Nutrient Management on Dairy Farms

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Nutrient balances on dairy farms

- The nutrient balance on all dairy farms is positive (unless the farm exports manure).
- For every 3 lbs of N, P and K coming onto the farm, about 1 lb leaves as milk, livestock and crop sales.
- Soil fertility is already high on many dairy farms, and is increasing.
- In a Cornell University study, dairy farm P efficiency was 32%.
- Improved manure management only makes the situation worse by retaining a higher percent of nutrients!

Phosphorus is the problem

- Crops don't remove a lot of P on a per-acre basis. One ton of alfalfa dry matter contains 6 lbs of P (15 lbs P_2O_5)
- And, increasing P fertilizer or manure rate has little if any effect on forage P concentration.
- Best way to increase P crop removal is to increase crop yields.
- No magic to this…simply better crop management.

CAFO (Concentrated Animal Feeding Operation)

Nutrient legislation

- Large dairy farms (CAFO farms, 200 cows +) are required to have Nutrient Management Plans (NMP).
- NMP required for all 700+ cow farms and for 200+ cow farms “with the potential to pollute” during a 4” rainstorm. In reality, this means all 200+ cow farms.
- CAFO regulations differ from state to state, but P is the focus in most states.
- Cornell data: At least prior to CAFO, larger farms did a poorer job of nutrient management: More fertilizer per acre with similar crop yields.

Phosphorus Index

- The details differ slightly from state to state, but most dairy states now use a Phosphorus Index to guide cropland application of P.
- Basis of the P Index: 90% of cropland P losses to surface waters come from 10% of the cropland.
- Severely restrict P management on that 10%, and it can be "business as usual" on the other 90%.
- Much more practical for farmers than basing P management on soil test P or crop P removal alone.

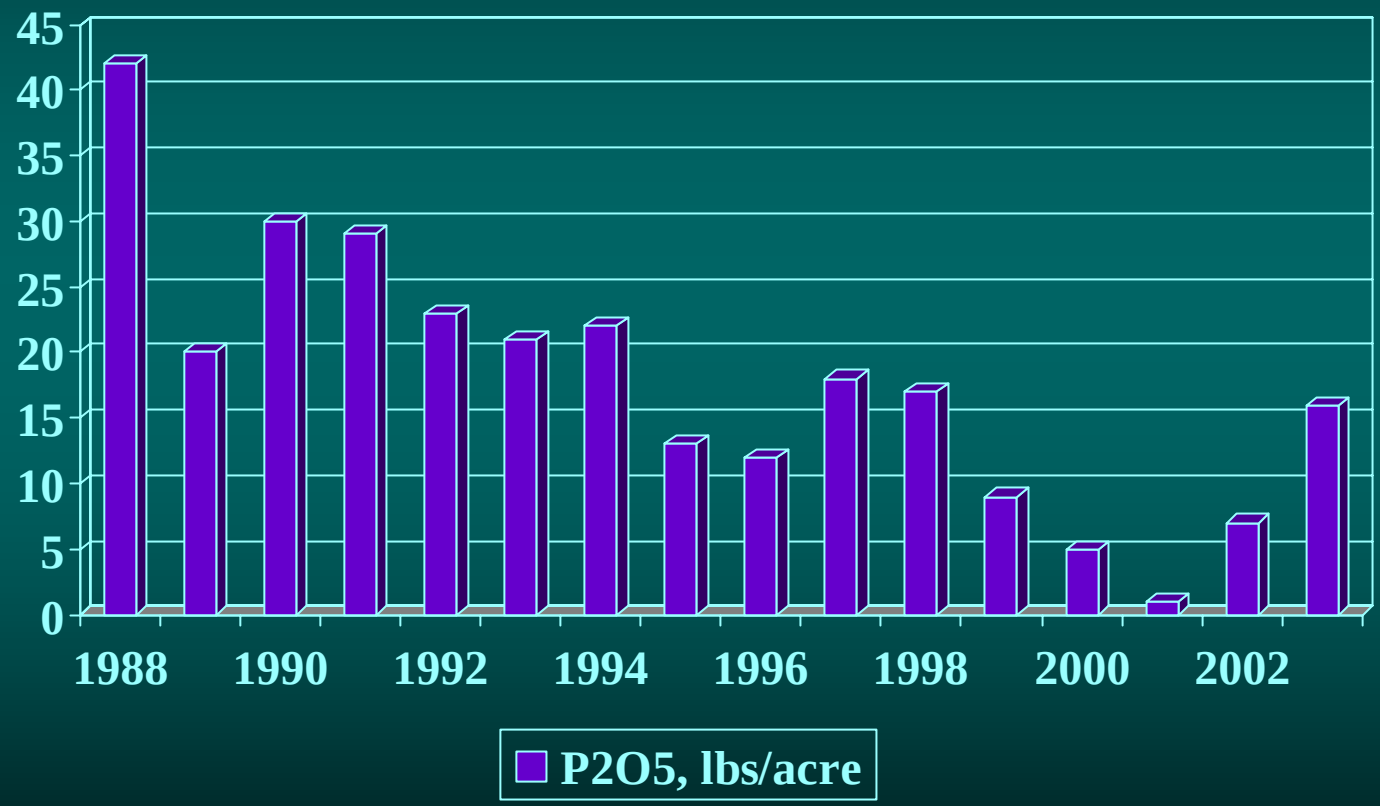
P availability vs. soil pH

- Phosphorus is not nearly as available to crops (and to leaching) at very low and very high soil pH levels.
- Low is ~5.8 and lower, high is ~7.2 and higher.
- At a pH of ~7.5, soils have the capacity to fix up to 16,000 lbs of P_2O_5 per acre.
- Fixed P isn't subject to leaching, but can be lost through soil erosion.
- Unfortunately, the P index doesn't take soil pH into account.

A Case Study: Nutrient balance at Miner Institute

- 1984: Miner Institute did its first nutrient balance. Phosphorus efficiency was *terrible* at only 16%.
- 1989: We decreased fertilizer P application rates significantly.
- 1992: Second nutrient balance. Phosphorus efficiency was still terrible at 18%, so we further reduced P fertilizer.
- 1997: Third nutrient balance. P efficiency increased to 28%. Reduced fertilizer P even more.
- 1999: P efficiency up to 33%. Average fertilizer P use was down to less than 10 lbs P_2O_5/acre.

P fertilizer rates at Miner Institute, 1988-2004



Fertilizer practices, 1995-2004

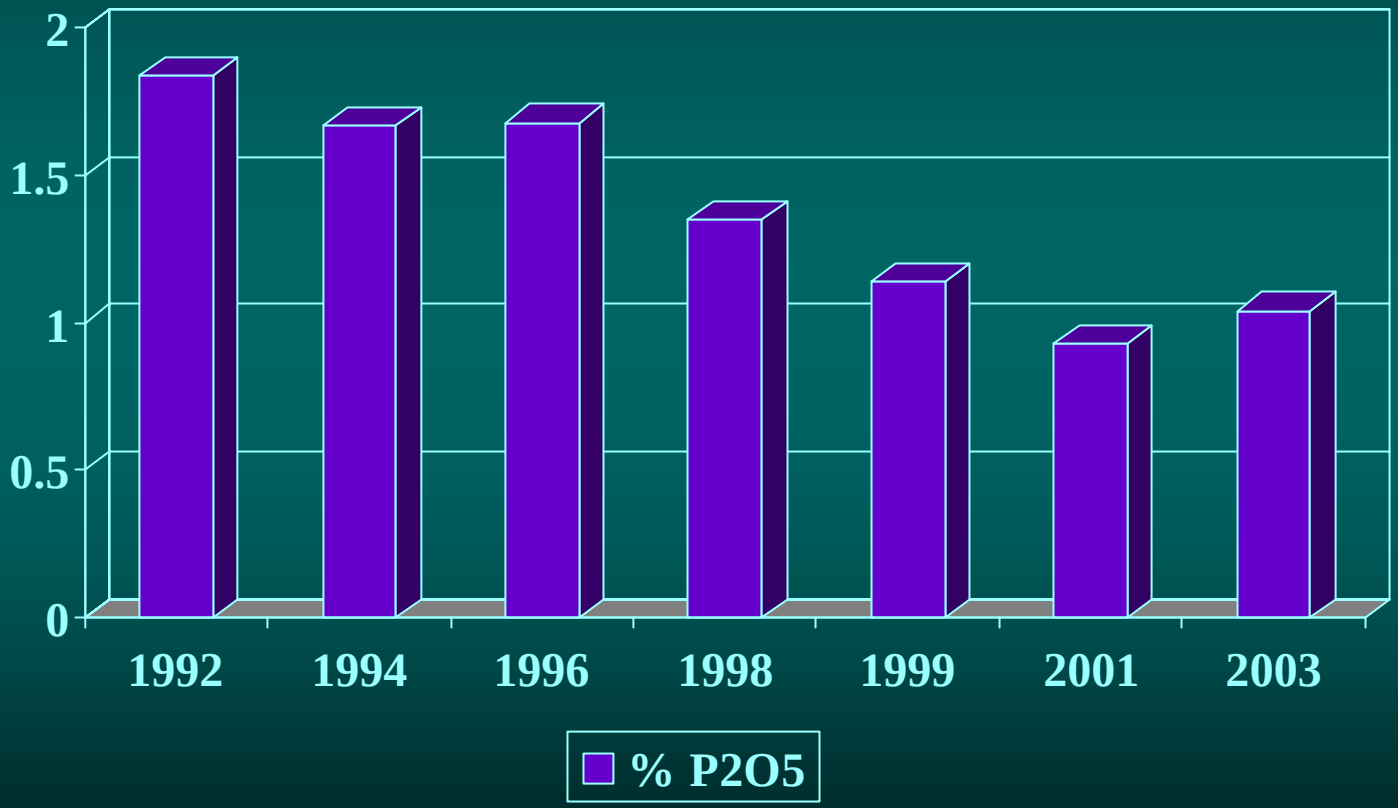
- Corn: No P_2O_5 on very high soil test P soils, 26-36 lbs P_2O_5 /acre on the rest depending on soil test P. *
- Alfalfa-grass seedings: Manure prior to seeding*
- Alfalfa-grass topdress: 0-0-60 + summer manure.
- Grass topdress: N in spring, then summer manure.

* 55 lbs/A P_2O_5 & 55 lbs/A K_2O on very low P (leased) land.

Where we are now:

- We weren't happy at Miner Institute being "just average" for P efficiency, finally figured out that the solution wasn't just in crop management, but in dairy ration P.
- Most farms bring much more P onto the farm as feed than as fertilizer.
- 2000: Reduced ration P from 0.40-0.42% to 0.35-0.38% P.
- 2003: P efficiency increased to 37%. ☺
- Manure P is the key: It's almost impossible to improve P management much if your dairy manure is loaded with phosphorus.

Manure P, Miner Institute
% P_2O_5 , DM basis.



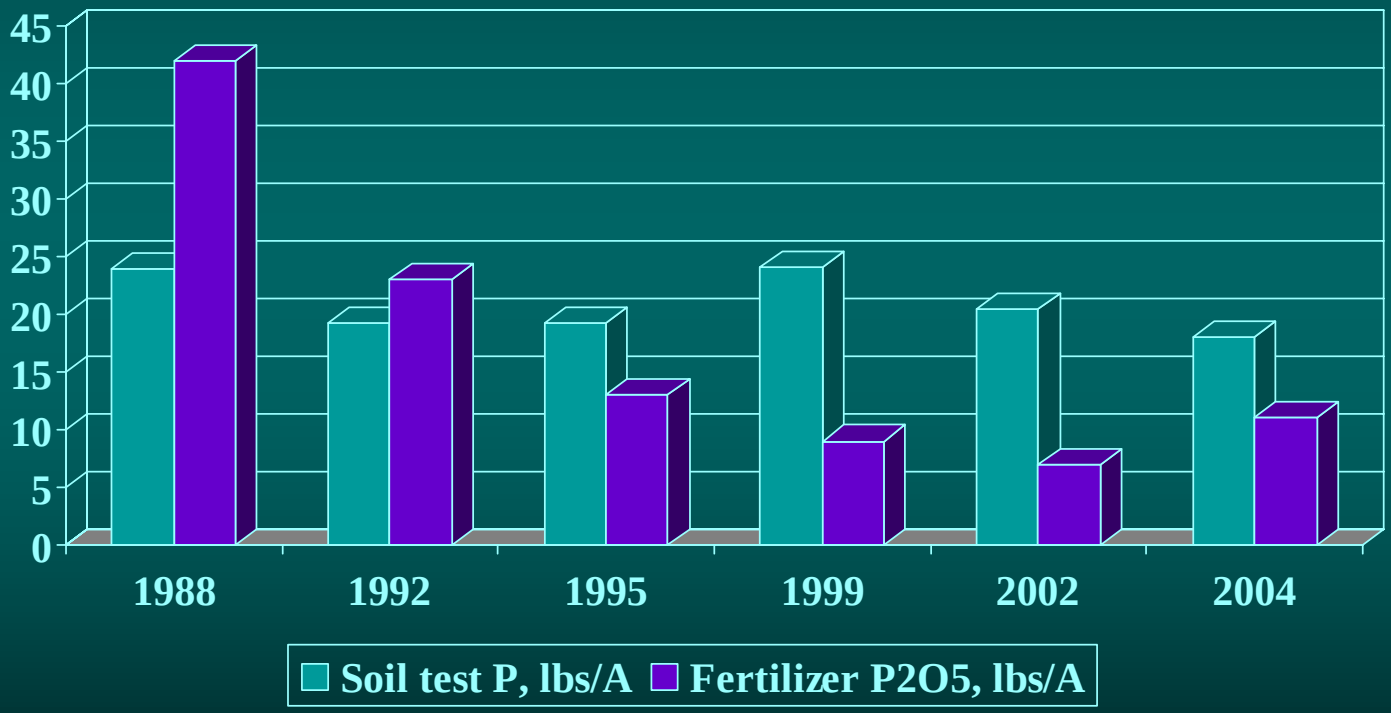
Miner Institute dairy manure 1992 vs. 2001-03

1992	2001-03
1.8% P_2O_5 (DM Basis)	1.0% P_2O_5 (DM basis)
1000 gal. @ 8% DM contains 11.5 lbs P_2O_5	1000 gal @ 8% DM contains 6.4 lbs P_2O_5
5000 gal/A = 58 lbs P_2O_5	9,000 gal/A = 58 lbs P_2O_5
	Plus almost twice as much N, K, O.M., secondary and micronutrients.

Impacts on Miner Institute crop production

- Corn silage yields in 2004 were at an all-time high, and for the past 5 years have averaged well above our long-term yield of about 19 tons/acre.
- Alfalfa-grass yields have also held up well, though in some cases we're having a hard time maintaining soil test K levels on our higher yielding alfalfa fields.
- We wouldn't expect reduced P fertilization to have any yield impact because we're still bringing lots more P onto the farm than is leaving it. Soil analyses confirm this.

Soil Test P, 1988-2004
Same 320 acres of cropland



Hold the P, but not the N

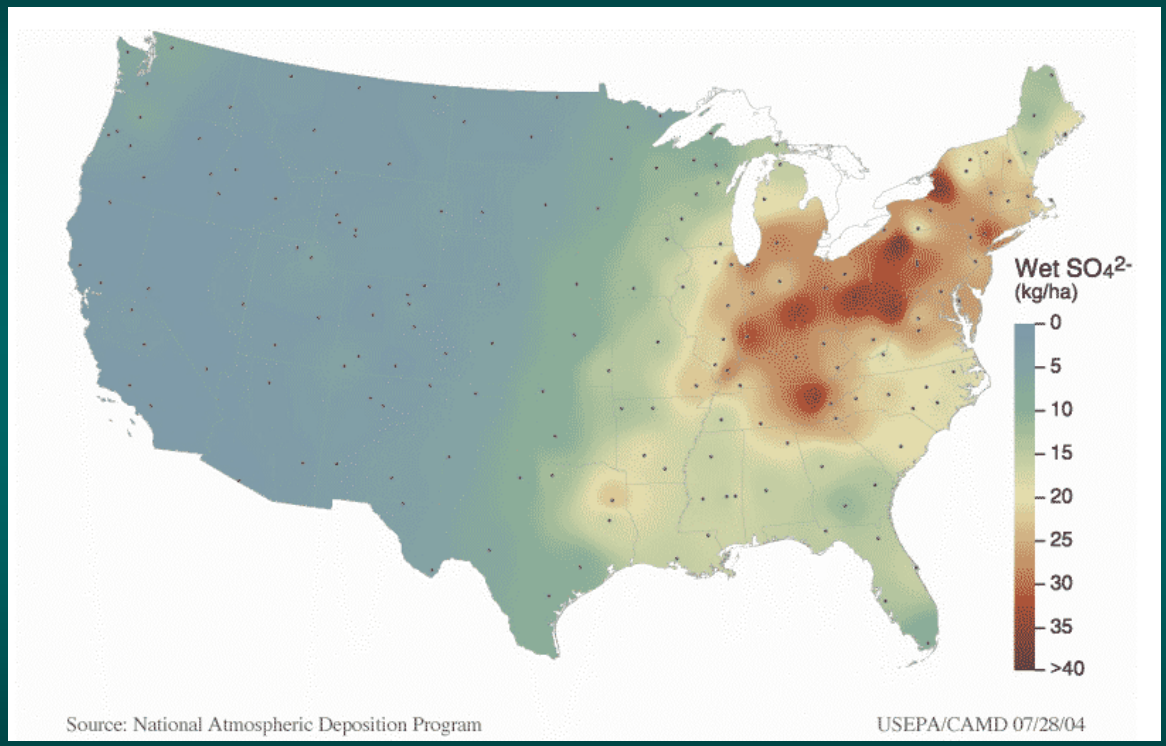
- We don’t need to apply starter P on very high soil test P fields, but corn needs starter N unless manure is applied in the spring prior to planting.

- 2003 Miner Institute starter fertilizer trial, very high soil test P and K soil, no manure for several years: 40-0-0 in a 2” x 2” fertilizer band resulted in 10% higher corn silage yield than 0-0-0.

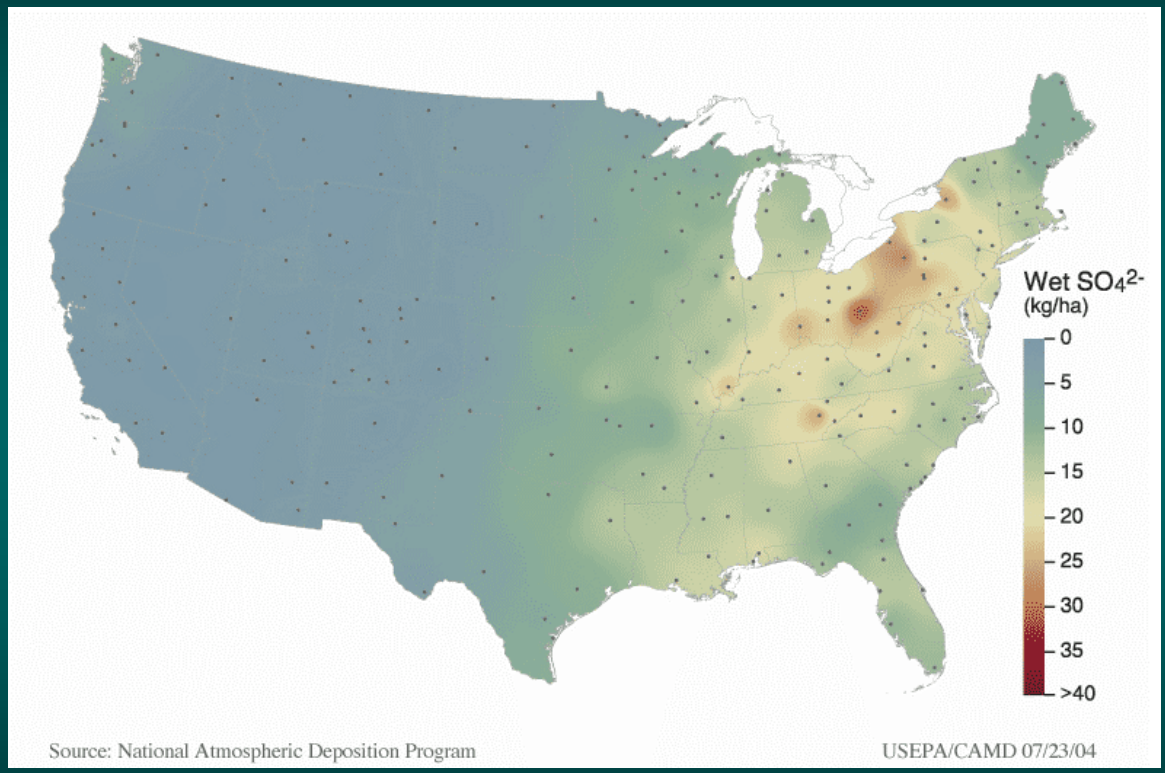
Other changes in dairy country

- Atmospheric sulfur depositions and "incidental" sources of sulfur have declined 30-40% in the past 15 years.
- Forage S concentrations in the Northeastern U.S. have also decreased, in some cases to the point of deficiency.
- New regulations would further reduce S emissions in the Northeastern U.S. by another 40% by 2010.
- Sooner or later we'll have to start supplementing sulfur—or perhaps increasing our current S application rates.
- *Watch forage analyses*, and if S is low confirm this with tissue analyses. I don't put much faith in soil analysis for sulfur.

Wet sulfate deposition, 1989-91



Wet sulfate deposition, 2001-03



Questions?