

# **Animal Agriculture and the Environment**

## **Are Virginia dairy farmers overfeeding phosphorus?**

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Reducing the amount of phosphorus in manure through nutrition is a powerful, cost effective approach to reducing potential phosphorus losses from dairy farms. Feeding phosphorus in excess of the cow's true requirements increases phosphorus excretion directly, increasing the amount of phosphorus applied to land. As most livestock farms in the state produce more manure phosphorus than their crops need, increased excretion increases the risk of phosphorus runoff and contamination of streams and lakes.

Several studies indicate a direct link between phosphorus intake and phosphorus excretion. A Florida study shows this link most clearly. 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.

We conducted a survey last fall to determine average nitrogen and phosphorus intake on Virginia dairy farms, and variation in nutrient intake among these farms. Our primary purpose in conducting this survey was to collect data on current feeding practices. In addition, we plan to use these data to design future studies to more precisely define the phosphorus requirement for high producing dairy cows. We also intended that this survey would begin an important discussion within our industry regarding the opportunity to reduce nutrient losses from Virginia dairy farms through more precisely defining and meeting the true nitrogen and phosphorus requirements of lactating cows.

We surveyed thirty-three farms in Rockingham, Franklin and Augusta counties, the top three counties in the state for cow numbers. The major feed mills and nutritionists serving the three counties were identified and approached about participating in the study. Farms were selected that fed a TMR (a total mixed ration), or supplemented a TMR with a known quantity of grain in the parlor. We obtained data from herds with a variety of herd sizes to represent the diversity in herd sizes within the region.

For each farm, we obtained samples of forages, grains, and mineral supplements fed in late September to October 1998; number of milking cows (by herd or group) at the time the samples were obtained; average herd or group milk yield and milk fat content; ration ingredient composition; and quantity of each ingredient fed. Feed samples were analyzed for nitrogen and phosphorus content. The actual requirement for nitrogen and phosphorus for each herd was calculated using the equations of the NRC, and assuming a mean body weight of 1320 lb, an average milk protein content of 3.25%, and average milk fat content of 3.5%.

Nutrient intake was calculated for each herd and group within herd. Mean, minimum, and maximum dietary nitrogen and phosphorus content were calculated by farm, by county and by feed mill. Herd nutrient excretion (intake minus nutrients retained in milk and pregnancy), and

fraction of nitrogen and phosphorus intake from purchased feeds were calculated. We assumed that all forages were grown on the farm, and all concentrates and minerals were purchased.

### ***Survey results***

Herd size of surveyed herds averaged 100 cows, and herds were included that ranged from 27 cows to 280 cows (Table 1). Milk yield of the surveyed herds averaged 61 pounds/cow/day, with a range of 50 lb/day to 85 lb/day. Current average herd size in the state of Virginia is 106 cows, and average milk yield is 62 lbs/day, so the herds surveyed were typical of herds in the state.

Mean dietary phosphorus content in the surveyed herds was .49% (Table 2), forty-five percent in excess of current published requirements. Again, we calculated required dietary phosphorus content for each survey herd from the herd average milk yield, reported dry matter intake, and an assumed body weight (1320 lbs) and milk composition (3.25% protein and 3.5% milk fat). The average requirement for dietary phosphorus in the survey herds was .34%. The range in dietary phosphorus content was from .35% (1.7% above the requirement) to .65% (125% in excess of the requirement). Thirty-two of thirty-three farms were overfeeding phosphorus relative to calculated requirements. Purchased feed was the source of 71% of the phosphorus fed on the average farm, with a range of 42 to 91%. Predicted phosphorus excretion, as a fraction of intake ranged from 55 to 83%, with a mean of 72%. All of these results were fairly consistent across feed mills and counties.

This survey indicates that most farms in Virginia overfeed phosphorus relative to current published requirements. Overfeeding phosphorus directly increases phosphorus excretion (Figure 1), increasing potential phosphorus losses from farms. Potential phosphorus losses could be reduced from the survey farms by an average of 45% if rations were formulated according to current published requirements.

### ***Why are we overfeeding phosphorus?***

There are a variety of reasons for this overfeeding. Undetected variation in the phosphorus content of feeds leads to imprecise ration formulation. Phosphorus content of forages analyzed by the Northeast DHI Forage laboratory from May 1994 through April 1995 was highly variable. The phosphorus content of forages varied by 20-25% from NRC book values for most forage types, and phosphorus content was more variable for grasses than for legumes. Despite this variation, wet chemistry analysis of forages for phosphorus content is not routinely requested.

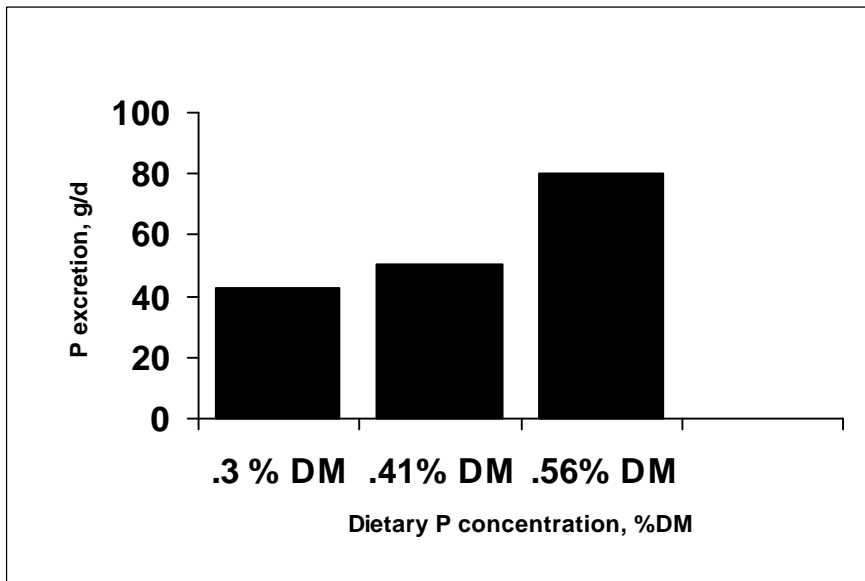
Another factor that often leads to overfeeding is the practice of targeting rations to a specific dietary phosphorus concentration, regardless of milk yield or dry matter intake. Like other nutrients, the requirement of the cow for phosphorus is for quantities, not concentrations. For convenience in balancing rations, phosphorus requirements are commonly expressed as a percentage of DM. The actual dietary concentration required to yield the required quantity of phosphorus, however, varies with dry matter intake. For instance, the requirement of a 1320 lb cow producing 66 lbs of milk with 3.5% butterfat is 76 g of phosphorus per day. The percent of phosphorus required in the diet for this cow is .45%, .40%, and .36% with dry matter intake of 37, 42, and 46 lb/d. The higher the dry matter intake on your farm, the lower the dietary phosphorus concentration needs to be.

Finally, field recommendations influence phosphorus intakes. Differing opinions among nutritionists, veterinarians, extension personnel and others have led many farmers to feed phosphorus in excess of the NRC recommendations. Until the environmental consequences became obvious, overfeeding phosphorus was viewed as cheap reproductive insurance.

Revisiting old research and more recent research with high producing cows makes clear that there is no documented benefit to overfeeding phosphorus. Current phosphorus requirements **do** include a significant margin of safety. The United States (NRC) recommendations for dietary phosphorus are **higher** than those of any other country. Now that we are realizing the true cost of overfeeding phosphorus, we must move aggressively to correct inconsistencies in our recommendations. If you are currently over-supplementing phosphorus, check with your nutritionist to see what changes can be made.

Additional research is needed to more precisely define both the true minimum phosphorus requirement of lactating cows and the availability of phosphorus in various feedstuffs. This research will likely lead to reductions in published dietary phosphorus requirements.

Overfeeding phosphorus increases feed costs and increases potential phosphorus losses on farms. As part of this survey, we also calculated the economic and environmental impact of this overfeeding, and will cover that and the results regarding nitrogen intake in more detail next month. This survey makes clear that phosphorus intakes in the field are significantly in excess of current requirements, giving farmers a tremendous opportunity to benefit both economically and environmentally by feeding phosphorus according to their herd's true needs.



**Figure 1. Effect of dietary P concentration on P excretion in lactating cows.**

**Table 1. Herd information for thirty-three dairy farms in Franklin, Rockingham and Augusta counties**

	Herd size	Milk yield	Herd size statewide	Milk yield statewide
Mean	100	61	106	62
Minimum	27	50	-	-
Maximum	280	85	-	-

**Table 2. Dietary phosphorus intake and requirements for thirty-three dairy farms in Franklin, Rockingham and Augusta counties**

	Dietary P, % of DM	Dietary P req't, % DM	% excess	Purchased P, % of intake	P excretion, % of intake
Mean	.49%	.34%	45.0%	71.3%	64.2%
Minimum	.35%	.29%	-11.8%	41.8%	43.3%
Maximum	.65%	.46%	124.8%	90.8%	77.8%