Phosphorus levels in the soil

In most soils, the phosphorus content of surface horizons is greater than that of subsoil. Except in special situations, added phosphorus does not move readily in soils and therefore little movement occurs down through the soil. Phosphorus is also cycled from roots to aboveground parts of the plant and is re-deposited in crop residues on the soil surface. In reduced tillage systems, fertilizers and manures are applied to the soil surface with little or no mechanical incorporation, contributing to phosphorus buildup in the top 2 to 5 inches. Although phosphorus moves little within most soils, these soils can be the source of phosphorus in runoff, especially where plant available soil phosphorus exceeds the agronomic optimum.

The reason why soil phosphorus increases is because in many areas of intensive livestock production, manure is normally applied at rates designed to meet crop nitrogen requirements or to control manure spreading costs. Unlike any excess nitrogen that would readily leach from soils, phosphorus applied in excess of crop needs stays where it is applied. There is a mismatch between manure nutrient content and crop nutrient needs.

Figure 1 illustrates that when manure is applied to balance crop nitrogen requirements exactly, excess phosphorus is applied. If manure is applied to balance the crop's phosphorus needs, nitrogen fertilizer is required to meet the nitrogen needs of the crop. In addition, less manure is applied per acre and thus two to four times as much land is required to apply the same amount of manure.

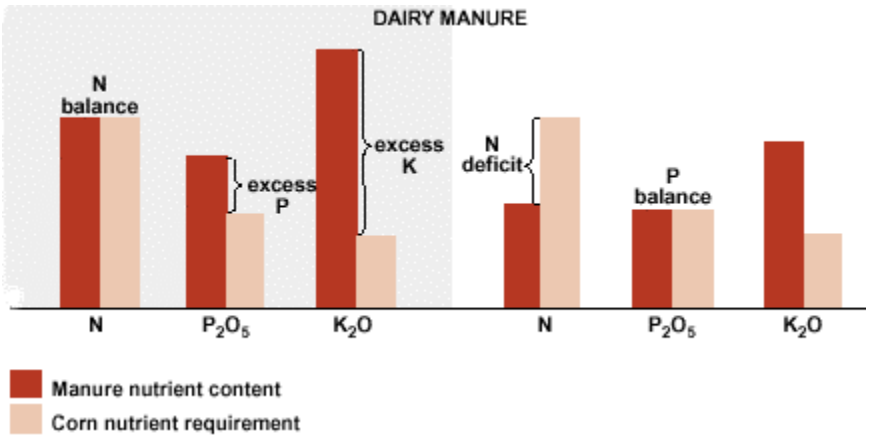

Figure 1. Applying manure to meet crop nitrogen needs (left hand side) will add more phosphorus and potassium than is needed by the corn crop. Balancing crop phosphorus needs (right hand side) adds insufficient nitrogen.
Source: Managing Phosphorus for Agriculture and the Environment, 2001.

The soil phosphorus levels can vary tremendously throughout the state and even more at a localized level. For example, in Lancaster County where an intensive animal agriculture has existed for years, 83% of the tested soils rated above optimum phosphorus levels. In contrast, nearby Adams County, where there are fewer animals, the soil tests rated mostly low (56%) and optimum. There can be large differences in phosphorus levels within individual farms. For example, fields near the barn where manure is applied more frequently sometimes have much higher phosphorus levels than more distant fields.

Once available phosphorus levels have built up, they decline slowly after manure applications have stopped. Studies have shown that without additional phosphorus applications, 10 to 20 years of corn or soybean production are needed to reduce available soil phosphorus (Mehlich-3) levels from 150 ppm to agronomic threshold levels of 20 ppm. It is in the producer's best interest to avoid applying excess phosphorus than trying to remedy the situation later on.

A strategy for applying manure and maintaining optimum levels of phosphorus is to evaluate the phosphorus status on a field to field basis. But because not all soils and fields have the same potential to transfer phosphorus to surface runoff, management recommendations will have to account for site vulnerability to surface runoff and erosion as well as soil phosphorus content. Threshold soil phosphorus levels should be indexed against phosphorus transport potential, with higher values for source areas than for areas not contributing to surface runoff. More information is available in the publication UC162 "Managing Phosphorus for Agriculture and the Environment". It can be found at the following web address: http://pubs.cas.psu.edu/nutrient.html