Trends in Feed and Manure Phosphorus

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Acknowledgments

• Laboratory manure and TMR data provided by:
  – Dairyland Laboratories, Inc.
  – Rock River Laboratory, Inc.

• Digester/separator data provided by Gordondale Farms, Nelsonville, WI

• Dairy dietary P information provided by Mark Powell, USDA-ARS
Phosphorus story

• More than half of Wisconsin dairy farmers feed more P than cows need

According to National Research Council recommendations

Source: Powell et al., 2002 survey of 93 farms.
How much P is being fed?

Beginning Signs of P Deficiency

Dietary Phosphorus (% DM)

0.30 0.35 0.40 0.50

NRC 1989

NRC 2001

What dairy producers fed (1999)

What dairy producers feed (today)
Potential annual phosphorus inputs and outputs from a 100 cow Wisconsin dairy farm

<table>
<thead>
<tr>
<th>P inputs</th>
<th>P outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein supplement</td>
<td>1219 (lb) Milk 1806 (lb)</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>1627 (lb) Cull cows/calves 300 (lb)</td>
</tr>
<tr>
<td>Grain 0</td>
<td>Surplus Feed 0</td>
</tr>
<tr>
<td>Forage 0</td>
<td>Manure 0</td>
</tr>
<tr>
<td>Fertilizer 1181</td>
<td>Runoff 201</td>
</tr>
<tr>
<td>TOTALS 4027</td>
<td>TOTALS 2307</td>
</tr>
</tbody>
</table>

Farm P balance = +1,720 lb P
Phosphorus (P) story

inputs

outputs

on-farm phosphorus cycling

soil P level

build up over time

P runoff

excessive
high
optimum
low

P run off
Average soil P levels of Wisconsin cropland fields over time

Average P Test, ppm

Period


29 34 36 40 44 48 50 52

Optimum 25 - 35 ppm
Why is P overfed?

• ‘Myth’ that increasing P improves reproductive performance
• Little research on the absolute minimum P content required to support moderate to high levels of milk production
• Aggressive marketing of P supplements
• Cheap and available protein feed sources that are high in P content
Debunking the myth: Milk production is not harmed by lower P diets
Summary of 8 studies
# National Research Council (NRC) feed-P recommendations

<table>
<thead>
<tr>
<th>Milk Production (lbs/day)</th>
<th>Dietary P Level (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
<td>0.32</td>
</tr>
<tr>
<td>77</td>
<td>0.35</td>
</tr>
<tr>
<td>99</td>
<td>0.36</td>
</tr>
<tr>
<td>120</td>
<td>0.38</td>
</tr>
</tbody>
</table>

New Assessment Tool:

TMR Sample
Dietary P data from 89 high-producing dairy herds

UW Soil & Forage Analysis Lab – Marshfield, WI-2002

Total Dietary P Level (wet chemistry analysis)

% of herds studied

NRC, 2001
TMR Quality Control Dietary Phosphorus Results

\[ y = -0.0001x + 4.223 \]

\[ R^2 = 0.0913 \]
TMR Quality Control Dietary Calcium Results

$$y = 0.0001556x - 4.9311247$$

$$R^2 = 0.0277642$$
TMR Quality Control Dietary Magnesium Results

y = 0.0000123x - 0.1064697

R² = 0.0005549

% Mg (DM basis)
TMR Quality Control Dietary Potassium Results

\[ y = -0.0000232x + 2.4244994 \]

\[ R^2 = 0.0001248 \]
Dietary P conclusions

- Performance (reproductive efficiency and milk production) is not adversely affected by reducing P to NRC recommendations
- Recent TMR tests indicate a trend toward reduced P levels in dairy rations
Effect of P intake on P in manure

Increasing P content from 0.35% to 0.55% of diet dry matter increases P output from 42 to 78 lbs/cow/year!
A high P diet produces manure that is more likely to cause environmental problems.
Land required for recycling fecal P from one cow fed various dietary P levels

†Alfalfa, corn, soybean rotation with 27 lb P/a removal
Rock River Laboratory Dairy Manure Summary

$P$ as $P_2O_5$

<table>
<thead>
<tr>
<th>Quarter</th>
<th>Average lbs/1000 gal. (liquid)</th>
<th>Average lbs/ton (solid)</th>
</tr>
</thead>
<tbody>
<tr>
<td>May-Jun 2003</td>
<td>8.9</td>
<td>4.5</td>
</tr>
<tr>
<td>Jul-Sep 2003</td>
<td>7.2</td>
<td>4.0</td>
</tr>
<tr>
<td>Oct-Dec 2003</td>
<td>8.5</td>
<td>4.8</td>
</tr>
<tr>
<td>Jan-Mar 2004</td>
<td>9.2</td>
<td>5.0</td>
</tr>
<tr>
<td>Apr-Jun 2004</td>
<td>6.1</td>
<td>4.3</td>
</tr>
<tr>
<td>Jul-Sep 2004</td>
<td>6.6</td>
<td>4.4</td>
</tr>
</tbody>
</table>
An Alternative Manure Handling Practice
Digested and Separated Manure
Gordondale Farms, Nelsonville, WI

- Digester - in
- Digester - out
- Separator liquid
- Separator solid

% Dry Matter
Digested and Separated Manure
Gordondale Farms, Nelsonville, WI

![Bar Chart]

Total P2O5 (lbs/ton)

- Digester - in: 3.0
- Digester - out: 2.5
- Separator liquid: 1.7
- Separator solid: 1.7

83% and 17% are percentages.
Digested and Separated Manure
Gordondale Farms, Nelsonville, WI

<table>
<thead>
<tr>
<th>Description</th>
<th>Total N (lbs/ton)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digester - in</td>
<td>8</td>
</tr>
<tr>
<td>Digester - out</td>
<td>6</td>
</tr>
<tr>
<td>Separator liquid</td>
<td>83%</td>
</tr>
<tr>
<td>Separator solid</td>
<td>17%</td>
</tr>
</tbody>
</table>
Digested and Separated Manure
Gordondale Farms, Nelsonville, WI

- Digester - in
- Digester - out
- Separator liquid (83%)
- Separator solid (17%)
PATHOGEN REDUCTION

Gordondale Farms

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>Raw Manure</th>
<th>Separated Solids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coliform</td>
<td>(x 10^4)</td>
<td></td>
</tr>
<tr>
<td>Env. Strep</td>
<td>(x 10^6)</td>
<td></td>
</tr>
<tr>
<td>Staph Species</td>
<td>(x 10^6)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>(x 10^6)</td>
<td></td>
</tr>
</tbody>
</table>

NOTE: SAMPLES COLLECTED 2/7/03
Summary

• An integrated approach to improving P nutrient management on dairy farms seems to be having an impact.

• TMR samples tested in Wisconsin show a trend toward decreased total P levels, bringing them more in line with NRC guidelines.

• It appears that a trend toward reduced dairy dietary feed P levels is being reflected in average manure P levels as well.