Nutrient management in alfalfa-corn silage rotations

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Problems with the C/S rotation

Net return over labor and management
(No government payments included)

OMAF, Ontario

NCAT

MN Farm Business Mgmt Assn.
The public is interested

- Over 80% are concerned about water and air pollution, and loss of habitat.
- Over 80% agreed that stricter laws are needed to protect the environment.
- Nearly 90% in the Midwest favor additional incentives for farmers.

1 nationwide Gallup Organization poll, 2001
2 nationwide poll by Pew Research Center for the People and the Press, 1999
3 regional poll by American Farmland Trust, 2001
Between 40 and 80% of P imports are retained on the farm.

Klausner, 1993
No WI counties with soil test P lower than 30 ppm but not all fields have sufficient P.
Long term soil P accumulation

Soil P
- very low
- low
- optimum
- high
- very high

Dairy farm: 0.7 AU/acre

Kleinman et al.
• Erosion control alone will not stop P runoff.

• Most BMPs are not permanent solutions for improving water quality.

The only permanent solution is to balance P inputs and outputs on individual farms.

Sharpley, 1996

Randall et al., 1997
## Whole-farm P balances
### 46 NE USA dairy farms

<table>
<thead>
<tr>
<th>Dairy type</th>
<th>Animal density</th>
<th>Annual Milk</th>
<th>P Import</th>
<th>Annual P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Confinement</td>
<td>0.8 AU/a</td>
<td>20,800 lb/cow</td>
<td>43 lb/a</td>
<td></td>
</tr>
<tr>
<td>Pasture</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-organic</td>
<td>0.5</td>
<td>15,300 lb/cow</td>
<td>15 lb/a</td>
<td></td>
</tr>
<tr>
<td>Organic</td>
<td>0.3</td>
<td>12,100 lb/cow</td>
<td>6 lb/a</td>
<td></td>
</tr>
</tbody>
</table>

P imported as feed, mineral, and fertilizer – **57% not exported**

Anderson and Magdoff, 200
Legumes help balance N
Legumes help balance N
Legumes help balance N

![Graph showing the relationship between DM yield and Fertilizer N rate](image)

- **450 lb N/acre**
- **B Agate**
- **J Ineffective Agate**

N derived from soil and manure (kg N/ha)

**Harvest 1**
**Harvest 2**
**Harvest 3**

Russelle et al., 2003
Nutrient removal

Corn silage

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Corn silage (lb/dry t)</th>
<th>Alfalfa silage (lb/dry t)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>10-15</td>
<td>50-60</td>
</tr>
<tr>
<td>P</td>
<td>2-4</td>
<td>4-7</td>
</tr>
<tr>
<td>K</td>
<td>10-15</td>
<td>25-60</td>
</tr>
</tbody>
</table>

Neither crop removes P quickly

Alfalfa is a great crop to remove excess N & K
## Nutrient removal

<table>
<thead>
<tr>
<th></th>
<th>Corn silage</th>
<th>Alfalfa silage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yield</td>
<td>15</td>
<td>3.5 t/a</td>
</tr>
<tr>
<td>N</td>
<td>120</td>
<td>170 lb/a</td>
</tr>
<tr>
<td>P</td>
<td>29</td>
<td>16 lb/a</td>
</tr>
<tr>
<td>K</td>
<td>120</td>
<td>130 lb/a</td>
</tr>
</tbody>
</table>

Yield averages for IL, IA, MN, WI, 1997 (NASS)
N management decisions

• Who uses manure N credits to reduce fertilizer N rates?
• Who uses legume N credits to reduce fertilizer N rates?
• Who has fields where a lot of manure has been applied over the years?
• Who does soil testing for N (PSNT, late fall deep cores, etc.)?
Manure applications

Swath distance (feet)

Box end
Side Slinger

(Lorimer, 2000)
Manure application with corn silage

Two recognized windows of opportunity:
- Preplant: *Too little time*
- Post-harvest: *Excess nitrate production*

Potential for sidedressing low rates

Should give credit for at least two years
- Second year credit averaged 12% of total dairy manure N applied

(Cusick et al., 2002)
Cover crop growth after silage corn

**Latest practical seeding date**

Biennial and perennial legumes  
(red clover, sweetclover, alfalfa)  
**August 1**

Annual and winter legumes  
(berseem clover, hairy vetch, medic)  
**August 15**

Warm-season annuals  
(buckwheat, sorghum-sudangrass)  
**August 15**

Cool-season annuals  
(oat, ryegrass, brassicas, winter rye)  
**September 1**
Manure application for alfalfa

• Preplant manure provides P, K, S, B, etc. and is an excellent soil conditioner

• Alfalfa can utilize manure N

• Apply at rates to avoid P build-up
  And apply rates for 2 to 3 years of P removal
  except on sands (nitrate losses)

• Mix preplant manure well (salt damage)

• Avoid companion crops (lodging)
Manure application on alfalfa

Apply moderate rates  Avoid compaction
Slurry injection in alfalfa

Yield increases when P, K, or S are low

Prairie Agricultural Machinery Institute, Saskatchewan
### Manure application on alfalfa

<table>
<thead>
<tr>
<th>Reason given for topdressing manure</th>
<th>Reason given for NOT topdressing manure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spread manure during summer</td>
<td>Lack of time</td>
</tr>
<tr>
<td>Good place to use nutrients</td>
<td>Lack of uniformity of spreading</td>
</tr>
<tr>
<td>Need to empty manure storage</td>
<td>Increased weed problems</td>
</tr>
<tr>
<td>Fields are close to storage</td>
<td>Manure is used on other crops</td>
</tr>
<tr>
<td></td>
<td>Fields are not close enough</td>
</tr>
<tr>
<td></td>
<td>Manure damages the stand</td>
</tr>
</tbody>
</table>

Russelle, 1996
Potential problems

**NH₄⁺-K⁺ competition – decreased winterhardiness**

(Joern and Volenec, 1996)

**Excess forage K**

*Keep soil K in optimum range*

**Manure on foliage can reduce silage fermentation**

*Inoculate before ensiling* (Wiederholt et al., 2002)

**Disease transmission?**

**Excess N generation**

*WORST application time is before terminating stand*

*If stand is poor, may apply very low rates*
Even the Queen has limited power
Manure alone

Manure + NaCl

Manure + NH₄

Manure + NaCl + NH₄

Lamb et al., 2002
Alfalfa helps protect water quality

Rooting depth

Russelle et al., 1993
When does leaching occur?

Monthly Tile Drainage Losses at Waseca

<table>
<thead>
<tr>
<th>Month</th>
<th>Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan</td>
<td>0.0</td>
</tr>
<tr>
<td>Feb</td>
<td>0.0</td>
</tr>
<tr>
<td>Mar</td>
<td>0.0</td>
</tr>
<tr>
<td>Apr</td>
<td>0.0</td>
</tr>
<tr>
<td>May</td>
<td>0.0</td>
</tr>
<tr>
<td>Jun</td>
<td>0.0</td>
</tr>
<tr>
<td>Jul</td>
<td>0.0</td>
</tr>
<tr>
<td>Aug</td>
<td>0.0</td>
</tr>
<tr>
<td>Sep</td>
<td>0.0</td>
</tr>
<tr>
<td>Oct</td>
<td>0.0</td>
</tr>
<tr>
<td>Nov</td>
<td>0.0</td>
</tr>
<tr>
<td>Dec</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Randall
Water use by alfalfa and corn

Corn

MAFF, BC, 2001
“Scientists and fishermen fear that the Gulf of Mexico is becoming a virtual graveyard for the livelihood of shrimpers trawling off the Louisiana and upper Texas coasts.”

MS State Univ. Ext. Serv. Sept 2002
Perennial forages reduce nitrate loss from tile drains – a partial solution for hypoxia?

Randall et al., 1997
A little nitrate adds up

40 million acres are tile drained in the Midwest

90% in corn or soybean

Average loss = 30 lb N/acre/year

Total loss > 1 billion lb N/year
Strategic planting of alfalfa

Predicted nitrate loss
GLEAMS

Kelley and Russelle, 2002

< 2 lb N/a  Dark green
2-4 lb N/a  Light green
4-8 lb N/a  Yellow
8-16 lb N/a  Orange
> 16 lb N/a  Red
### 1st year fertilizer N credit after alfalfa

<table>
<thead>
<tr>
<th>State</th>
<th>Regrowth</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>IL</td>
<td>100</td>
<td>50</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>IA</td>
<td>- - - -</td>
<td>150</td>
<td>180</td>
<td>- - -</td>
</tr>
<tr>
<td>MN</td>
<td>150</td>
<td>75</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>MO</td>
<td>120-140</td>
<td>40-60</td>
<td>0-20</td>
<td></td>
</tr>
<tr>
<td>NE</td>
<td>150</td>
<td>120</td>
<td>90</td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>150</td>
<td>50-100</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>MI,IN,OH</td>
<td>140</td>
<td>100</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>WI</td>
<td>&lt; 8”</td>
<td>150</td>
<td>120</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td>&gt; 8”</td>
<td>190</td>
<td>160</td>
<td>130</td>
</tr>
</tbody>
</table>
Pre-sidedress N test (PSNT)
There is increasing attention to agriculture’s effect on the environment.

Farmers and consultants can avoid or mitigate regulatory solutions by:

- using conservative nutrient management
- increasing acreage of perennials, like alfalfa
- communicating effectively