Phosphorus Best Management Practices

Protecting Water Quality

Dietary Phosphorus Levels for Dairy Cows

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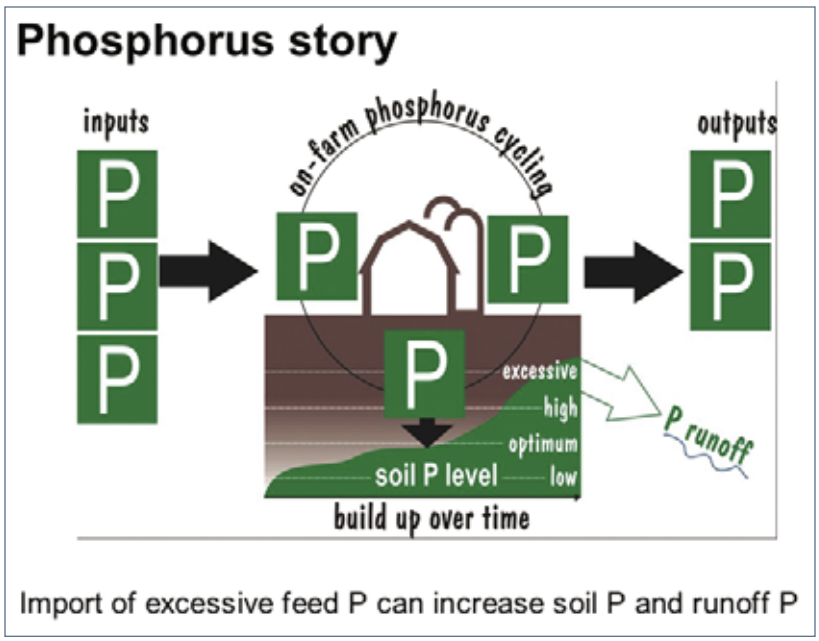
Definition:

Guidelines for manure application to cropland are becoming increasingly based on a combination of manure phosphorus (P) content, soil test P level, crop P requirements and a field's risk to lose runoff P to surface water. Given the direct relationship between the amount of P fed to dairy cows and the amount of P in manure, the simple practice of adopting the dietary P recommendations for dairy cows recently established by the National Research Council (NRC, 2001) would greatly reduce manure P levels and would help farmers meet manure P-based management practices.



Import of excessive feed P can increase soil P and runoff P

Purpose:

The P requirement of most lactating dairy cows can be met if the diet contains 0.32-0.38 percent P (Figure 1). Holstein cows producing milk containing 3.5 percent fat and 3.0 percent true protein have a dietary requirement (dry matter basis) of 0.32, 0.35, 0.36 and 0.38 percent P for milk production amounts of 55, 75, 100, and 120 lbs/day, respectively. Many dairy farmers feed P in great excess of these NRC-recommended levels.

How Does This Practice Work?

Depending on the ration ingredients used, most dairy diets contain 0.35-0.40 percent P before supplemental

Figure 1. Current status of P feeding to lactating dairy cows milking 20,000 lbs per 305 days of lactation.

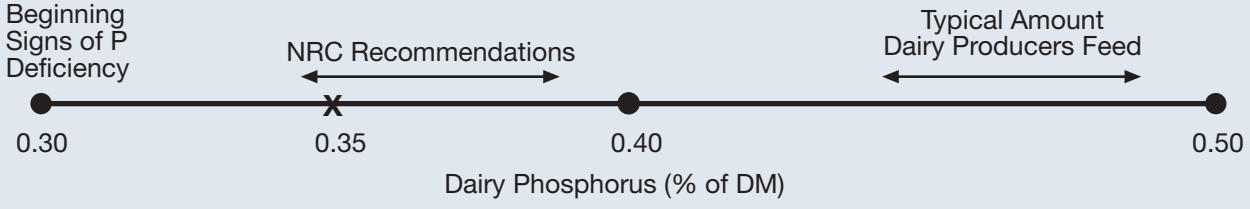


Table 1. Protein and phosphorus concentrations in common dairy protein supplements.			
Feed	Protein content % DM	Phosphorus content %	Protein: Phosphorus ratio
Blood meal	95	0.30	317
Corn gluten meal (dried	65	0.60	108
Soybean meal (expellers)	46	0.66	65
Soybean (roasted)	43	0.64	67
Brewer's grain (dried)	29	0.67	44
Cottonsee	23	0.60	38
Corn distiller's grain	29	0.83	35
Wheat midds	18	1.02	18
Wheat bran	17	1.18	14
Meat and bone meal	54	4.73	11

mineral P is added. Because such diets already contain sufficient P for high milk production, the simple elimination of mineral P supplements may be sufficient to eliminate excessive P feeding. All P in excess of dietary requirement is excreted in manure.

In addition to mineral P, a large part of excessive dietary P may come from protein supplements. The selection of protein supplements is usually based on their availability and how they fit into a least-cost ration. The protein supplements commonly used in dairy rations contain a very wide range of P concentrations (Table 1). For dairy farms attempting to improve P management, the choice of a low-P protein supplement could have a major impact on manure P, land requirement for manure application (Table 2) and the farm's accumulation and loss of P.

Grouping cows by milk production level would enable a closer match between dietary P and P requirement. For example, it is fairly common for dairy producers to split the herd into two or three groups according to milk production or stage of lactation, and formulate diets to meet the nutritional needs of each group. A reasonable approach to feeding P levels close to herd requirements may be to formulate group rations using NRC recommendations that match the average milk production level of the top 25 percent of cows in a feeding group. If this were done, then high-production groups in the highest-producing herds would meet their P requirement with a reasonable margin of safety by feeding diets containing 0.36 - 0.40 percent P. This amount of dietary P can be supplied with little or no use of mineral P supplements and represents a significant reduction in P content of the average dairy diet fed. Reducing P content of dairy diets from 0.45 to 0.38 percent represents a 15-20 percent reduction in dietary P, and a 20 – 25 percent reduction in manure P. Reducing dietary P concentrations below 0.36 – 0.40 percent could be done for low-producing cows, but low-diet P ingredients would have to be used, and that could be more costly.

Table 2. Amount of P fed and excreted by a lactating cow producing 20,000 lbs milk in 305 days, and the amount of land required to effectively use manure P.				
Dietary P concentration	Estimated Supplemental P	Manure P	Land area needed to recycle manure P	Change in land area
(%)	(lbs/lactation)	(lbs/lactation)	(acres)	(%)
0.35	0	34.8	1.3	Base
0.40	7.5	42.3	1.6	23
0.48	19.6	54.5	2.0	53
0.55	30.2	60.0	2.4	83

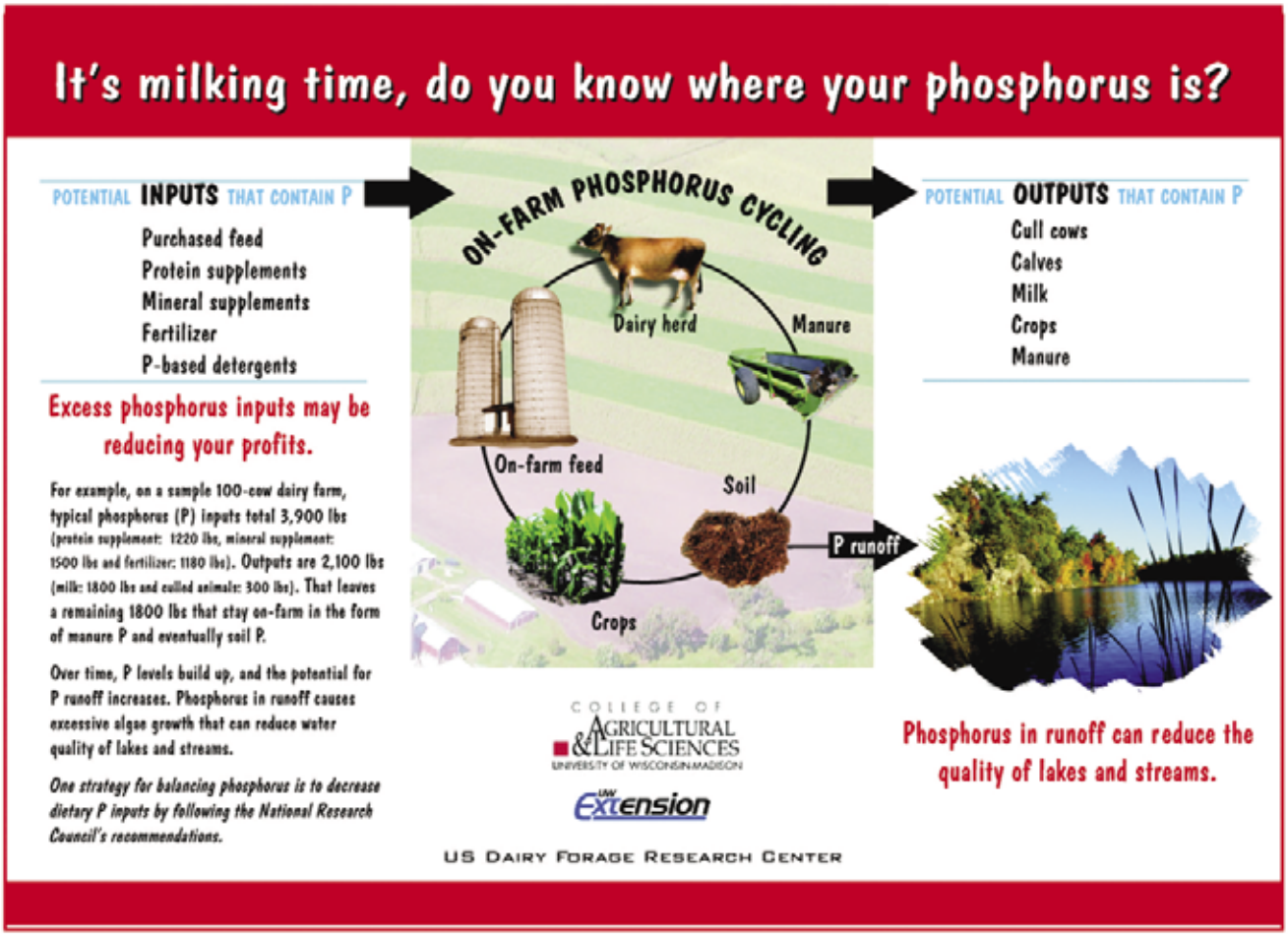
Where This Practice Applies and Its Limitations:

The reduction or elimination of mineral P supplements so dietary P levels meet NRC recommendations can be practiced on any dairy farm. A possible limitation may be the formulation of least-cost rations using protein supplements high in P. Table 1 provides a guide for selecting protein supplements that have low P content

Effectiveness:

Feeding P in excess of NRC-recommended levels does not increase milk production, milk composition or reproductive performance of the cows. It simply increases manure P excretion and, therefore, the amount of land needed to effectively recycle manure P through crops (Table 2).

Assumptions: Cow is consuming an average of 49.6 lbs DM daily, and milk contains 0.09 percent P. There is no net change in P content of the cow. The cropping area is comprised of 37 percent



corn for grain, 7 percent corn for silage, 47 percent alfalfa and 9 percent soybeans. Crop yields are typical for the Midwest US, and crops remove 27 lbs P per acre per year. Manure application rate is based on crop P removal.

In addition to reducing the manure P levels and the amount of cropland needed to recycle manure, feeding P to NRC-recommended levels also aligns the N:P ratio of manure to coincide closely with N:P ratio of crops. This means that when manure from cows fed excessive amounts of P is applied to cropland in amounts to meet a crop N demand, soil test P would increase much more quickly. Increased soil test P increases the risk of runoff P.

Reductions of diet P to recommended levels not only decreases manure P excretions but also greatly reduces the potential for runoff of soluble P from manure-amended fields. A recent field trial showed that when manure from dairy cows fed a high (0.49 percent) and low (0.31 percent) P diet were applied at equal amounts, difference in P runoff between plots amended with high P manure was eight to 10 times greater than from plots amended with the low P manure. When manure was applied at equivalent rates of P (36 lbs. P per acre), runoff concentrations and loads from plots amended with the high P manure were approximately four to five times those from the low P manure. Excessive diet P supplementation increases both total and water-soluble P content of manure.

Cost of Establishing and Putting the Practice in Place:

Separate feed, fertilizer and manure management strategies that do not consider balancing on-farm P inputs and outputs can result in loss of profits through excessive P use, undesirable P accumulation in soil, and increased risk of negative environmental impacts. Diet P reductions to NRC-recommended levels would eliminate the purchase of unnecessary mineral P supplements and decrease manure spreading costs, as less cropland would be required for manure P recycling (Table 2).

Many dairy producers already have reduced diet P levels and have saved money. For example, surveys and other studies have shown that the average P content of dairy diets recommended by

consultants and the feed industry in 1999 was approximately 0.48 percent of ration dry matter. The average P content of dairy rations in 2003 is estimated to be about 0.44 percent. If the target dietary P level is NRC's recommendation of 0.38 percent for high-producing dairy cows, then we have come about one-third of the way toward these recommendations. The reduction of diet P levels has already saved U.S. dairy farmers $30-35 million annually, and has the potential of an additional savings of $65-70 million. The reduced environmental risk associated with P runoff loss from manure-amended fields, and the potential to reduce eutrophication of fresh-water systems, would be potentially enormous.

Operation and Maintenance:

Any strategy aimed at improving P use on dairy farms, including dietary practices, must be done in partnership with the consultants, feed industry, veterinarians and others who assist dairy farmers in making nutrient management decisions.

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For Further Information:

Contact dairy Extension specialists and Extension agents, feed consultants and veterinarians.

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Bottom line for dietary nutrient management

Don't feed it if they don't need it!