

# Reducing Phosphorus Losses Through Nutrition

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Increasingly farmers across the United States are feeling pressure to minimize the impact of their farm management practices on the environment. The challenge facing the industry is to identify techniques to reduce the environmental impact of farming operations while maintaining their economic viability.



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Recent work suggests real opportunities to reduce nutrient losses through improved nutrition and herd management.

This article is the third in a series covering the relationship between dairy farms and the environment. Its focus is the opportunity farmers and their advisors have to reduce phosphorus losses from dairy farms through nutrition.

## Environmental Concerns With Phosphorus

Phosphorus (P) contamination of surface water (for example, streams, lakes, the Chesapeake Bay) leads to algae blooms that impair aquatic life, fishing, and recreational opportunities. Historically, phosphorous runoff has been primarily associated with soil erosion. With excessive application of P to soils over a period of time, soil test P in areas of intensive animal agriculture has increased and it is becoming apparent that P runoff can occur even when erosion is controlled. Increased soil test P has been linked to greater P runoff.

This concern has led to the development of P-based nutrient management regulations in many areas of the country. These include the Lake Okeechobee watershed

in Florida and certain watersheds in New York. Phosphorus-based nutrient management is now the law for all farms in Maryland and for poultry farms in Virginia.

These P-based regulations limit manure application to the P needs of crops. This standard increases land required for manure application, and may have a severe negative impact on profitability of many farms.

## Link Between P Intake and Excretion

More precisely defining and meeting the phosphorus needs of cows to reduce excretion is a powerful and cost-effective approach to reducing potential P runoff from farms. The link between P intake and P excretion was best demonstrated in a Florida study. Twelve cows were fed diets containing one of three levels of phosphorus (.30%, .41%, .56% of dietary DM). Excretion increased linearly with increasing intake (Figure 1), and virtually every extra gram of phosphorus fed in the high phosphorus diet compared to the low phosphorus diet was excreted.

## Are Dairy Farmers Overfeeding P?

A survey of 33 Virginia dairy herds in the fall of 1998 indicated that Virginia dairy farms overfeed phosphorus by an average of 45% relative to NRC requirements. This overfeeding increased feed costs by \$800 to \$2,800 per year and increased the land required to land-apply manure under P-based regulations by 65% or more (Figure 2). Surveys of Wisconsin and Texas herds, and discussions with nutritionists nationwide indicate that this overfeeding of P is the norm, rather than the exception.



Efforts to control phosphorous contamination now extend beyond the historical concern with P runoff through soil erosion. USDA-ARS photo.

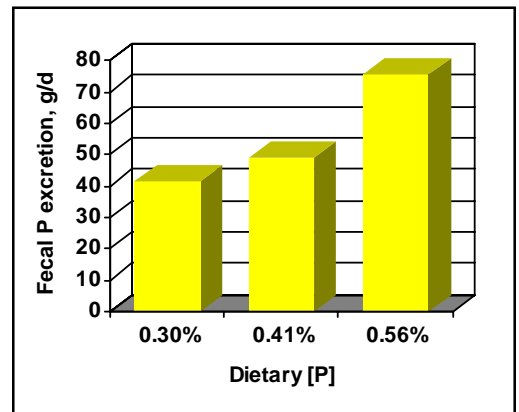


Figure 1. Effect of dietary P concentration on phosphorus excretion.

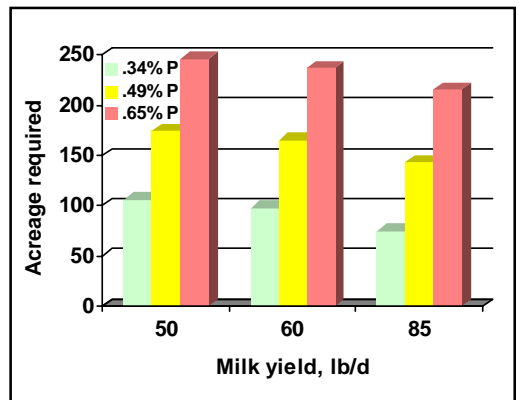


Figure 2. Effect of overfeeding phosphorus on acreage required to land-apply manure from a 100 cow dairy herd under P-based regulations.

## Why Overfeed?

Most overfeeding of phosphorus is due to three factors: (a) uncertainty about P content of feeds; (b) lack of awareness of the actual P requirements; and (c) a belief that overfeeding P helps milk yield or reproduction.

Wet chemical analysis of P content of forages should be performed a minimum of twice a year to monitor actual P content. Armed with this data, diets should be formulated to meet P needs as defined in the most recent publication of the National Research Council (NRC). These published P requirements are a conservative interpretation of the available research data with significant margin of safety built in. These requirements are often lower than commonly believed.

As with all nutrients, cows require specific quantities of P, not a specific con-

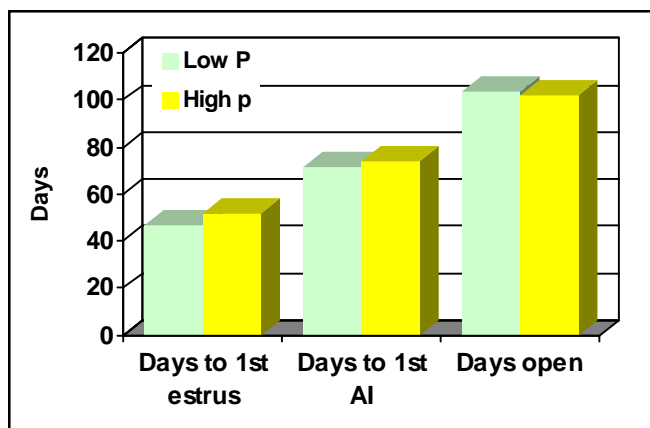


Figure 3. The effect of dietary P concentration on reproductive performance in lactating cows (summary of 13 trials, 785 cows).

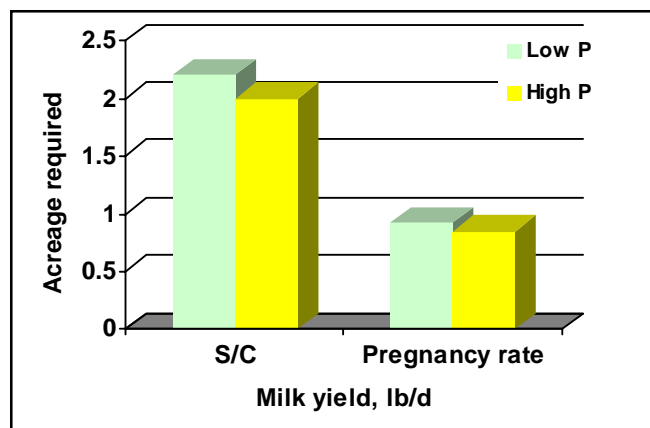


Figure 4. The effect of dietary P concentration on reproductive efficiency in lactating cows (summary of 13 trials, 785 cows).

centration. We refer to dietary concentrations for convenience, but the practice of targeting a specific concentration often leads to unintentional overfeeding.

Depending on milk yield and feed intake, the dietary P content needed to meet the published NRC P requirement of cows in most herds ranges from .36% to .40%. Only with very high milk yield and unusually low feed intake are P concentrations higher than .40% needed. The 33 herds surveyed in Virginia required just .34% P on average.

One important point for Jersey farmers is that Jerseys digest and metabolize phosphorus in the same manner as Holsteins. So the published requirements do not, and should not, vary by breed.

The perception that overfeeding phosphorus helps reproduction or milk yield is simply not supported by research data. In one recent study with 24 cows fed very low P diets over two lactations, dietary P had no effect on milk yield (mean 20,000 lbs./yr.) until dietary P was reduced to .24%. Even on this very low P diet, no reproductive effects were observed. In other recent work, impaired milk yield was only observed after two years on a diet containing .31% P, but .37% to .40% P was sufficient for high-producing cows. Interestingly, in one study, high dietary phosphorus actually reduced milk yield by 4 lbs. per day.

A recent summary of all published data on the effects of dietary P on reproduction should put to rest any concern about dietary P and reproduction. Wisconsin researchers summarized 13 long-term studies with 785 cows fed diets low in P (.32%–.40% P) or high in P (.39%–.61% P). They found no effect of dietary P on any mea-

sure of reproductive performance (Figures 3 and 4).

#### Can Reduced Overfeeding Make It Easier To Meet Future Environmental Regulations?

Reduced overfeeding of phosphorus reduces P content of manure. Because of variation in volume of manure, simply analyzing manure for its P concentration is not a reliable predictor of overfeeding. Because P excretion is easily calculated as the difference between P intake and P in milk, however, we can calculate the reduction in excretion with reduced overfeeding. These calculations indicate that the acreage required to land-apply manure under P-based nutrient management regulations is dramatically reduced with reduced overfeeding (Figure 2).

Interestingly, federal agencies are exploring ways to credit farmers who implement feeding practices like reduced overfeeding as part of their comprehensive nutrient management plan. This presents farmers with a win-win situation: Imple-

menting a practice that will save them money will also make it easier for them to meet future regulations.

#### Conclusions

Overfeeding phosphorus costs farmers money through higher feed costs and hurts their ability to meet future environmental regulations.

All P fed in excess of the cow's true requirement is simply excreted in the feces. The current NRC publication provides a conservative interpretation of the true requirements of dairy cows for P including generous margin of safety. Controlled research studies make it very clear that while severe deficiencies of P (< .31% P) may impair milk yield and/or reproductive performance, there is no benefit to overfeeding.

Reducing the phosphorus content of diets to the published requirements provides dairy farmers a real opportunity to protect water quality and reduce feed costs while positioning themselves to accommodate more stringent environmental regulations.

### How To Find The NRC Dairy Cattle Nutrition Manual

The *Nutrient Requirements of Dairy Cattle (Sixth Revised Edition, Update 1989)* is published the Committee on Animal Nutrition of the National Research Council. It includes a computerized database (on diskette) that includes all requirements for energy, protein, calcium, phosphorus, and vitamins A and D.

The list price is \$24.95, but it can be purchased at a 20% discount from the National Academy Press (NAP) website

([www.nap.edu/catalog/1062.html](http://www.nap.edu/catalog/1062.html)). You can also view the entire book online while you're at the NAP website, and even search for specific topics by using its search engine, the Open Book Interface. Printing from the website is possible, but the quality is about that of a very poor fax machine (72 dots per inch).

The *Nutrient Requirements of Dairy Cattle* is in revision with publication scheduled for later this year.