Alfalfa, clovers, and grasses as companion crops for silage corn

John H. Grabber
USDA-Agricultural Research Service
U.S. Dairy Forage Research Center
Madison, WI
Corn silage production is increasing on dairy farms

Greater potential for soil and nutrient loss compared to perennial forages

- Various cover crops and living-mulches (i.e. “companion crops”) are promoted to lessen the environmental impacts of silage corn production
- Few (if any) studies have directly compared the performance of various companion crop systems across multiple cropping seasons
Methods

• Replicated field trials were conducted on a silt loam soil near Prairie du Sac, Wisconsin from 2001 to 2007 (main study 2003 to 2006)
• Roundup-Ready corn was no-till planted in 30 inch row spacings at 32,000 seeds per acre in early May and harvested for silage in mid September
• Compared the following five companion crop systems for corn...
A rotation with corn grown one year in herbicide-suppressed and stripped-killed kura clover...

...followed by one year of kura clover harvested three times for forage

(Ken Albrecht and coworkers at UW-Madison)
A rotation with corn grown one year with June no-till interseeded red clover (12 lb per acre) followed by one year of red clover harvested three times for forage.
Continuous corn grown with June no-till interseeded Italian ryegrass (30 lb per acre), fall no-till seeded winter rye (100 lb per acre), or no companion
• Dairy manure slurry was applied on a phosphorus basis (12,000 gal per acre) to ALL crops in early November OR in early April

• Manure plus inorganic fertilizer supplied 160 lb per acre of available nitrogen for continuous corn

• Manure plus legume credits provided 225 lb per acre of available nitrogen for corn grown in rotation with clovers
Results
Companion crop effects on silage corn yields (2003-2006)

- The corn-red clover rotation had the greatest & most stable corn yields
- Lower yields in other systems due to excessive competition from companion crops or weeds

Means followed by unlike letters differ ($P = 0.05$)
Red clover established by interseeding had a higher yield potential, but in 2 out of 4 years stands failed; yields of spring reseeded red clover were similar to kura clover.

Kura clover had stable yields, but stands were often weedy.

Means followed by unlike letters differ ($P = 0.05$)
Manure application time only influenced yields of continuous corn grown with grass companion crops (2003-2006)

- Yields of corn with ryegrass were greater with fall manure
- Yields of corn with rye were greater with spring manure

Means followed by unlike letters differ ($P = 0.05$)
Cropping effects on total residual soil nitrate (0-4 ft depth) in late October (2003-2006)

Means followed by unlike letters differ ($P = 0.05$)

- Average residual soil nitrate of rotations were comparable to continuous corn
Conclusions

• The interseeded red clover system produced the highest yields of silage corn and clover, but interseedings often failed and provided only modest ground cover.

• Kura clover provided good year-round ground cover, but it often competed excessively with corn and produced low clover forage yields.

• Grass companion crops provided good ground cover and had neutral to slightly negative effects on corn yields. Fall manure maximized yields with ryegrass and spring manure maximized yields with winter rye.

• No system excelled in all agronomic and environmental traits. See proceedings paper for additional information.
Next, we examined interseeding of alfalfa into corn to jumpstart full alfalfa production following corn

Problem: Yields of spring-seeded alfalfa are only 50% that of established stands
- Could skip the normal establishment year by interseeding alfalfa into corn, but...
- Interseeded alfalfa is prone to stand failure
- Corn yields are reduced

Solution: Use growth regulators to lessen interspecies competition
- Prohexadione-calcium (Apogee) promising in preliminary studies
Methods

• Replicated field trials were conducted on a silt loam soil near Prairie du Sac, Wisconsin from 2009 to 2013
• Clearfield or Roundup-Ready corn were no-till planted in 30 inch row spacings at 35,000 seeds per acre in early to mid May
• Conventional or Roundup-Ready leafhopper resistant alfalfa were no-till interseeded at 16 lb per acre immediately after corn planting
Sprayed 10 to 30 oz per acre active ingredient of prohexadione in June on 3 to 8 inch tall alfalfa (4 to 6 weeks after planting)
Results
Growth of interseeded alfalfa in July

Control

Prohexadione
Growth of interseeded alfalfa in August

Control

Prohexadione
Growth of Interseeded alfalfa in October

Control

Prohexadione
Primary finding: Prohexadione (PHD) greatly increased stand density of alfalfa interseeded into corn

Results with alfalfa interseeded into Clearfield corn in 2011

Means followed by unlike letters differ ($P = 0.05$)
Interseeded alfalfa depressed silage corn yields even with prohexadione (PHD) treatment

<table>
<thead>
<tr>
<th>Cropping system</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>10.1a</td>
<td>12.3a</td>
<td>11.0a</td>
<td>10.7a</td>
</tr>
<tr>
<td>Corn-interseeded alfalfa</td>
<td>8.5b</td>
<td>10.7b</td>
<td>10.2b</td>
<td>10.1b</td>
</tr>
<tr>
<td>Corn-interseeded alfalfa- PHD @ 10 or 14 oz per acre</td>
<td>8.3b</td>
<td>11.4ab</td>
<td>10.1b</td>
<td>9.9b</td>
</tr>
</tbody>
</table>

Means within columns followed by unlike letters differ ($P = 0.05$)
Alfalfa interseeding into corn and prohexadione (PHD) treatment both enhanced 1st year alfalfa yields

<table>
<thead>
<tr>
<th>Cropping system</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>------</td>
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</tr>
<tr>
<td>Spring-seeded alfalfa</td>
<td>2.6c</td>
<td>--</td>
<td>2.2c</td>
</tr>
<tr>
<td>Interseeded alfalfa</td>
<td>5.0b</td>
<td>dead</td>
<td>4.4b</td>
</tr>
<tr>
<td>Interseeded alfalfa plus PHD @ 10 or 14 oz per acre</td>
<td>5.5a</td>
<td>dead</td>
<td>5.0a</td>
</tr>
</tbody>
</table>

Means within columns followed by unlike letters differ ($P = 0.05$)
1st year alfalfa growth in early June

Inter-seeded into corn

Spring seeded after corn
Conclusions

• Interseeding alfalfa into corn doubles first year yields of alfalfa, but yields of corn are reduced about 7%
• Prohexadione enhances the establishment and subsequent yield of alfalfa interseeded into corn
  – Improves survival of alfalfa seedlings
  – Must identify optimal timing and rates of application (focus of current studies with Mark Renz and Joe Lauer, UW-Madison)
• Prohexadione suppression of interseeded alfalfa does not mitigate reductions in corn yield
  – Must identify ways to reduce early season competition
Thanks to...

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