Experiences with Kura Clover Living Mulch Cropping Systems

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Alfalfa: Queen of Forages

King Corn
The proportion of corn silage has increased to 25% of dairy cattle rations.
Soil Loss in the Corn-Alfalfa Rotation

Crop Legend

MB=moldboard plow
CT=conservation-till
NT=no-till
A=alfalfa
AB=alfalfa-brome
B=brome
FA=fall kill/Aug. harvest
FS=fall kill/Sept. harvest
SA=spring kill/Aug. harvest
SS=spring kill/Sept. harvest

Soil loss (tons/A)

11%
50%
73%
30%
25%
79%
67%

corn -> alfalfa
established forage
alfalfa -> corn
Agriculture and recreational land are intimately associated in the landscape.
Agricultural runoff from WI is affecting the environment a thousand miles away.
High N costs encourage us to maximize legume N credits.

Nitrogen fertilizer costs $0.45 per pound and will increase as price of natural gas increases.
Can a cropping system be developed to provide the N benefits of an alfalfa-corn rotation and provide permanent ground cover?

Will a legume living mulch work for corn production?
Kura clover (*Trifolium ambiguum* cv. Endura)
Kura Clover

✓ Persists > 15 years (Sheaffer, Albrecht)
✓ NDF < 30%, IVDMD > 80%, CP > 25%  
  (Sheaffer, Albrecht, Moore, Leep)
✓ Yields are about 80% of alfalfa (Sheaffer, Albrecht, Leep)
✓ Is a challenge to establish (1000 farmers)
Can corn be grown in kura clover living mulch?
Methods

• 1999 & 2000, Arlington and Lancaster
• Glyphosate-resistant corn hybrids
• Seeding Rates: 32,000 kernels/acre
• No-tillage maize planter
• Three Treatments:
  – Kura clover suppressed + 50 lbs N/acre
  – Kura clover killed + 50 lbs N/acre (Control)
• Corn whole-plant and grain yields
Corn in suppressed kura clover in early June.

Second application of glyphosate is made to kill annual weeds and provide additional clover suppression.
Control plot
(killed Kura)
Glyphosate Resistant Corn Silage Yield

Expt 1  Expt 2  Expt 3
Silage DM Yield (t/ha)

Killed Glyph + Dicam Glyph

a    a    a  n    n   n  x    x    x

P = 0.05

Affeldt and Albrecht
Glyphosate Resistant Corn Grain Yield

Grain Yield bu/acre

Expt 1  Expt 2  Expt 3
Killed  Glyph+Dicam  Glyph

P = 0.05

Affeldt and Albrecht
Does kura clover provide N to the companion corn crop?
Methods

• 2001-2003, Arlington and Lancaster
• Glyphosate-resistant corn hybrids
• Seeding Rates: 32,000 kernels/acre
• Starter fertilizer
• Five Treatments:
  – Kura clover suppressed + 0, 25, 50 or 75 lbs N/acre
  – Kura clover killed + 75 lbs N/acre (Control)
• Corn N uptake, whole-plant and grain yields
Corn Yields and N Uptake

Lancaster, 2003 (dry year)

Whole-Plant

Grain

N Uptake

Linear: $P < 0.01$

Yield, Mg/ha

N Uptake, Kg/ha

- 0N
- 28N
- 56N
- 84N
- Killed-84N

Legend:

- a
- b
- c
- ab
- bc
May the year after corn production.
Conclusions

• Corn can be grown in kura clover living mulch with no negative effect on yield.
• Kura clover provides most or all of the N requirement of the corn crop.
• Kura clover recovers to full production the year after corn production.
Living Mulches: Part II
Refinements and Application
• Cropping systems
• Organic production
• Water quality
Cropping Systems
Soybean in kura clover?
Virus transfer may be a limitation.
• Organic Production?
Zone Tillage replaces band herbicide.
Mulch Effects on Soil Temperature

Arlington - May 15, 2001

Soil Temperature, °C

Zone tilled
Band killed
Killed
Suppressed

a
bc
b
c
Corn Yields and Densities

Arlington, 2001

Whole-Plant Grain Density

Yield, Mg/ha

Zone-Tilled Band-Killed Killed Suppressed

Population Density, plants x 10,000/ha

Density

a b c

a b

a a a

a b c
Mechanical control of inter-row kura clover
Water stress can be a problem when replacing herbicide suppression with mechanical suppression.
• Runoff and Water Quality
Sediment and runoff delivery from conventional and living mulch corn production systems.

<table>
<thead>
<tr>
<th>Sample date</th>
<th>Sediment delivery (lbs./acre)</th>
<th>Runoff delivery (gal./acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tilled</td>
<td>Mulch</td>
</tr>
<tr>
<td>July 27</td>
<td>85</td>
<td>4</td>
</tr>
<tr>
<td>Aug. 3</td>
<td>93</td>
<td>11</td>
</tr>
<tr>
<td>Sept. 11</td>
<td>76</td>
<td>7</td>
</tr>
</tbody>
</table>

Slope was 6 to 8%.
Ground water quality?
Preliminary data show that nitrate concentrations in water below the corn root zone at the end of the growing season are about 10 X greater without kura clover living mulch.
Conclusions

We’re just beginning to understand the roles that legume living mulches can play in cropping systems.

Preliminary research demonstrates:
• N fertilizer savings
• Reduced erosive soil loss
• Reduced nitrate leaching