CHAPTER 3a

Reducing the Nutrient Load from Poultry Manure

Peter Skewes, John Albrecht and Jim Camberato

The application of poultry manure to the land is typically done to increase the amount of nitrogen that is available to plants. The manure contains other nutrients, which are also added to the soil. When the manure is applied based on nitrogen, other nutrients like phosphorus, copper, zinc, and non-nutrients such as arsenic are added to the soil even though they may not be needed for maximum plant growth. Although plants have requirements for three of these elements, the amounts in the manure are in excess of the plants needs. In fact, often these nutrients are present in adequate amounts in the soil, making any application unnecessary. Of these four elements, phosphorus is the only one that results from trying to meet the nutritional needs of the chicken. The other three, copper, zinc, and arsenic result from the ingestion of compounds given to the chicken for pharmaceutical reasons rather than nutritional reasons. Although the three pharmaceutical based nutrients are commonly present in poultry feeds to address animal health and growth issues, their use could be modified in some cases by switching to alternative compounds thereby reducing the level of these compounds in the manure.

Phosphorus, however, presents a more challenging situation. A source of phosphorus must be included in the diet to meet the basic nutritional needs of the bird. Restricting the amount of phosphorus in the feed in an effort to reduce the amount of phosphorus in the manure is not an option. There are, however, other strategies available to reduce the amount of phosphorus in poultry manure.

To better understand the problem it is necessary to understand the origins of the phosphorus in the manure. Birds must have a certain amount of phosphorus available from the feed they consume for normal growth and development. The phosphorus in the feed has two origins. First, phosphorus is added to the feed as inorganic phosphorus. A commonly used source is dicalcium phosphate. This material is mined from the earth and added to the poultry feed to help meet the birds' nutritional need. Inorganic phosphorus is readily absorbed and utilized by the bird as a nutrient. The second source of phosphorus in the feed is the phosphorus that is in the crop grains, typically corn, wheat, or soybeans. The phosphorus in the grain exists in two forms, inorganic and phytate. The predominant form is phytate which is the storage form of phosphorus in plants. This form of phosphorus is poorly utilized by nonruminant animals, like chickens. The result is that much of the phytate phosphorus passes directly through the chicken and is excreted in the feces. Phytate phosphorus added to the soil is decomposed by microorganisms to available phosphorus forms.

The solution to the environmental phosphorus problem may be to: 1) reduce the amount of phytate phosphorus in the corn, wheat, and soybean, 2) make the existing phytate phosphorus in the crop more available to the birds, or 3) bind the phosphorus making it less water soluble so that it does

not run off or leach after it is applied to the land. All three of these solutions are currently under study to determine their effectiveness. Of course, some combination of the three may present the best solution.

Reducing the Amount of Phytate Phosphorus in the Feed.

There are new varieties of grains being developed that are lower in phytate phosphorus than traditional varieties. Currently, there are several corn varieties that have increased the total phosphorus availability from the original average of 28% to as high as 85%. Unfortunately, these varieties are not prevalent on the commercial market. When grain varieties with enhanced phosphorus availability are used in animal feeds, the amount of inorganic phosphorus added to the feed can be reduced. Consequently, the phosphorus content of the manure will be reduced.

Make the Existing Phytate Phosphorus in the Plants More Available to the Birds.

The absence of the proper enzymes to digest phytate phosphorus in the stomach of birds makes it impossible for birds to utilize this form of phosphorus. However, the enzyme phytase can be added to poultry feed to enable utilization of phytate phosphorus. Studies on the effectiveness of adding phytase to poultry feeds have not shown conclusively the amount of improvement in phosphorus utilization that can be realized. Although some benefit is likely, it may be somewhat less than had originally been promoted. Reductions in phosphorus excretion as high as 50% have been reported, but a more realistic expectation under commercial conditions might be 20% - 30%. Recent advances in the production of phytase, using molecularly modified microbes, have made the enzyme less expensive. Even with the new production methods, phytase still represents an additional cost to feed formulation. It is possible that the additional cost of the phytase might be compensated for by reducing the amount of inorganic phosphorus needed for a balanced diet.

Bind the Phosphorus Making it less Water-soluble So That it Does Not Run off or Leach after it Is Applied to the Land.

The application of alum (aluminum sulfate) to litter in poultry houses binds litter phosphorus. The resulting aluminum phosphate compound is not very water soluble, so it is less likely to be moved across or through the soil by water. In short term studies, the amount of phosphorus in surface runoff from fields fertilized with poultry manure treated with alum was reduced compared to that with untreated manure. The impact of alum on phosphorus runoff over the long-term is not known. The additional cost of the alum treatment must also be considered when deciding on this method of phosphorus control.

In almost all situations, it is possible to significantly reduce the amount of phosphorus in the manure by formulating the diet more accurately. The tendency to over formulate for phosphorus is very common. Concerns about the variation in phosphorus levels and availability in feed ingredients, combined with a low cost for additional phosphorus, predisposes the nutritionist to a philosophy of better “safe than sorry”. So a little extra phosphorus may be added just in case. Of course, this extra phosphorus ends up in the manure.

The information presented above was included to provide the poultry producer with an overview of the current strategies being developed to address the environmental phosphorus problem before the manure is applied to the land.. In most commercial production situations, the feed formulation is determined by the integrated poultry company. Few producers, therefore, have the opportunity to change feed formulation under modern management systems. Producers are asked to do what they can to maximize the efficiency of production and thus decrease total feed consumption.