Scientific Workshop « Management of Variability for the Optimization of Fertilization Practices »
Institut nationale de la recherche scientifique (INRS) Siège social
Quebec, QC, Canada
9 April 2014

Bringing Better Practices to the Farm

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Guelph, Ontario, Canada

Agrium Inc.
Arab Potash Company
Belarusian Potash Company
CF Industries Holdings, Inc.
Compass Minerals Specialty Fertilizers
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 Tarım
Uralchem
Uralkali

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

Bringing Better Practices to the Farm
Outline

1. 4R Nutrient Stewardship & Sustainability
2. Adaptive management
3. Data
4. Lake Erie Watershed

See http://nane.ipni.net/ for slides

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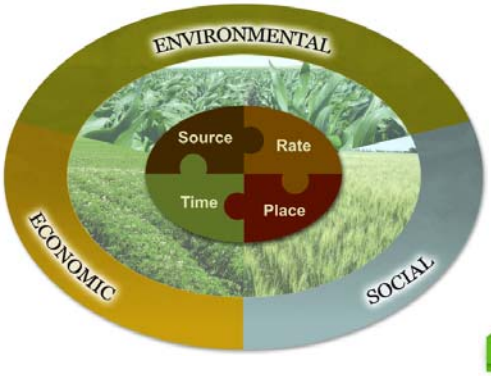
4R: "right" means sustainable



Field to Market
The Keystone Alliance for Sustainable Agriculture

THE SUSTAINABILITY CONSORTIUM

Walmart
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Home Our Goals How To Make A Difference Share What You've
Home > How To Make A Difference > Fertilizer Optimization
How to Make a Difference - Fertilizer optimization

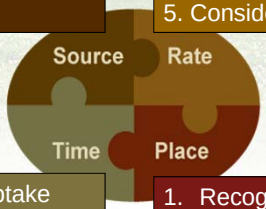
4R PLANT NUTRITION

4 nutrient stewardship

The basic scientific principles of managing crop nutrients are universal

1. Provide essential elements
2. Supply plant-available forms
3. Suit soil properties
4. Synergisms, blend compatibility
5. Associated elements

1. Assess plant demand
2. Assess soil supply
3. Assess all available sources
4. Predict fertilizer use efficiency
5. Consider resources and economics

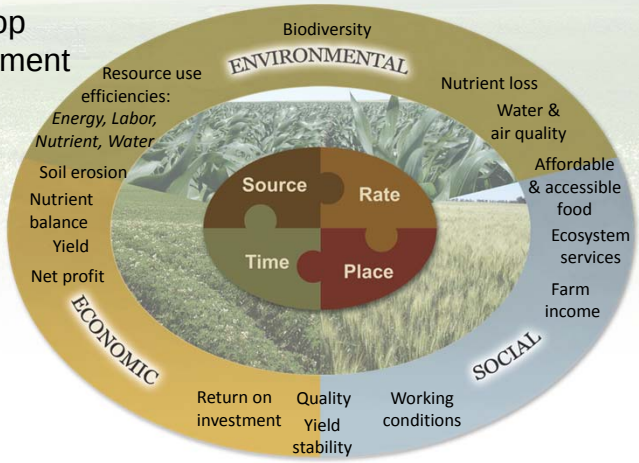


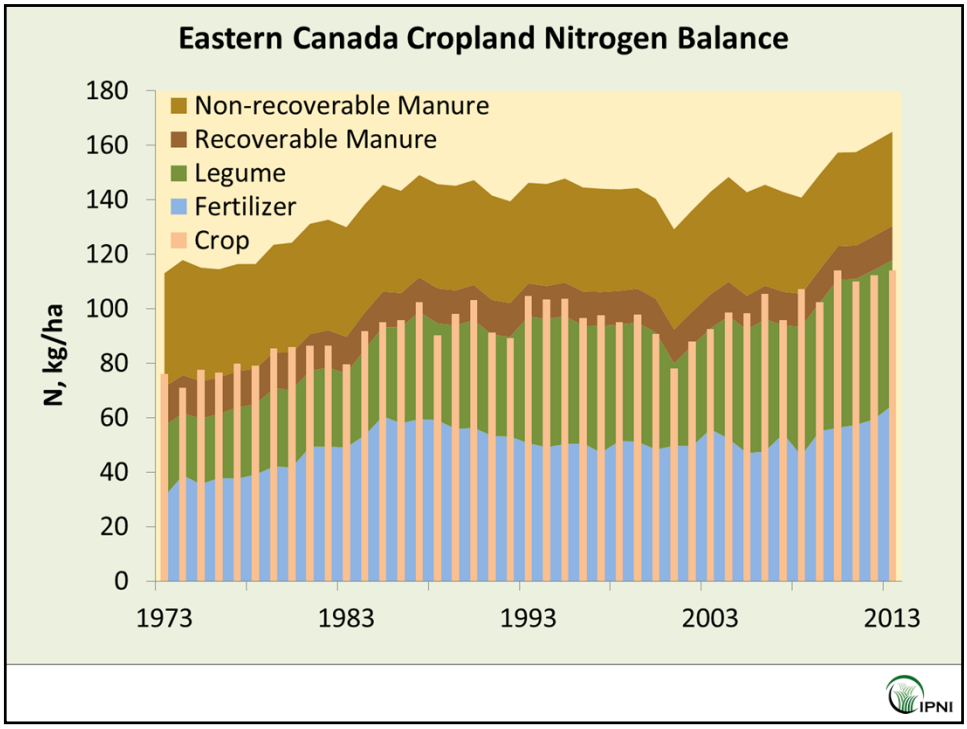
1. Assess timing of crop uptake
2. Assess dynamics of soil supply
3. Assess timing of weather factors
4. Evaluate logistics

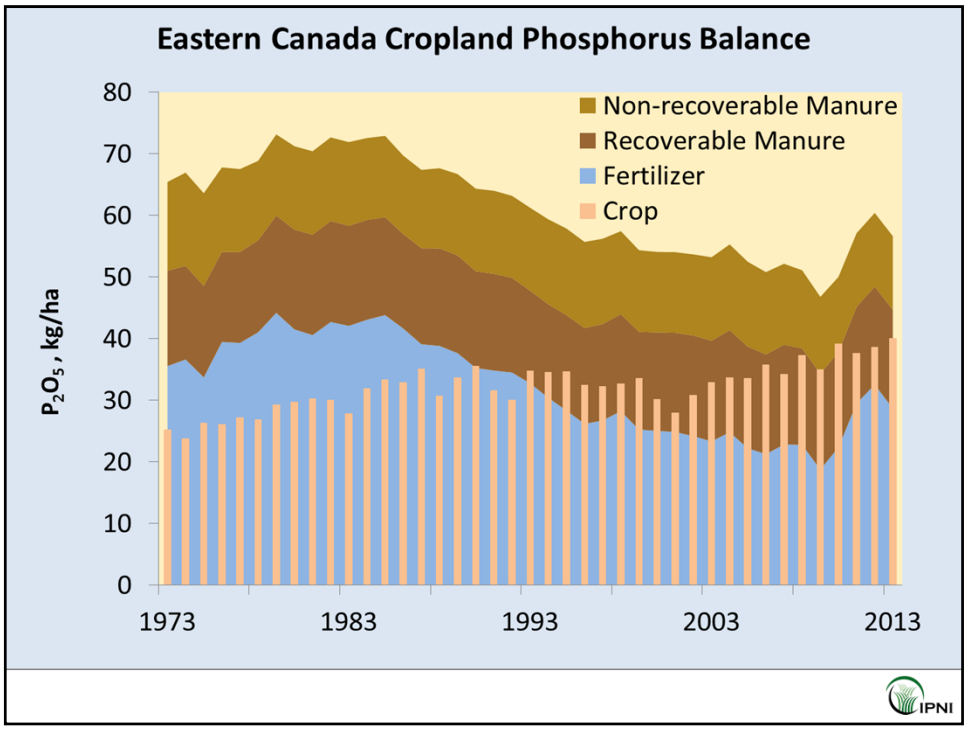
1. Recognize root-soil dynamics
2. Consider soil chemical reactions
3. Manage spatial variability
4. Fit needs of tillage system

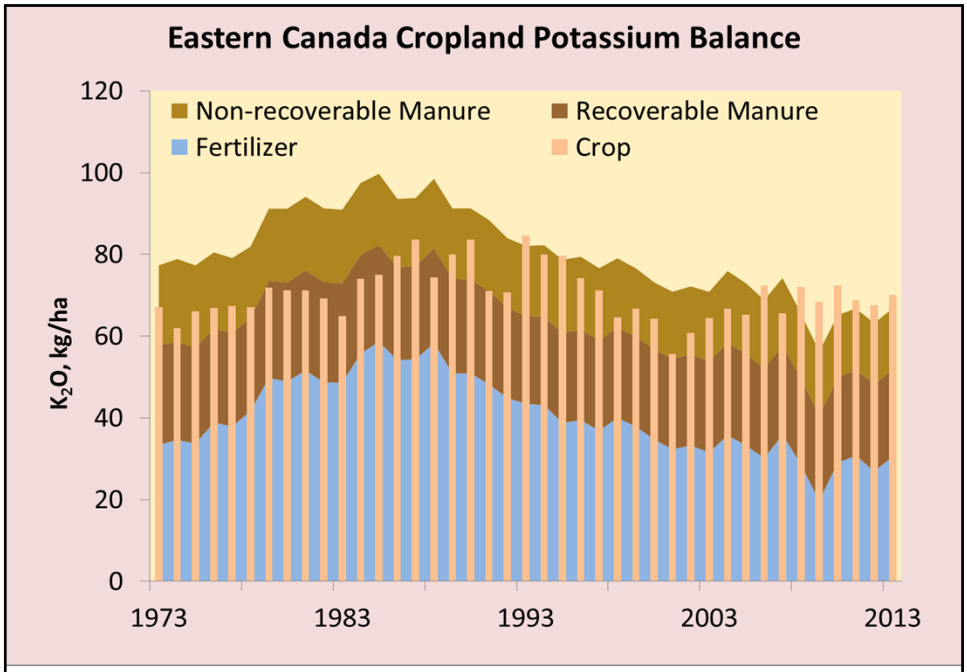
The 4Rs influence performance indicators

- Social, economic and environmental performance
- Influenced by crop and soil management as well
- Stakeholders need to choose priorities

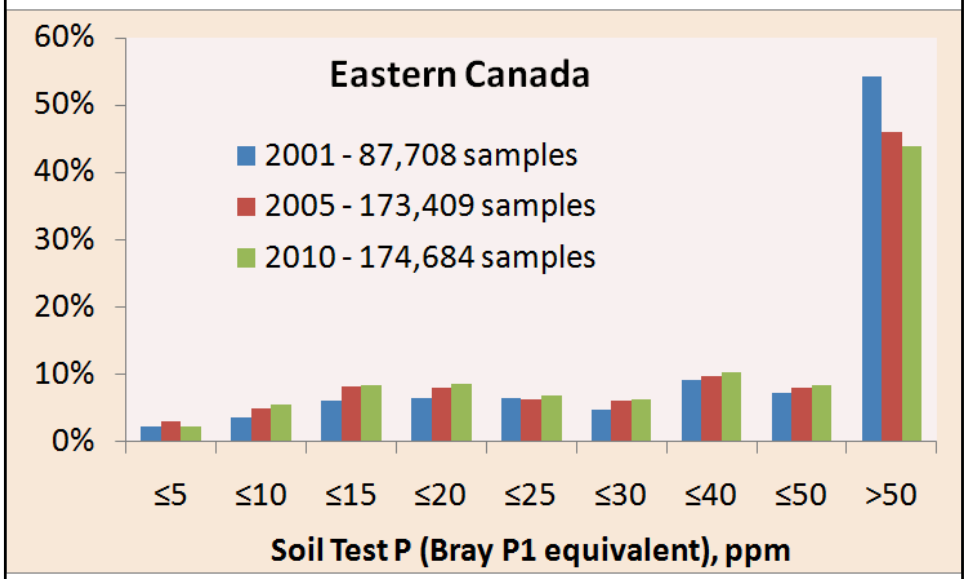



Eastern Canada Cropland Nitrogen Balance
N, kg/ha
180
160
140
120
100
80
60
40
20
0
1973
1983
1993
2003
2013
Non-recoverable Manure
Recoverable Manure
Legume
Fertilizer
Crop
IPNI

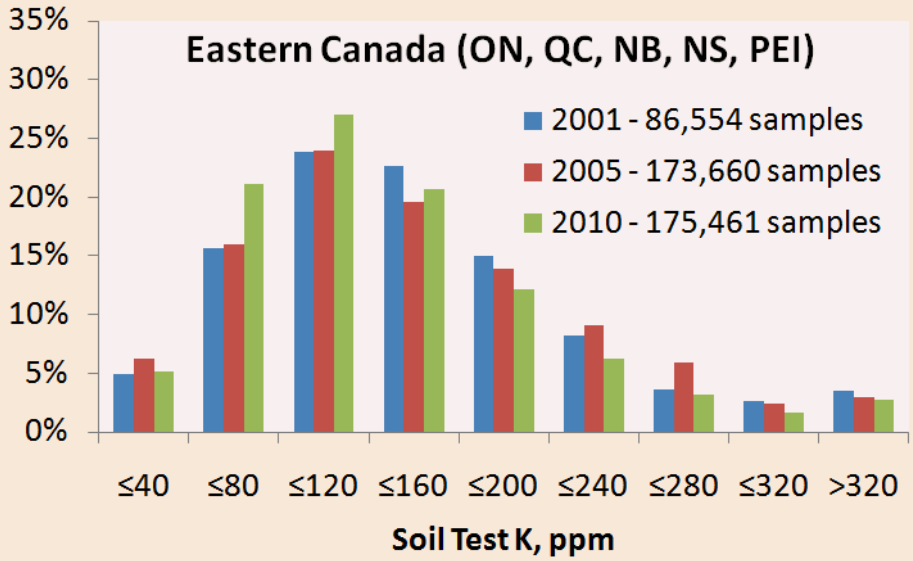

Eastern Canada Cropland Phosphorus Balance
P_2O_5, kg/ha
80
70
60
50
40
30
20
10
0
1973
1983
1993
2003
2013
Non-recoverable Manure
Recoverable Manure
Fertilizer
Crop
IPNI



Soil Test Summary – P



Soil Test Summary – K



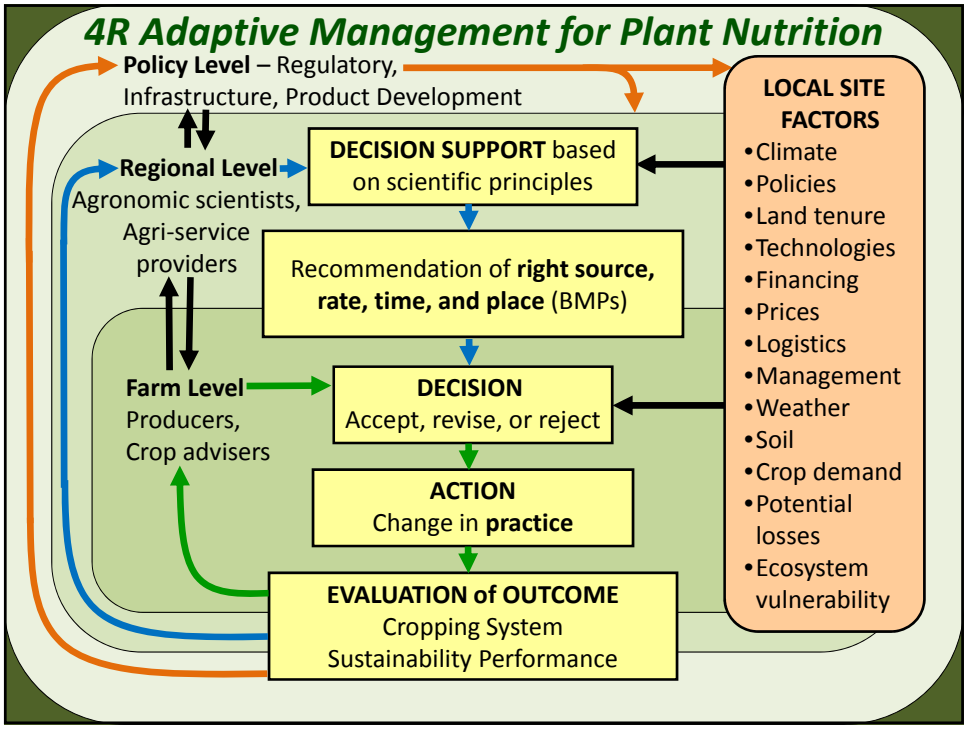
Social impact of 4R Nutrient Stewardship

- Less direct than economic and environmental
- Easy: right place and odour
- More profound: sustainable intensification – sparing land for nature – employment in decision support
- Precision ag: intensive approaches on extensive areas
- Accountability & communication
- Maintaining soils for future generations.

Sustainability

- 4R framework for communication
- Performance indicators for nutrient stewardship include:
  - effectiveness and efficiency
  - economic, environmental and social dimensions
- Global approach

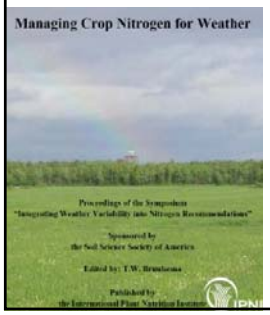
Adaptive Management

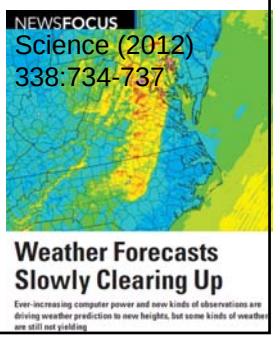


Improving nutrient use efficiency depends on adapting management to weather

❖**STRATEGY**

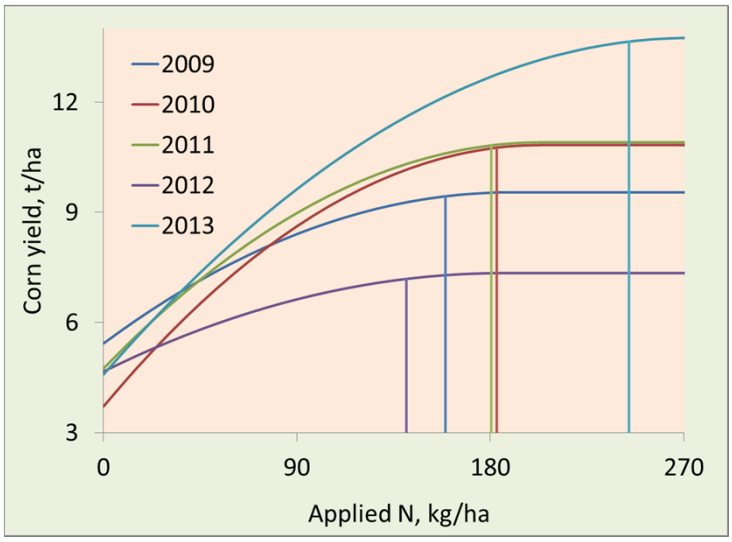
Support development of decision support systems that account for weather.





Corn yield response, first 5 years, Elora, Ontario

IPNI-2008-CAN-ON29 – hybrid Pioneer 38B14



Decision Support for Adapting N Management to Weather

- Different soils respond differently to weather
- Complexity demands a decision support system
- Adapt and innovate – right time and weather
- Any tool needs field testing – adaptive research, on-farm

Maize hybrids differ in N uptake

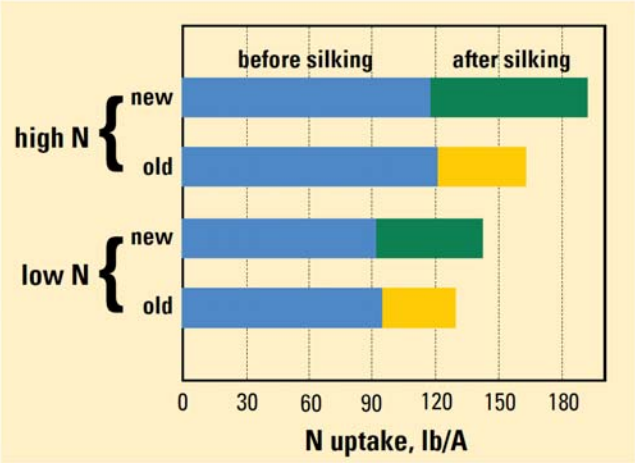


Figure 1. Corn N uptake in a new and an old hybrid in response to high and low soil N availability. Means over 3 years (1993-1995) at Elora, Ontario.

"Old":
Pride 5,
released in 1959

"New":
Pioneer 3902,
released in 1988

Adaptive management

- On-farm research required
- Transparent models
- Understanding new hybrids

Data

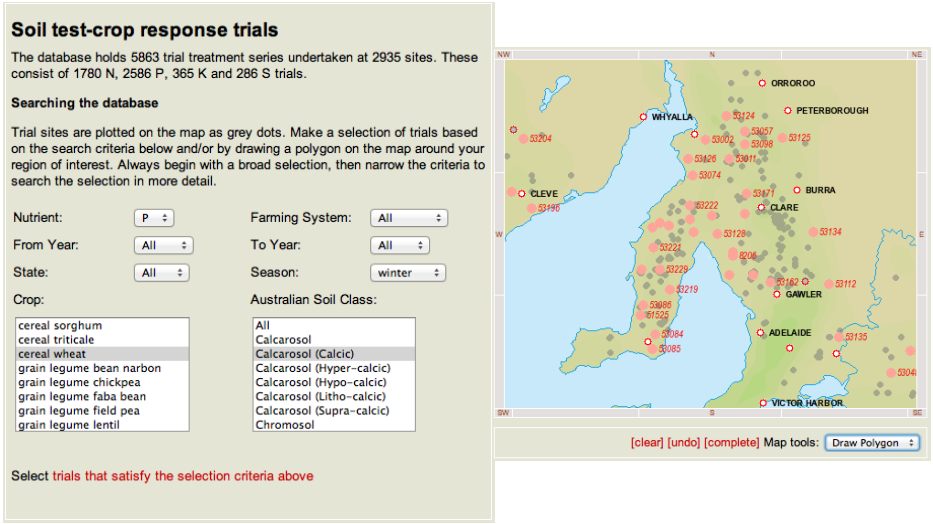
Database for Interpreting Soil Test Results

"Better Fertilizer Decisions for Crops in Australia"

www.bfdc.com.au

Database for Interpreting Soil Test Results

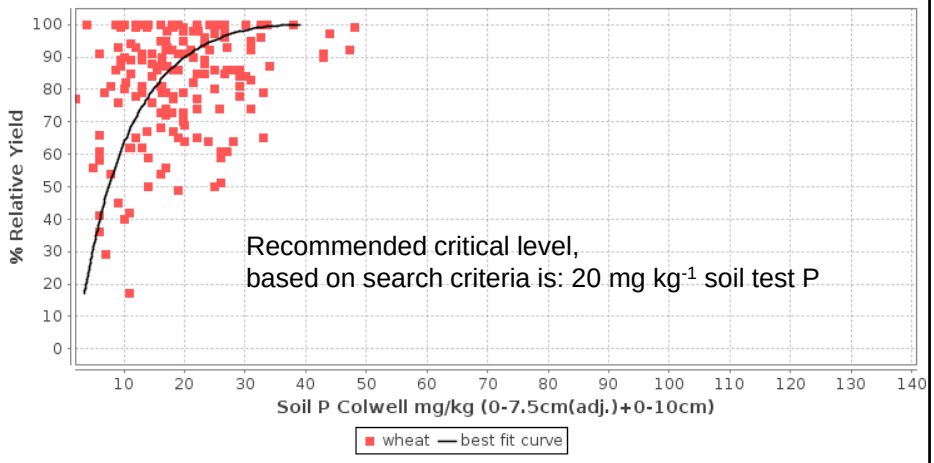
"Better Fertilizer Decisions for Crops in Australia"



www.bfdc.com.au

Database for Interpreting Soil Test Results

"Better Fertilizer Decisions for Crops in Australia"



Soil test calibration:

80% Relative Yield: 15.0 (11.0 - 20.0)
90% Relative Yield: 20.0 (15.0 - 27.0)
95% Relative Yield: 25.0 (17.0 - 36.0)

Correlation R: 0.26
Slope RY(50-80): 4.0 (1.5 - 6.5)
Regression equation: $x = e^{(2.1301(\arcsin(\mathrm{sqrt}(y/100))) + 0.34003)}$
70% confidence limit at 90% Relative Yield: 20.0 (17.0 - 24.0)

Data filters:

Crop: wheat

Can crop nutrition match health care?

Evidence-based health care and systematic reviews

Evidence-based health care

Are scientific methods used to determine which drugs and procedures are best for treating diseases? The answers may surprise you. Modern healthcare is undergoing a long-overdue and dramatic evolution.

The Evidence-based Medicine Triad
Source: Florida State University, College of Medicine. Retrieved 08.07.11.

Systematic reviews

A systematic review is a high-level overview of primary research on a particular research question that tries to identify, select, synthesize and appraise all high quality research evidence relevant to that question in order to answer it.[i]

Key Points:

1. Systematic reviews seek to collate all evidence that fits pre-specified eligibility criteria in order to address a specific research question
2. Systematic reviews aim to minimise bias by using explicit, systematic methods
3. The Cochrane Collaboration prepares, maintains and promotes systematic reviews to inform healthcare decisions: Cochrane Reviews

http://www.cochrane.org

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Systematic review – challenges

- “quasi” systematic reviews
- the sheer number of hypotheses to test

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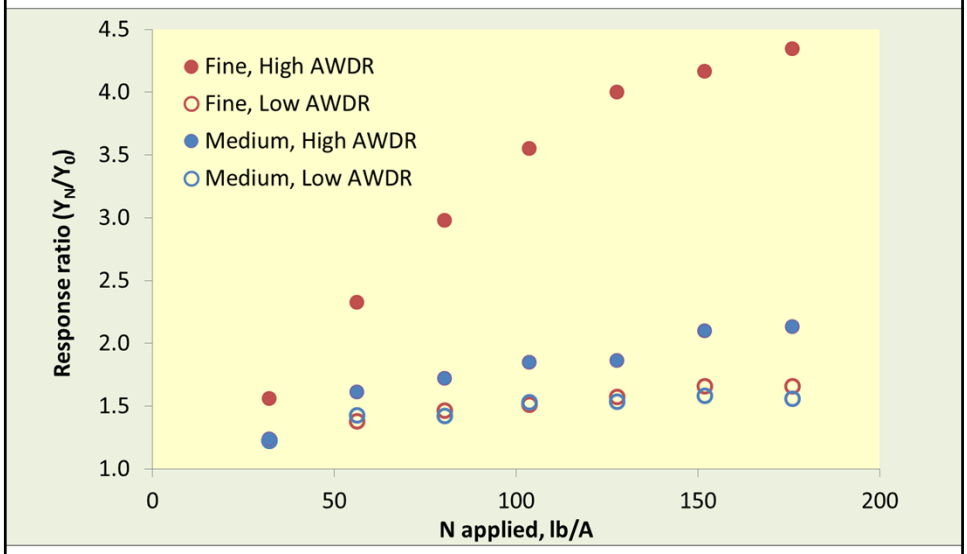
Networking studies through meta-analysis



Parent et al., 2013; Tremblay et al., 2012

Meta-analysis – challenges

- "a procedure to analyze and synthesize datasets from separate studies pursuing similar objectives" (Borenstein et al., 2009)
- Published studies – criterion of originality
- Grouping
- Response ratios
- Log transformations

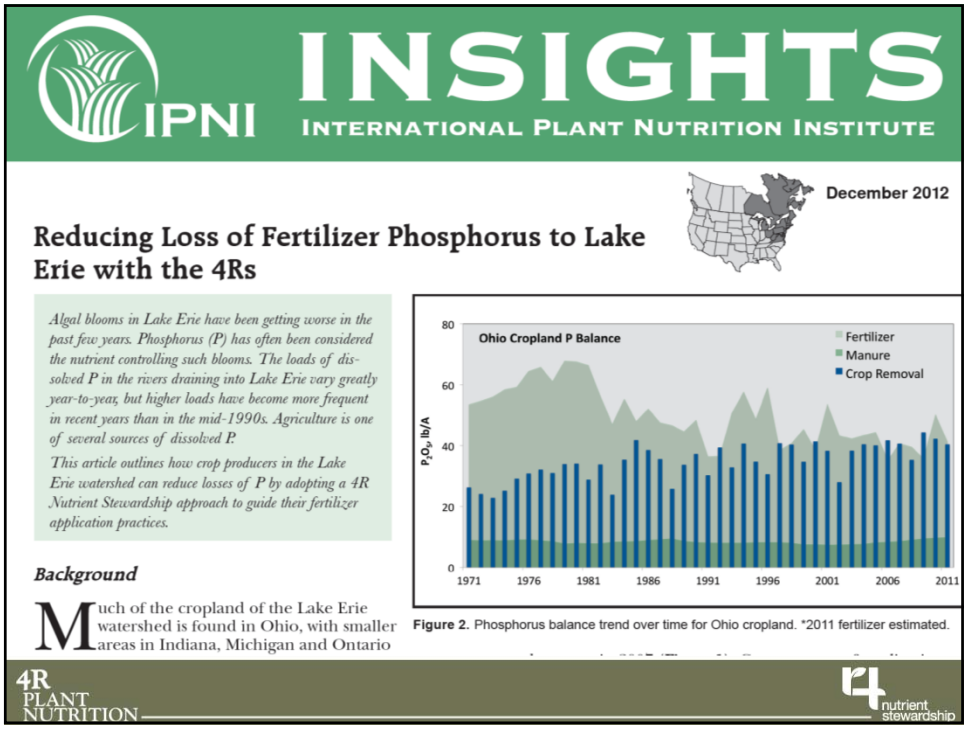
Data

- Curation and accessibility
- Systematic reviews
- Meta-analysis

- Opportunity: networking across political jurisdictions

Lake Erie watershed

nutrient stewardship



IPNI INSIGHTS
INTERNATIONAL PLANT NUTRITION INSTITUTE

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

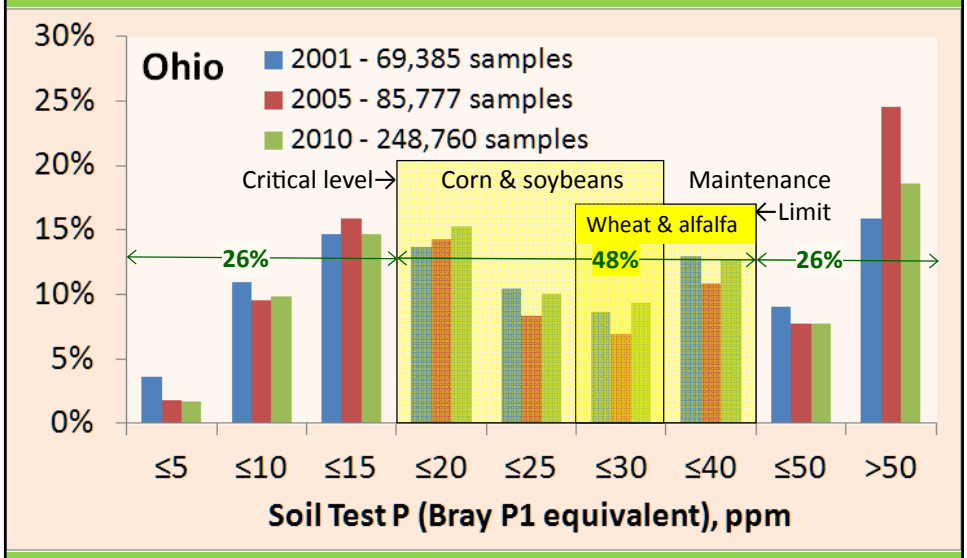
Much of the cropland of the Lake Erie watershed is found in Ohio, with smaller areas in Indiana, Michigan and Ontario

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

4R PLANT NUTRITION

nutrient stewardship

Soil test P distribution, 2001-2010



Build, maintain or drawdown as per soil test

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Practice	Advantages	Limitations
S – MAP or DAP R – rotation removal T – fall P – broadcast	Minimal soil compaction Allows timely planting in spring Low-cost fertilizer form Low cost of application	Risk of elevated P in runoff in late fall and winter Low N use efficiency
S – MAP or DAP R – rotation removal T – spring P – broadcast	Minimal soil compaction Better N use efficiency Low-cost fertilizer form Low cost of application	Risk of elevated P in spring runoff before incorporation Potential to delay planting Retailer spring delivery capacity
S – MAP or fluid APP R – one crop removal T – spring P – 2" x 2" band	Low risk of elevated P in runoff Most efficient use of N Less soil P stratification	Cost and practicality Potential to delay planting Retailer delivery capacity Cost of fluid versus granular P
S – MAP or DAP R – rotation removal T – fall P – banded in zone	Low risk of elevated P in runoff Maintain residue cover Allows timely planting in spring Less soil P stratification	Cost of RTK GPS guidance Cost of new equipment More time required than broadcast
S – fluid APP P – point injection	As above	As above, plus cost of fluid versus granular P

Choice of practice considers both advantages and limitations.

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4R Nutrient Stewardship Certification Standard

Requirements for Certification

For Nutrient Service Providers in the Lake Erie Watershed

Version 2.0

October 2013

NUTRIENT STEWARDSHIP CERTIFIED

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Who is working on 4R Certification?

4R Certification – Lake Erie Watershed

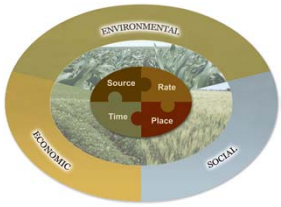
- Rollout 18 March 2014 – 190+ agri-retail audience
- 22 agri-retail locations signed up for audit summer 2014
- Audit procedures from SCS Global

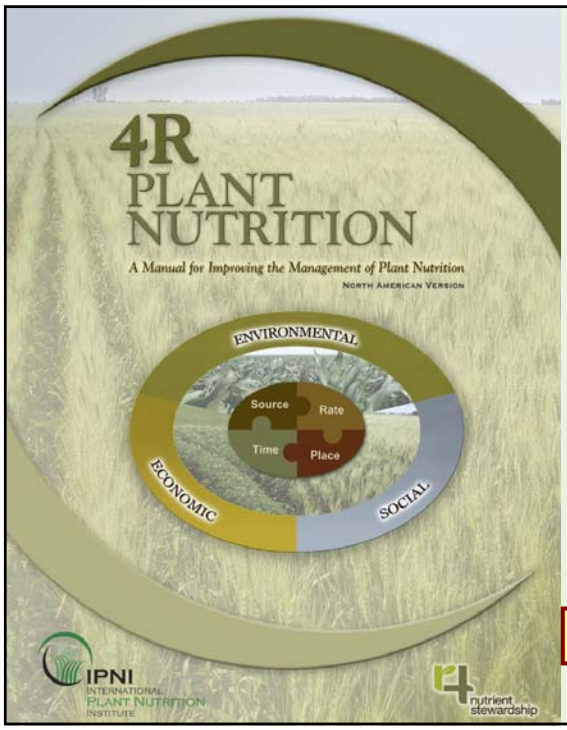
4R Nutrient Stewardship Certification Program Launched

http://4rcertified.org/

Summary – Bringing Better Practices to the Farm

1. Sustainability performance indicators – industry is engaging stakeholders.
2. Adaptive management & on-farm research is needed to improve nutrient use effectiveness and efficiency.
3. Accessible Data is required for both #1 and #2.
4. Certification and professional recognition are important.





Thank You

http://nane.ipni.net