



Joint meeting of the
Canadian Society of Soil Science
Manitoba Soil Science Society
Canadian Society of Agricultural and Forest Meteorology

Winnipeg, Manitoba
23 July 2013

Managing losses of dissolved phosphorus by time and place of application



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Northeast Region, IPNI



Agrium Inc.



Arab Potash Company



Belarusian Potash Company



CF Industries Holdings, Inc.



Compass Minerals
Specialty Fertilizers



Incitec Pivot



International Raw
Materials LTD.



Intrepid Potash, Inc.



K+S KALI GmbH



The Mosaic Company



OCP S.A.



PotashCorp



Qatar Fertiliser Company
(QAFCO)



Simplot



Sinofert Holdings
Limited



SQM



Toros Tarim



Uralkali

Formed in 2007 from the Potash & Phosphate Institute, the **International Plant Nutrition Institute** is supported by leading fertilizer manufacturers.

Outline

- Lake Erie algae and dissolved P
- Right rate, right place or right time?
- 4R Nutrient Stewardship - certification
- 4R Research Fund
- *Slides: available at <http://nane.ipni.net>*





MODIS
satellite image
3 Sept 2011.
Source: Michalak
et al., 2013,
PNAS.



December 2012

Reducing Loss of Fertilizer Phosphorus to Lake Erie with the 4Rs

Algal blooms in Lake Erie have been getting worse in the past few years. Phosphorus (P) has often been considered the nutrient controlling such blooms. The loads of dissolved P in the rivers draining into Lake Erie vary greatly year-to-year, but higher loads have become more frequent in recent years than in the mid-1990s. Agriculture is one of several sources of dissolved P.

This article outlines how crop producers in the Lake Erie watershed can reduce losses of P by adopting a 4R Nutrient Stewardship approach to guide their fertilizer application practices.

Background

Much of the cropland of the Lake Erie watershed is found in Ohio, with smaller areas in Indiana, Michigan and Ontario

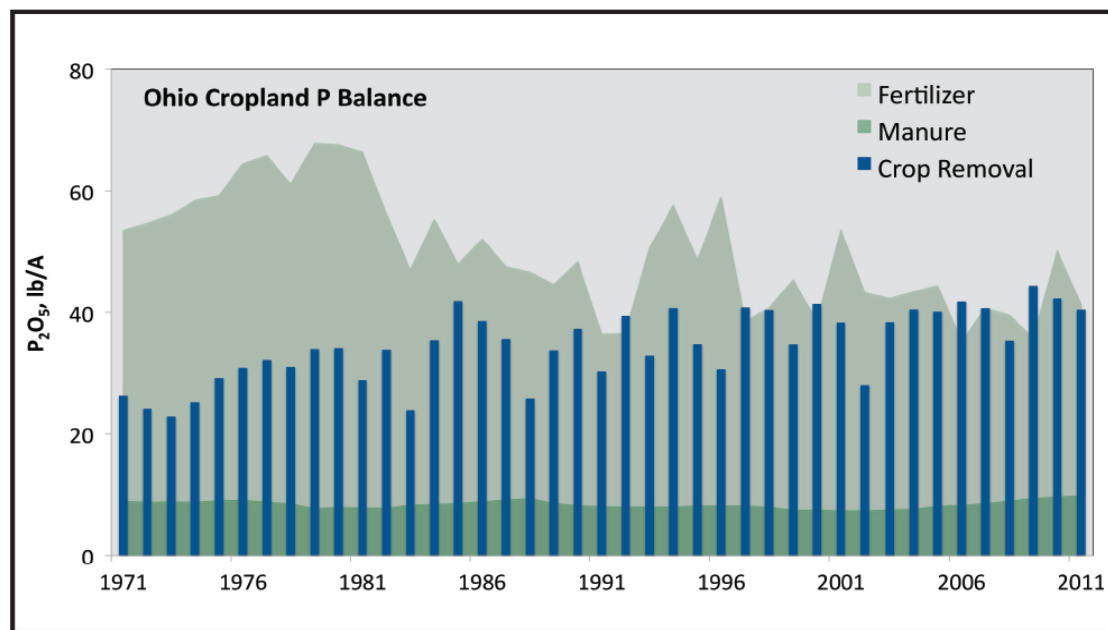
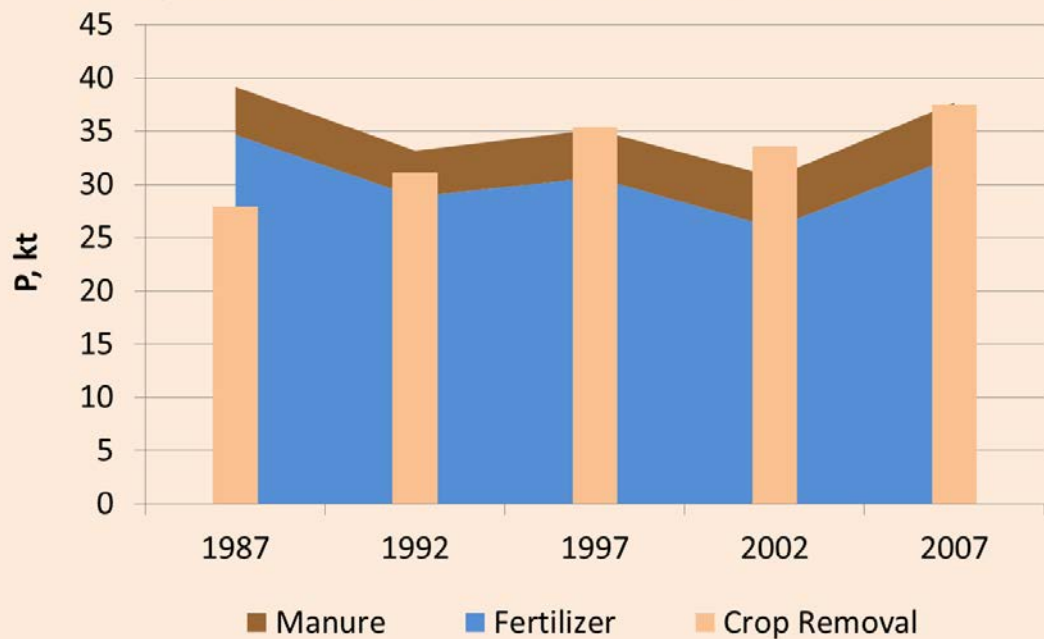


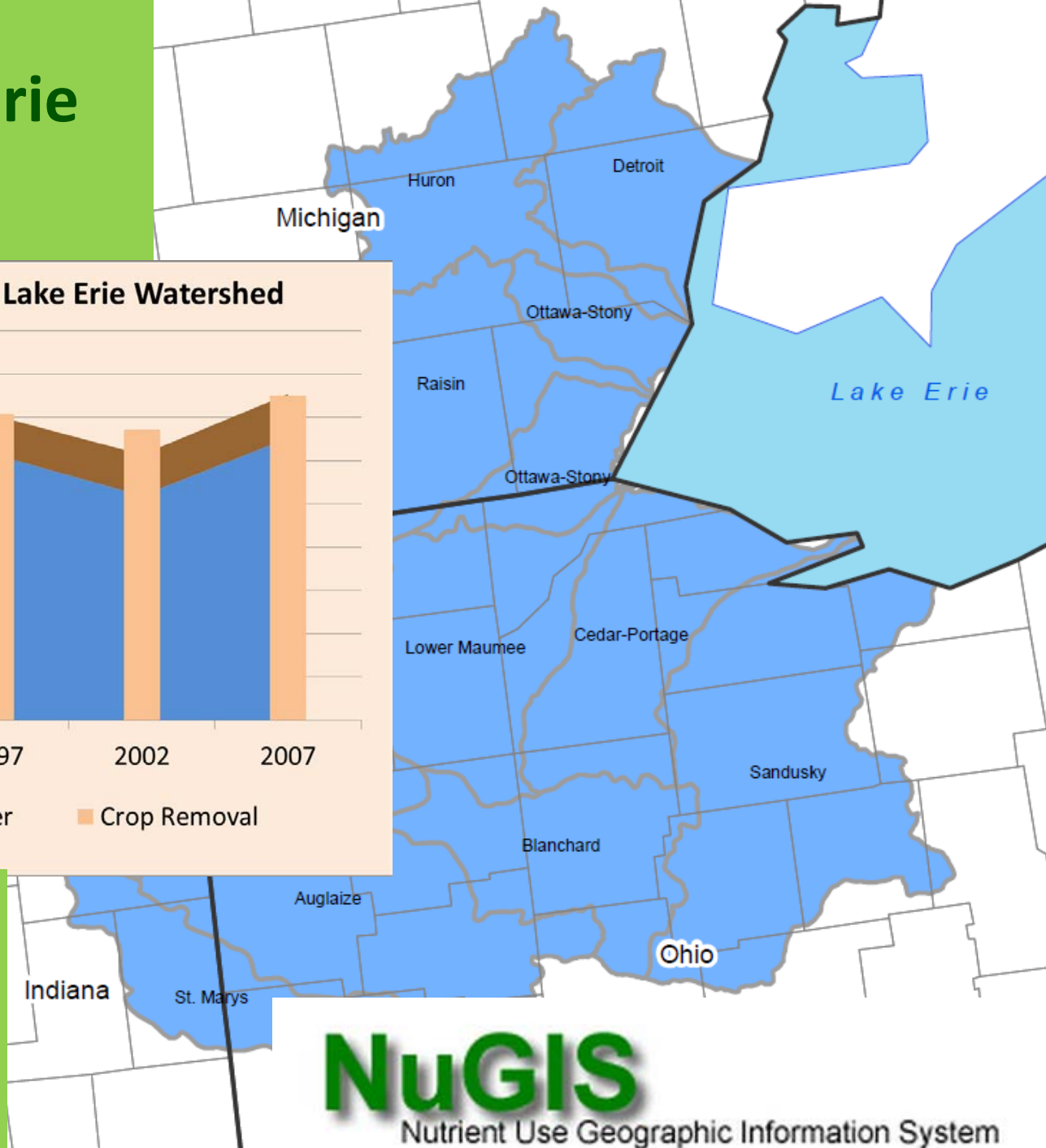
Figure 2. Phosphorus balance trend over time for Ohio cropland. *2011 fertilizer estimated.

Western Lake Erie Watershed

Cropland P Balance, Western Lake Erie Watershed



Excess Rates?



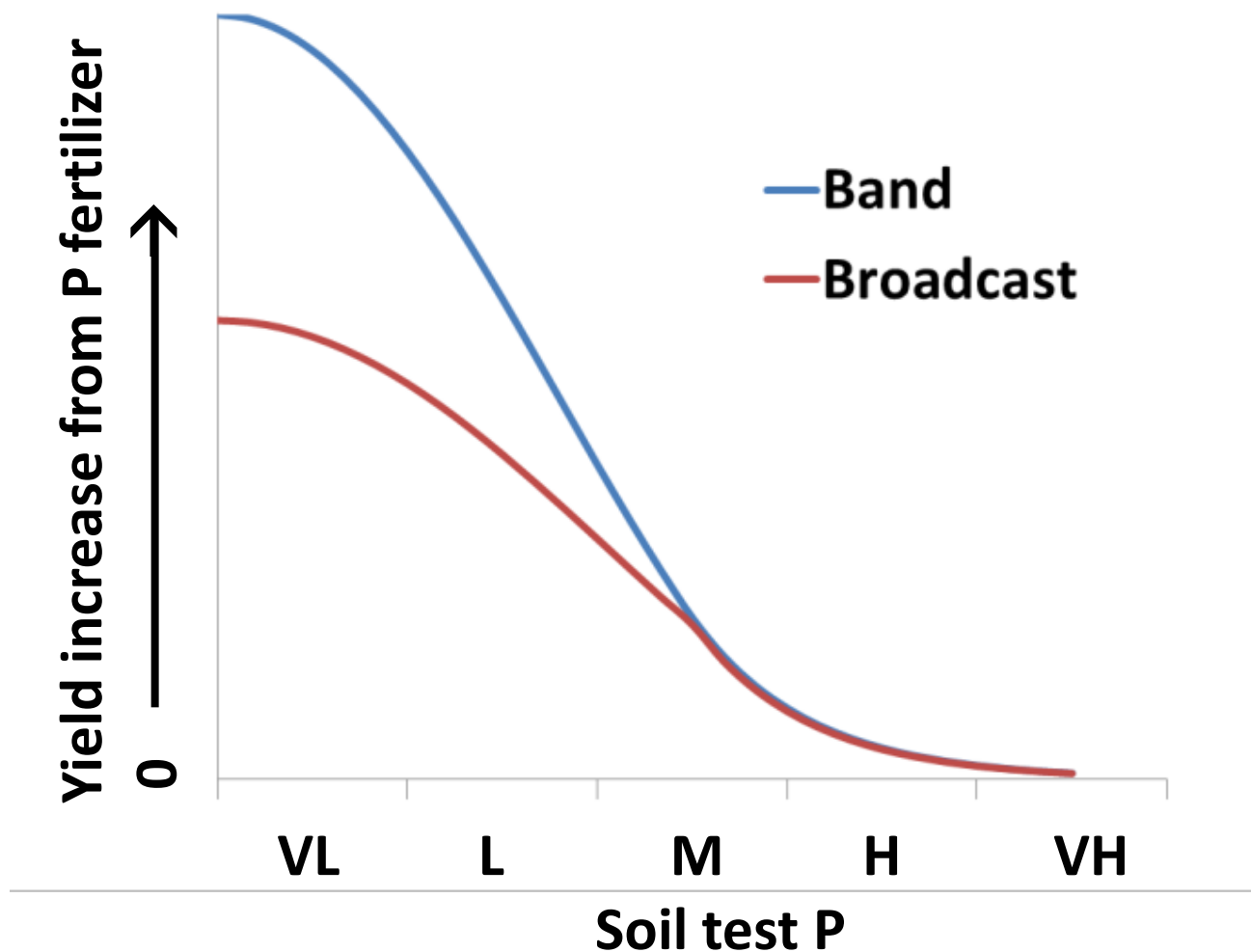
Timing and Placement: Planter Banding?



Planter without bins: leads to more broadcasting?



Idealized effect of placement on crop response





Broadcast placement issues

- Fertilizer on the soil surface (acute)
 - If first rainfall generates runoff, can raise [DRP] to 5-20 mg/L in a single event
- Stratification in soil (chronic)
 - Tillage more than placement
 - [STP] in top 5 cm moves to 3-4 times that in top 20 cm within 5 years of no-till
 - Even annual chisel plowing only reduces stratification by half
 - Increase runoff [DRP] from ~0.1-0.2 mg/L to perhaps 0.4 to 0.8 mg/L
- Timing
 - Fall application: lower frequency of intense rainstorms than spring
 - Spring broadcast more likely to be incorporated before first rain
 - Recent research indicates that March-June loadings are most closely related to algal bloom extent from 2001-2011. (Stumpf et al., 2013)

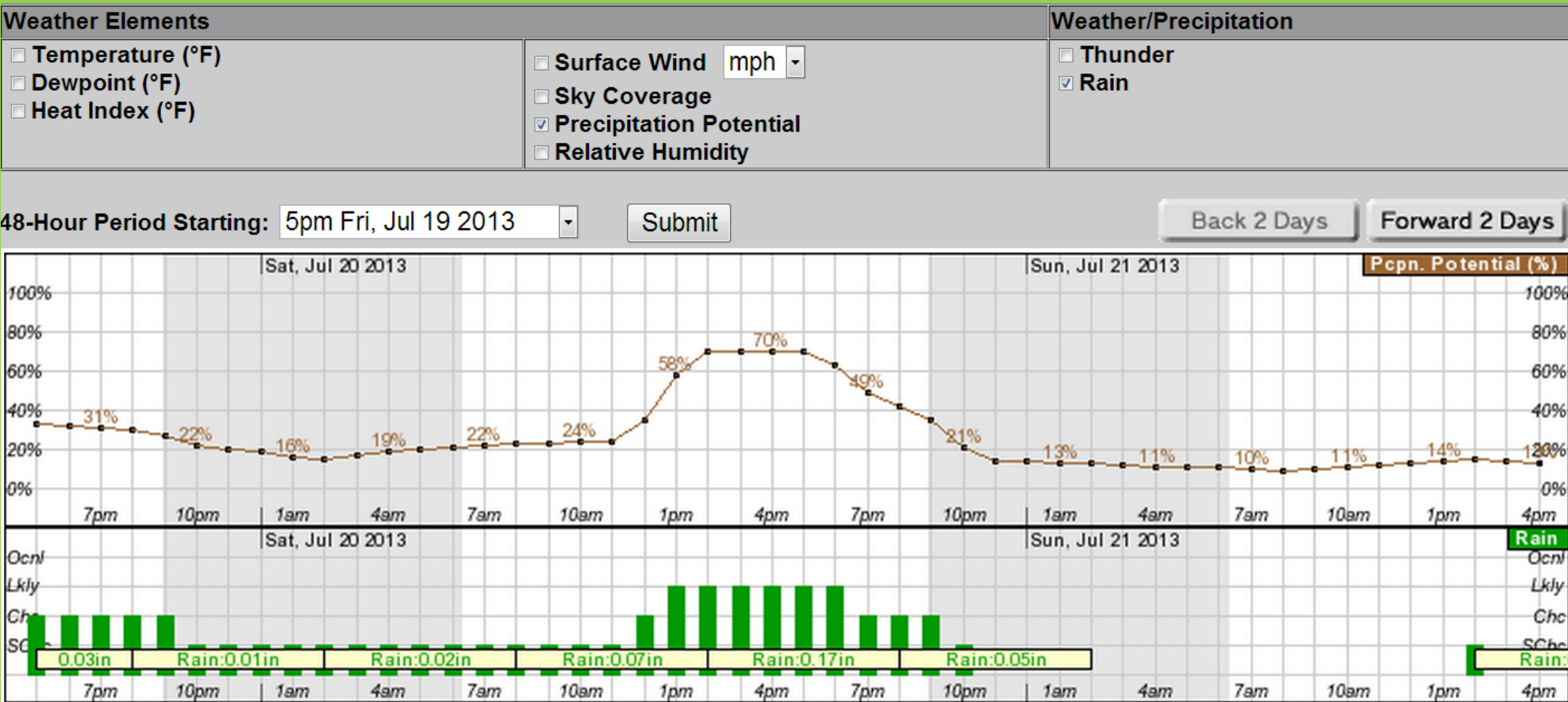


Placement of granular P with strip tillage



Placement of granular P with strip tillage

Can weather forecast data be harnessed to drive a “safe time to broadcast P” decision support tool?



**PoP x
Rainfall amount x
Soil infiltration capacity
= time to stop broadcast?**

 **National Weather Service Forecast Office**
Wilmington, OH

[Home](#) [News](#)

Point Forecast: Pleasantville OH
39.81N 82.53W

Hourly Weather Forecast Graph



4R Nutrient Stewardship Certification Standard

Requirements for Nutrient Service Providers in the Lake Erie Watershed

1. Training
2. Monitoring
3. Recommendations
4. Applications



Version 1.0

May 2013

Example recommendation standards:

3.5.7 Nutrients are not recommended for surface application within 24 hours prior to heavy rainfall (i.e., at least 50% chance of more than ½ inch rainfall).

3.5.8 According to the nutrient recommendation, nitrogen and phosphorus must not be applied to frozen ground.

Ohio

Industry Partnerships

- Outreach at expos and meetings – TFI, TNC, OH ABA
- October 2011 – adoption of 4Rs by OH Dept. of Ag, OH EPA, OH DNR
- March 2012 – final report naming 4Rs Foundation of Nutrient Management
- June 2012 – Healthy Lake Erie Fund, \$3M – to help implement 4Rs
- Developing 4R service provider recognition program

KEEP PHOSPHORUS IN YOUR FIELD

THE ISSUE



An aerial photo of a Lake Erie algal bloom on August 13, 2011.
Source: www.globe.gov/news/Centers/RMS/news_lake_erie

Historically, commercial fertilizer phosphorus was considered immobile on or in the soil. However, new data suggests fertilizer phosphorus left on the surface when followed by heavy rainfall can also be a major source of phosphorus loading. Research suggests current agricultural practices within the Western Lake Erie Basin contribute to the growing algal crisis, with more than 50 percent of the phosphorus load potentially attributed to agriculture.

THE ACTION

4R nutrient stewardship provides a framework to achieve cropping system goals – increased production, increased farmer profitability, and enhanced environmental protection. To achieve these goals the 4Rs utilize fertilizer best management practices that address the Right Nutrient Source, at the Right Rate, the Right Time, and in the Right Place. The 4R nutrient stewardship principles are the same globally, but how they are used locally varies depending on field and site specific characteristics such as soil, cropping system, management techniques and climate. The following describes the principles generally, and their specific application to lake-friendly P management.

RIGHT SOURCE: Ensure a balanced supply of each of the essential nutrients in plant available forms, utilizing all available sources. *Specifically, choose sources of P that can be placed in the soil.*

RIGHT RATE: Assess and make decisions based on soil nutrient supply and plant demand. *Specifically, soil test and determine the P rate appropriate to the crop.*

RIGHT TIME: Assess and make decisions based on the dynamics of crop uptake, soil supply, loss risks, and field operation logistics. *Specifically, avoid applying over snow or frozen soil during mid-winter, and consider replacing fall applications with spring applications where possible.*

RIGHT PLACE: Place nutrients where they are accessible to crops, addressing root-soil dynamics, and managing spatial variability within the field. *Specifically, place P in the soil for each crop, in ways that attain the goals of conservation tillage.*

There is no single practice to solve the problem. Each farm has different circumstances such as soil type, surface drainage, tile drainage, soil test levels, and tillage programs, which can be modified to make a difference. Farmers can play a critical role in reducing the algal blooms in Lake Erie and we all need to do our part.

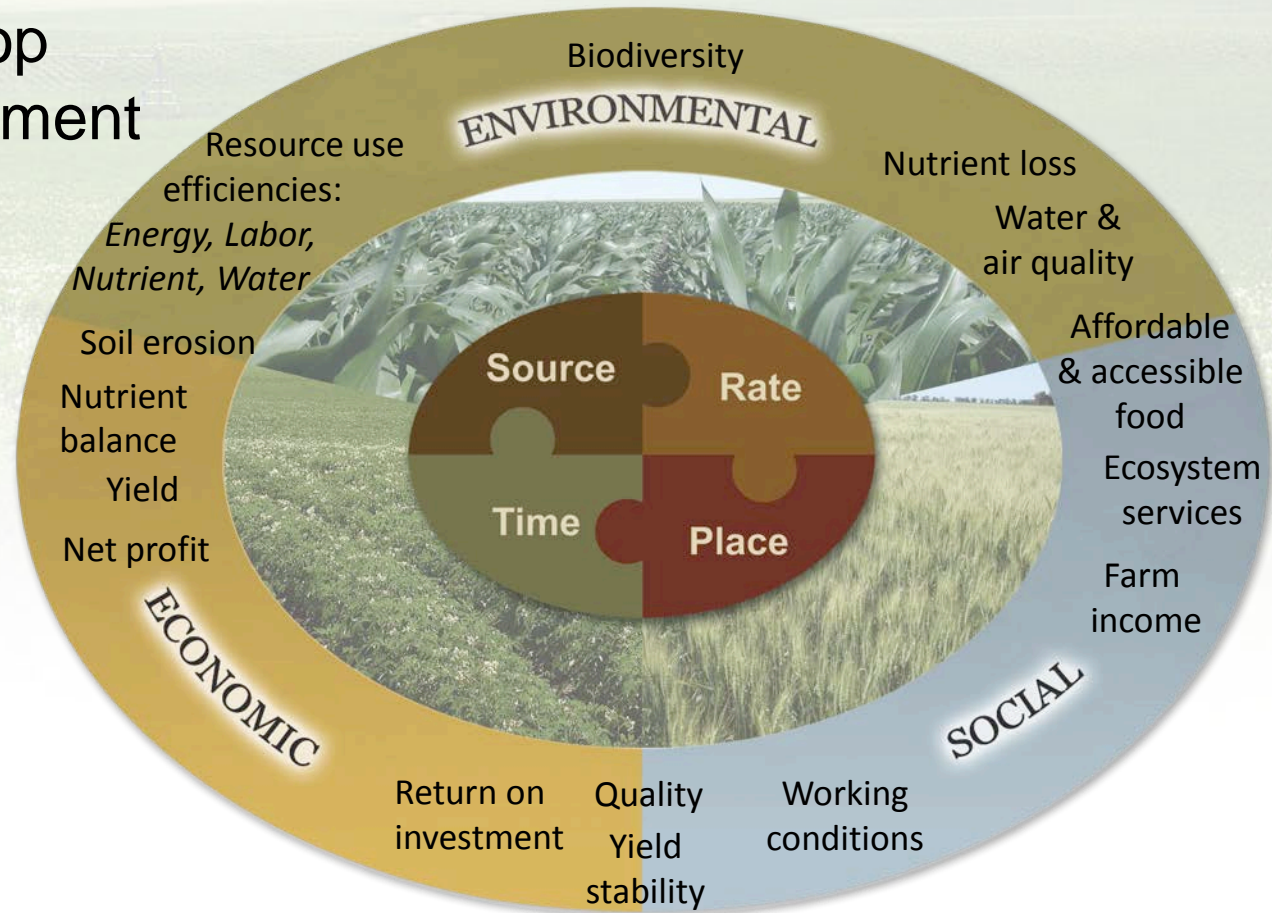
SUGGESTED PRACTICES TO REDUCE PHOSPHORUS TRANSPORTATION INTO LAKE ERIE

- Inject or incorporate phosphorus when ever possible.
- For low-lying fields that are prone to flooding, delay application to just before planting, and either incorporate, band-place, or inject.
- Avoid spreading phosphorus near tile stand pipes or surface drains.
- Utilize cover crops to improve soil health and increase water holding capacity thereby reducing surface run-off.
- Include starter phosphorus or row fertilizer phosphorus where ever practical.
- Schedule phosphorus broadcast applications when shallow tillage is possible for conventional/reduced tillage programs.
- Schedule phosphorus applications for no-till programs as close to crop utilization as practical.
- Do not schedule phosphorus applications just prior to heavy rainfall.
- Do not schedule phosphorus applications when soils are frozen during mid-winter.
- Do not schedule phosphorus applications when soils are snow covered.
- Soil test to determine nutrient requirements for the next crop.
- Keep fertilizer phosphorus out of ditches, streams and waterways while making application.
- Consider all nutrient sources available to the crop when deciding on how much to apply.



The 4Rs influence many performance indicators

- social, economic and environmental performance
- influenced by crop and soil management as well
- whole system outcomes



Who is working on 4R Certification?

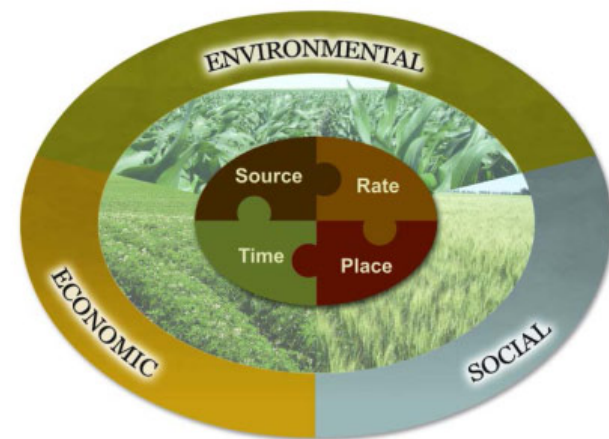


Timeline

- July: 4 Pilot Audits (Certifications)
- August: 4R Advisory Committee Review
- Fall 2013/Winter 2014: Begin to promote
- Summer of 2014: Certifications

4R Nutrient Stewardship Research Fund

- Launched April 2013
- The North American fertilizer industry has pledged \$7 million to fund a multi-year research effort aimed at measuring and evaluating the economic, social and environmental impacts of 4R Nutrient Stewardship (applying the right source of nutrients at the right rate, at the right time and in the right place).
- The fund will support U.S. and Canadian projects in partnership with land-grant universities, watershed stakeholders and government agencies.

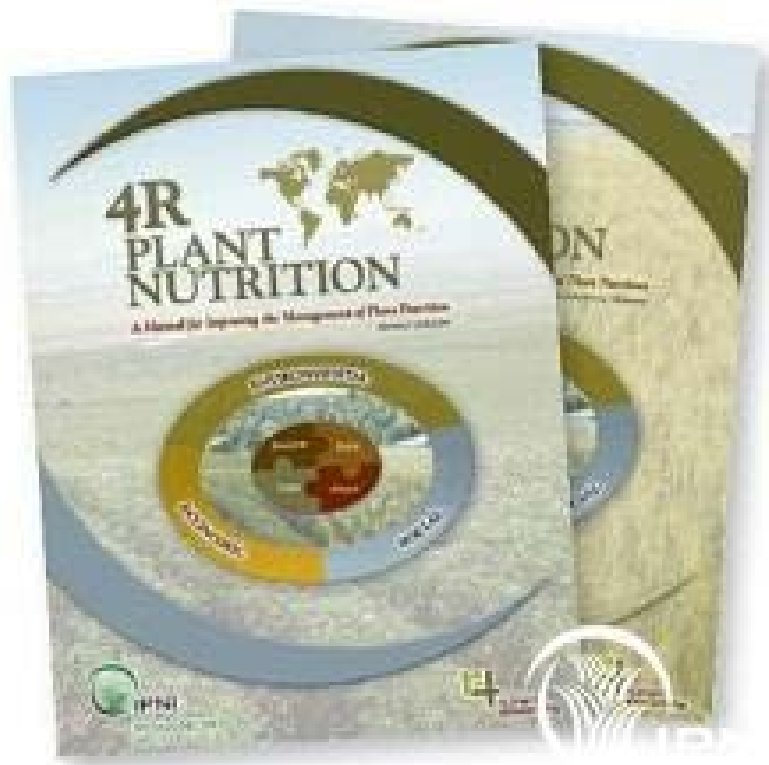


Modules and Case Studies for the 4R Plant Nutrition Manual

Modules describe specific practices related to principles explained in the text of the 4R Plant Nutrition Manual.

Module 5.3-2 Timing broadcast phosphorus fertilizer applications can help protect Lake Erie

Module 6.3-1 Place phosphorus in the soil to protect water quality in Lake Erie



Summary

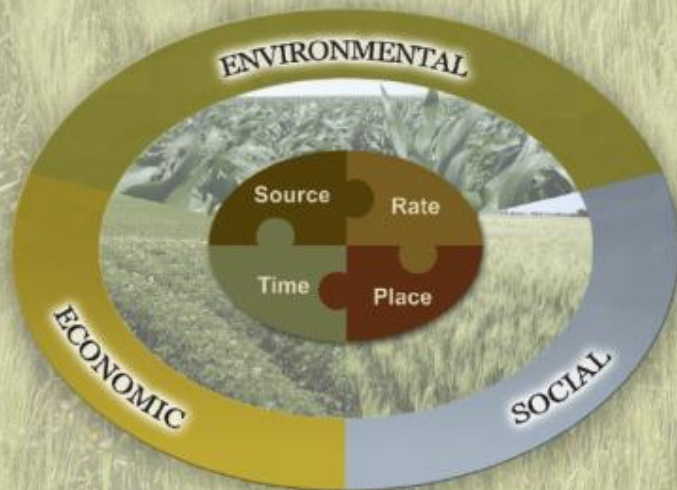
- 1. 4R Nutrient Stewardship has been embraced in Ohio to address the Lake Erie P issue.**
- 2. “Right place” – banding – can reduce loss of dissolved P in runoff.**
- 3. “Right time” – scheduling broadcast applications to avoid runoff – could help.**
- 4. 4R Nutrient Stewardship research is needed to develop trusted, reliable decision support.**



4R PLANT NUTRITION

A Manual for Improving the Management of Plant Nutrition

NORTH AMERICAN VERSION



Comments Welcome

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