Clark Agri Service Inc. Crops Day
Kohler Agricultural Centre, Cayuga, Ontario
1 March 2016

IPNI
INTERNATIONAL
PLANT NUTRITION
INSTITUTE

4R Nutrient Stewardship for Haldimand

Tom Bruulsema, Phosphorus Program Director

Twitter
twitter.com/IPNIstewardship

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Arab Potash Company

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Shell Sulphur Solutions

Simplot

Sinofert Holdings Limited

SQM

Toros Tarım

Uralchem, JSC

Uralkali

The **International Plant Nutrition Institute** is supported by leading fertilizer manufacturers.

Its mission is to promote scientific information on responsible management of plant nutrition.

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Ancaster, Ontario – 26 June 2009 – tilled corn
SOIL EROSION IS A REAL RISK

Northwest of Guelph, Ontario – 6 April 2014 – no-till
DISSOLVED P IN RUNOFF – AN INVISIBLE RISK

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Outline

1. 4R Nutrient Stewardship & Sustainability
2. Lake Erie Phosphorus Issue
3. 4R Implementation
   - Western Lake Erie Watershed 4R Certification
   - 4R in Ontario
   - 4R Nitrogen
   - Certified Crop Adviser Specialties

- *Slides: available at* ***http://phosphorus.ipni.net***

4 nutrient stewardship

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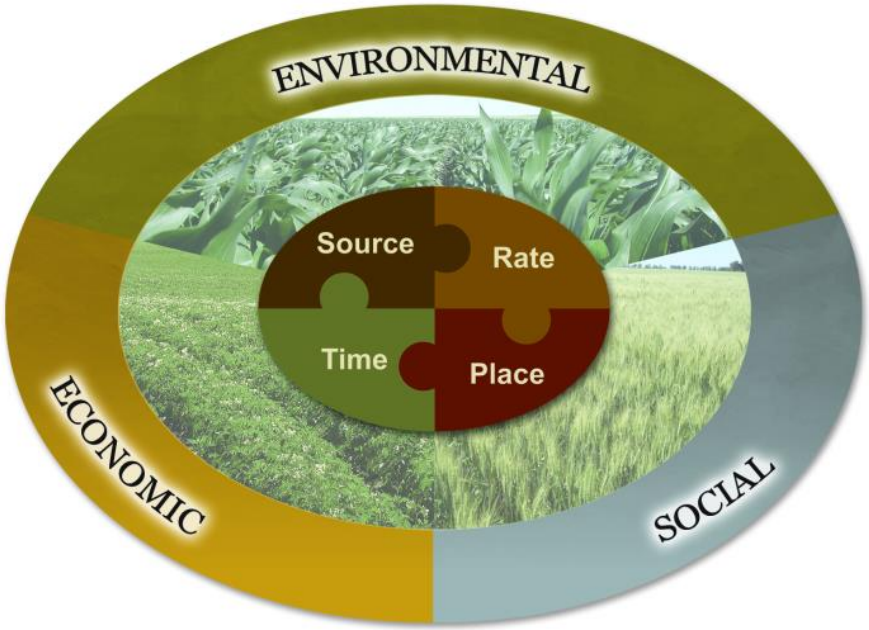
4R: “right” means sustainable



PROVISION COALITION
PROCESSING FOOD SUSTAINABLY

Walmart SustainabilityHUB

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

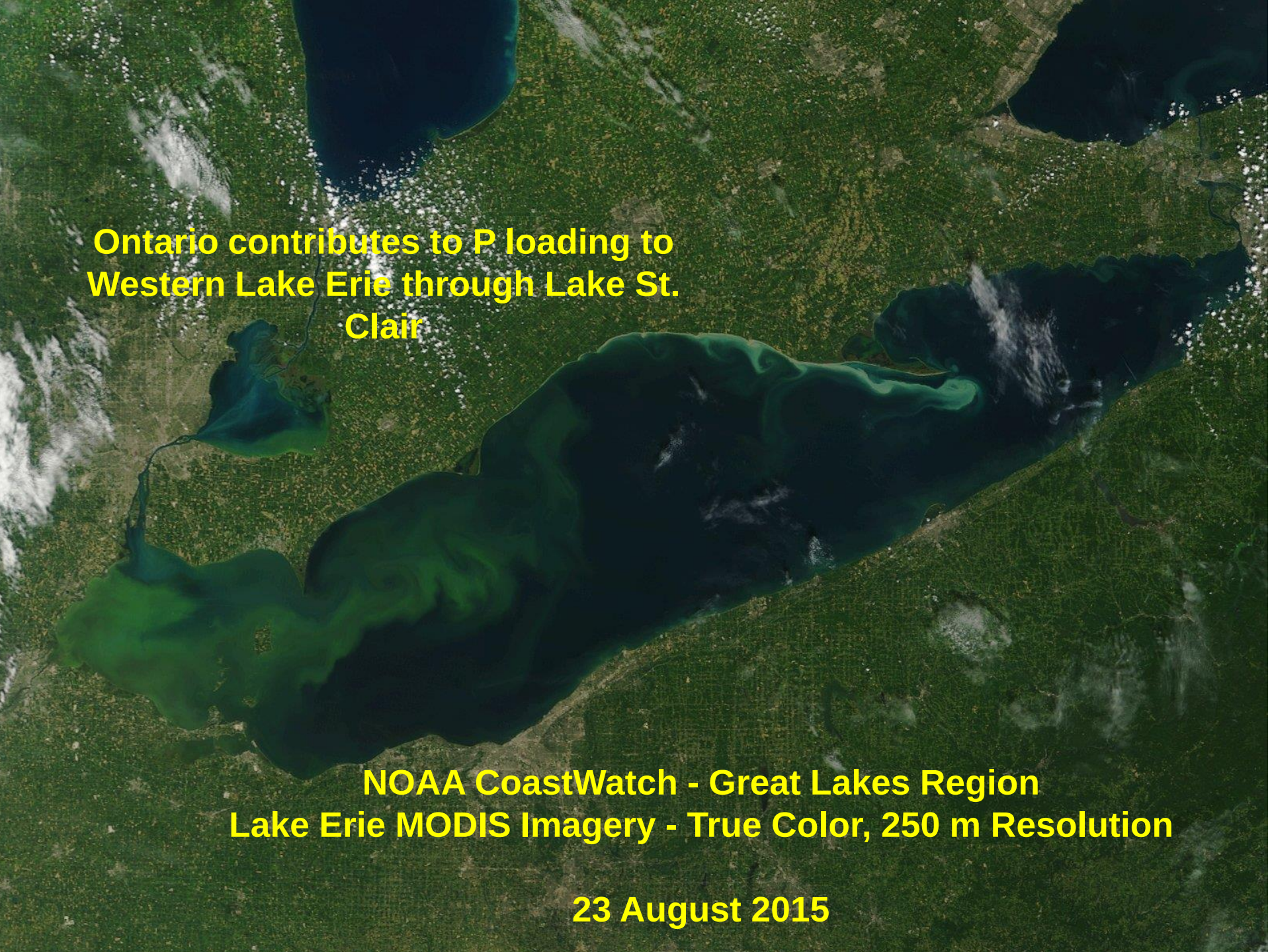
CCA - THAT'S SOUND ADVICE TM

FARM & FOOD Care ONTARIO

“Building public trust in food and farming”

4R PLANT NUTRITION

nutrient stewardship


Ontario contributes to P loading to Western Lake Erie through Lake St. Clair
NOAA CoastWatch - Great Lakes Region
Lake Erie MODIS Imagery - True Color, 250 m Resolution
23 August 2015

International Joint Commission (IJC)

More than a century of coope

Protecting Shared Resources

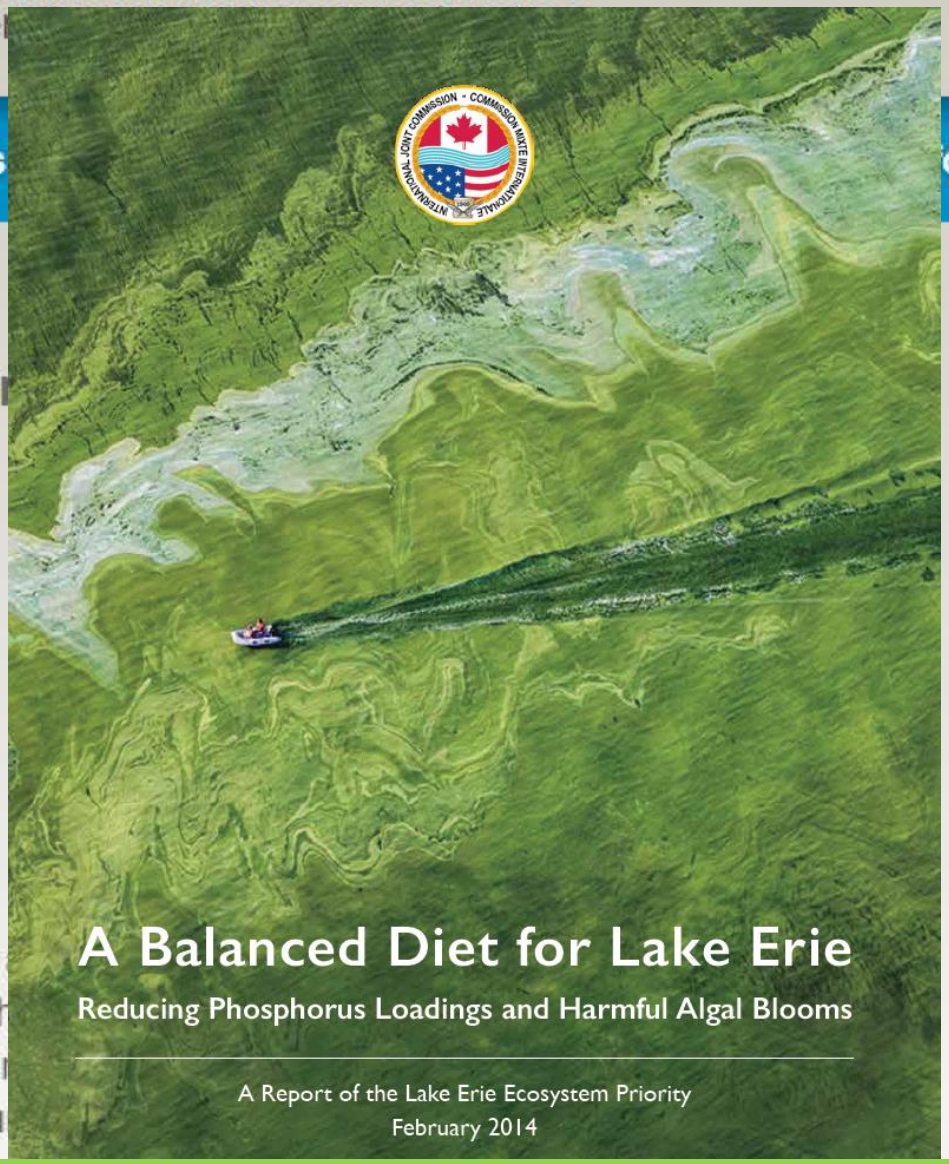
Go Back

The 4R Approach: One Tool to Contr Algae-Choked Lake Erie

IJC admin | 2014/09/04

By Nicole Frantz
IJC intern, University of Waterloo

"4 R" programs in Canada and the United States are
on best management practices. In other words, with th
Right place. The 4Rs encourage farmers to better ma
practices may make a notable difference in curbing ru



The IJC supports 4R… but calls for mandatory measures.

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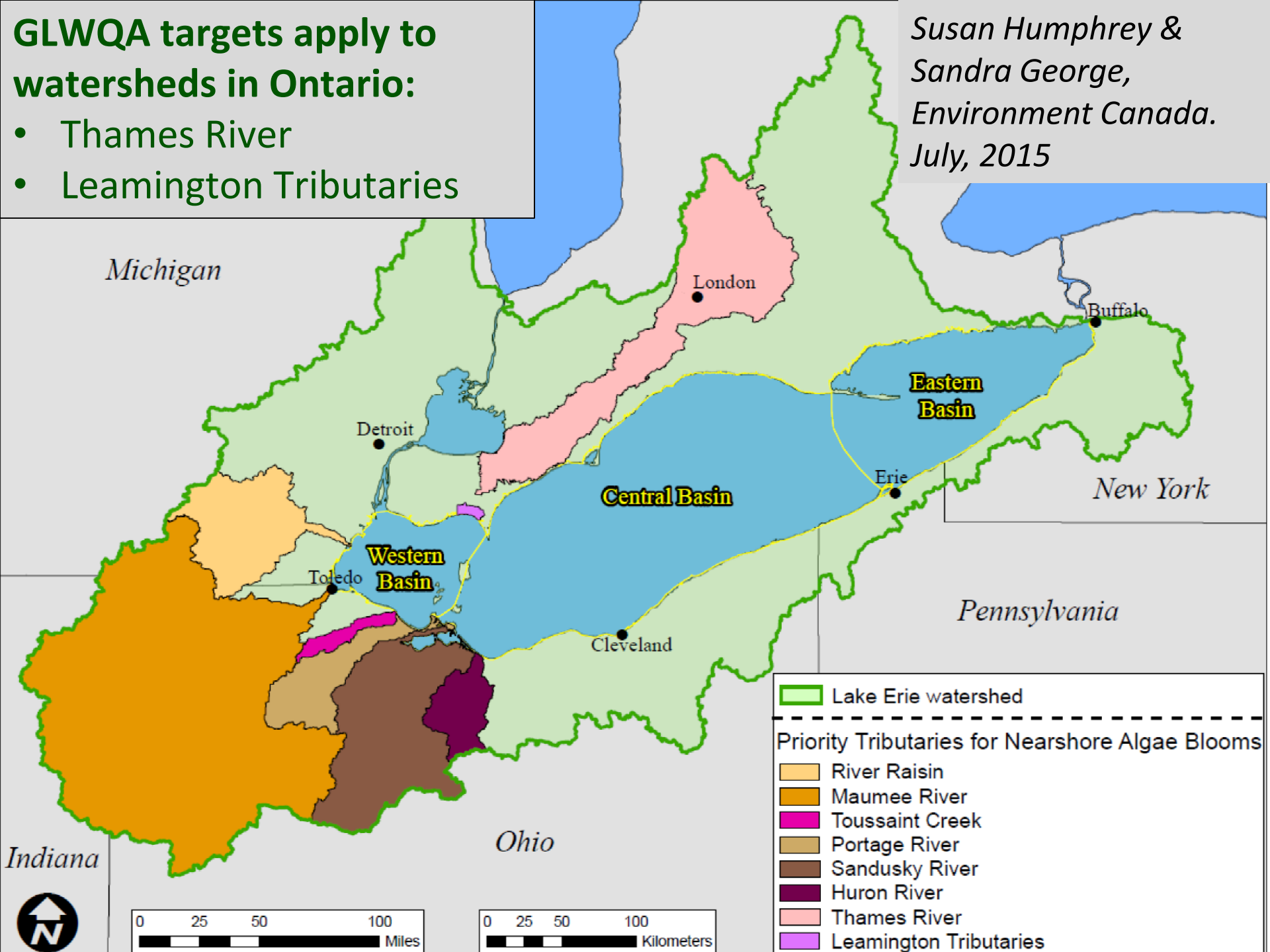
Great Lakes Water Quality Agreement

- Agricultural Task Team, Annex 4 – Nutrients – co-chaired by OMAFRA and Ohio Department of Agriculture
- By February 2016 – binational phosphorus objectives, loading targets and allocations… starting with Lake Erie.
- By 2018 – phosphorus reduction strategies and domestic action plans [*regulatory and non-regulatory programs and other measures*] designed to meet the nearshore and open water phosphorus objectives and loading targets for Lake Erie.

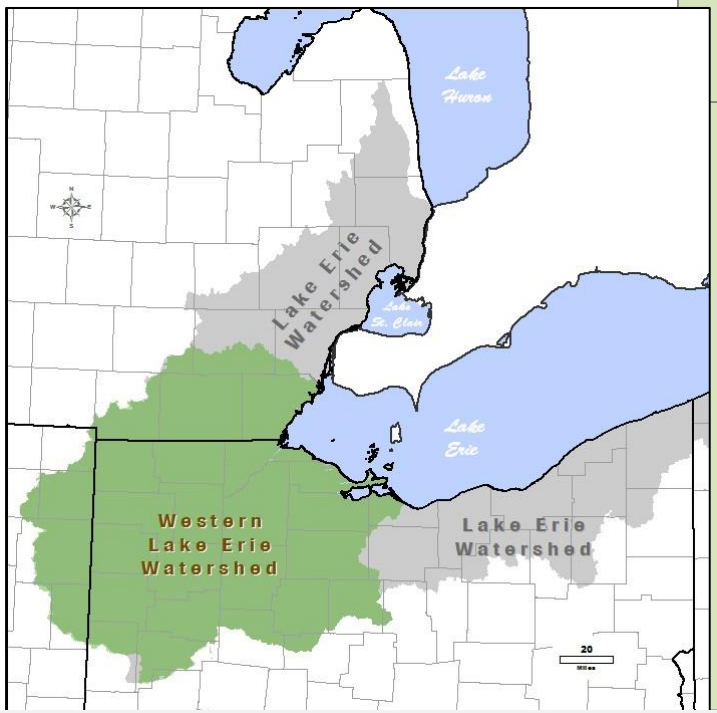
GLWQA targets apply to watersheds in Ontario:

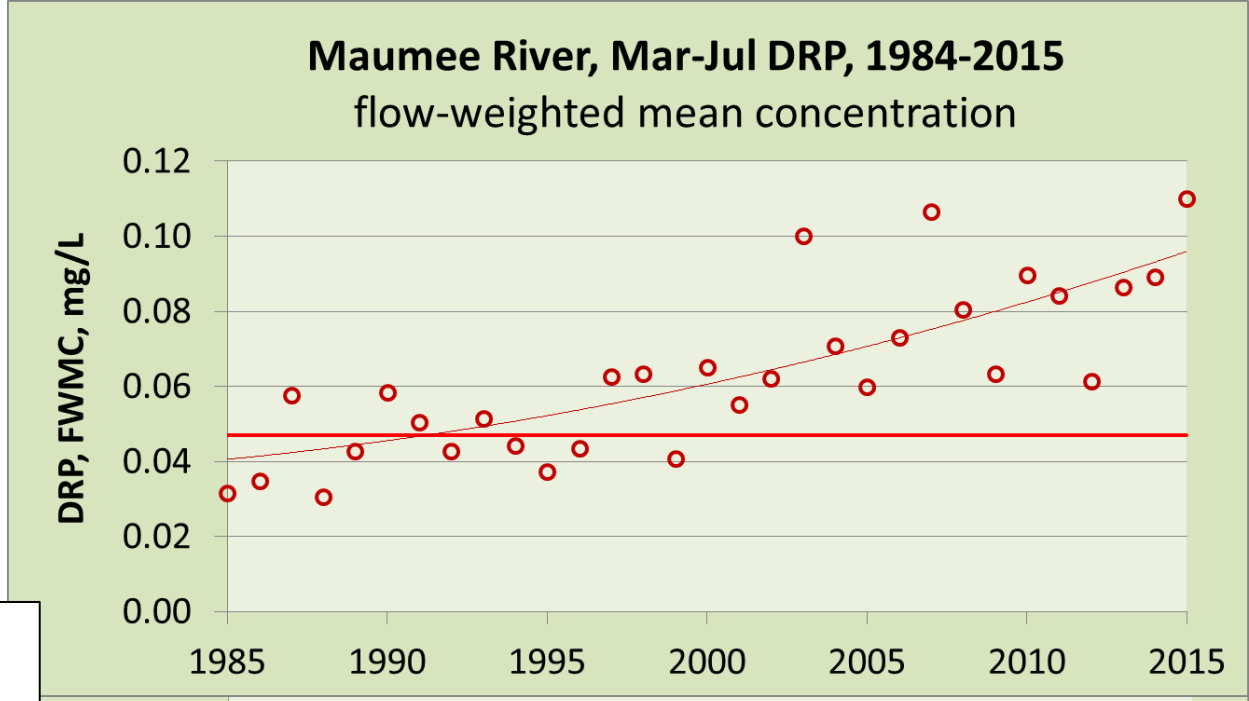
- Thames River
- Leamington Tributaries

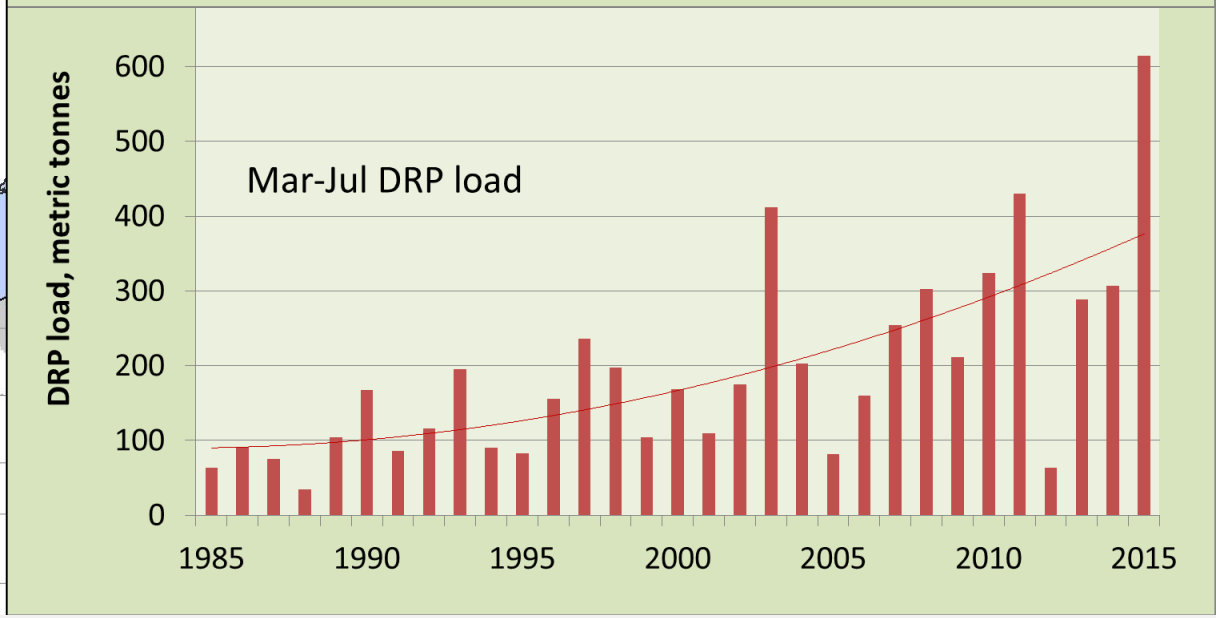
Susan Humphrey & Sandra George, Environment Canada. July, 2015



Western Lake Erie: dissolved P trends increasing since early 1990s







GLWQA Annex Nutrients Committee, May 2015
David Baker & Laura Johnson, National Center for Water Quality Research, Tiffin, OH

Developing 4R Nutrient Stewardship Certification

The Andersons

MABA

AGRIbusiness Council of INDIANA

MORRAL COMPANIES

Michigan Corn Growers Association

CAP CONSERVATION action PROJECT

SOIL AND WATER RESOURCES
Ohio Department of Natural Resources

The Fertilizer Institute
Nourish, Replenish, Grow

The Nature Conservancy
Protecting nature. Preserving life.™

SOY OHIO
Ohio Soybean Council
www.soyohio.org

INDIANA CONSERVATION PARTNERSHIP

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Ohio AgriBusiness Association

Ohio Federation of Soil and Water Conservation Districts

NRCS

Legacy Farmers Cooperative

WESTERN LAKE ERIE BASIN PARTNERSHIP

EDF ENVIRONMENTAL DEFENSE FUND
Finding the ways that work

OHIO FARM BUREAU

FARMERS ELEVATOR

Nester Ag LLC

SANDUSKY RIVER WATERSHED COALITION

MAEAP

MICHIGAN STATE UNIVERSITY

THE OHIO STATE UNIVERSITY

OhioCorn&Wheat Growers Association

AMERICAN SOCIETY OF AGRONOMY
CERTIFIED CROP ADVISER

WLEB 4R Certification Program

RIGHT SOURCE

Matches fertilizer type to crop needs

- Account for all sources of nutrients in recommendations

RIGHT RATE

Matches amount of fertilizer to crop needs

- Conduct soil tests regularly in uniform areas less than 25 acres
- Document crop yield goals based on crop history
- Base nutrient application on Tri-State recommendations or adaptive management using soil test and yield goals
- Calibrate nutrient application equipment annually

RIGHT PLACE

Keeps nutrients where crop can use them

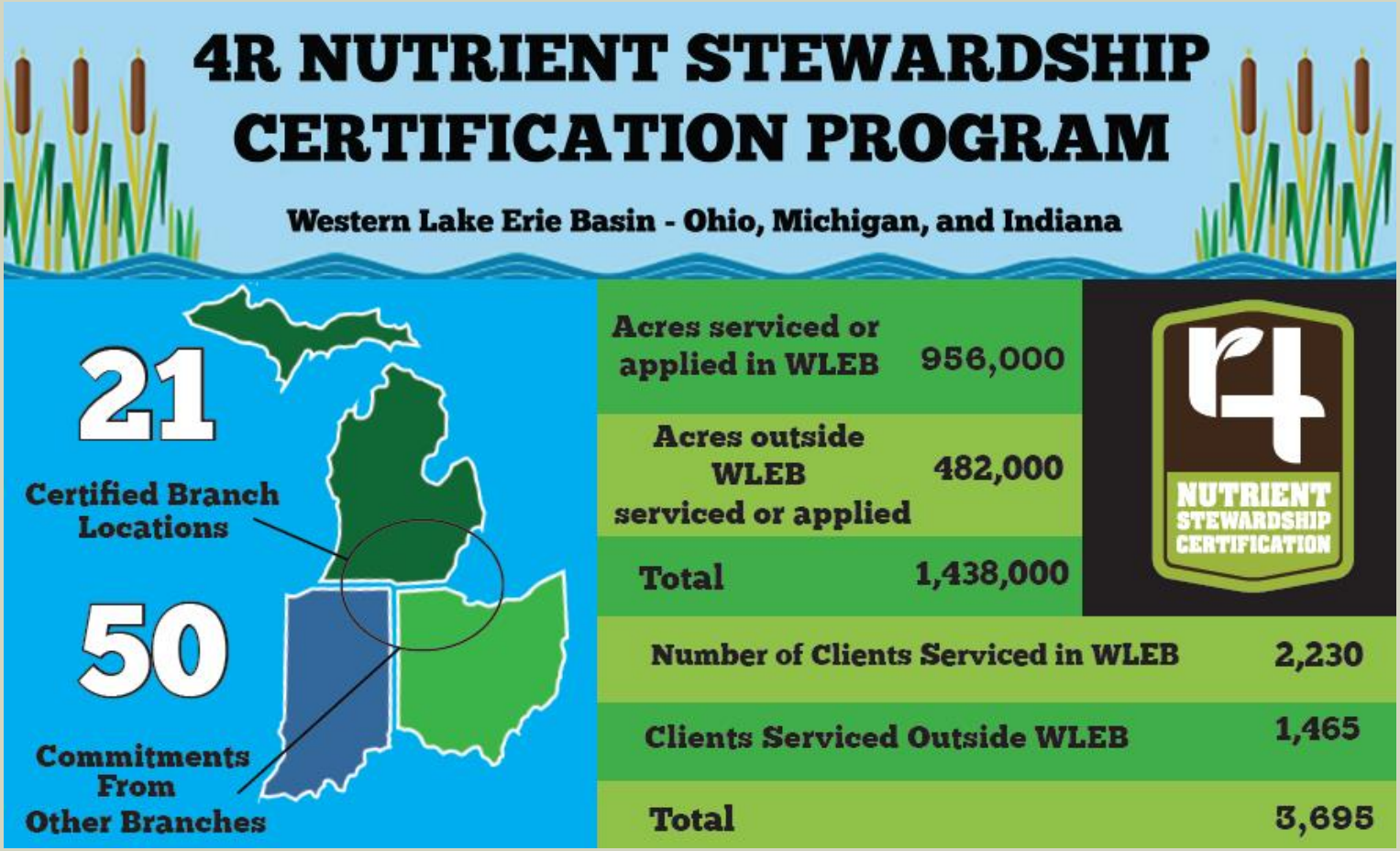
- Utilize variable rate application
- Utilize phosphorus injection, subsurface banding or broadcasting with immediate incorporation
- Don't broadcast apply nutrients without incorporation unless the risk of phosphorus loss is demonstrated to be low
- Apply nutrients using minimum setbacks from sensitive areas

RIGHT TIME

Makes nutrients available when crops need them

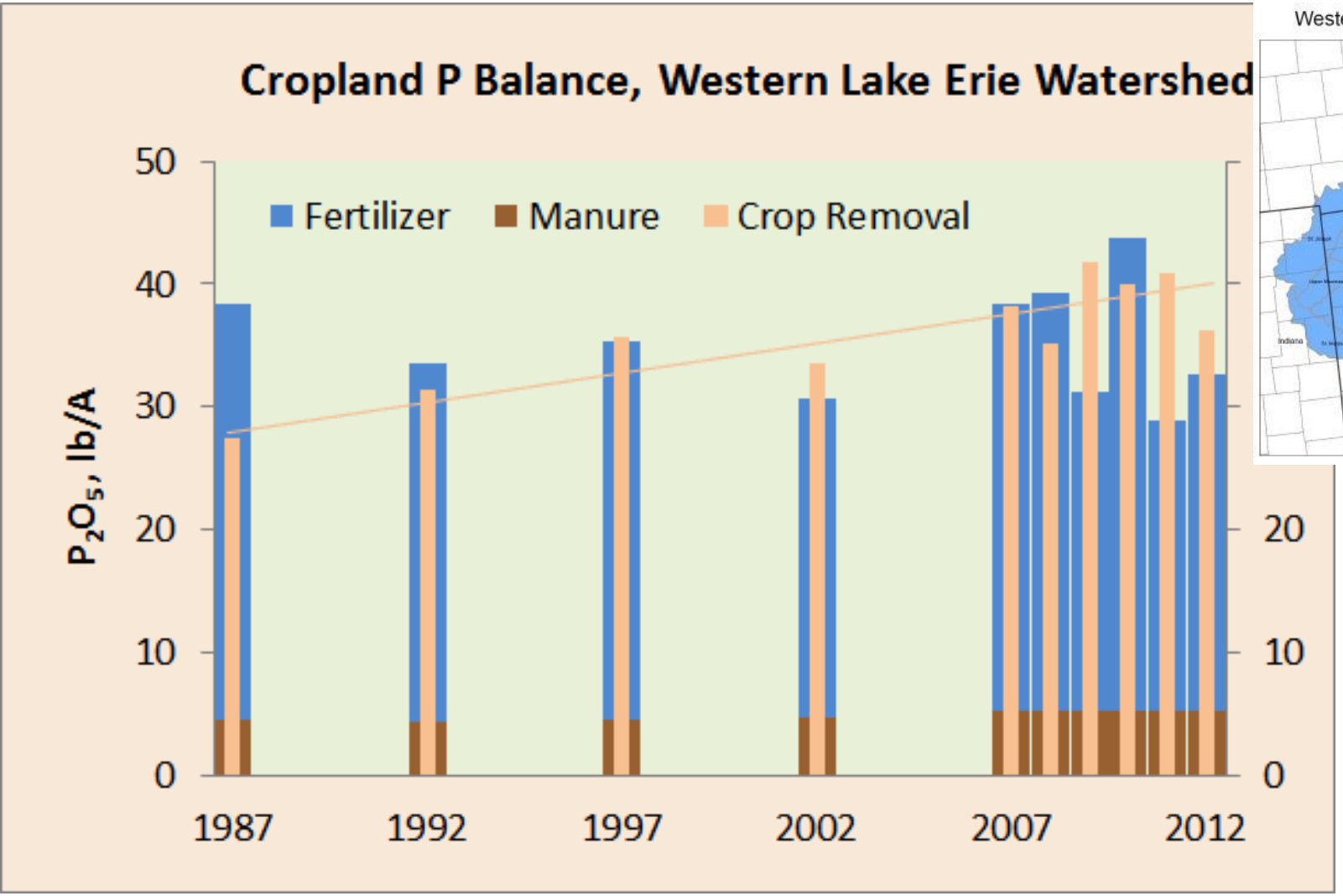
- Don't apply phosphorus on frozen or snow covered ground
- Don't apply phosphorus or nitrogen if a large rainfall is in the weather forecast

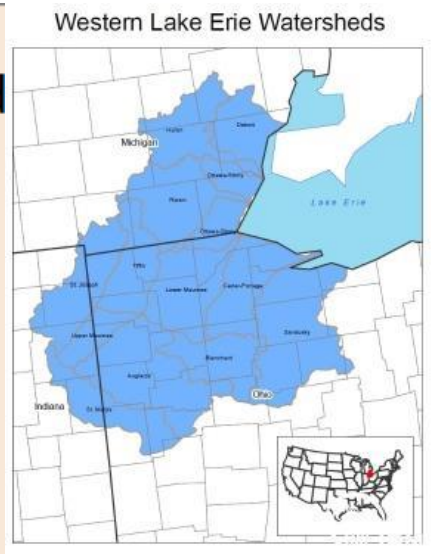
WLEB 4R Certification Program



The Fertilizer Institute
Nourish, Replenish, Grow

http://4Rcertified.org/





1. Crop removal increasing with yield.
2. Application rates falling short of crop removal.

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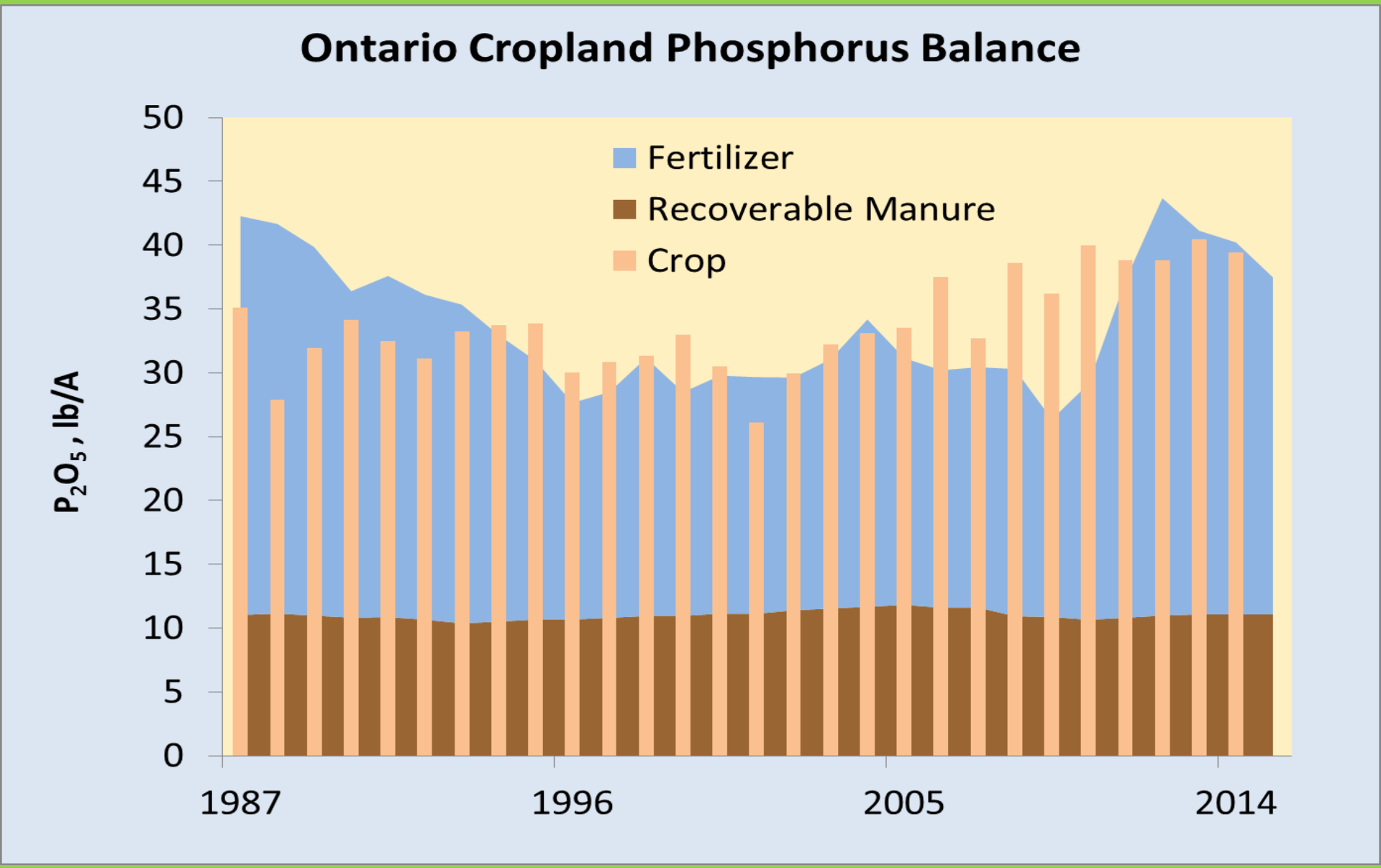
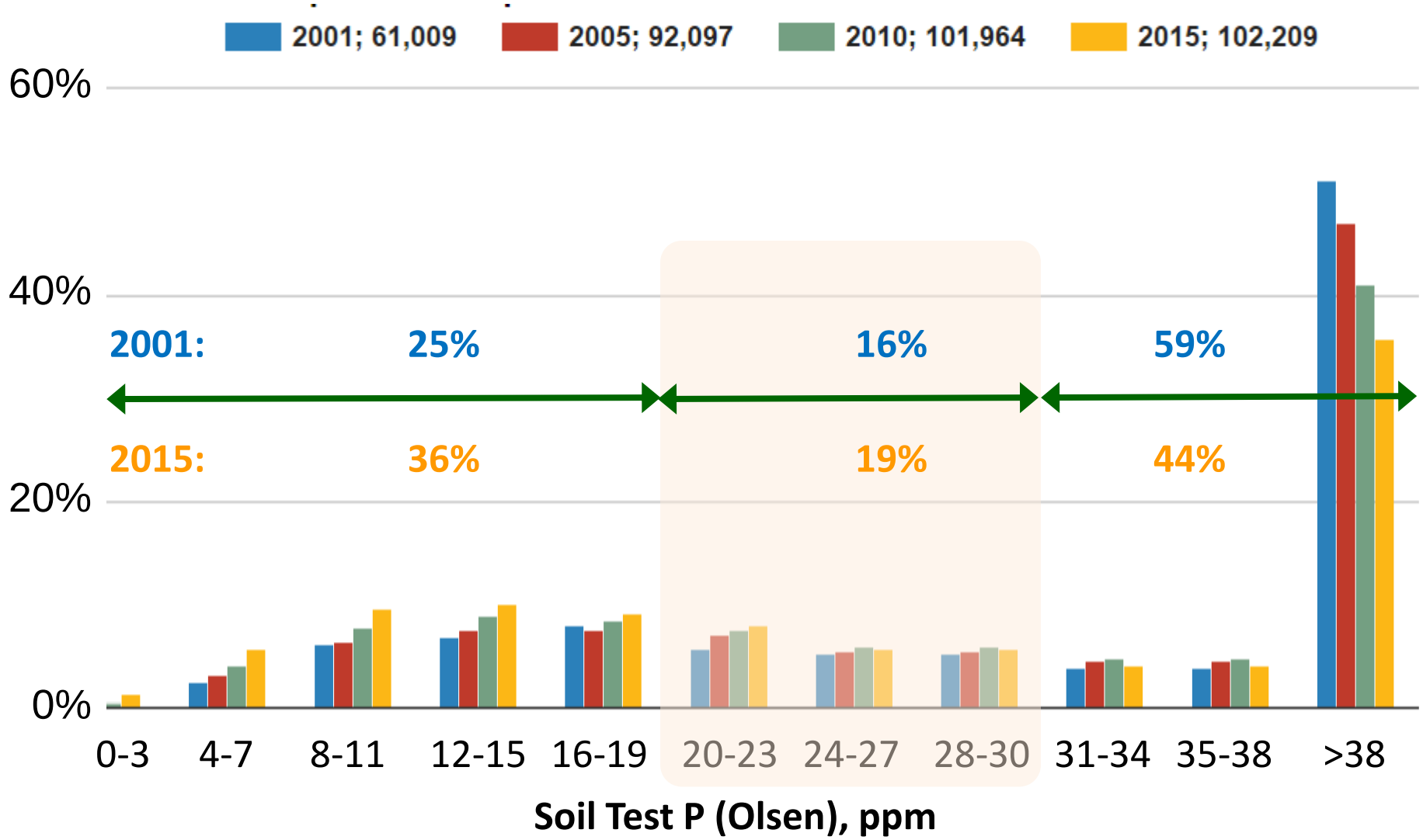
NuGIS
Nutrient Use Geographic Information System

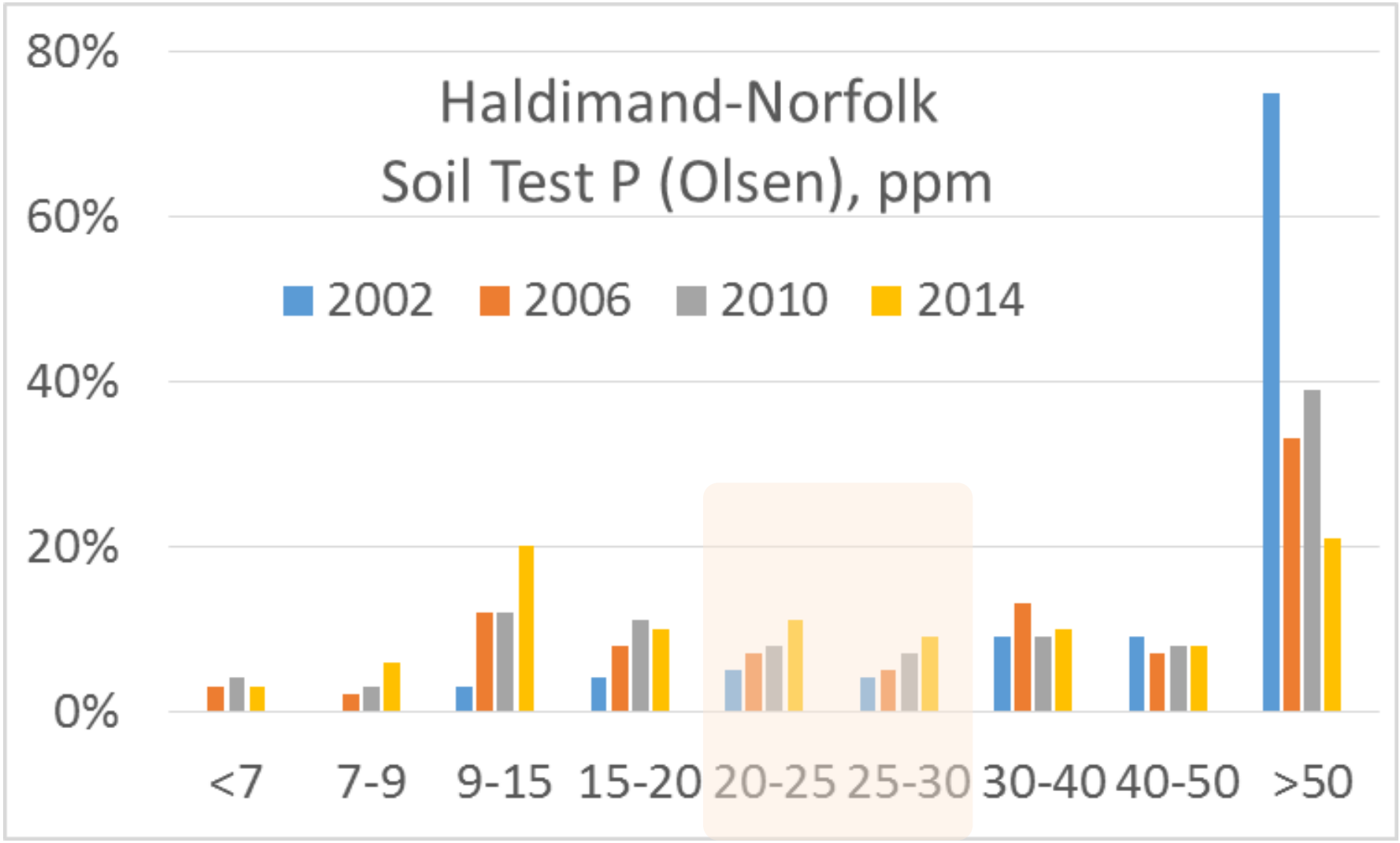


Ontario's P balance: more manure than in the Lake Erie watershed

Ontario has more soils very high in P than Ohio

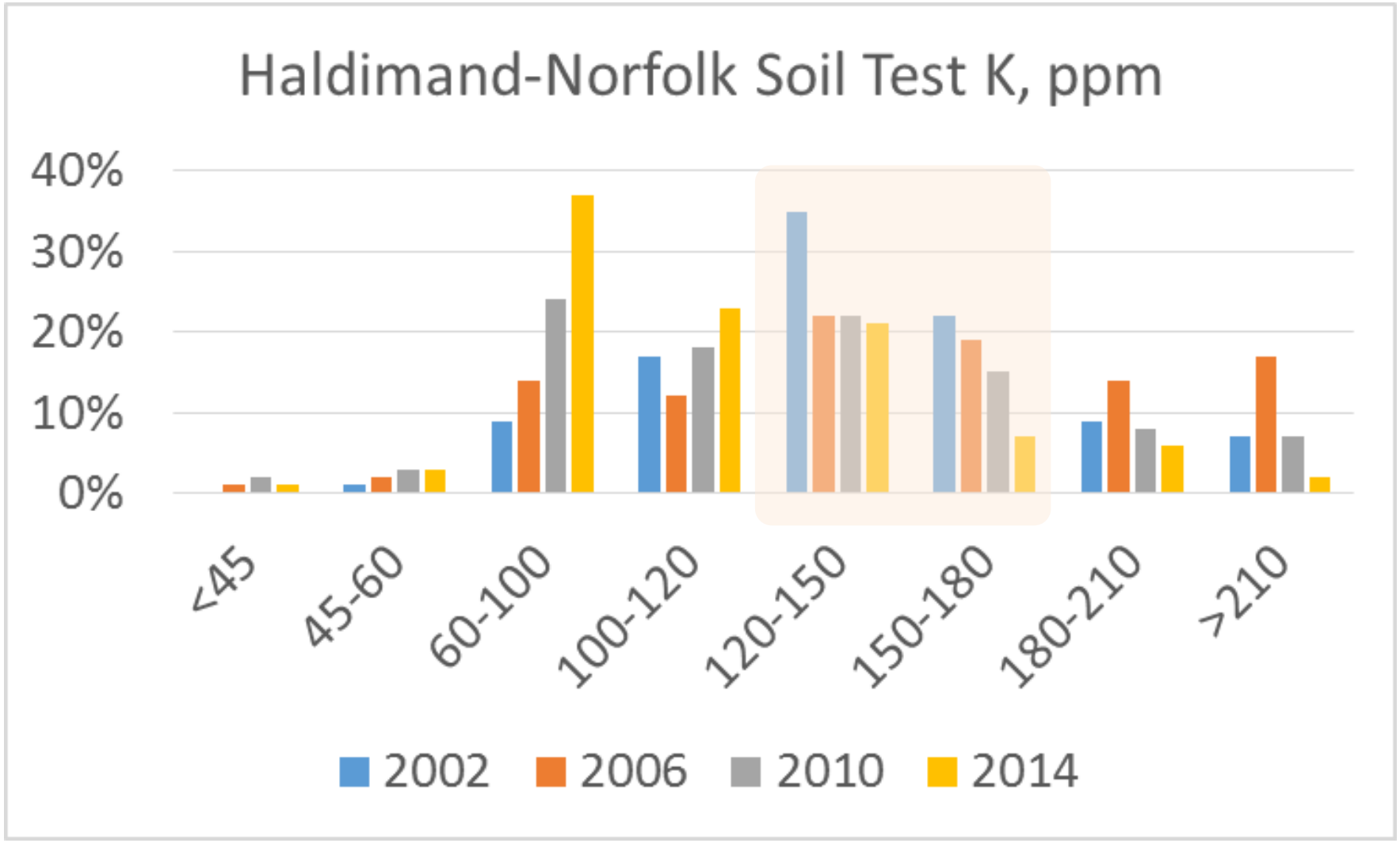


http://soiltest.ipni.net



Haldimand-Norfolk reflects Ontario

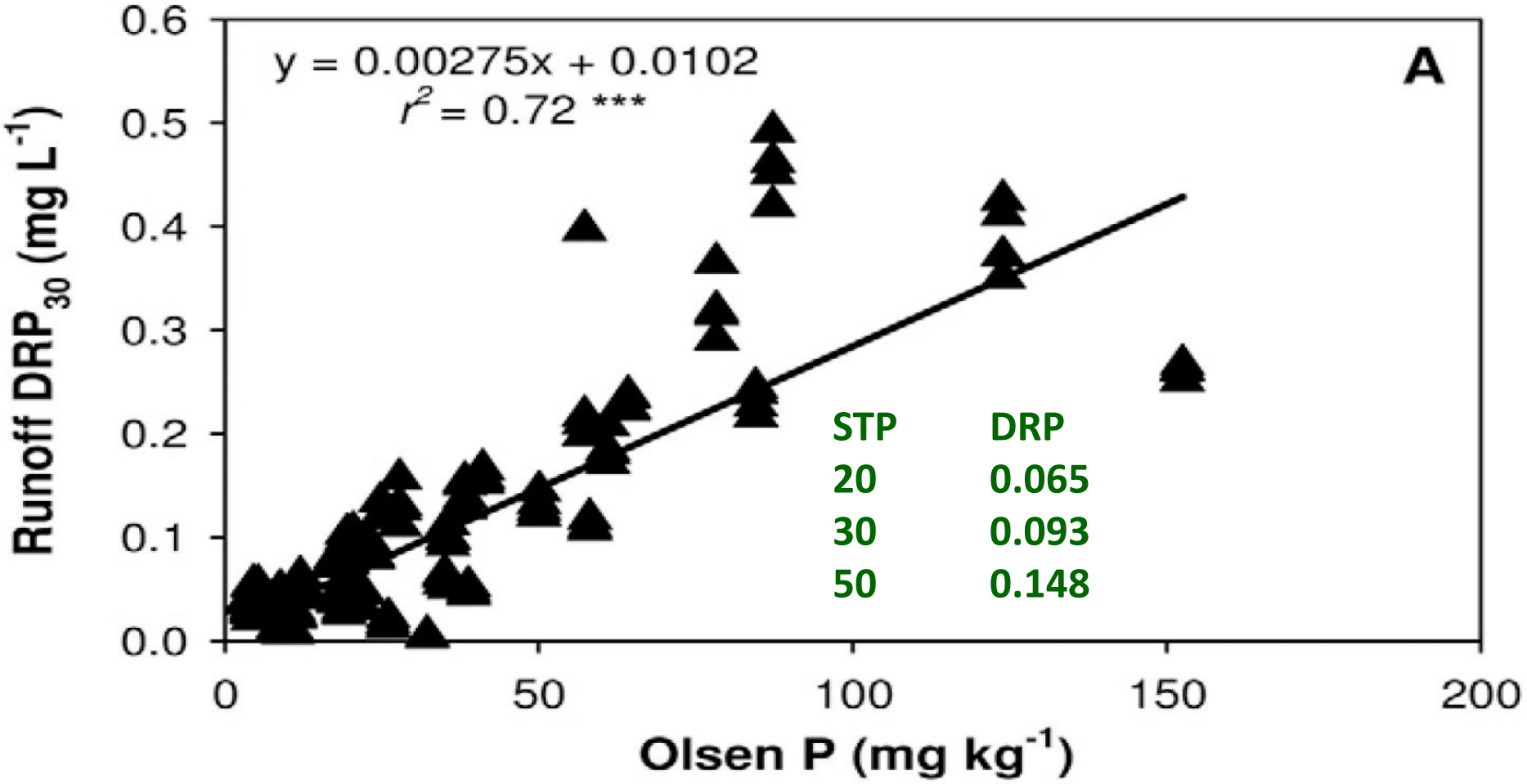
Jack Legg, SGS Agri-Food Laboratories



Many Haldimand-Norfolk soils need more potash

Jack Legg, SGS Agri-Food Laboratories

Soil test P and runoff P in Ontario



Six soil series, ten sites each, ranging in soil test P.
Standardized runoff boxes, rainfall applied at 3” per hour for 30 minutes runoff.

Wang et al., 2010. J. Environ. Qual. 39:1771–1781

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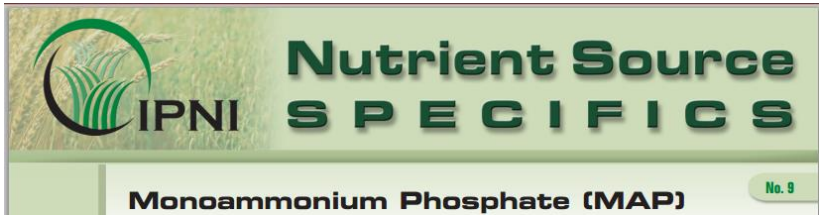
Fertilizer P is Soluble P

- MAP (11-52-0) has water solubility of 370 g/L
- = 84 grams P per litre
- = 84,000 mg P per litre

- Maumee river target for DRP = 0.047 mg P per litre
- Targets for Lake Erie:
  Western Basin – 0.012 mg/L
  Central Basin – 0.006 mg/L
  Eastern Basin – 0.006 mg/L



Chemical Properties

Chemical formula:	$NH_4H_2PO_4$
P_2O_5 range:	48 to 61%
N range:	10 to 12%
Water solubility (20°)	370 g/L
Solution pH	4 to 4.5

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Fall Strip-till Banding

- Puts the P in the soil
- Keeps residue on the soil
- RTK GPS for precision planting

Greg LaBarge, Ohio State University Extension

Effect of tillage on preferential flow and phosphorus transport

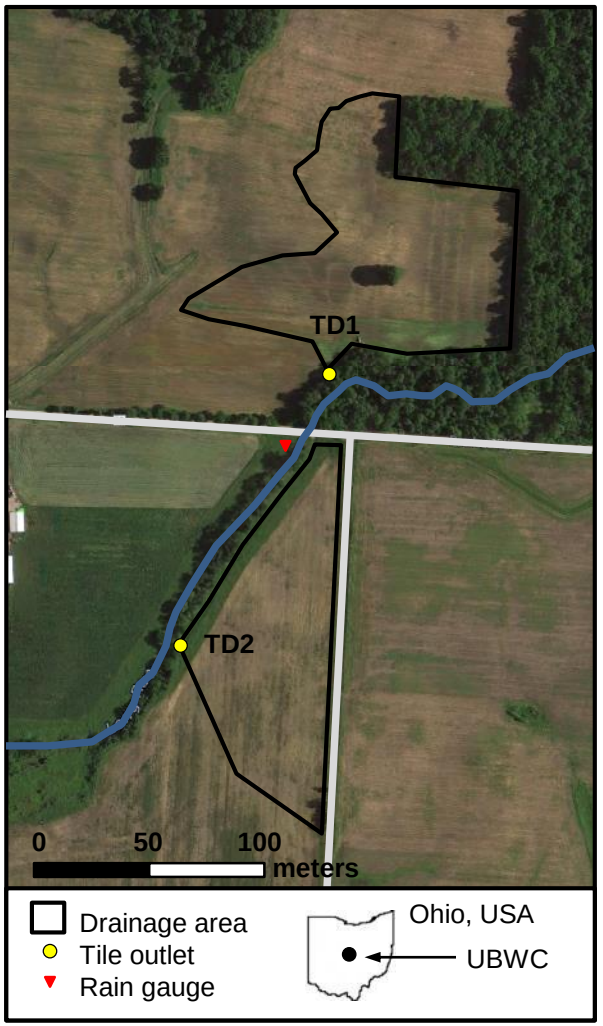
Soil type: Silt loam
Tile depth: 90 cm
Soil test P: 30 ppm Mehlich-3P
Tillage: No-till

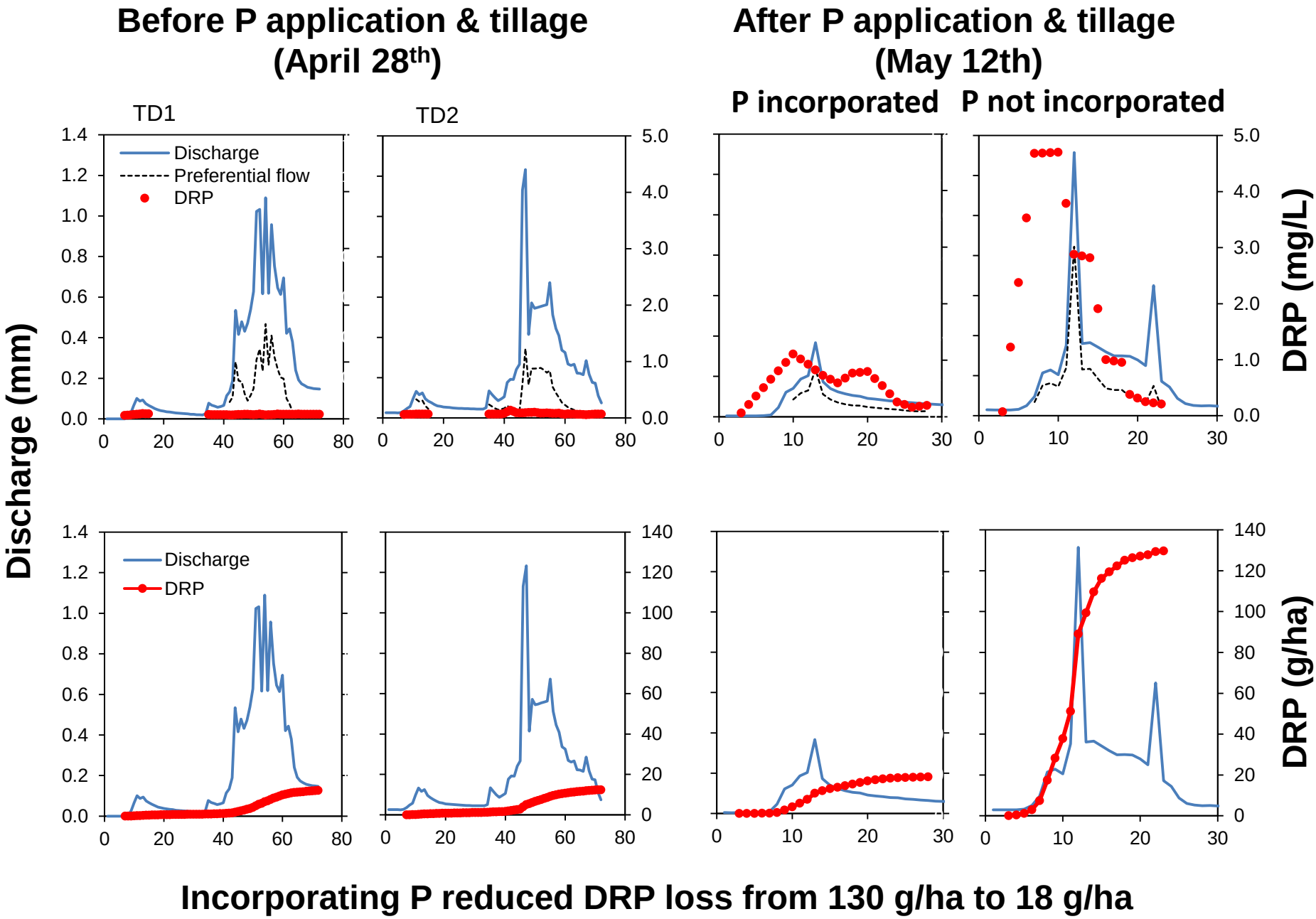
2014 management

May 6th – Applied MAP @ 45 kg P/ha
May 8th – Tilled field TD1 (disc)
(TD2 remained no-till)

Study Objective

Compare P transport before and after tillage and between tilled and no-till fields





Williams and King, USDA-ARS, Columbus, Ohio

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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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.

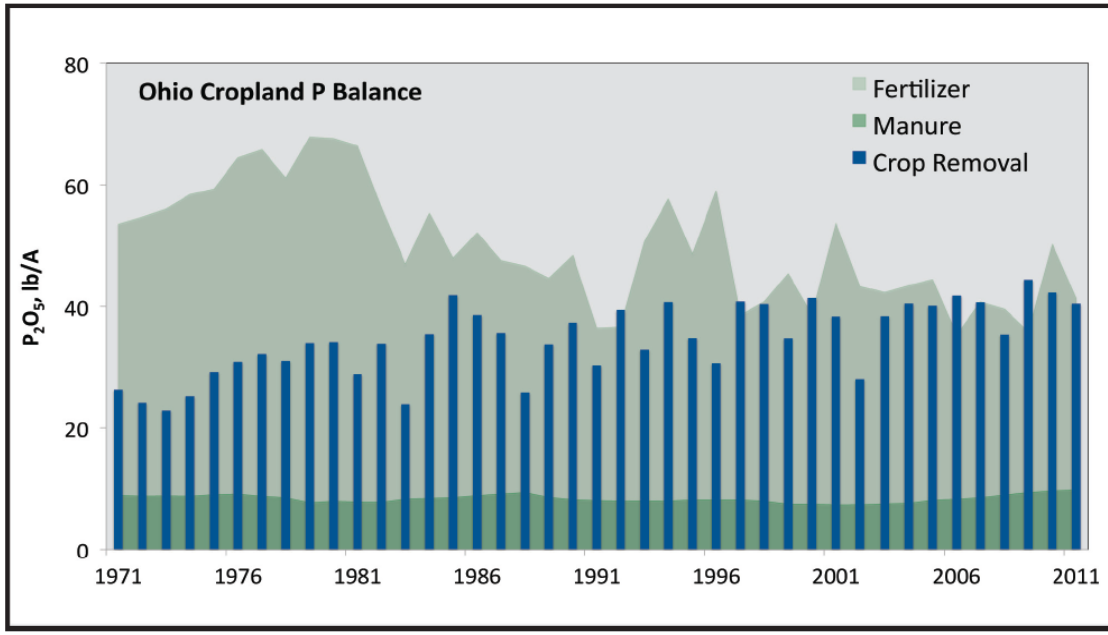
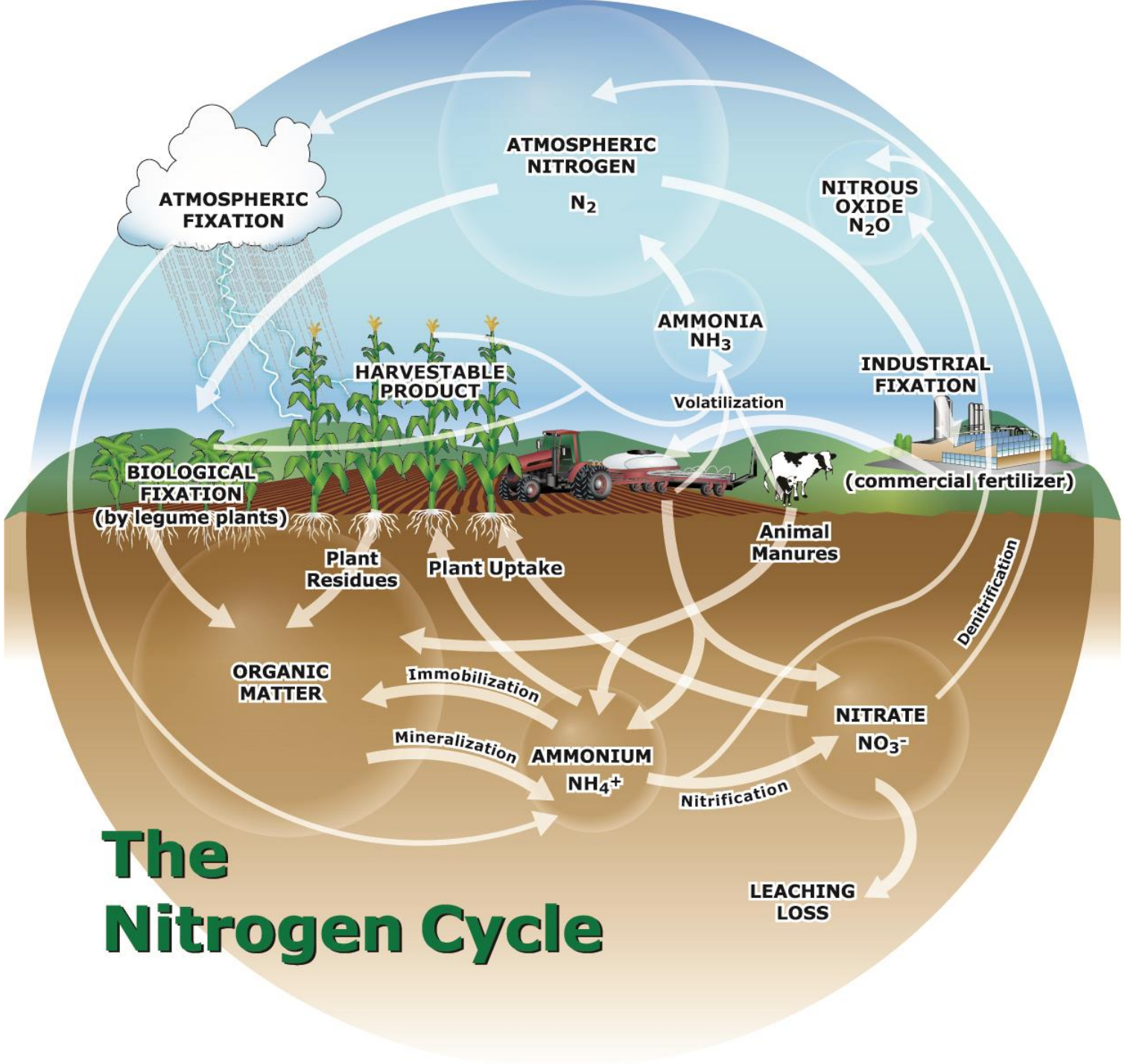


Figure 2. Phosphorus balance trend over time for Ohio cropland. *2011 fertilizer estimated.

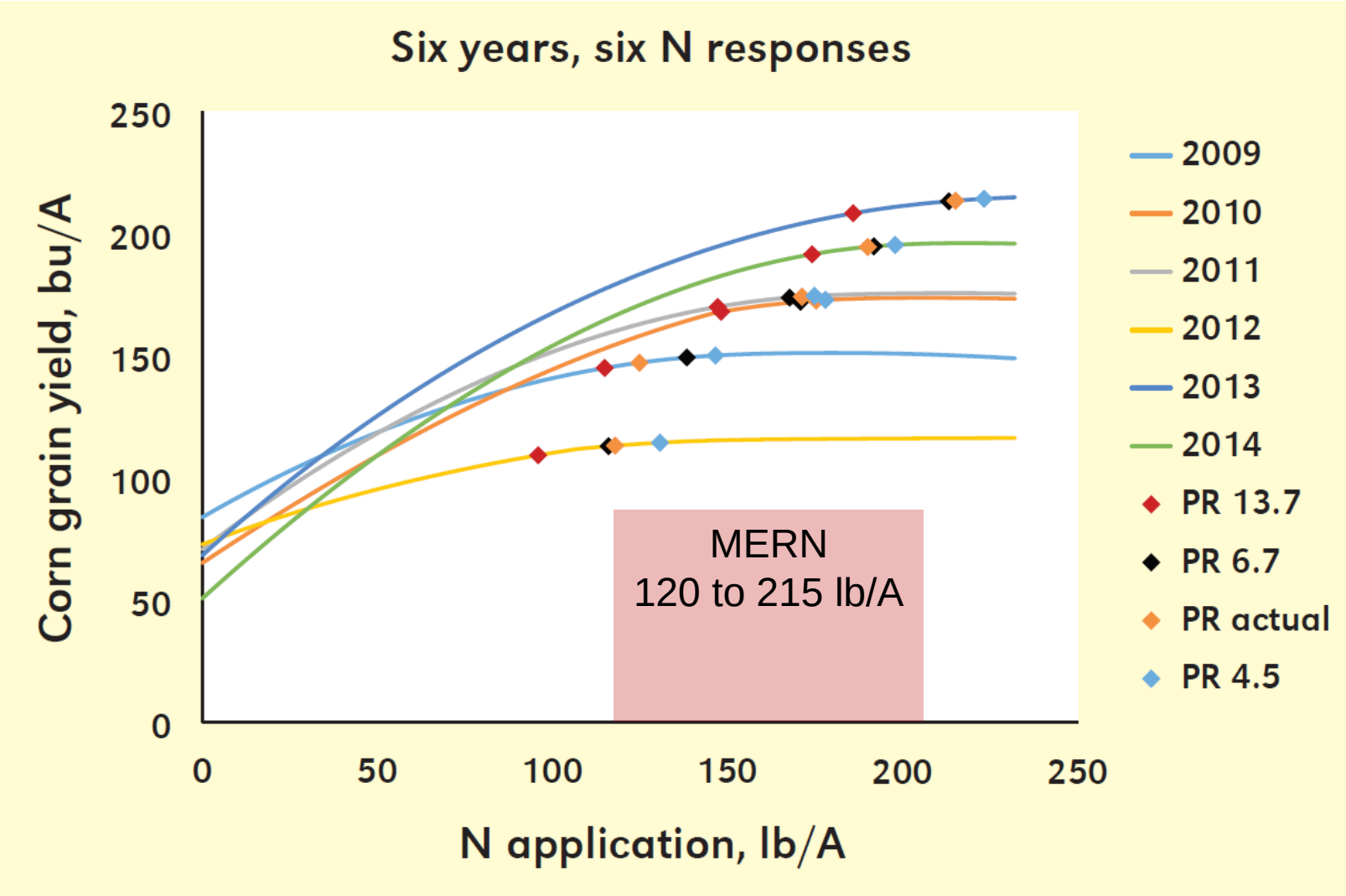
Background

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


ATMOSPHERIC FIXATION
ATMOSPHERIC NITROGEN
N_2
NITROUS OXIDE
N_2O
AMMONIA
NH_3
HARVESTABLE PRODUCT
Volatilization
INDUSTRIAL FIXATION
(commercial fertilizer)
BIOLOGICAL FIXATION
(by legume plants)
Plant Residues
Plant Uptake
Animal Manures
Denitrification
ORGANIC MATTER
Immobilization
Mineralization
AMMONIUM
NH_4^+
NITRATE
NO_3^-
Nitrification
LEACHING LOSS
The Nitrogen Cycle

Weather influences corn response to N

first 6 years, Elora, Ontario



Deen et al. 2015. Better Crops 99(2):16-18

Potential 4R Corn Nitrogen Practice Definitions

Level	Source	Rate	Time	Place
Basic	Guaranteed or known analysis	Rate based on Ontario N Calculator	Spring; not on frozen soil	Broadcast & incorporated, injected or subsurface band
Intermediate	+ with inhibitors if surface applied	+	+ Split application, or EEF	+, or sidedress, with inhibitors if surface applied
Advanced	+	+ and variable rate using tools such as crop sensors, PSNT, and/or models for weather	+	+

Define levels of 4R to support metrics

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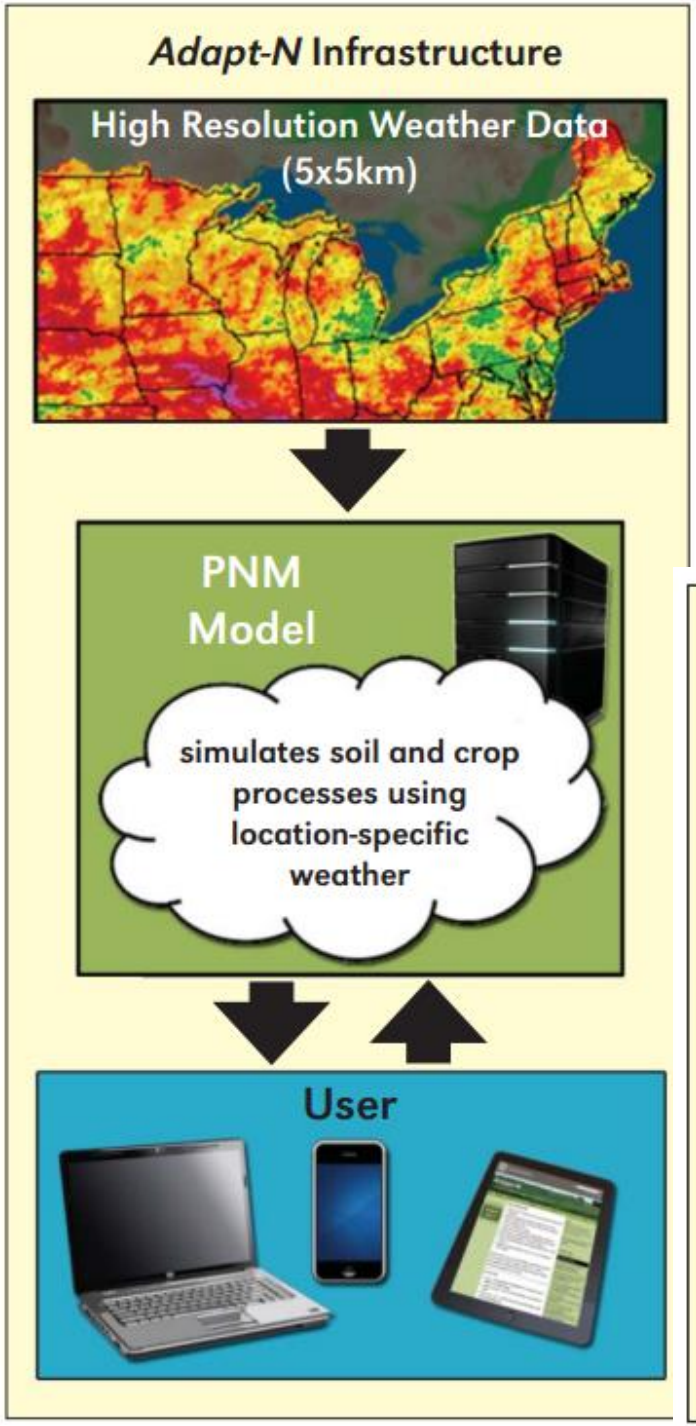
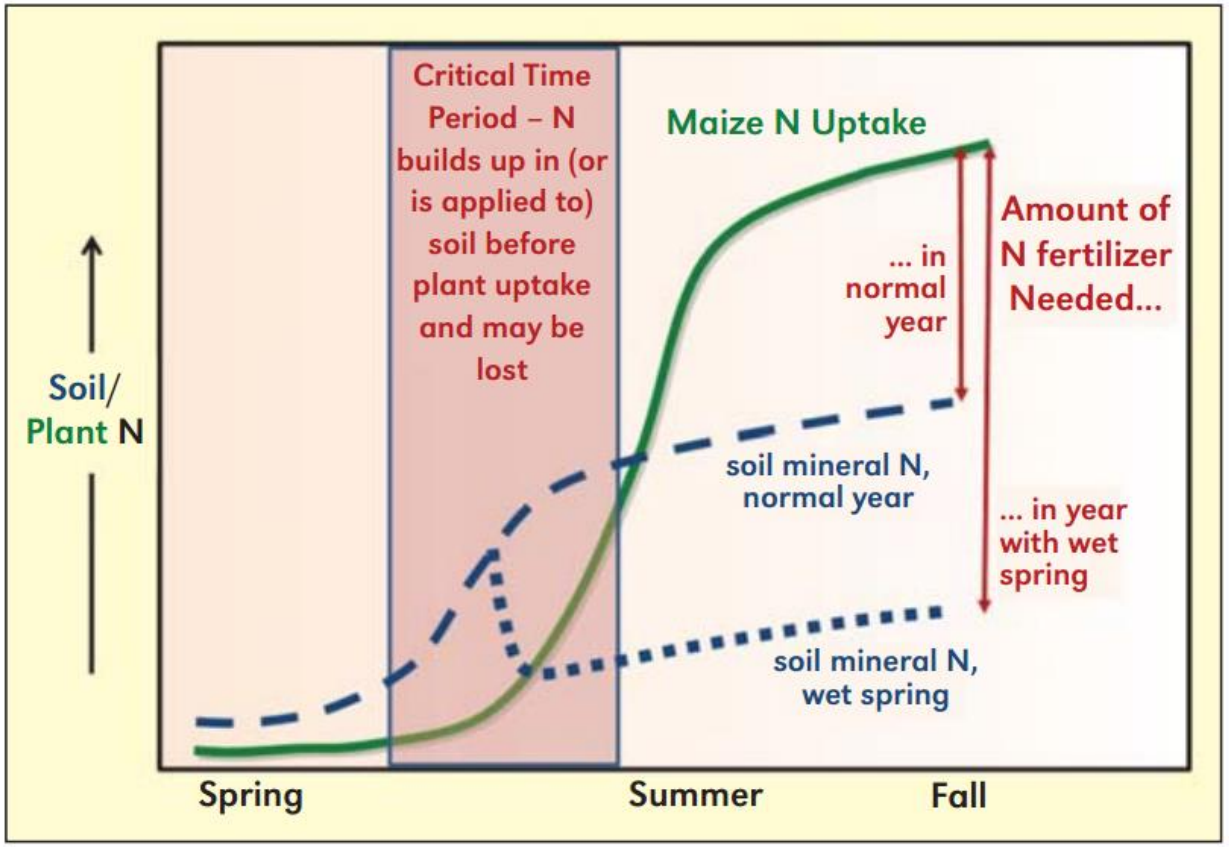
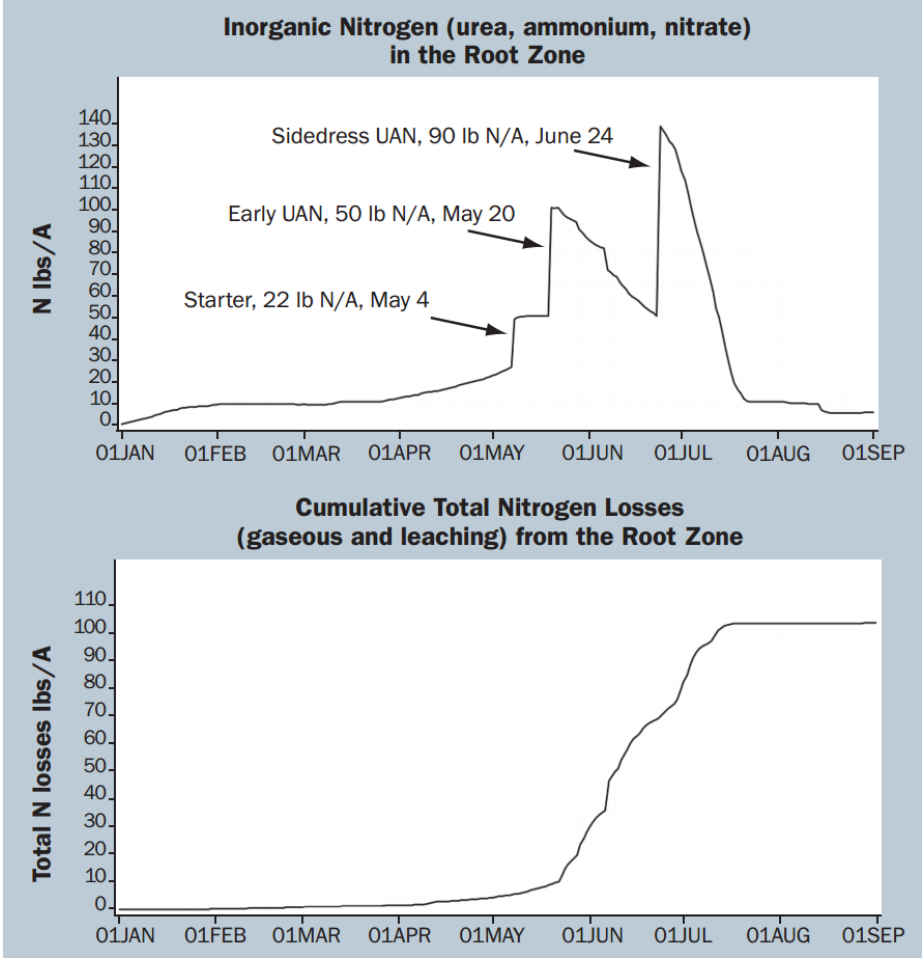
Common elements of model-based nitrogen decision support





Adapt-N validation in NY

The Richardson Farm crew (left to right): Arnold, Eric, and Ryan Richardson and Nick Humphrey.



- 2013: ↑ N rates by 20-40 lb/A, ↑ yields by 22-30 bu/A, ↑ profit $90-$120/A.
- "Arnold and sons were struck by the tool's graphs of soil N availability and rainfall, which clearly showed the farm's weather-related early N losses."
- 2011-2012: ↓ average N rates by 66 lb/A, ↑ profit by $31/A.

Ball, Moebius-Clune, van Es & Melkonian. 2014. IPNI 4R Plant Nutrition Manual Case Study 7.4-4

“Sidedress”

- **Traditionally, coulter injection at 6-12” plant height**
- **On-farm in NY – high-clearance drop tubes provide more flexibility in application timing**
- **UAN with urease inhibitor**

DeGolyer, D. 2014. Western NY Crop Management

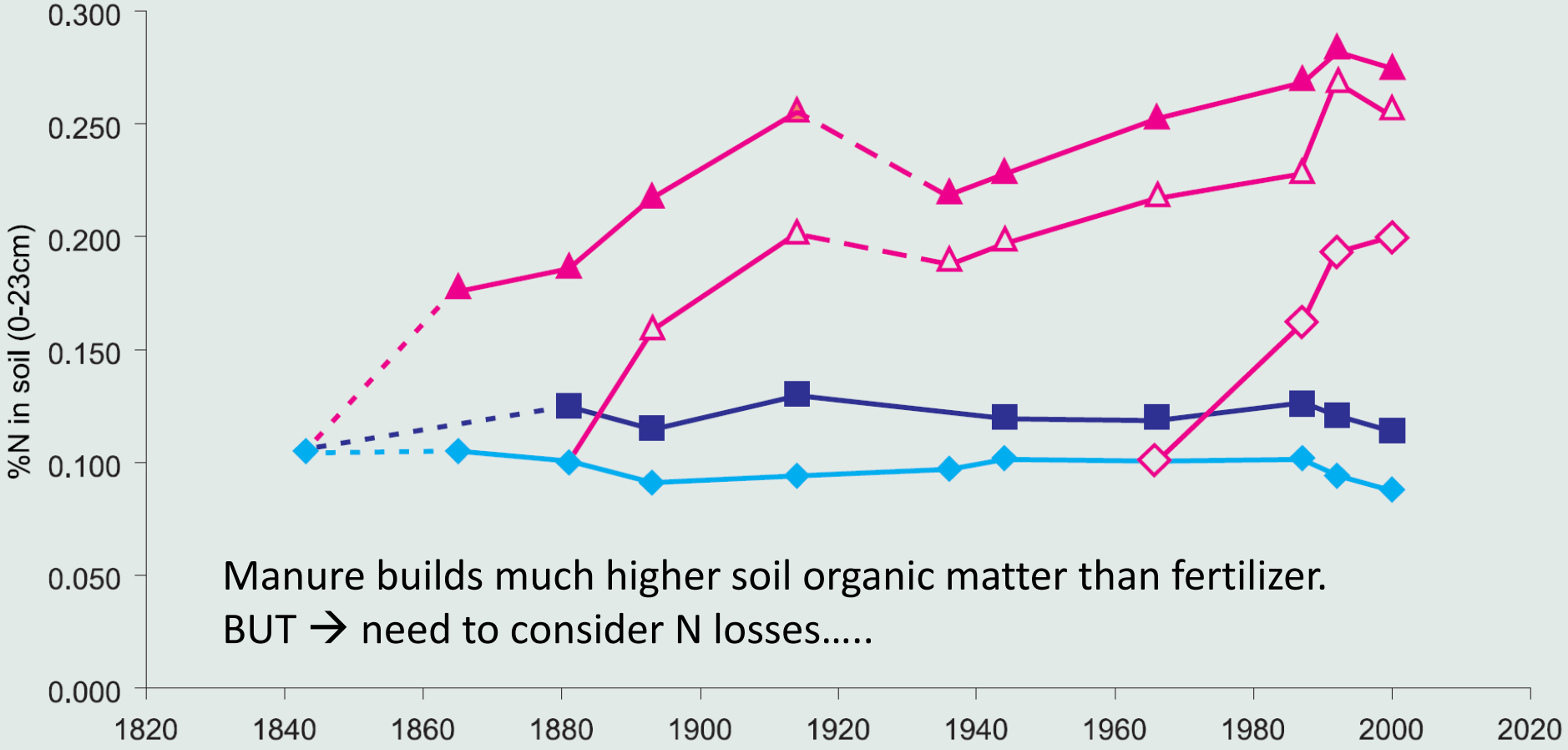
Soil Organic Matter
depends on crop
residue input

Average corn yields (1989-1993) and soil organic matter levels for a Brookston clay loam soil under different management practices since 1959.

Management Practice	Fertilization $N\text{-}P_2O_5\text{-}K_2O$ (lb/A)	Grain Yield bu/A	Organic Matter %
Continuous corn	115-70-30	104	3.6
Continuous corn	0-0-0	13	3.1
Rotation corn	115-70-30	145	4.4
Rotation corn	0-0-0	65	3.3

Gregorich & Drury, 1996

Fig.3 Broadbalk. Long-term changes in soil nitrogen



Manure builds much higher soil organic matter than fertilizer.

BUT → need to consider N losses…..

ROTHAMSTED RESEARCH

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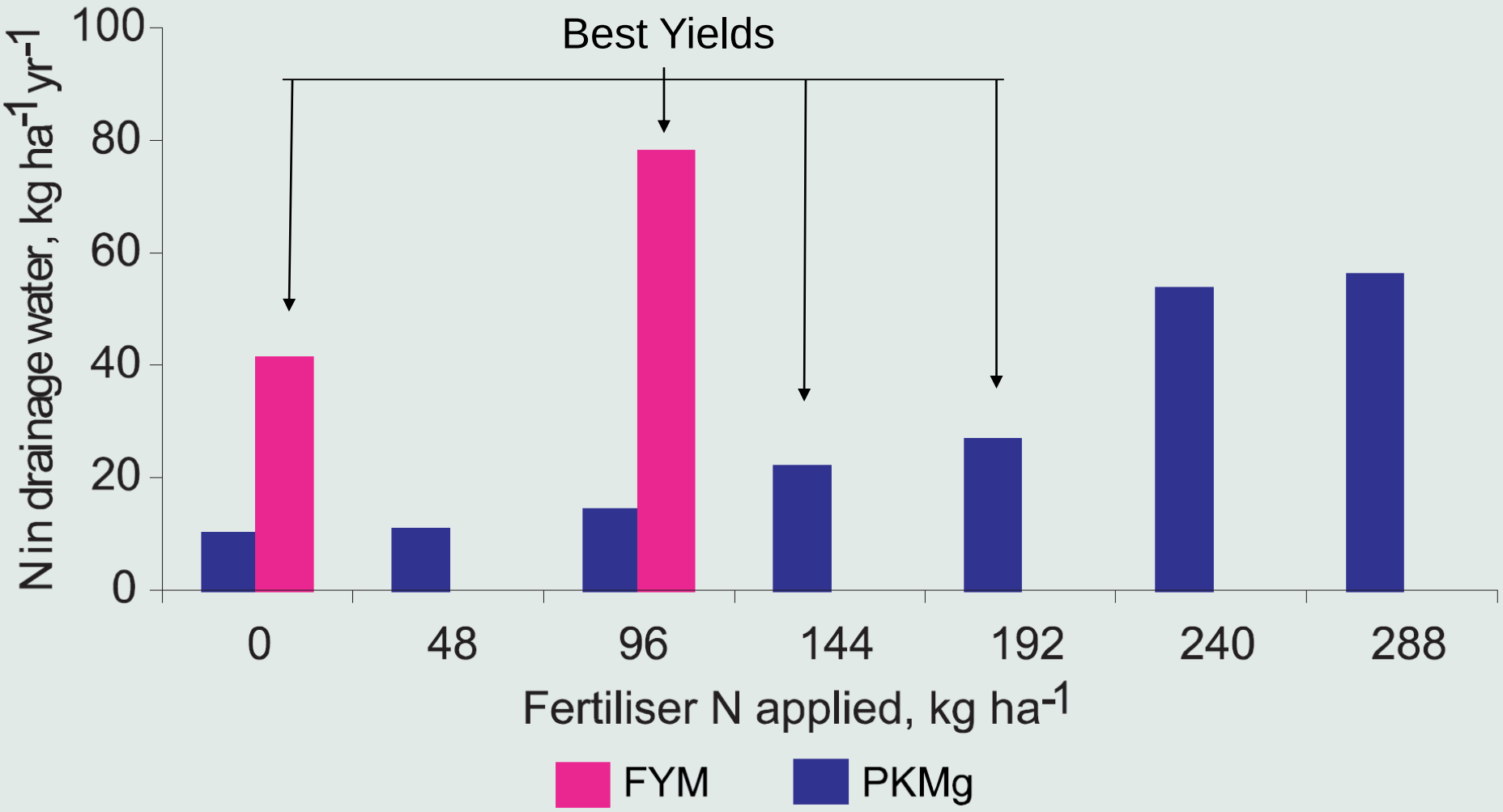
Fig.4 Broadbalk. Mineral N in drainage water, mean 1990-98



Fertilizer supported high yields with less nitrate leaching than relying on high rates of manure alone → need P-based manure management

Certified Crop Adviser Specialties

- 4R Nutrient Management Planning Specialist
  - Performance objectives effective May 2015
  - Over 60 people wrote August 2015 exam, ~50% pass rate
  - Ontario version in development (CCA Ontario and Fertilizer Canada)
- Sustainability Specialty Exam
  - Performance objectives effective May 2015
  - launched last week in Minneapolis, MN
  - First exam August 2016 (postponed from February)
  - References 4R Nutrient Stewardship

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4R Ontario
Designated Acres Pilot Program

FERTILIZER CANADA
FERTILISANTS CANADA

ONTARIO AGRI BUSINESS ASSOCIATION

Overview for Agri Retailer Participation
in the
2016 Ontario 4R Designated Acres Pilot Program

23 February 2016

With Ontario Certified Crop Advisers & OMAFRA

4R nutrient stewardship

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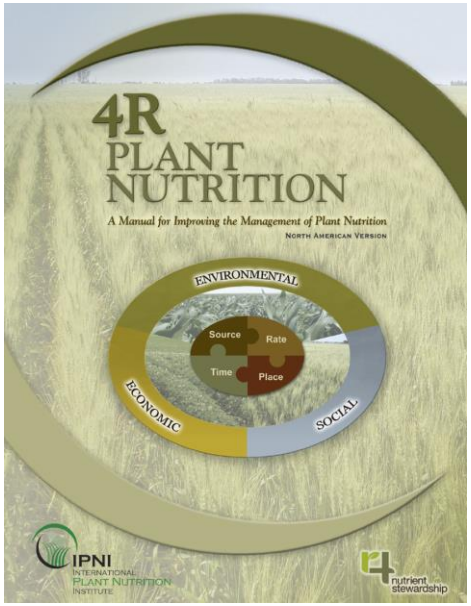
For some soils, right place for N is dual band 4” from the row.

Some growers fertilize all their crops in bands near the seed.

Strip tillage with granular placement puts P in the right place – and controls erosion.

Summary – 4R Future

- **4R is a global concept applicable locally in Ontario**
- **Lake Erie P** – we all play a role. Right place, right time.
- **Nitrogen** – tools to manage for weather
- **4R Certification or Designation?** – welcoming collaboration
- **4R Further Learning**
  - http://phosphorus.ipni.net/
  - www.ipni.net/4R
  - www.farming4rfuture.ca



nutrient stewardship

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