Agronomic Uses of Manure that Reduce Environmental Risk

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Question to answer:

- Do 4R Nutrient Stewardship principals apply to Manure Management?
- Is manure only “insurance” nutrients or a “primary nutrient source” that replace purchased fertilizer?
- Can manure sourced Nitrogen be better utilized and Phosphorus Balanced in a crop rotation?
- What effects to water quality could happen?
How are the 4R’s being adopted into Manure Sourced Nutrients

What are the 4Rs

**RIGHT SOURCE**
Matches fertilizer type to crop needs.

Primary nutrient source P & K, also N

**RIGHT RATE**
Matches amount of fertilizer type crop needs.

Rates limited to 2-year (in some situations 3 year) crop rotations P needs

Using technology to monitor and or VRT rate

**RIGHT TIME**
Makes nutrients available when crops needs them.

Apply in growing cash crop

Apply into established forage/cover crop

Using technology to monitor and or VRT rate

**RIGHT PLACE**
Keep nutrients where crops can use them.

Use manure application to establish cover crop seeding

Manure Incorporation

Makes economic & environmental sense...
P Losses from Manure vs Fertilizer Applied at Same Rate

Field 1: Liquid dairy manure - 13,000 gallons/A

Field 2: MAP

76 lbs $P_2O_5$/A

Field 1: Liquid dairy manure - 13,000 gallons/A

Field 2: MAP
Manure Supplied Nutrients Compared to 2-year removal  
Corn - 180 bu/ac & Soybeans - 60 bu/acre

<table>
<thead>
<tr>
<th>Nutrient (pounds/ac)</th>
<th>2-Year Grain Removal</th>
<th>Swine*</th>
<th>Dairy*</th>
<th>Poultry*</th>
</tr>
</thead>
<tbody>
<tr>
<td>5500 gallon/ac</td>
<td>13000 gallon/ac</td>
<td>2 ton/ac</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>N</strong> 133</td>
<td>=</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>P</strong> 111</td>
<td>=</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>K</strong> 104</td>
<td>=</td>
<td>+</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td><strong>Ca</strong> 24</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td><strong>Mg</strong> 17</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>S</strong> 20</td>
<td>=</td>
<td>=</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>B</strong> 0.19</td>
<td>=</td>
<td></td>
<td>-</td>
<td>nd</td>
</tr>
<tr>
<td><strong>Cu</strong> 0.07</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>=</td>
</tr>
<tr>
<td><strong>Fe</strong> 0.56</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td><strong>Mn</strong> 0.14</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td><strong>Zn</strong> 0.32</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>=</td>
</tr>
</tbody>
</table>

* Based on a single operation’s test values. Recommend each operation establish history of manure test results.
In Season Application Utilizes Nitrogen

Corn
N Requirement-190 lbs. Ac
$68.25 @ $0.35 N

Wheat
N Requirement-115 lbs. Ac
$40.25 @ $0.35 N
Sidedressing Manure on Corn - Economic Incentive to Use this Practice

**Corn Yield with Sidedress Manure Compared to 28% UAN Check (OARDC NW)**

- **6 Year Average +24 Bu/A**

**Corn Yield with Sidedress Swine Manure Compared to 28% UAN Check**

- **On-Farm in Darke County, OH**
- **6 Year Average +17 Bu/A**

### Treatment Costs and Economic Analysis

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Cost</th>
<th>Yield Increase</th>
<th>Net Over UAN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial Budget Nitrogen Cost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>UAN @ $0.35</td>
<td>$75</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Swine (5500 gal)</td>
<td>$55*</td>
<td>$84</td>
<td>$104</td>
</tr>
<tr>
<td>Dairy (13,600) + 70 UAN</td>
<td>$160 ($136* + $24)</td>
<td>$84</td>
<td>-$1</td>
</tr>
</tbody>
</table>

* Cost of application @ $0.01/gallon
North Field Treatment
28% UAN applied on June 5
  – 172 pounds of N per acre
  – 0 pounds per acre P$_2$O$_5$

South Field Treatment
Swine manure on June 1 @ 6000 gallons/acre
  – 172 pounds available N per acre
  – 120 pounds per acre P$_2$O$_5$
Soil Test Results 6/24/2020
20 Days after nutrient application

• Sample Core Depth of 0-12 inch
• Eleven cores composited across the row
• Timing
  • 19 days after manure
  • 23 days after UAN

Results

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Nitrate (PPM)</th>
<th>Ammonium (PPM)</th>
<th>Total N NO₃ + NH₄ (PPM)</th>
<th>P (PPM)</th>
<th>OM (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>28%</td>
<td>21</td>
<td>15</td>
<td>36</td>
<td>32</td>
<td>3.3</td>
</tr>
<tr>
<td>Manure</td>
<td>32</td>
<td>7</td>
<td>39</td>
<td>38</td>
<td>3.4</td>
</tr>
</tbody>
</table>

STP values of N and P identical after nutrient application
Normalized Difference Red Edge (NDRE) Index of Plant Health

- South field appears healthier common comment by farmers.
- South field corn is planted diagonally to reduce equipment/labor cost recent adaptation.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>NDRE Index</th>
<th>Stand Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>28%</td>
<td>0.60</td>
<td>28,500</td>
</tr>
<tr>
<td>Manure</td>
<td>0.63</td>
<td>31,000</td>
</tr>
</tbody>
</table>
## Estimated Yield on 8/26/2020

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Yield Bu/A</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>28%</td>
<td>132</td>
<td></td>
</tr>
<tr>
<td>Manure</td>
<td>185</td>
<td>+53</td>
</tr>
</tbody>
</table>
Use of Practice/Adoption Barriers to be Overcome

- Application window based on crop growth stage
- Equipment availability
  - Applicators
  - Transport
- Weather Window
- Farmer confidence

* 2019 Weather Hindered Planting and Manure Applications
Manure Compared to Commercial Fertilizer over a Crop Rotation

2016 Soil Test P 53 PPM

2019-September
• Applied Swine Finishing Manure
• Planted to Cereal Rye/Rape Seed

2020-May
• North Field-Corn
• South Field-Soybeans
Swine Manure Applied on 9/15/2019

- **Corn**
  - Rt_Apd_Liq
    - ≤4700
    - 5200 (plus/minus 500)
    - >5700

- **Soybean**
  - Rt_Apd_Liq
    - ≤5800
    - 6300 (plus/minus 500)
    - >6800
# Soil Test Results in Spring after Fall Applied Manure

Soil Sample (0-8 inch) Taken 5/6/2020.

<table>
<thead>
<tr>
<th>Soil Test Parameter</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Manure</td>
</tr>
<tr>
<td>pH</td>
<td>5.4</td>
</tr>
<tr>
<td>Organic Matter(%)</td>
<td>4.3</td>
</tr>
<tr>
<td>NO3-N (ppm)</td>
<td>7</td>
</tr>
<tr>
<td>NH4-N (ppm)</td>
<td>4</td>
</tr>
<tr>
<td>P* (ppm)</td>
<td>57</td>
</tr>
<tr>
<td>S* (ppm)</td>
<td>8</td>
</tr>
</tbody>
</table>
Cover Crop Growth on 5/6/2020.

<table>
<thead>
<tr>
<th>Manure Applied</th>
<th>% Ground Cover</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>70 a</td>
</tr>
<tr>
<td>No</td>
<td>42 b</td>
</tr>
<tr>
<td>LSD (0.01)</td>
<td>21</td>
</tr>
<tr>
<td>C.V. %</td>
<td>20</td>
</tr>
</tbody>
</table>

40% Cover 80% Cover
Cover Crop with Manure at 2 Rates

Treatments

- 7,000 and 14,000 gallons per acre applied August 1
- Cover crop species White Mustard

Results:

- tile flow (-35%)
- Nitrates (-74%)
- DRP (-33%)

Note: DRP reductions from CC are not consistent across literature.
Summary

• Farmers knowledge/confidence of using manure as a primary nutrient source for P & K is common.
• Knowledge/confidence to better utilize N as a primary nutrient source increasing.
• Practices of:
  – Cover crop after summer manure application
  – In crop applications to corn and wheat are increasing
• Economics are driving innovation in planting and application equipment improvements.
• All leading to 4R Nutrient Stewardship in use of manure sourced nutrients.
• Water Quality impacts:
  – Manure and fertilizers applied at the same rate have an equal impact
  – Cover crops reduce N losses, for P there is variable results
  – In crop applications of manure reduces overall applied N in environment
Contacts

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