Alternative P-Based Manure Applications Evaluated

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Background

- Concern over the potential for nutrients and pathogens in manure to move into water
- Manure rates based on crop nitrogen demand will result in phosphorus accumulation
- Applying manure based on crop phosphorus demand could be costly
- Manure is a disposal ‘problem’ for livestock feeders

Background

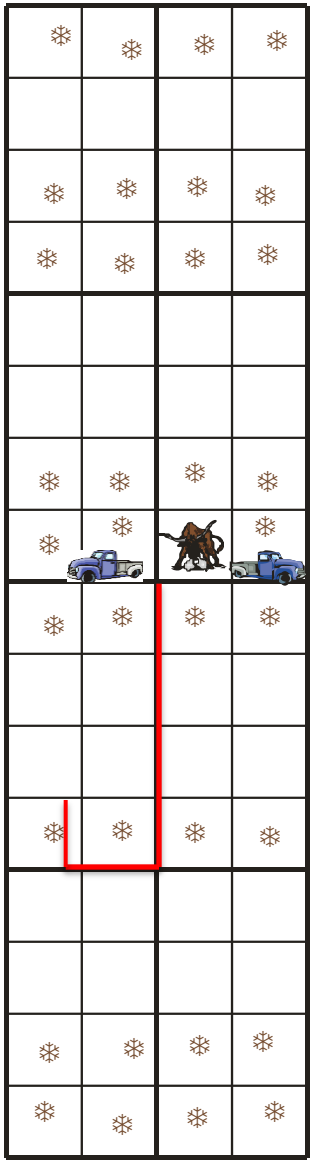
- The impact to producers from P-based manure application rates is not well known
- There could be other strategies to reduce P applied to land
  - Composting to move P out of the region
  - Application strategies
- Use an economic model to evaluate alternatives

Objective

- Maximize the return from crop production, less the cost of manure application, inorganic fertilizer, and all other crop production costs
  - Does not include the animal feeding
  - All manure must be applied to land (not consider composting and removal from the region)
  - Land area is limited, but adequate to accept the manure produced
  - Land is a mix of irrigated and dryland
  - Only consider private benefits and costs

Feedlot and Land Configuration

- Hypothetical feedlot (10,000 head) and quarter section layout
- Not all near-by land can receive manure from the feedlot (other land owners, perennial crops, etc.)
- Roads are on a grid (1 mile E-W, 2 miles N-S)



Model Characteristics

- Crops include barley (grain and silage), corn silage, wheat, canola
- N application constrained by (1) the impact on crop yield (yield equation) or (2) regulation
- P can be applied (1) in excess of annual crop requirements or (2) based on plant requirements
- P strategies: Option of applying manure once every year, or three times the P rate once every third year

Model Characteristics

- Manure handling costs
  - Custom rate: $/hr for trucks and loader
  - Costs included: loading, hauling to field (distance), applying manure in the field (rate of application)
- Manure benefit
  - Crop yield increased with nitrogen, up to a maximum yield (depended on the crop)
  - Inorganic nitrogen and phosphorus fertilizer could be applied

Systems Evaluated

- Allocation and costs associated with different manure application systems (BMPs)
  - Annual nitrogen based rate (current regulation) (N-Based)
  - Annual phosphorus based rate (P-Based)
  - Triennially three times annual phosphorus based rate (3XP-Based)

General Results

- Without regulations (N or P), manure will be applied at a higher rate nearer the feedlot, but also applied at a distance from the feedlot
- Excessive application had a cost through lower yield at high rates (crop lodging, disease, etc.), and lost value in the over-applied P and N
- An N-Based rate will have reduced manure application rates nearer the feedlot (compared to no regulations)

General Results

- Crops with higher N demand will be grown nearer the feedlot (corn silage)
- With higher fertilizer P costs, there is an incentive to reduce manure rates (< N-Based) and apply manure to more land
- Additional manure is a cost, except when fertilizer costs are very high

P-Based Results

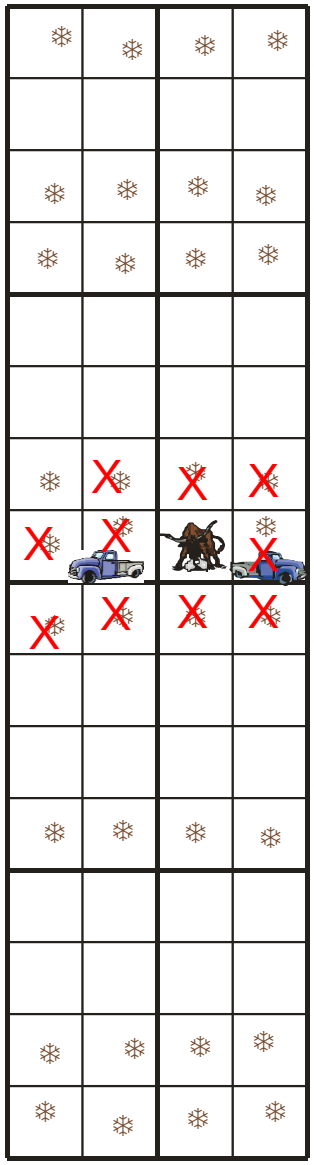
- An annual P-Based manure application rate increased manure application costs (further distance and more time to apply manure in the field)
- Some savings in P fertilizer purchases
- Little impact on cropping (barley vs. corn vs. other crops)
- Fertilizer N applied to all land to meet crop needs (supplement the N from manure)

3XP-Based Results

- Application rate was very similar to N-Based
- Application was rotated over fields with an application every third year
- Little impact on cropping (barley vs. corn vs. other crops)

Manure Application by Quarter

N

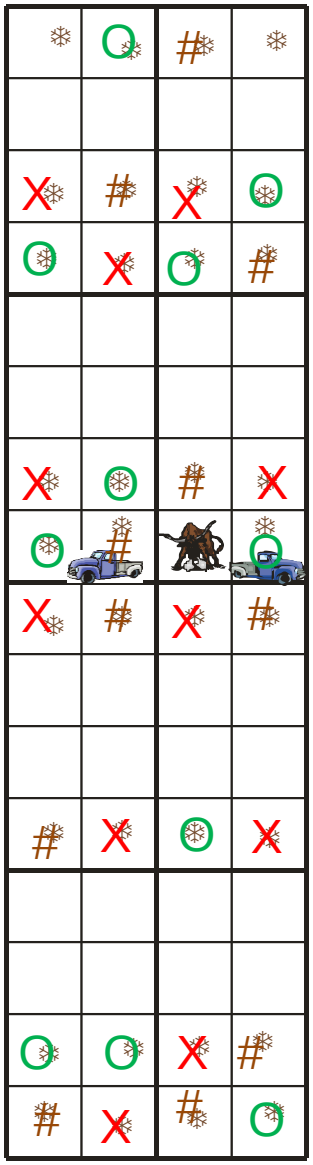


3XP

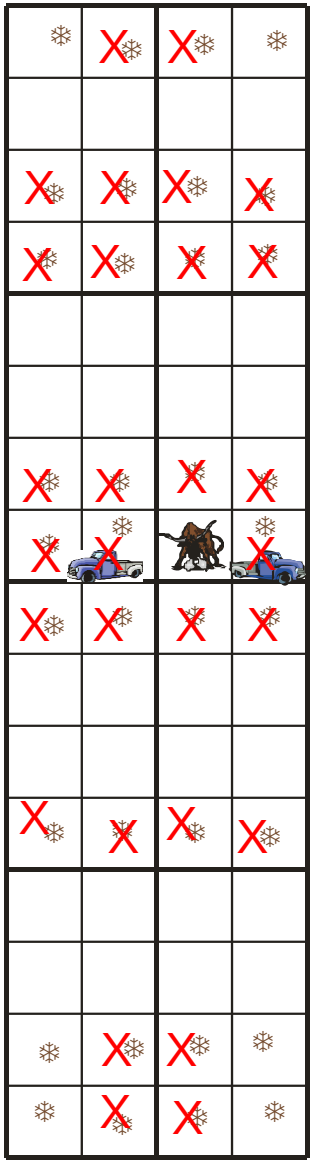
X 1st

O 2nd

3rd



P



Results Summary

	N-Based	P-Based	3XP
Return ($/hd)	Base	-8.80	-2.80
Manure application cost ($/t)	7.50	11.93 (+60%)	9.03 (+20%)
Hauling distance (t-km/hd)	7.4	13.2 (+78%)	10.2 (+20%)
Value of additional manure ($/t)	-1.05	-11.62	-5.13
N purchases (t)	Base	-2.9%	+6.5%
P purchases (t)	Base	-71%	+5.4%

Price Impacts: N-Based

	N-Based	High N$	High P$
Return ($/hd)	Base	-9.8	-6.3
Manure application cost ($/t)	7.50	7.48	7.55
Hauling distance (t-km/hd)	7.4	7.4	7.4
Value of additional manure ($/t)	-1.05	2.17	-0.47
N purchases (t)	Base	-17%	-0.1%
P purchases (t)	Base	+3.5%	-1.8%
Urea; MAP ($/t)	592; 788	900; 788	592; 1250

Summary

- P-Based manure application rates will increase the cost of manure application (cost: +60%)
- Triennially applying 3 times the annual P-Based rate is a lower cost manure application strategy than annual P-Based (cost: +20%)
- 3 times P-Based rate is very similar to annual N-Based rate
- Increased hauling distance with P-Based

Summary

- The cost of N and P fertilizer will have minimal impact on the manure application decision
- High P costs will not impact rates near the feedlot, but for further distances a lower rate can be profitable to reduce P fertilizer cost
- High nutrient using crops are best grown nearer to the feedlot (silage corn vs. wheat) so higher rates can be applied near the feedlot

Thank you