La venue de ce conférencier a été rendue possible grâce au soutien financier du ministère de l’Agriculture, des Pêcheries et de l’Alimentation.
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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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
4R: “right” means sustainable
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
Soil Test Summary – P

Eastern Canada

- 2001 - 87,708 samples
- 2005 - 173,409 samples
- 2010 - 174,684 samples

Soil Test P (Bray P1 equivalent), ppm

- ≤5
- ≤10
- ≤15
- ≤20
- ≤25
- ≤30
- ≤40
- ≤50
- >50

IPNI
Soil Test Summary – K

Eastern Canada (ON, QC, NB, NS, PEI)

- 2001 - 86,554 samples
- 2005 - 173,660 samples
- 2010 - 175,461 samples

Soil Test K, ppm

- ≤40
- ≤80
- ≤120
- ≤160
- ≤200
- ≤240
- ≤280
- ≤320
- >320
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
4R Adaptive Management for Plant Nutrition

Policy Level – Regulatory, Infrastructure, Product Development

Regional Level
Agronomic scientists, Agri-service providers

Farm Level
Producers, Crop advisers

DECISION SUPPORT based on scientific principles

Recommendation of right source, rate, time, and place (BMPs)

DECISION
Accept, revise, or reject

ACTION
Change in practice

EVALUATION of OUTCOME
Cropping System Sustainability Performance

LOCAL SITE FACTORS
- Climate
- Policies
- Land tenure
- Technologies
- Financing
- Prices
- Logistics
- Management
- Weather
- Soil
- Crop demand
- Potential losses
- Ecosystem vulnerability
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

“Old”: Pride 5, released in 1959

“New”: Pioneer 3902, released in 1988

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.
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”

Soil test-crop response trials
The database holds 5863 trial treatment series undertaken at 2935 sites. These consist of 1780 N, 2586 P, 365 K and 286 S trials.

Searching the database
Trial sites are plotted on the map as grey dots. Make a selection of trials based on the search criteria below and/or by drawing a polygon on the map around your region of interest. Always begin with a broad selection, then narrow the criteria to search the selection in more detail.

Nutrient: P ▲▼
From Year: All ▲▼
State: All ▲▼
Crop:
- cereal sorghum
- cereal triticale
- cereal wheat
- grain legume bean
- grain legume chickpea
- grain legume faba bean
- grain legume field pea
- grain legume lentil
- Calcarosol
- Calcarosol (Calcic)
- Calcarosol (Hyper–calcic)
- Calcarosol (Hypo–calcic)
- Calcarosol (Litho–calcic)
- Calcarosol (Supra–calcic)
- Chromosol

Australian Soil Class:
- All

Farming System: All ▲▼
To Year: All ▲▼
Season: winter ▼

Select trials that satisfy the selection criteria above

www.bfdc.com.au
Recommended critical level, based on search criteria is: 20 mg kg\(^{-1}\) soil test P.
Can crop nutrition match health care?

Evidence-based health care and systematic reviews

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.

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.

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

Source: Florida State University, College of Medicine. Retrieved 08.07.11.

http://www.cochrane.org
Systematic review – challenges

• “quasi” systematic reviews
• the sheer number of hypotheses to test
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
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.
Soil test P distribution, 2001-2010

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

Choice of practice considers both advantages and limitations.
4R Nutrient Stewardship Certification Standard

Requirements for Certification
For Nutrient Service Providers in the Lake Erie Watershed

Introduction

A Background

B Scope

C Goals

D Structure and Implementation

E Contact

Terms and Definitions

References

Standard – Requirements for First 3 Years

1 Initial Training and Ongoing Education

2 Monitoring of 4R Implementation

3 Nutrient Recommendations and Application

Version 2.0
October 2013
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

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