How Much Land Will Be Needed for Manure Disposal in a Changing Regulatory Climate?

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Historically applied manure to meet crop N needs

Issues
- N to P ratio
- Soil P build-up
- P and water quality
- Field P variation
Available nutrient content from dairy manure

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>P$_2$O$_5$</th>
<th>K$_2$O</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Solid (lb/ton)</strong></td>
<td>3 / 4</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td><strong>Liquid (lb/1,000 gal)</strong></td>
<td>8 / 10</td>
<td>8</td>
<td>21</td>
</tr>
</tbody>
</table>
Recommended crop nutrient applications for corn grain at optimum soil test levels.

<table>
<thead>
<tr>
<th>Crop Description</th>
<th>N</th>
<th>P$_2$O$_5$</th>
<th>K$_2$O</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn (@ 200 bu/a)</td>
<td>160</td>
<td>75</td>
<td>55</td>
</tr>
<tr>
<td>Corn (@ 160 bu/a)</td>
<td>160</td>
<td>60</td>
<td>45</td>
</tr>
<tr>
<td>Corn (@ 120 bu/a)</td>
<td>160</td>
<td>45</td>
<td>35</td>
</tr>
</tbody>
</table>
Comparing Crop Removal With Manure Nutrient Content

- Corn utilizes approximately three times more nitrogen than phosphorus.
- Manure supplies $N \& P_{2}O_{5}$ at approximately a 1:1 ratio.
- Result = Soil test phosphorus levels increase if applying manure to meet crop nitrogen needs.
Average Soil Test P in Wisconsin

ppm


29  34  37  40  44  48  50  52
P and Water Quality: Why the concern?

- No plant toxicity
- Held in soil
- Accumulates slowly
- Does not leach
Soil Test Phosphorus Variability from a Wisconsin Dairy Farm
Regulations increasing P emphasis:

- New NRCS Nutrient Management Standard 590 applies if accept federal cost share

- DNR Nonpoint Performance Standard
  * Waters impaired by P (303d list)
  * Outstanding and exceptional resource waters
Features of P-based nutrient management

Using soil test P criteria

- N-based management when soil test is < 50 ppm
- Soil test 50-100 ppm, P additions limited to crop removal or less over 4 year rotation
- Soil test > 100 ppm, limit P to less than crop removal
Using P Index criteria

- Rates individual fields to predict risk of P loss
- Considers erosion, P levels, cover, fertilizer/manure practices
Other 590 restrictions that affect needed land base:

- Cannot spread in concentrated flow channels or buffers
- No winter spreading near lake (1000 ft), stream (300 ft) or groundwater conduit (200 ft)
- No winter spreading on slopes > 9% or 12% with RRP
- Winter application limited to P for current crop, not exceeding 7000 gal/a liquid manure
Land needs per cow:

1. 1400 lb cow produces about 10,000 gal diluted manure/yr

2. Average analysis of available nutrients (10 - 8 - 21)

3. Raising corn at 160 bu/a (160 - 60 - 45)
N-based land need for 100 cow herd:

- 100 cows x 10,000 gal/yr = 1,000,000 gal/yr

- 1,000,000 gal x 10 lb N/1000 gal = 10,000 lb N/yr

- 10,000 lb N/yr ÷ 160 lb N/a = 62.5 a/yr
P-based land need for 100 cow herd:

1,000,000 gal/yr x 8 lb P$_2$O$_5$/1000 gal
= 8,000 lb P$_2$O$_5$/yr

8000 lb P$_2$O$_5$ ÷ 60 lb P$_2$O$_5$/a
= 133.3 a/yr
# Dairy Dietary P Management

<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>

Dairy Dietary P Management – Implications of a High- P Diet

<table>
<thead>
<tr>
<th>Dietary-P Acres (%)</th>
<th>Manure-P (lbs/ cow/ year)</th>
<th>Spreadable Acres* (acres/ cow/ year)</th>
<th>Increase In (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.35</td>
<td>42</td>
<td>1.6</td>
<td>--</td>
</tr>
<tr>
<td>0.38</td>
<td>47</td>
<td>1.8</td>
<td>13</td>
</tr>
<tr>
<td>0.48</td>
<td>65</td>
<td>2.4</td>
<td>57</td>
</tr>
<tr>
<td>0.55</td>
<td>78</td>
<td>2.9</td>
<td>87</td>
</tr>
</tbody>
</table>

*Acres required to meet a P-based nutrient management plan. Manure application rates restricted to crop-P removal from an alfalfa, corn, soybean cropping system.


Farmers may need to manage dietary P intake in order to reduce manure-P.
Dairy dietary-P intake effects on soluble P losses in runoff from fields manured at 25 tons/acre.

<table>
<thead>
<tr>
<th>Runoff Event</th>
<th>Dietary- P Intake (%)</th>
<th>Runoff- P Concentration (ppm)</th>
<th>Runoff- P Load (g/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>June</td>
<td>0.32</td>
<td>0.30</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>0.48</td>
<td>2.84</td>
<td>79</td>
</tr>
<tr>
<td>October</td>
<td>0.32</td>
<td>0.21</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>0.48</td>
<td>0.89</td>
<td>37</td>
</tr>
</tbody>
</table>

Source: Ebeling et al., 2002.
P Best Management Practices

- Balance P inputs and removals
- Check and limit P in animal diets
  0.40% P adequate for dairy
- Minimum P in starter
  15-20 lb $P_2O_5$/a
- Incorporate manure & fertilizer?
- Time applications to minimize runoff
  Fall or winter apply to tilled fields
  Spring apply to NT fields
BMP’s continued

- Apply manure P on lowest fields first
- Allow soil P to build on low risk areas
- Avoid applications if soil test P >100-150 ppm
- Use conservation practices
- Cover/ buffers