Technologies for Addressing Phosphorus Associated with Livestock Operations

1. Are there any studies being done for other types of livestock other than dairy cattle?

   Yes. There has been work done with all livestock. Joe Harrison from WSU led a team to develop curriculum for all groups based on the research that has been published. PA was lucky to have Jana Malot and Dan Ludwig from NRCS who have a lot of dairy and beef experience and have been great cooperators with Penn State. We met with Joe Harrison to cater curriculum to PA. NRCS felt dairy (leading livestock industry in PA) and beef should be the priority. Poultry and swine have been discussed but you need the right people to be engaged and that has not happened yet.

2. On the PA map showing the number of Feed Management Plans for 2011: were all of these farms dairy operations? Are you doing similar feed ration analysis for P for poultry?

   On the PA map, the beef herds would have been included. There are a handful participating. We have met with the poultry folks to discuss their participation in feed management but nothing to date has evolved.

3. Why did you use the .03% for the margin, it seems really small given the way feeds are measured and analyzed?

   I was the herd manager for the PSU dairy herd for 12 years. I implemented precision feeding and know firsthand that you can keep P very close to formulated (within 0.01%). I have worked with other herds that have implemented precision feeding and keeping P within a very narrow range is doable (0.01-0.02%) Dan Ludwig and I used 0.03% as a generous starting place. However, when we observed how poorly the formulated matched to the actual, we felt the illustration made the point we were trying to make.

4. Can rotational grazing help correct some of these issues of high P on pasture and in water?

   For grazing herds regardless of how the pasture is managed – we recommend sampling throughout the seasons so the farm can establish a library or history of pasture quality (we also focus on quantity). This really helps the nutritionist balance the pasture quality much better if it is anticipated that there will be major differences in the rotations and/or seasons. Instead of sticking with the same grain mix for the grazing season,

the nutritionist can be prepared based on historical data for the farm that adjustments may need made.

5. How do the changes in phosphorus and nitrogen affect the composting of the manure?

   Carbon to nitrogen ratio is very important in composting. Ideally the C:N ratio should be 25/30:1. So depending on the nitrogen level in the manure, will determine how much carbon needs to be added.

6. What is the reasoning that nutritionists may be hesitant to remove inorganic P?

   There is still a lot of misinformation being communicated about P. Very old research related P level with poor reproduction. Limited phosphorus gets blamed for fresh cow problems. Regarding reproduction, this research was poorly conducted and it was a true deficiency. In today's environment, it would be practically impossible to have an animal become P deficient based on what we feed them. Even with a lot of recent research to demonstrate the P fed at required levels does not negatively affect reproduction, it still gets credited for it. Anytime a cow gets milk fever or has metabolic problems, P levels get blamed, even though we have research to show otherwise. It would be nice to think adding a single mineral could off-set these problems, but it doesn't. So when a sales person is getting hammered by the producer for poor repro or health, the nutritionist can add in more P and say this will solve the problem. Producers are not up on the research so they go with what their nutritionist or vet says. It all goes back to precision feeding. I removed inorganic P from the PSU herd 12 years ago and by adjusting other nutritional issues, we had good repro and minimal health issues. Management, not P, has a greater influence on repro and health, but they are much harder to control and resolve.

7. If the solids from liquid/solid separator (e.g. screw press or centrifuge) are reused as bedding, and then that bedding becomes part of the manure waste stream, over time, won't the P concentration in the manure, and then the recovered solids, continue to increase over time as those P concentrated solids get reused and then re-concentrated?

   For the most part that is correct. Some phosphorus is found in the separated manure solids, but without

chemical enhancement the phosphorus content is relatively low. For most dairies using manure solids, more material is generated than can be used for bedding. This excess material can be sold to other operations (if pathogen and other issues are properly addressed), used for other applications. The potential cost savings with this type of bedding could allow for other uses of this excess material. Utilizing these other applications in conjunction with bedded manure solids could be used to help balance the phosphorus levels. As with most manure management strategies, several practices may have to be implemented to properly balance the nutrient issue.

8. Do any of the chemicals added affect whether I can spread residuals on my farmland?

   As far as I know utilizing these chemicals with solid/liquid separation should not affect spreading the solids (or liquids) on crop/pasture land. One would need to verify this with the appropriate entity (i.e. regulatory or nutrient management specialist). Some of the chemicals can have an impact on the nutrient availability in a given year.

9. How expensive are these separation technologies?

   The cost of the various solid/liquid separation technologies varies dramatically depending on the type of equipment used and the separation efficiency desired. Basic gravity systems can be as low as a few thousands of dollars, while some of the more elaborate systems with chemical enhancement can cost well over $100,000. Proper planning is essential to find the right technology for a given operation.

10. Are polymers and other added materials detectable in the soil and what are the implications for regulated farms?

    The use of coagulants lead to the formation of compounds such as aluminum phosphate and ferric phosphate which are organic forms of phosphorus that are not readily available for crop uptake. It is important to perform "jar" tests to determine the appropriate coagulant application rate for solid/liquid separation and nutrient partitioning. Excess aluminum or iron in the liquid waste stream has the potential to immobilize plant available phosphorus in the soil following land application. According to work by Philip Moore, ARS, it

would take 400-500 years of normal application of poultry litter amendment of alum to raise the soil aluminum level by one percent when land applied.

11. How deep into the soil are these injections you're discussing?

    Most go up to about 6” with injection slits about 30” apart, but there are some available that will do shallower injection, e.g. 4” deep on 15” centers

12. You would be injecting it into aquifers in many cases. Counterproductive in my opinion.

    This depends on your location. In Virginia we have regulations for some sandy soils that are considered a risk for excessive nitrogen leaching, but these apply even to surface applications. For most of our soils the losses of nitrogen and phosphorus in surface runoff are of a much greater concern for water quality than leaching. As with most nutrient management, applying the right amount of nitrogen at the right time is the most important factor.

13. For fields that have high phosphorus loads, are there recommendations for crops that can take up large amounts of phosphorus? In my part of the country, it looks like alfalfa has the highest uptake.

    This depends on what state you live in, as regulations vary across the country. For soils low in phosphorus, following a soil test recommendation is straight forward. Some soils have soil test phosphorus considered excessive, and these are often regulated. Sometimes no more P is permitted to be applied, sometimes a P index has to be followed, and sometimes P can be applied at crop removal rates. For P applications at crop removal rates, obviously more manure can be applied to high P removal crops such as corn silage and alfalfa.