Focus on Forage

Wisconsin TEAM Forage

Sampling and Analytical Variation Associated with Evaluating Phosphorus in Forages and Total Mixed Rations

by **John Peters and Pat Hoffman**

Introduction

Nutrient management has become an integral component of managing a commercial dairy and livestock operation. Specifically, reducing phosphorus content of livestock diets, manure and soil is a common goal of nutrient management programs. As a result, there is considerable interest among dairy and livestock producers, nutrition consultants, crop consultants and nutrient management specialists regarding the accuracy and precision of measuring phosphorus in feed, manure and soil. Taking representative and frequent samples are key to obtaining meaningful phosphorus test results for soil, plant tissue, animal manure, feeds and forages, as well as other materials. Taking a representative sample followed by sound laboratory work are both essential in evaluating feed phosphorus. The accuracy and precision of measuring feed phosphorus is primarily dependent on the laboratory receiving a representative sample. This Focus on Forage article will give and overview of current issues as related to evaluating phosphorus in dairy and livestock feeds and diets.

Can dietary phosphorus be determined from sampling a Total Mixed Rations?

One of the most convenient ways to evaluate the amount of dietary phosphorus fed to dairy cattle is to send a representative sample of the total mixed ration (TMR) to a laboratory. The Marshfield Soil and Forage Testing Laboratory routinely evaluates TMRs for phosphorus as well as other nutrients. In an evaluation of the first four years of this testing program a steady decline in the average total P content in TMR rations has been observed over time. For the first 100 TMR samples tested during this evaluation period, the average P content was 0.46%. The average P content of 100 random TMRs four years later was 0.42%. However, a wide range of phosphorus content exists in this data set, with the highest and lowest phosphorus contents being 0.91 and 0.22%, respectively. The question then becomes is this variation due to diet formulation, sampling error or laboratory error.

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How much variability in measuring feed phosphorus exists in the laboratory?

There is a significant amount of variability in the P content of forages and livestock diets. How much of that variability can be attributed to laboratory error? Two main methods are used for the analysis of P in feed and forage materials. These include total analysis following digestion using inductively coupled plasma spectrometry (ICP) and colorimetric methods. These procedures have similar laboratory error and in relationship to other widely used laboratory assays of feeds and forages, the evaluation of P in feeds is a highly precise assay. The precision of the P assay in the laboratory is presented in Figure 1. This figure represents the day to day variation in the P content of a high and low phosphorus standard evaluated by the same technician over time. The standard deviation for these phosphorus standards is 0.01 on the low testing standard and approximately 0.04 on the higher testing standard. Thus, if a dairy producer sent the laboratory a TMR that is supposed to contain 0.40 percent P, the laboratory error would be ± 0.01 percent P. If the TMR contains 0.39 or 0.41 percent P then it is within normal laboratory error. Any P value outside of this range would likely be the result of diet formulation error, mixing error or sampling error.

Can I use near infra-red reflectance spectroscopy (NIRS)to monitor P content of forages and TMRs?

Caution must be used when balancing and evaluating dairy and livestock rations using mineral levels based on NIRS forage analysis. In a study by Peters, et. al., (2001) mineral estimates by NIR were not highly correlated to traditional wet chemistry mineral analyses (Table 1). In general, NIRS has difficulty in predicting the mineral content of feed samples when mineral content is either very high or very low. Among the minerals studied, NIRS phosphorus was the most poorly correlated to wet chemistry values. The principle reason NIRS has challenges evaluating

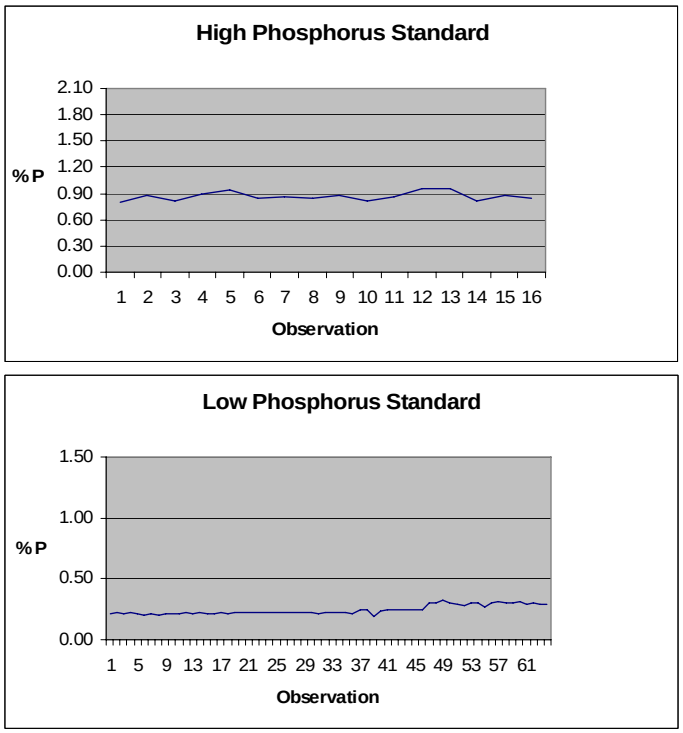

Figure 1. Precision of the P assay in the laboratory representing the day to day variation in P content of a high and low phosphorus standard evaluated by the same technician over time.

mineral content of feeds, forages or TMR's is because minerals do not absorb light in the near infra-red region. In contrast organic bonds associated with protein and fiber such as C-N or C-0 absorb light in the near infra-red region and as result nutrients such as CP and NDF are well predicted by NIRS.

How do I take a good forage or TMR sample to evaluate phosphorus?

An excellent publication on taking proper forage and TMR samples is available at http://www.uwex.edu/ces/crops/uwforage/Feeding.htm.

Summary

If proper sampling techniques are followed and samples are sent to a reputable feed and forage testing laboratory with a good quality control program, the variation in P due to normal laboratory error is very small in comparison to P distribution in feeds and TMRs. The keys to success in monitoring P levels in dairy and livestock diets on commercial farms are to 1) sample frequently, 2) take a representative sample, 3) use wet chemistry procedures, 4) send the sample to a reputable laboratory. Using book P values or using only NIRS to evaluate P management programs can lead to significant errors in estimating the P content of forages, diets or TMRs.

References

Peters, J. B., K. A. Kelling, P. E. Speth and P. M. Laskowski. 2001. "Forage Cations as Affected by Soil pH and Topdressed K." Proceedings of the 2001 Wisconsin Fertilizer, Aglime and Pest Management Conference.