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Science and Industry Work to Improve Phosphorus Management on New York Dairy Farms

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Phosphorus (P) is a key mineral in dairy cattle rations and farm nutrient management. In the dairy cow, P is essential for bone growth and repair, nerve function muscle contraction and acid-base buffering in blood and the rumen. Phosphorus is also a key element for energy metabolism at the cellular level. In crops, P is an essential element in photosynthesis and stimulates root development. Phosphorus is needed for energy transfer and is component of DNA which is required for plant growth and reproduction. Management of P in agricultural, urban and natural ecosystems has become an increasingly important topic because increasing P levels in aquatic environments has led to ecosystem imbalances including harmful algal blooms. The goals of P management on the dairy farm are to provide adequate P in the ration to support milk production, reproduction and health while minimizing excretion of manure P which can be lost to the environment.

In the late 1990's, surveys were done by several academic and industry groups to assess the P feeding levels in dairy rations compared with nutrient requirements. The results indicated that many dairy producers were feeding P at levels of 30 to 40% above requirements. One reason for feeding these higher P levels was to provide a "safety" factor above requirements to account for variability in forage and feed P levels and availability. There was also a perception that feeding higher ration P helped to improve reproductive performance. Some responses indicated that more P was needed than the current nutrient requirement recommendation. The results of these surveys indicated an opportunity to adjust P feeding levels in rations.

At same time, the academic community conducted many research trials examining P feeding levels, milk production, the effect on reproductive performance and P excretion in manure. Several of these trials were conducted over multiple lactations to examine long term interactions between dietary P and bone P metabolism. Results of these trials indicated that feeding lower ration P levels did not negatively affect milk production or reproduction. However, manure P did increase with higher ration P levels. In 2001, the National Research Council published the revised Nutrient Requirements of Dairy Cattle. The P requirement was lowered from the previous 1989 edition based on these research results.

Speakers at the 2001 New York Feed Dealer meetings challenged the feed industry to adopt the revised P requirements and implement them when formulating rations for their customers. This is an annual seminar co-sponsored by Cornell Cooperative Extension and Pro-Dairy. The feed industry was receptive and began changing their feed formulation practices by lowering ration P levels. One approach used was to decrease the amount of P added to rations from the mineral mix. A second strategy was to use more routine forage analysis which helped in formulating lower P rations based on farm specific forage P information. The use of higher forage rations also helped by decreasing the amount of feed P imported on farms.

What was the impact of formulating lower P rations? To evaluate this, we compared changes in the New York dairy industry between 1999 and 2019. Key points are in the following figure.

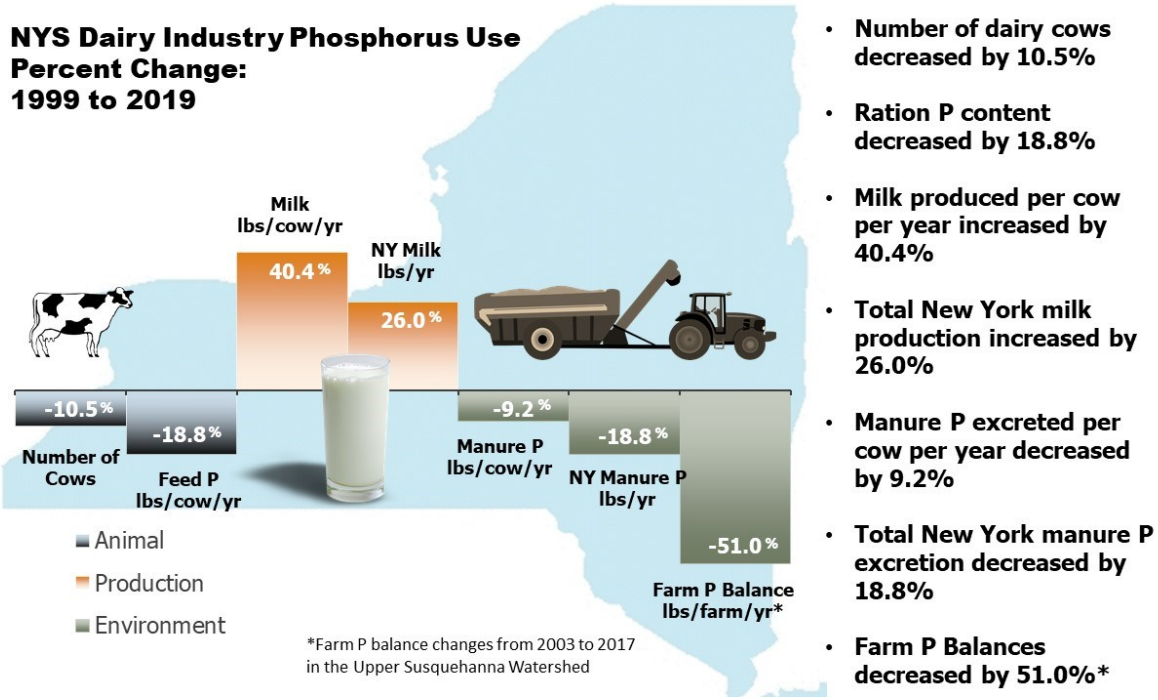

Figure 1. NYS Dairy Industry Phosphorus Use Percent Change – 1999 to 2019.

How do these changes affect whole farm P nutrient balance? The whole farm nutrient balance is the difference between the amount of a nutrient imported to the farm minus the amount of nutrient exported from the farm. Dr. Quirine Kettering's and her group at Cornell have been doing whole farm mass balance studies on farms in New York for many years. A study of 27 dairy farms from 2003 to 2013 found a 63% decrease in P mass nutrient balance. The decrease in P from purchased feeds was a key reason for this change. A second study used 91 dairy farms in the Upper Susquehanna watershed from 2004 to 2017. These farms lowered P mass balance by 51%. Imported P decreased by 20% and 65-75% of the imported P was from purchased feed.

Summary

1. New York dairy farms have decreased ration P levels and total manure P excretion by 18.8%.
2. This reduction in total manure excretion is a decrease of 6.9 million pounds on an annual basis.
3. The feed industry was the primary driver of decreased ration P levels by adopting and implementing new information on P requirements of dairy cattle.
4. The efforts of the feed industry have been of benefit to dairy producers by lowering purchased P cost and to the environment by decreasing P excretion in manure.

Conclusion

These results are an excellent example of how the dairy industry can adjust feeding practices while increasing productivity and decreasing excretion of P into the environment. The dairy and feed industries will continue to explore opportunities to adjust rations and feeding management practices to lower environmental impact while improving efficiency of nutrient use, productivity and profitability.

For More Information

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