What's Cropping Up?

A NEWSLETTER FOR NEW YORK FIELD CROPS & SOILS VOLUME 11, NUMBER 4, MAY-JUNE, 2001

Phosphorus and Agriculture VIII: The New Phosphorus Index for New York State

Karl J. Czymmek, PRO-DAIRY, Quirine M. Ketterings, Dept. of Crop & Soil Sciences, and Larry Geohring, Dept. of Agricultural and Biological Engineering, Cornell University

Introduction

The NY-PI is designed to assist producers and planners in identifying fields or portions of fields that are at highest risk of contributing phosphorus (P) to lakes and streams. The NY-PI assigns two scores to each field based upon its characteristics and the producer's intended management practices. One of the two scores, the **Dissolved P Index**, addresses the risk of loss of water-soluble P from a field (flow across the field or through the soil profile) while the **Particulate P Index** estimates the risk of loss of P that is either attached to soil particles or a component of manure.

The NY-PI scores will rate a field to determine its susceptibility to P losses. Fields with high or very high site vulnerability should be managed with minimizing P losses in mind. A low or medium ranking implies management can be nitrogen based. The NY-PI score will also indicate whether other management changes such as winter spreading must be addressed.

It is important to note that the PI is not a measure of actual P loss, but rather an indicator of potential loss. A high or very high PI score is a warning to further examine the causes, and a low PI score means the risk of phosphorus loss is reduced, but perhaps not eliminated.

In this article, the NY-PI is described. In a future issue of "What's Cropping Up?" the source and transport components will be explained in more detail and management options will be discussed.

The NY-PI in general

The NY-PI's are separated into two main parts: potential sources of P ("source score") and potential movement of P ("transport score"). The final score is the multiplication of the source score and the transport score:

Dissolved P index =
P Source score x Dissolved P Transport score

Particulate P index =
P Source score x Particulate P Transport score

Rankings and management implications for final field scores are listed in Table 1. Both P forms (dissolved and particulate) are a concern for water quality. They should be managed jointly.

PI Source Components

Contributing to the source component are soil test P level, as well as manure and fertilizer additions:

P Source Score =
Soil Test P + Fertilizer P + Organic P

The Soil Test P portion of the NY-PI score is obtained by multiplying Morgan soil test P by 1.25:

Soil test P = 1.25 * Morgan's Soil Test P (lbs P/ac)

Soil test P results based on Mehlich-III and modified Morgan must be converted to a Morgan P equivalent (see the March-April 2001 issue (Vol 11, No 3) of

Table 1: NY-PI scores and their rankings and management implications.

Ranking Values	Site Vulnerability	Management
< 50	Low	N based management
50 – 74	Medium	N based management with BMP's
75 – 99	High	P applications to crop removal
≥ 100	Very High	No P_2O_5 fertilizer or manure application

Nutrient Management

"What's Cropping Up?" or http://www.css.cornell.edu/nutmgmt/index.html). The fertilizer and organic P scores are first determined by a multiplication of application rate (lbs P_2O_5/acre) by the weighing factors for application timing and method (see Tables 2 and 3), and then the scores are added to the Soil Test P score.

Table 2: To obtain the fertilizer P score for the NY-PI, P_2O_5 application rate, timing and method scores need to be multiplied.

Fertilizer P =	**$(P_{fa}) * (P_{ft}) * (P_{fm})$**			
Fertilizer P application rate (P_{fa})	lbs P_2O_5 / acre			
Fertilizer P timing (P_{ft})	May – August	September – October	November – January	February – April
	0.4	0.7	0.9	1.0
Fertilizer P method (P_{fm})	Injected or subsurface banded	Broadcast and incorporated within	Surface applied or broadcast and incorporated >5 days after application	Surface applied on frozen, snow covered or saturated ground
	0.2	1-2 days: 0.4; 3-5 days: 0.6	0.8	1.0

PI Transport Components

To assess dissolved P transport, the NY-PI considers soil drainage class, flooding frequency and predominant water flow distance to a stream (Table 4).

Dissolved P Transport Score = Soil drainage + Flooding frequency + Flow distance to stream

(if Dissolved P Transport is > 1, then Dissolved P Transport = 1)

The soil drainage classification is determined from a soil survey and the category should not be modified to reflect any drainage practices that may have been installed. The flooding frequency is also determined from the soil survey or sometimes this information may be available on flood hazard boundary maps. The flow distance is the edge of "field" drainage path that excess water takes as it leaves a field and finds it way downhill to a watercourse (blue line stream). This can be estimated by field observation or determined from topographic maps whereby the flow path is perpendicular to the contour lines.

Table 3: To obtain the organic P score for the NY-PI, P_2O_5 application rate from organic sources, timing and method scores need to be multiplied.

Organic P =	**$(P_{oa}) * (P_{ot}) * (P_{om})$**			
Organic P application rate (P_{oa})	0.75 * lbs P_2O_5 / acre			
Organic P timing (P_{ot})	May – August	September – October	November – January	February – April
	0.4	0.7	0.9	1.0
Organic P method (P_{om})	Injected or subsurface banded	Broadcast and incorporated within	Surface applied or broadcast and incorporated >5 days after application	Surface applied on frozen, snow covered or saturated ground
	0.2	1-2 days: 0.4; 3-5 days: 0.6	0.8	1.0

The particulate P component of the NY-PI is similar to the dissolved P component in that flooding frequency and the predominant water flow distance to a stream are again considered (Table 5). Additionally, particulate P loss potential is influenced by soil erosion and the presence of concentrated flow paths. Soil erosion rate is estimated using the Universal Soil Loss Equation (USLE) or the Revised Universal Soil Loss Equation (RUSLE).

Table 4: The Dissolved P Transport score is obtained by adding factors for soil drainge, flooding frequency and predominant flow distance to stream.

Dissolved Transport P =	**D + F + FLD**			
Soil Drainage (D)	Well / Excessively well drained 0.1	Moderately-well drained 0.3	Somewhat poorly drained 0.7	Poorly / very poorly drained 1.0
Flooding frequency (F)	Rare / Never > 100 years 0	Occasional 10 - 100 years 0.2		Frequent < 10 years 1.0
Flow distance to blue line stream as depicted on topographic map or equivalent (FLD in feet) **Intermittent Stream = dashed blue line.** **Perennial Stream = solid blue line.**	Intermittent Stream >200 feet Perennial Stream >300 feet --- 0	Intermittent Stream 25 to 200 feet Perennial Stream 50 to 300 feet --- Intermittent Stream 1 – (Distance–25)/175 Perennial Stream 1 – (Distance–50)/250		Intermittent Stream <25 feet Perennial Stream < 50 feet --- 1.0

Acknowledgments

The NY-PI has been developed by individuals representing NRCS, Cornell faculty and educators, and the New York State Soil and Water Conservation Committee. In addition to the authors of this article, the PI Work Group consists of: Greg Albrecht, Shawn Bossard, Ray Bryant, Dale Dewing, Fred Gaffney, Dean Hively, Paul Ray, Tammo Steenhuis, and Jeff Ten Eyck. A spreadsheet calculator is available at http://www.css.cornell.edu/nutmgmt/index.html (click on software) and a detailed user manual will be available sometime this summer.

The determination of whether or not concentrated flow paths are present in the field is best done through field observation. The current resolution of contour lines on topographic maps may not be sufficient to indicate whether a concentrated flow path is present.

Particulate P Transport Score = Soil erosion + Flooding frequency + Flow distance to stream + Concentrated flow

(if Particulate P Transport is > 1, then Particulate P Transport = 1)

One should note that both the dissolved and particulate P Transport Scores are set equivalent to 1.0 when the various transport components add to more than one. Thus, the dissolved and particulate P Transport Scores represent a percentage of the P source factor.

Table 5: The Particulate P Transport Score is obtained by adding factors for soil erosion, flooding frequency, predominant flow distance to stream and the presence or absence of concentrated flow patterns.

Dissolved Transport P =	**SL + F + FLD + CF**		
Soil erosion RUSLE or USLE (SL)	0.1 * Erosion rate (tons/acre)		
Flooding frequency (F)	Rare / Never > 100 years 0	Occasional 10 - 100 years 0.2	Frequent < 10 years 1.0
Flow distance to blue line stream as depicted on topographic map or equivalent (FLD in feet) **Intermittent Stream = dashed blue line.** **Perennial Stream = solid blue line.**	Intermittent Stream >200 feet Perennial Stream >300 feet --- 0	Intermittent Stream 25 to 200 feet Perennial Stream 50 to 300 feet --- Intermittent Stream 1 –(Distance–25)/175 Perennial Stream 1 –(Distance–50)/250	Intermittent Stream <25 feet Perennial Stream < 50 feet --- 1.0
Is concentrated flow (CF) present?	No 0	Yes 0.2	