger more mature plants
Which side has 30% cover?
RUSLE2 Erosion Estimates Using Beta Version of Cover Crop Vegetation Files

- **Corn–Soybean rotation, NT, spring anhydrous, 5% slope, 150 ft slope length, Ames, IA**
  - without rye cover crop = 2.1 t/ac/yr
  - with rye cover crop = 1.2 t/ac/yr

- **Continuous Corn Silage, NT, spring anhydrous, 5% slope, 150 ft slope length, Ames, IA**
  - without rye cover crop = 4.8 t/ac/yr
  - with rye cover crop = 1.9 t/ac/yr
The graph shows the remaining growing degree days (GDD) at 4°C base temperature and days of the year (DOY) at Ames. The equation for the trend line is:

\[ y = 0.1002x^2 - 65.33x + 10620 \]

with an \( R^2 = 0.9992 \).

Some key points on the graph include:

- **Aug 1 = DOY 213 = 1221 GDD**
- **Sept 1 = DOY 244 = 660 GDD**
- **Oct 1 = DOY 274 = 237 GDD**
- **Nov 1 = DOY 305 = 15 GDD**
- **10% 28°F = DOY 271 = 272 GDD**
- **50% 28°F = DOY 286 = 126 GDD**
- **90% 28°F = DOY 301 = 34 GDD**
- **Aug 30 = DOY 242 = 694 GDD**
- **Sept 26 = DOY 269 = 296 GDD**
- **Oct 17 = DOY 290 = 96 GDD**
Annual N Loss in Tile Drainage for a Corn-Soybean Rotation with or without a Winter Cover Crop

- No Cover Crop
- Rye Cover Crop
- Oat Cover Crop

Fig. 2
Practices to Reduce the Risk of Corn Yield Drag Following Grass Cover Crops

- Kill grass cover crops 14 days before corn planting or use spring oat which winter kills
- Kill grass cover crops before they reach about 6 to 8 in tall
- Apply some N and P fertilizer at planting
- Use strip till or residue clearing attachments
- Monitor soil water conditions
- Increase corn population/stand - ???