

# Livestock Manure Management

## – The Basics on Why and How

### Coordinating Manure Utilization Plans With Crop Rotations

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# Rationale and Objective

- Rationale: Many resource concerns result from manure mismanagement. View manure as a resource to grow crops and improve soil quality.
- Objective: Realize the economic and soil quality benefits of managing manure.
  - Develop and evaluate manure management strategies to utilize nutrients from manure to grow crops without impairing water quality.

# Background Considerations

- Understand how soil functions to make good nutrient management decisions
  - Soil microbes run the nutrient cycles
    - Cool, moist, stable soil environment is best
  - Nutrients from manure and crop residue become available over an extended period of time
- Resistance is futile. You will be assimilated.



# Economics of Manure Management

## Dollar Value of N, P, K

Table 2. Value in dollars of N, P, and K per ton\*

Species	Form	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O	Total \$/ton
Beef	Solid	8.25	5.40	3.52	17.17
Dairy	Solid	3.63	2.10	1.44	7.17
	Liquid	7.26	4.20	3.20	14.66
Swine	Solid	4.29	3.90	1.44	9.63
	Liquid	8.91	5.70	2.40	17.01

\* Actual N at 33, P<sub>2</sub>O<sub>5</sub> at 30 and K<sub>2</sub>O at 16 cents per lb

# Economics of Manure Management

- Proper manure application pays
  - Typical application is worth a net \$3.00 to \$7.00 per acre per year.
  - A 10% crop yield increase has been noted on fields that received nutrients from manure vs. commercial fertilizer.

# Soil Quality Value of Manure

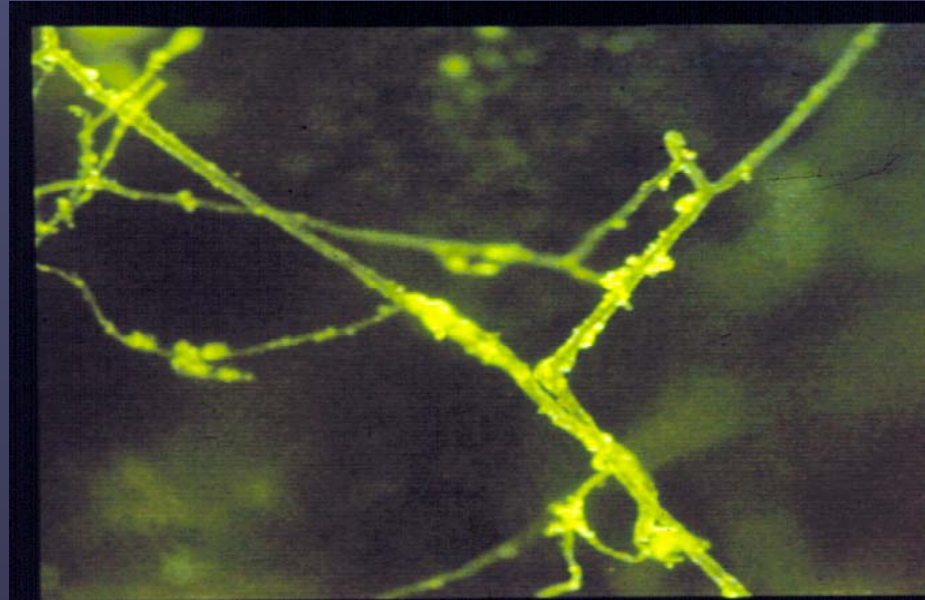
- Increase Organic Matter
  - Improve soil structure
    - Increase water infiltration
    - Decrease runoff
    - Improve root penetration
    - Increase crop production
  - Increase moisture & nutrient capacity
    - Soil holds more water
    - Soil retains and releases more nutrients



# Soil Quality Value of Manure

## ➤ Boost Soil Microbiology

- Increase diversity of microscopic workforce
  - Reduces crop disease
  - Improves nutrient cycling
  - Builds more organic matter



# Considerations When Using Manure

## ➤ Tillage System Considerations

### ➤ Runoff and loss of nutrients

- Research has shown higher concentrations of dissolved P in runoff from no-till plots vs. chisel plowed but the total amount of P lost was lower for no-till vs. chisel plow.
- Increased infiltration of water in no-till lowered sediment loss and reduced the P load in runoff

# Considerations When Using Manure

- Nutrient Availability Considerations
  - N is typically the limiting nutrient in crop production
  - N mineralization from beef feedlot manure or composted manure is the same whether it is incorporated with conventional tillage or left on the surface in no-till systems
  - Research has shown beef feedlot manure applied and not incorporated in a no-till system has first year availability of 38% of total N for manure and 20% for compost
    - These numbers are similar to incorporated values

# Considerations When Using Manure

- More Nutrient Availability Considerations
  - Manure takes the place of Commercial Fertilizer
  - Need to analyze manure, test soils, and calibrate application
  - Research has shown an application of several years worth of nutrients is feasible in dryland conditions
  - Visually, crops growing on manured soils look lighter colored because nutrients are slowly being released for their use

# Considerations When Using Manure

Two Approaches to manure utilization:

- Nitrogen (N) based
  - Supply Crop Nitrogen needs
  - P in excess of crop needs
- Phosphorous (P) based
  - Supply Crop Phosphorous needs in an already high P environment.

# Considerations When Using Manure

## Nitrogen based

- Manure applied to meet the nitrogen needs of the crop grown
- Typical of most plans
- Allows for higher application rates
  - Manures have similar levels of N and P
  - Plants utilize almost 4 times more N than P
  - Can lead to high soil test P levels

# Considerations When Using Manure

## Phosphorous based

- Apply manure based on soil test P rates or crop P removal
- Only use when soil test P levels are high and water resource contamination is a concern (Phosphorous Index - High)
- Field specific  
Increases amount of acres needed

# Considerations When Using Manure

- Crop yields are not depressed when manure is surface applied or incorporated at the correct rates and in the long term, manure applications have shown positive effects on soil quality.
- Long term studies have shown increased carbon sequestration, higher cation exchange capacity, lower bulk density and increased levels of organic matter in soils where manure was consistently applied.

# Considerations When Using Manure

- Mineralization from beef feedlot manure or composted manure is the same whether it is incorporated with conventional tillage or left on the surface in no-till systems
- If a sound nutrient management plan is implemented, producers should feel confident in fully utilizing manure nutrients in no-till crop production

# Getting the Poop in a Group!

Manure is only waste to the cow...

- What nutrients are available from manure?
- How do the nutrients become plant available?
- How much manure do I have to spread?
- How many acres do I need to spread the manure?
- How much nutrient will each acre of crop need?

# What nutrients are available from manure?

Species	Form	N	P <sub>2</sub> O <sub>5</sub>	K <sub>2</sub> O
Beef	Solid	25	18	22
Dairy	Solid	11	7	9
	Liquid	22	14	20
Swine	Solid	13	13	9
	Liquid	27	19	15

Proper manure sampling and analysis is the only way to know what nutrients you have.

# How Do the Nutrients Become Plant Available?

- Most research shows about 30-50% of manure N available in first year and about 20-25% for composted manure
- Understand how soil functions to make good nutrient management decisions
  - Soil microbes run the nutrient cycles
    - Cool, moist, stable soil environment is best
  - Nutrients from manure and crop residue become available over an extended period of time

# How Much Manure Do I Have to Spread?

## How Many Acres Do I Need to Spread the Manure?

- Estimate the volume of manure generated
  - Determined by the type and size of livestock and number of days per year they are on site.
- Determine nutrient content of manure.
- Spread enough manure (nutrient) at a rate that will fertilize **two** crops.

# How Much Nutrient Will Each Acre of Crop Need?

- Set realistic yield goals.
- Follow current soil test recommendations.
- Quantify all nitrogen and phosphorus sources
  - Soil test results
  - Commercial Fertilizer
  - Volunteer crops/cover crops
  - Legumes
- Apply manure at rates where the nutrients will be used by the crop(s) grown.
  - Recommended nitrogen and phosphorous rates, timing, method of application

# A Quick and Dirty Calculation

$$\frac{\text{Average pounds of beef in lot} \times \text{days confined}}{100,000} = \text{Manure to spread (tons)}$$

$$\frac{\text{Nitrogen needs of next 2 crops (lbs/ac)}}{\text{Nitrogen analysis of manure (lbs/ton)}} = \text{Manure application rate (tons/acre)}$$

$$\frac{\text{Manure to spread (tons)}}{\text{Manure application rate (tons/acre)}} = \text{Acres fertilized for 2 crops}$$

Do not put manure on these same acres until 2 crops have been harvested.

Do not put commercial fertilizer on these same acres until 2 crops have been harvested.

# Beef Manure Examples

Given: 200 Beef Cows @ 1100 pounds confined in an open lot for 150 days.

Result: 286 tons of manure containing 1540# available N and 3520# available  $P_2O_5$

Grow Corn for grain @ 100 bushels/acre and assume 0# N or  $P_2O_5$  from soil test

Apply 16.7 tons of manure/acre on 17.1 acres to fertilize the crop on a N basis

Apply 5.7 tons of manure/acre on 50.3 acres to fertilize the crop on a  $P_2O_5$  basis

Grow Spring Wheat @ 45 bushels/acre and assume 0# N or  $P_2O_5$  from soil test

Apply 20.9 tons of manure/acre on 13.7 acres to fertilize the crop on a N basis

Apply 3.7 tons of manure/acre on 78.2 acres to fertilize the crop on a  $P_2O_5$  basis

For rough estimate:

Number of Beef Cows confined over winter / 13 = acres to spread manure

# Manure Management Tools

- NRCS eFOTG (Field Office Technical Guide)

- <http://www.nrcs.usda.gov/technical/efotg/>
- Select State and County then...
- Section 1
  - Reference Subjects
    - Agronomy
      - Nutrient Management

- NDSU Extension Service

- <http://www.ext.nodak.edu/extpubs/watanim.htm>

# Summary

- Understand how soil functions with added manure.
- Understand how to provide adequate *but not excessive* crop nutrients with manure.
- Goal is to grow good crops and keep surface and groundwater clean!
- A Look at some Tools...
  - [Nutrient Management Planner](#)
  - [Jon's Beef Cattle Manure Spreadsheet](#)