The role of composting and soil and manure testing in comprehensive nutrient management planning

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What is comprehensive nutrient management planning?

♦ On a farm scale, accounting for all of the nutrients coming into and leaving a farm

♦ On an field scale, using soil and manure test data together with crop nutrient use information to balance manure and fertilizer nutrients with crop needs

♦ *Overall, balancing nutrient needs with nutrients applied*
Why?

- Nutrient loading and water quality concerns
- Inputs > Outputs = nutrients accumulate in soils → run off or travel through soil to water
- Human health concerns (nitrate)
- “Quality” concerns (phosphate and nitrate)
*Pfiesteria* -related fish lesions. Photo courtesy of the Aquatic Botany Lab, North Carolina State University.

- **Pfiesteria piscicida**
- **Pfiesteria**-like organisms
- **Pfiesteria**-related fish lesions or fish kills

Suspected range of *Pfiesteria* and *Pfiesteria*-like organisms.
Agriculture focus

♦ Nutrient loss from agriculture

Surface runoff

Leaching
The role of

♦ Composting
♦ Soil testing
♦ Manure testing
Composting

♦ Accelerating the natural decomposition process

♦ Create ideal conditions for decomposition
  – moisture
  – quality food source
  – oxygen

♦ Rapid microbial activity results in heat and loss of material
Compost windrow
What composting will do

♦ Create a more uniform product, easier to handle, transport and spread
♦ Reduce moisture content
♦ Reduce mass and volume by ~50%
♦ Reduce nitrogen content and the total amount of nitrogen to dispose of
♦ Reduce odor in final product
♦ Create a more marketable product, if the market is available
Fresh vs composted dairy manure

- **Fresh**
  - 63% moisture
  - 14 lb nitrogen/ton
  - 8 lb phosphate/ton
  - 18 lb potash/ton

- **Composted**
  - 22% moisture
  - 21 lb nitrogen/ton
  - 18 lb phosphate/ton
  - 29 lb potash/ton
What composting won’t do

♦ Won’t solve all of your manure problems
  – not an odor free process
  – pricey equipment requirements
  – increased labor requirements
  – may reduce nitrogen but will not reduce the total amount of phosphorus you have to deal with
  – So, composting won’t reduce the land base you need for on farm manure disposal
Recall: fresh vs composted dairy manure

♦ Fresh
  – 63% moisture
  – 14 lb nitrogen/ton
  – 8 lb phosphate/ton
  – 18 lb potash/ton

♦ Composted
  – 22% moisture
  – 21 lb nitrogen/ton
  – 18 lb phosphate/ton
  – 29 lb potash/ton
When composting may help

- No or inadequate land base to dispose of manure
- Market for the compost
- No other options
Web resources on composting

♦ U.S. Composting Council (http://www.compostingcouncil.org/)

♦ NRAES (Natural Resource, Agriculture and Engineering Service) http://www.nraes.org/
Soil testing

- Nitrogen
  - ground and surface water concern
- Phosphorus
  - surface water concern
Nitrogen

- Soil test nitrogen measures what is currently in soil available for plants to use – spot check soil nitrogen level
- Nitrate-nitrogen (NO$_3$-N) value in mg/kg soil (or parts per million, ppm)
- Multiplying mg NO$_3$-N/kg soil by 4 = pounds of available N per acre
Example 1

- Silage corn nitrogen recommendation of 200 pounds nitrogen/acre
- Soil test NO₃-N = 10 mg/kg soil
- 10 mg NO₃-N/kg soil x 4 = 40 pounds nitrogen/acre
- 200 pounds – 40 pounds in soil = 160 pounds nitrogen/acre to apply as fertilizer or manure
Example 2

- Soil test NO$_3$-N = 60 mg/kg soil
- 60 mg NO$_3$-N/kg soil x 4 = 240 pounds nitrogen/acre
- 200 pounds – 240 pounds in soil = -40 pounds nitrogen/acre to apply (too much already in soil)
Phosphorus

- Soil test phosphorus measures what is currently in soil available for plants to use – spot check soil phosphorus level
- Phosphorus (P) value in mg/kg soil (or parts per million, ppm)
Phosphorus recommendation

- For manure applications:
  - 0 to 50 mg P/kg soil apply manure based on nitrogen needs of crop
  - 50 to 100 mg P/kg soil apply manure based on phosphorus removal by crop
  - Above 100 mg P/kg soil, don’t apply manure
Why? – P in soil and soluble P

Soil Test P (mg/kg soil)

Soluble P (mg/L)

“Change point”
Why does phosphorus accumulate?

♦ Dairy manure nitrogen to phosphorus ratio is about 2 to 1
♦ Crop nitrogen to phosphorus ratio is about 5 to 1
♦ Applying manure based on the nitrogen needs of crops over-applies phosphorus
Dairy land base requirement

- Based on sustainable (long term, indefinite) phosphorus utilization
  - ~1.0 to 1.5 acre per milking cow
  - ~1/2 acre per heifer (2 heifers per acre)
  - ~1/4 to 1/3 acre per calf (3-4 calves per acre)
Soil testing

- Nitrate-nitrogen, phosphorus
- Cost ~ $20/sample
- 1 sample can represent 20+ acres in a uniform field
  - Composite sampling required
- See handouts
Manure testing

- Used to determine manure nutrient content
- What is the manure nutrient content on your farm?
- Can you use average or book values?
# Utah values \((n = 36\) samples\)

<table>
<thead>
<tr>
<th>Measure</th>
<th>Average</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Moisture</td>
<td>63 (48)</td>
<td>20</td>
<td>77</td>
</tr>
<tr>
<td>Pounds N/ton</td>
<td>14 (9)</td>
<td>6</td>
<td>28</td>
</tr>
<tr>
<td>Pounds P(_2)O(_5)/ton</td>
<td>8 (4)</td>
<td>3</td>
<td>18</td>
</tr>
</tbody>
</table>
Manure testing

- Nitrogen, phosphorus, other nutrients
- Cost ~ $38/sample
- How often?
  - Near application times
- Composite sampling required
  - Remove skin, collect grab sample
  - Collect grab samples from 6-8 different areas
The manure stack
The future

♦ It’s a fact of life – changing regulations
♦ More emphasis on nutrient management
♦ Requirement for nutrient management planning, including soil and manure testing? – Yes