Problem - Solutions

Class Exercise (Nutrient Planning) – 1

- A 500-head dairy cow operation is located on a tract of land with the current land base of 750 acres of row cropland.
- Average daily milk production = 70 lbs/cow (0.1% phosphorus content); P content of the diet = 0.45%; average DMI = 50 lbs./cow/day.
- Calculate P_20_5 equivalent excreted annually with 500 cow herd
- With average P_2O_5 uptake/acre/year at 65 lbs. how many acres are required for manure application with this 500 cow dairy?
- List alternatives to balance the phosphorus supply with the need.

Class Exercise (Nutrient Planning)

Formula for determining excretion of P per cow per day:

- (Avg. DMI x P in feed) – (Avg. lbs. milk/cow/d x P in milk) = lbs. P excreted/cow/day
  - (50 lbs x 0.45%) – (70 lbs x 0.10%) = (50 x .0045) – (70 x .001) = 0.225 – 0.07 = 0.155 lbs P/cow/day
- Convert P to P_2O_5 = lbs. P X 2.29 = lbs. P_2O_5
  - 0.155 lbs. P/cow/day x 2.29 conversion = 0.355 lbs P_2O_5 equivalent/cow/day

Class Exercise (Nutrient Planning)

- P_2O_5 excreted from 500 cows per year:
  - 0.355 lbs P_2O_5 equivalent/cow/day X 500 cows x 365 d = 64,788 lbs P_2O_5
- Current acreage removes 49,200 lbs P_2O_5 therefore there is excess P excreted above what annual crops remove (64,788 – 49,200 = 15,588 lbs. excess)
- Acres needed for P excretion: 64,788 lbs P_2O_5 /65 lbs P_2O_5 = 997 acres

Class Exercise (Nutrient Planning)

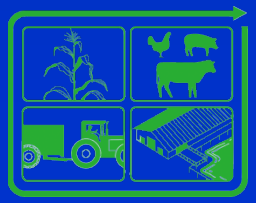
- Alternatives to balance P_2O_5
  - Feed management
  - Increased land base for manure application
  - Change crop rotation to include crops which have higher P_2O_5 crop removal rates
  - Reduce herd size

Example – 2

If the phosphorus index is in the high-risk category, and manure can be applied only on a P removal basis, determine the amount of manure that can be applied to a field for a silage crop that yields 23 tons per acre?

Required Information

Corn silage yield	23 tons per acre
Manure P_2O_5, based on manure test	3 lbs/1000 gal
Total Manure N, based on manure test	10 lbs/1000 gal
P removed USDA Plants Database	30 lbs of P per acre



Solution

- To convert to P_2O_5 multiply P by 2.29
  - 30 X 2.29 = 68.7 lbs. P_2O_5 removed per acre
- Apply 68.7 (69) lbs. of P_2O_5 per acre to meet the P removal rate
- Manure analysis: 3 lbs. P2O5/1,000 gal.
- Determine gallons required to meet crop removal
  - 69 lbs. P2O5/3 lbs. P2O5 per 1,000 gal = 23 units
  - 23 units X 1,000 gallons = 23,000 gallons of manure/ac

Other Considerations

- The method of application should be considered, in this instance, can the soil accept and hold 23,000 gallons if it is irrigated? If it were applied in one pass via injection, or via multiple applications that add up to 23,000 over time?
- What rate of other nutrients will be applied (specifically N and K) at this application rate, and are they agronomically acceptable?

In-class exercise – 3

A dairy producer gives you the following manure analysis from an anaerobic manure storage. He indicates that they generally apply 15,000 gallons per acre of this manure type in the spring and incorporate a week later (assume 7 days).

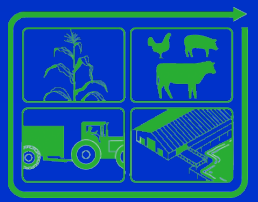
Assume 160 lbs. per acre of nitrogen are required by University recommendations for 140 bushels of corn per acre.

Assume that 1 bu. of corn grain removes 0.37 pounds of P_2O_5.

NH_4^+ Nitrogen available from manure

	% NH_4^+ remaining		
Incorporated	95		
Sprinkling	75		
Broadcast	Soil Conditions		
Days to incorporation	warm dry	warm wet	cool wet
1	70	90	100
4	60	80	95
7	50	70	90

Source: NRCS Ag Waste Mgt. Field Handbook, Ch. 11



Mineralized Organic Nitrogen

Source: MWPS

Manure Type	Manure Handling	Mineralization Factor for first year
Swine	Fresh	0.50
	Anaerobic Liquid	0.35
	Aerobic Liquid	0.30
Beef	Solid w/o bedding	0.35
	Solid with bedding	0.25
	Anaerobic liquid	0.30
	Aerobic liquid	0.25
Dairy	Solid w/o bedding	0.35
	Solid with bedding	0.25
	Anaerobic liquid	0.30
	Aerobic liquid	0.25
Poultry	Deep pit	0.60
	Solid with litter	0.60
	Solid without litter	0.60

Dairy Manure

LAB NUMBER: 99999
MANURE TYPE: DAIRY, LIQUID PIT
SAMPLE ID: 2

DATE RECEIVED: 07/07/2005
DATE REPORTED: 07/07/2005
PAGE: 2

MANURE ANALYSIS REPORT

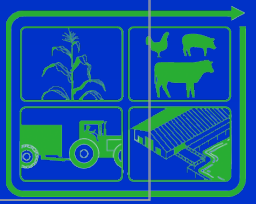
PARAMETER	UNIT	ANALYSIS RESULT	TOTAL POUNDS PER 1,000 GAL**	FIRST YEAR AVAILABILITY @ POUNDS PER 1,000 GAL
Moisture	%	90.00	7497.0	
Solids	%	10.00	833.0	
Nitrogen, Total (N)	%	0.468	39.0	25.0 *
Nitrogen, Ammonium (NH4-N)	%	0.228	19.0	19.0 *
Nitrogen, Organic (N)	%	0.240	20.0	6.0 *
Phosphorus (P)	%	0.089	16.9 (as P2O5)	16.9 (as P2O5) *
Potassium (K)	%	0.300	30.0 (as K2O)	30.0 (as K2O) *

Questions for the Manure Nitrogen Class Example

Dairy Anaerobic Liquid Manure Total N = ____

Total Ammonium N =_____ Warm and dry conditions Incorporated in 7 days Estimated lbs. of available Ammonium N per 1000 gallons =_____	Total Organic N = _____ % Mineralized first year =_____ Estimated lbs. of available organic N Per 1000 gallons =_____

1. How many pounds of est. plant available N (PAN) are available per 1000 gal.?_____
2. How many pounds of PAN will be applied at 15,000 gal?____
3. How many pounds too much N per acre is this?_____
4. How many pounds of P_2O_5 will be applied?_____ and K_2O_____
5. How many years worth of P_2O_5 crop removal will be applied?_____
6. How many gallons per acre would you recommend?_____ Why?
7. At your recommended rate, how many pounds of P_2O_5 will be applied?_____
8. And how many pounds of K_2O will be applied?_____



- - Answers - -

Dairy Anaerobic Liquid Manure Total N = ***39***

Total Ammonium N =

19 lbs./1000 gal.

Warm and dry conditions

Incorporated in 7 days

Chart indicates 50% available

0.50 x 19= 9.5 lb/1000 gal.

Organic N

Total Organic N =

20 lbs./1000 gal.

% Mineralized first year = ***30%***

Estimated lbs. of available organic N
Per 1000 gallons =

20 x 0.30 = 6 lbs./1000 gal.

1. How many pounds of est. plant available N are available per 1000 gal.?
   - *9.5 ammonium N + 6 lbs. organic =*

   15.5 lbs./1000 gal. plant available N

2. How many pounds of PAN will be applied at 15,000 gal?
   - *15 one thousand gallons x 15.5 lbs. PAN/1000 gallons* =

   232.5 lbs. PAN per acre

3. How many pounds too much N per acre is this?
   - *232.5 lbs. PAN applied – 160 lbs. N needed for yield goal =* **72.5 lbs. excess N**
   - *Missed opportunity: 72 lbs. x 50 cents/lb = $32 of N/ac*

4. How many pounds of P_2O_5 will be applied?

   15,000 gal. x 16.9 P_2O_5 per 1000 = **<u>253.5 lbs./acre</u>**

   How many pounds of K_2O will be applied?

   15,000 gal. x 30 lbs. K2O per 1000 = **<u>450 lbs./acre</u>**

5. How many years worth of P_2O_5 crop removal will be applied?

   140 bu/a corn x 0.37 lbs P_2O_5 crop removal per bushel = 52 lbs./acre crop removal.

   Since 253 pounds P_2O_5 were applied divided by 52 lbs. per acre = **<u>4.8 years worth.</u>**

6. **How many gallons per acre would you recommend? <u>10,300 gal/a.</u> Why?**

a. This will supply 160 lbs./a of plant available N for 140 bu. corn

(160 ÷ 15.5 = 10.3)

b. Another option would be to apply 6,666 gallons of manure per acre, and inject or immediately incorporate the manure. The ammonium would be 95% available (19 x 0.95 = 18 lbs. plus the 6 organic would = 24 lbs. per 1000 gallons PAN. When 160 lbs. N is required, divided by 24 pounds per 1000 gallons = 6,666 gallons per acre.

c. Use P_2O_5 crop removal rate of 52 lb/ac. Divide 52 by 16.9 lb/1,000 gallons yields 3.1 units or 3,100 gallons/ac

7. **At your recommended rate, how many pounds of P_2O_5 and K_2O will be applied?**

   At 10,300 gallons = 174 lbs. P_2O_5 and 309 lbs. K_2O.

   At 6,666 gallons = 112 lbs. P_2O_5 and 200 lbs. K_2O

   At 3,100 gallons – 52 lbs. P2O5 and 93 lbs. K_2O

Balancing Math with Common Sense

- Is this a good idea?
  - Infiltration rate of soils
  - Tile line discharges
  - Lost opportunity cost of wasted N
  - Over application of other nutrients