Cover Crops for Nutrient Management

Jim Stute
Rock County UWEX
Four Applications

Add N to cropping system
old practice of “Green Manure”

Retain nutrients in cropping system
“sponge” excess or easily lost nutrients

Manage levels of soil test nutrients

Enhance nutrient availability
Green Manure

Purpose:
• add nitrogen

Goal:
• fix as much nitrogen as possible
• release it efficiently to the following crop

Desirable attributes:
• legume
• competitive growth
• medium to high yield potential
• degradable biomass
• not an alternate host for disease
<table>
<thead>
<tr>
<th>Legumes</th>
<th>Forage</th>
<th>Seed, Oil seed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clovers</td>
<td>Berseem (a)</td>
<td>Cowpea (a)</td>
</tr>
<tr>
<td></td>
<td>Red (b,p)</td>
<td>Field pea (a)</td>
</tr>
<tr>
<td></td>
<td>Crimson (a)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subterranean (a)</td>
<td>Soybean (a)</td>
</tr>
<tr>
<td></td>
<td>White (p)</td>
<td></td>
</tr>
<tr>
<td>Vetches</td>
<td>Hairy (wa)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wollypod (a)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Chickling (a)</td>
<td></td>
</tr>
<tr>
<td>Medics</td>
<td>(a)</td>
<td></td>
</tr>
<tr>
<td>Sweetclover</td>
<td>(a,b)</td>
<td></td>
</tr>
</tbody>
</table>

Lifecycle: a, annual; wa, winter annual; b, biennial; p, perennial

Source: SAN MCCP 3rd ed.
### UWEX green manure nitrogen credits

<table>
<thead>
<tr>
<th>Crop</th>
<th>&lt; 6&quot; growth</th>
<th>&gt; 6&quot; growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alfalfa</td>
<td>40</td>
<td>60 - 100</td>
</tr>
<tr>
<td>Red clover</td>
<td>40</td>
<td>50 - 80</td>
</tr>
<tr>
<td>Sweetclover</td>
<td>40</td>
<td>80 - 120</td>
</tr>
<tr>
<td>Vetch</td>
<td>40</td>
<td>40 - 90, 110 - 160</td>
</tr>
</tbody>
</table>

*Source: A2809*
Corn response to additional nitrogen

\[ y = 88.4 + 0.1421n - 0.0006n^2 \]

\[ r^2 = 0.37 \]

Nmax = 118 lb/a
EONR = 35 lb/a

Source: Unpublished

Nitrogen Dynamics: mineralization and corn uptake

Adapted from Stute and Posner, 1995, Agron. J.
Medium red clover
October 1

No-till corn
July 1
Nutrient Cycling

Purpose:
• retain nutrients and make available for other crops

Goal:
• “sponge” available/ excess nutrients
• keep “available” nutrients available

Desirable attributes:
• rapid growth
• medium to high yield potential
• degradable biomass
• deep root system
• high nutrient demand
Applications
Following high and medium N demand crops
• corn (silage)
• sweet corn
• potato

Following nutrient application to fallow situations
eg. manure after winter wheat

Where organic nutrient sources are used
continued mineralization after harvest
Impact of previous N rate on rye N removal

Impact of winter rye on soil nitrate measured in spring at Elkhorn, 2002.

Source: Stute, unpublished
Manage soil test nutrient levels

Goal:
• Maintain or reduce STP by increasing annual removal
• Maintain manure application flexibility

Desirable attributes:
• Same as nutrient cycling
• Must be harvestable
Impact of nitrogen rate on rye dry matter yield and nutrient removal

Source: Shelley and Stute, 2008, WFAPMC proc.
Impact of rye on nutrient removal for various crops following corn silage, calculated by SNAP Plus (version 1.121) compared to tissue sampling to estimate removal.

<table>
<thead>
<tr>
<th>Crop Rotation</th>
<th>P$<em>{2}$O$</em>{5}$ balance (lb/a)</th>
<th>K$_{2}$O balance (lb/a)</th>
<th>Impact of rye P$<em>{2}$O$</em>{5}$ (lb/a)</th>
<th>K$_{2}$O (lb/a)</th>
<th>Annual increase (year 2) with rye %</th>
</tr>
</thead>
<tbody>
<tr>
<td>SNAP Plus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn silage</td>
<td>-160</td>
<td>-370</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rye - Corn silage</td>
<td>-190</td>
<td>-490</td>
<td>-30</td>
<td>-120</td>
<td>38</td>
</tr>
<tr>
<td>Rye - Alfalfa seeding</td>
<td>-135</td>
<td>-410</td>
<td>-30</td>
<td>-120</td>
<td>120</td>
</tr>
<tr>
<td>Tissue testing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn silage</td>
<td>-160</td>
<td>-370</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rye - Corn silage</td>
<td>-210</td>
<td>-590</td>
<td>-50</td>
<td>-220</td>
<td>63</td>
</tr>
<tr>
<td>Rye - Alfalfa seeding</td>
<td>-155</td>
<td>-510</td>
<td>-50</td>
<td>-220</td>
<td>200</td>
</tr>
</tbody>
</table>

Yield goals: corn silage, 21-25 t/a; rye, 2-3.5 t/a; soybean, 46-55 bu/a; alfalfa seeding, 1-2.5 t/a.

Source: Shelley and Stute, 2008, WFAPMC proc.
Enhance nutrient availability

Goal:
• Increase nutrient availability in root zone

Desirable attributes:
• Same as nutrient cycling
• Deep root system
• Effective forming mycorrhizal associations
• Special properties (buckwheat)
Buckwheat
Cover crop applications for field crops
Three Applications

Red clover interseeded with winter wheat variation: legumes with spring grains

Winter rye after corn silage

Oats after short season crop
   Sweet corn is best example
Interseeding red clover in winter wheat
Interseeding red clover with winter wheat

Optimize wheat production!
- Previous herbicide choice
- Population and planting date
- N rate and application timing
- MCPA is only herbicide option

Red clover “frost seeded” in mid-March
- Frost seeding is really “cracked soil surface seeding”

Seed broadcast
- Specialized equipment (spreader on ATV)
- Air-flow applicator during N application
- Double spreading improves stand

Red clover
- Use cheapest seed available
- Medium vs mammoth
- 12 to 15 lb/acre (10 to 12 with optimal conditions)
- Inoculate seed
Red clover management

Red clover can be clipped!
- Weed control
- If clover flowers
- Remove diseased tissue
- Manage excessive biomass, especially in NT

Clover should be terminated in fall
- Initiate decomposition
- No moisture concern in spring
- Fall chemical kill more efficient
  - Herbicide translocated
  - Combination of glyphosate and growth regulator
- Facilitate strip tillage

Spring residue management in NT
- “fluffing” speeds soil warming and drying
  - Rotary hoe or “Phoenix” like tool
- Row cleaners necessary?
Corn management

Nitrogen

Starter supplies early season N
  • especially important in cool springs

Use UWEX credit as base for supplemental N decision
  • 50 to 80 lb/a for >6” growth

Base decision on amount of growth in fall

Response to supplemental N likely in cool springs

PSNT to guide decision

Pests

Scout for secondaries and cutworm
Variant western corn rootworm?
Variations

Clovers and be interseeded with spring grains

Other species can be seeded after small grain harvest

Summer seeding is more risky!
  – Moisture
  – Shorter time for growth

Berseem clover most likely choice
  – Annual lifecycle maximizes growth in time available

Biennials and perennials will produce significant growth the following spring but...
  – Soil moisture depletion
  – Delayed planting
  – N fixation only happens above 52° F
### Seeding year legume yield at East Troy, 2007

<table>
<thead>
<tr>
<th>Legume</th>
<th>Biomass</th>
<th>Yield (t/a)</th>
<th>N Yield (lb/a)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Summer seeded</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Berseem clover</td>
<td></td>
<td>1.58</td>
<td>87</td>
</tr>
<tr>
<td>Annual sweetclover</td>
<td></td>
<td>1.72</td>
<td>92</td>
</tr>
<tr>
<td>Chickling vetch</td>
<td></td>
<td>0.59</td>
<td>31</td>
</tr>
<tr>
<td><strong>Spring seeded</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium red clover</td>
<td></td>
<td>2.34</td>
<td>113</td>
</tr>
<tr>
<td><strong>lsd</strong></td>
<td></td>
<td>0.4</td>
<td>18</td>
</tr>
</tbody>
</table>

Source: Stute, unpublished
### Performance of summer seeded legumes in Wisconsin, 1995-2007

<table>
<thead>
<tr>
<th>Legume</th>
<th>Nitrogen Yield</th>
<th>Site Years of Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Range</td>
</tr>
<tr>
<td>Hairy vetch</td>
<td>85</td>
<td>55 - 147</td>
</tr>
<tr>
<td>Annual medic</td>
<td>51</td>
<td>23 - 97</td>
</tr>
<tr>
<td>Berseem clover</td>
<td>56</td>
<td>16 - 111</td>
</tr>
<tr>
<td>Crimson clover</td>
<td>56</td>
<td>42 - 69</td>
</tr>
<tr>
<td>Annual alfalfa</td>
<td>30</td>
<td>29 - 30</td>
</tr>
</tbody>
</table>

Source: Stute et al, unpublished
Winter rye after corn silage
Winter rye after corn silage

**Corn silage**
- Watch herbicide selection
- Follow UWEX recommendations for N (?)

**Winter rye**
- Plant early, before October 10 if possible
- Seeding rate 90 to 112 lb/a, increase after October 10
- 1 to 1.5 inches deep
- Variety unimportant
- No-till if possible
Winter rye after corn silage

Nitrogen management
   Apply in spring
   Based on harvest management
      • No N for unharvested cover crop
      • 40 to 60 lb/acre fertilizer N
      • 80 lb/acre “creditable” N
      • Do not exceed 80 lb/acre even though removal can exceed 120 lb/a

Harvest management
   Harvest at boot stage
   Rapid quality decline after boot stage
   Watch soil moisture, harvest earlier in dry conditions

Subsequent crop
   Alfalfa, soybean preferable to corn
   Watch armyworm?
Oats after short season crops
Oats after short season crops

Main crop
• Watch herbicide choice, rotational restrictions

Planting
• Date: by September 1 if possible
• Rate: 80 to 96 lb/a, increase with difficult environments

Establishment Possibilities
• No-till
• Broadcast into chopped residue
• Broadcast and incorporate with shallow tillage
• Broadcast following primary tillage

Can be done in conjunction with fertilizer application
Figure 1. Dry matter yield of individual species as affected by seeding date.

Source: Stute, 2000, WFAPMC proc.
Figure 2. Mean DM yield of warm and cool-season species as affected by seeding date.

Source: Stute, 2000, WFAPMC proc.
Publications by application

Red clover in winter wheat
  http://www.extension.iastate.edu/Publications/PM2025.pdf

Winter rye after corn silage
  http://ipcm.wisc.edu/Publications/tabid/54/Default.aspx

Small grain covers after corn and soybean

Kura clover living mulch for corn
  http://extension.agron.iastate.edu/soybean/production_kuraclover.html