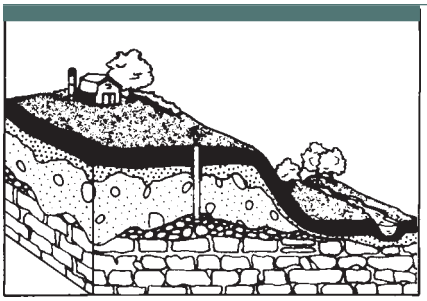

Soil Facts

The North Carolina Phosphorus Loss Assessment Tool (PLAT)

Nutrient management is the correct placement of the correct amount of nutrients in the soil at the right time and in the right form. Nutrient management should always be used when applying fertilizer or animal waste.

For many applications in North Carolina, nutrient management must meet the standards set by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS). Specific instances in which NRCS nutrient management guidelines must be followed are:

- If your nutrient management plan is being written by an USDA-NRCS employee or by county Soil and Water District Conservation personnel.
- If you are receiving state or federal agricultural cost share funds.
- If your animal waste is regulated under state .0200 laws.
- If your animal waste is regulated under NPDES permits.
- If you farm in the Neuse or Tar-Pamlico River Basins.

Phosphorus (P) management is one important aspect of the USDA-NRCS nutrient management standard (590). Anyone applying animal waste or fertilizer in a nutrient-impaired subwatershed must determine potential P loss from each field. Under the national 590 standard, each state chose from three methods for determining potential off-site P loss: agronomic soil test level, environmental soil test threshold, or a P index methodology. Soil tests are valuable as site-specific estimators of P accumulation, but they do not predict potential P loss because loss is a function of soil-test P and the amount of soil loss and runoff.

A state interagency group composed of faculty from NC State University and personnel from the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Soil and Water Conservation (DSWC), the North Carolina Department of Agriculture and Consumer Services (NCDA&CS), and the USDA- NRCS[1] chose to develop a site-specific index because both the agronomic soil test and environmental threshold approaches were too strict and not scientifically defensible. In addition, North Carolina has very diverse agricultural conditions and systems. The P index, which is referred to as the North Carolina Phosphorus Loss Assessment Tool, or PLAT for short, was adopted in November 2003 and is described below.

Loss Pathways

Phosphorus loss from fields to waters occurs along four major pathways:

- Soil-attached P erosion.
- Soluble-P runoff.
- Soluble-P leaching.
- Source-P loss (fertilizer and/or animal waste).

The dominant loss pathway in any field depends on many factors. One or more pathways may contribute to significant P loss for a site.

[1] Members included David Crouse, Wendell Gilliam, John Havlin, Eugene Kamprath, Rory Maguire, and Deanna Osmond (Soil Science Department, NC State University); Robert Evans, John Parsons, Wayne Skaggs, and Phil Westerman (Biological and Agricultural Engineering Department, NC State University); David Hardy and Richard Reich (NCDA&CS); Steve Coffey and Carroll Pierce (NCDENR-DSWC); and Roger Hansard and Lane Price (USDA-NRCS).

NC STATE UNIVERSITY A&T STATE UNIVERSITY COOPERATIVE EXTENSION
Helping People Put Knowledge to Work

Each of the four loss pathways is calculated in PLAT and added together to estimate the total P loss for a field.

Total P Loss =
Soil-Attached P Erosion Loss + Soluble-P Runoff Loss + Soluble-P Leaching Loss + Source-P Loss

1. Soil-attached P erosion loss

Phosphorus added from fertilizers and animal waste usually attaches to soil particles. If these soil particles erode, the attached P will move with the soil when it erodes. Soils with higher soil-test P levels will have higher P in eroded particles.

Soil lost through erosion (and the P attached to these soil particles) may be reduced by redeposition in areas near the edge of the fields that are flatter (these are referred to as receiving slopes) or by certain best management practices (BMPs). The BMPs that can reduce P are diverse and consist of terraces, minimum tillage, and changes in cropping systems. Off-field BMPs include buffers, controlled drainage, ponds, and sediment basins.

2. Surface water runoff loss

When water runs off fields, it carries dissolved P. The amount of dissolved P in the runoff increases proportionally as the soil-test P level increases. The amount of P the soil releases to runoff at a given soil-test level also varies with soil texture, organic matter content, and types of soil minerals. If field practices reduce runoff (e.g., conservation tillage, soil cover, contour farming), then P losses will be reduced.

Runoff depends on rainfall, soil texture, field slope, field practices, and drainage. For calculation of runoff in PLAT, soils are divided into two broad drainage categories: artificially drained soils (mostly in the eastern part of the state) or naturally drained soils (upper coastal plain and piedmont).

The BMPs that effectively reduce soluble P transport are the same ones that reduce erosion.

3. Leaching loss

Phosphorus may be discharged into surface water as a result of subsurface flow processes on sites with tile drains and ditches. Soils with very high soil-test P and sandy textures can cause P to leach deeply into the soil and possibly into the shallow groundwater. This most often occurs when large applications of animal waste have been applied over long periods.

4. Applied P loss

There is a strong relationship between the P application rate from either solid waste or slurry and the concentration of P in runoff following applications. In manured or fertilized fields, the concentration of P in surface runoff increases with the type and form of the waste, the application rate, the application method, and the solubility of the applied P.

PLAT Rating

Index values are computed for each of the four P loss pathways. These indices are added to produce the final PLAT rating for the field (see Table 1). When commercial fertilizer is applied, soil-test P recommendations as specified in the nutrient management plan should always be followed. If animal waste is applied, a PLAT rating of "High" will limit the amount of waste that can be applied to the quantity that will be removed by the crop; a rating of "Very High" will prohibit any P application at all, except as a starter fertilizer.

PLAT Results

The necessary data to run PLAT were collected from 1,379 fields throughout North Carolina. These data were used to predict P losses from the different pathways. It was apparent that loss of P from certain P loss pathways was more significant than others. For example, *Soil-Attached P Erosion Losses* were generally low, due either to cropping systems that kept the soil in place (such as pastures) or to low soil-test P. Loss of P through *Soluble-P Runoff* was relatively more important to overall P loss, especially from sandy coastal plain sites that received animal waste. Soils from these sites tended to have much higher soil-test P levels. Sites with sandy soils were more susceptible to *Soluble-P Leaching* losses than other soil types.

Predicted P losses were higher from fields on which animal waste was applied, although there were differences in loss depending on which animal waste was used. More P was lost, in general, from fields receiving poultry waste because of the higher P content of the waste. Dairy waste has an equally high total P content, but application rates tend to be lower relative to poultry waste. Fields receiving swine waste tend to predict more P loss as soluble P, in both surface runoff and subsurface drainage, rather than applied source P, because most of the P in this waste is in a soluble form.

Table 1. PLAT Rating When Applying Animal Waste.

Rating	Index Value	Consequence of Rating
Low	0-25	Nitrogen-based manure application rate
Medium	26-50	Nitrogen-based manure application rate
High	51-100	Manure application rate is limited to phosphorus removal from the site in the harvested crop
Very High	>101	No additional phosphorus application is allowed (except starter fertilizer P)

PLAT Website

North Carolina's PLAT tool is one of the most comprehensive of its kind. Its development over a three-year period was based on the integration of all the available research and science. Information about PLAT can be found on the NC State University Interagency Nutrient Management Website at http://www.soil.ncsu.edu/nmp/ncnmwg/. The North Carolina Agricultural Nutrient Assessment Tool, which includes the PLAT software, can be downloaded from this site. There are additional materials, such as how to take deep soil samples and other information, available on this site.

Prepared by

***D. L. Osmond**, Soil Science Department, North Carolina State University*

***R. O. Evans**, Biological and Agricultural Engineering Department, North Carolina State University*

***D. H. Hardy**, North Carolina Department of Agriculture and Consumer Services*

***L. Price**, USDA Natural Resources Conservation Service*

***A. M. Johnson**, Soil Science Department, North Carolina State University*

Published by
NORTH CAROLINA COOPERATIVE EXTENSION

1/05—JL
EO5-44548

AGW-439-56