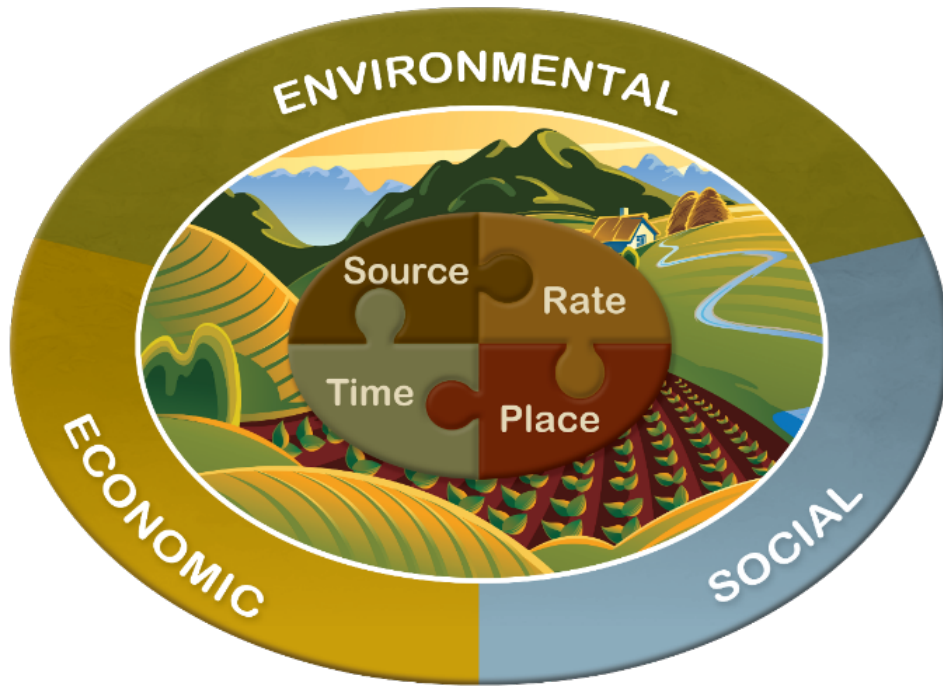




Tom Bruulsema,
Plant Nutrition Canada

Trends in Nutrient Stewardship in Ontario

4R Nutrient Stewardship - Impacts



1. Farmland productivity
2. Soil health
3. Nutrient use efficiency
4. **Water quality**
5. **Air quality**
6. **Greenhouse gases**
7. **Biodiversity**
8. **Macroeconomic value**
9. **Food security**

On-farm

P

N

External

Lake Erie –
both
dissolved and
particulate P
loads are
important.



NASA Earth Observatory, late Sept 2017 (National Geographic)



Terra MODIS Direct Broadcast Image 7 May 2017

**Google
“coastwatch
Lake Erie”**



Lake Ontario 1 May 2021

<https://coastwatch.glerl.noaa.gov/modis/>

Western Lake Erie Watershed

Cropland PUE almost doubled.

Loss of dissolved P to the lake also doubled.


Year	P outputs, kt crop removal	--- P inputs, kt --- fertilizer manure	PUE
1987	30	37	72%
2014	49	31	135%

“unintended consequence” of conservation tillage with broadcast application of P fertilizer.

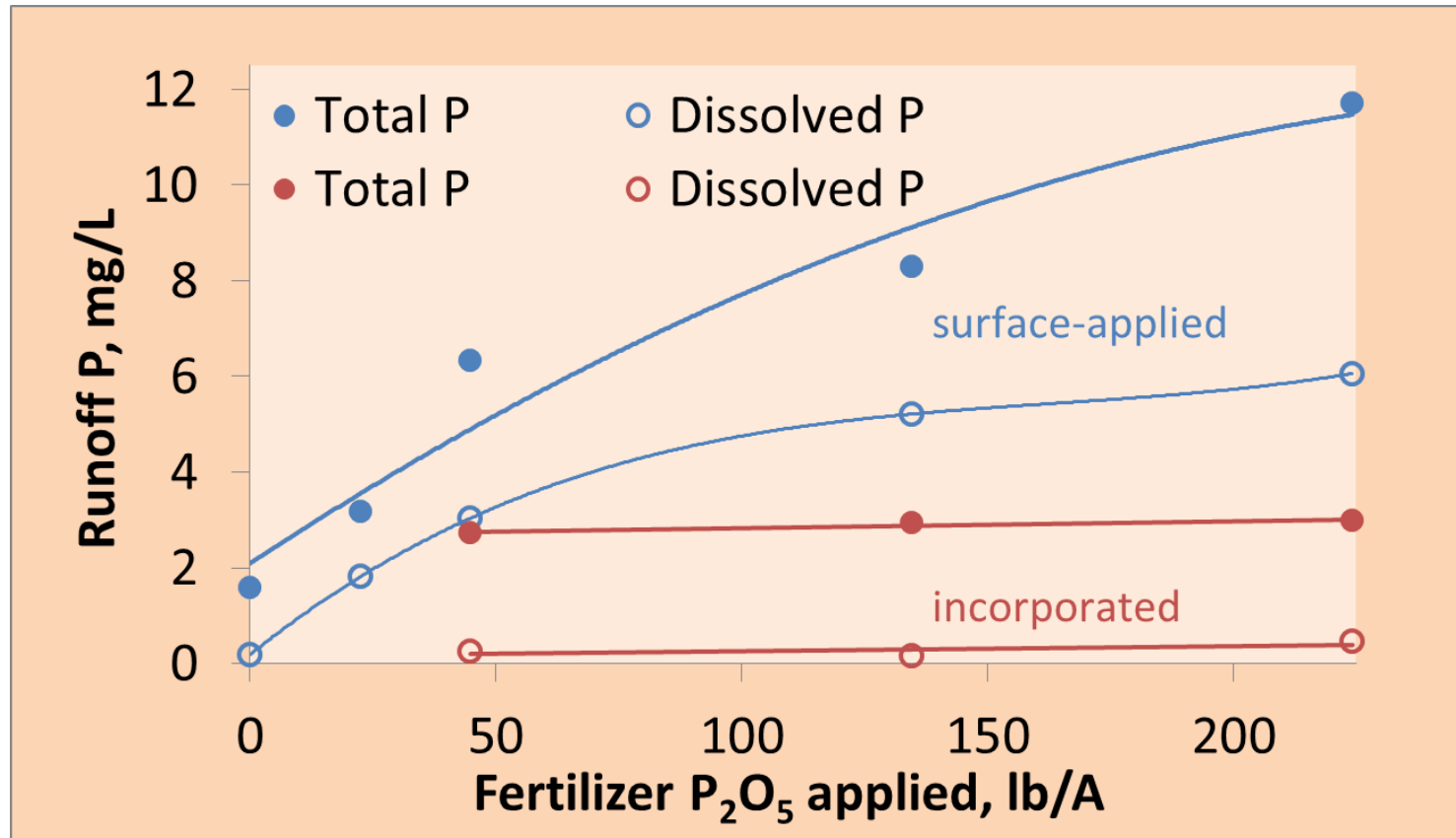


Fertilizer P is Soluble P

- MAP (11-52-0) has water solubility of 370 g/L
= 84,000 mg P per litre
- In the soil solution, crops require 0.1 to 0.3 mg P per litre
- Maumee river target for DRP = 0.047 mg P per litre

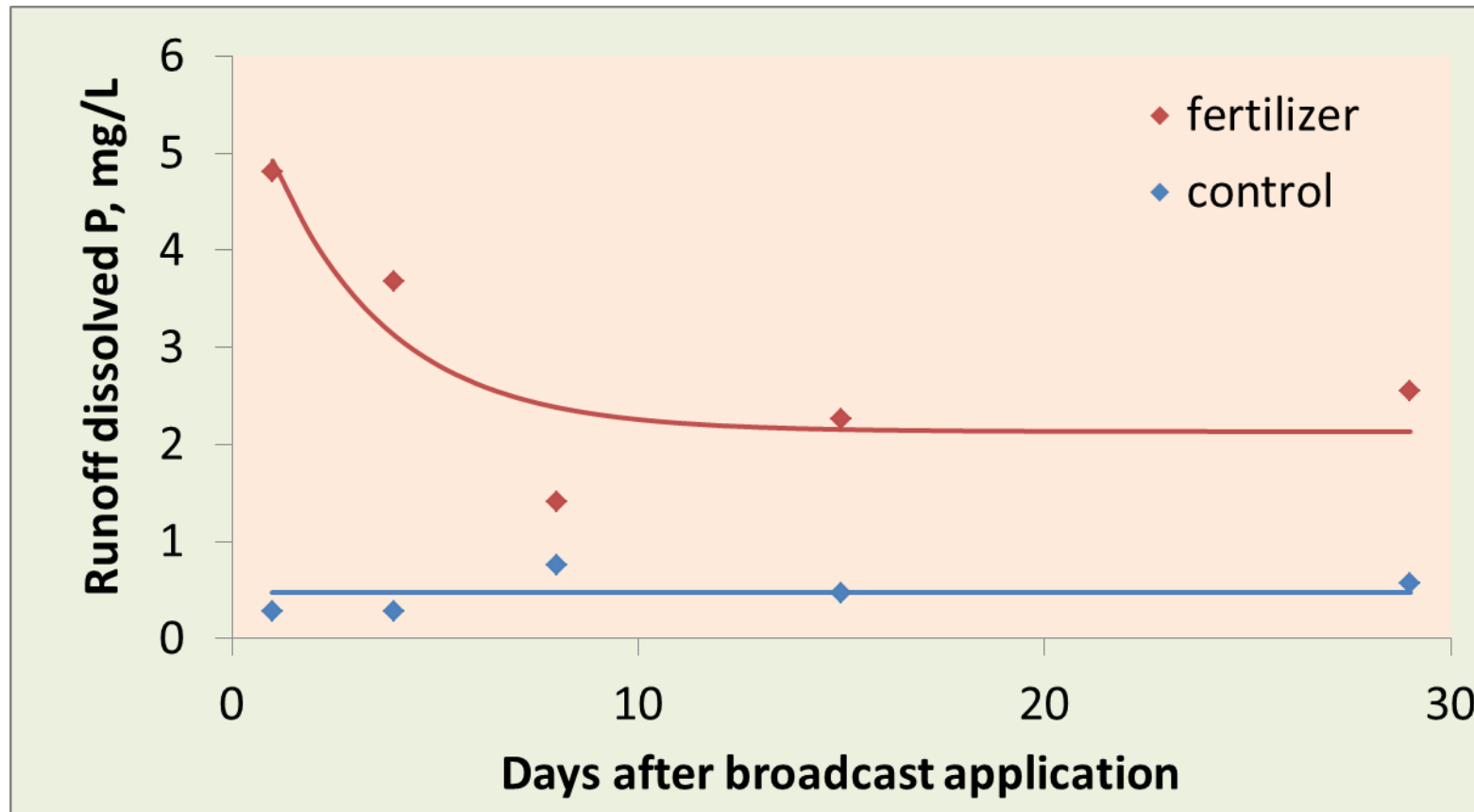
 Nutrient Source SPECIFICS	
Monoammonium Phosphate (MAP) <small>No. 9</small>	
Chemical Properties	
Chemical formula:	$\text{NH}_4\text{H}_2\text{PO}_4$
P_2O_5 range:	48 to 61%
N range:	10 to 12%
Water solubility (20°)	370 g/L
Solution pH	4 to 4.5

Placing P in the soil reduces P loss from a single immediate runoff event



Concentration of dissolved and total P in runoff from a clay loam soil in North Carolina, from artificial rainfall immediately following application of superphosphate fertilizer. Incorporation was to a depth of 5 inches by rotary tillage following application. Data from Tarkalson and Mikkelsen (2004).

Less P is lost with more time between broadcast and runoff



Concentration of dissolved P in surface runoff from plots cropped to tall fescue during rainfall simulations that occurred 1 to 29 days after broadcast application of triple superphosphate fertilizer (Smith et al., 2007).

Evaluate phosphorus management decisions using a water quality vulnerability assessment

Phosphorus Index

- USLE
 - $A = R \times K \times LS \times C \times P$
- Water runoff class
 - Soil hydrological group
 - Max field slope within 150 m of surface water
- Soil test P
- Fertilizer rate and method
- Manure rate and method

<https://agrisuite.omafra.gov.on.ca/#>

- Application rate
 - In relation to crop removal
- Setback distance

PLATO

<https://agrisuite.omafra.gov.on.ca>

LOCATIONS

OPTIONS

Year(s)

- | | |
|---|------|
| ✓ | 2001 |
| ✓ | 2005 |
| ✓ | 2010 |
| ✓ | 2015 |
| ✓ | 2020 |

Element

- | | |
|---|---------------------|
| ✓ | Phosphorus |
| | Potassium |
| | Magnesium |
| | Sulfur |
| | Zinc |
| | Chloride |
| | Soil Organic Matter |
| | pH |

CANCEL

OK

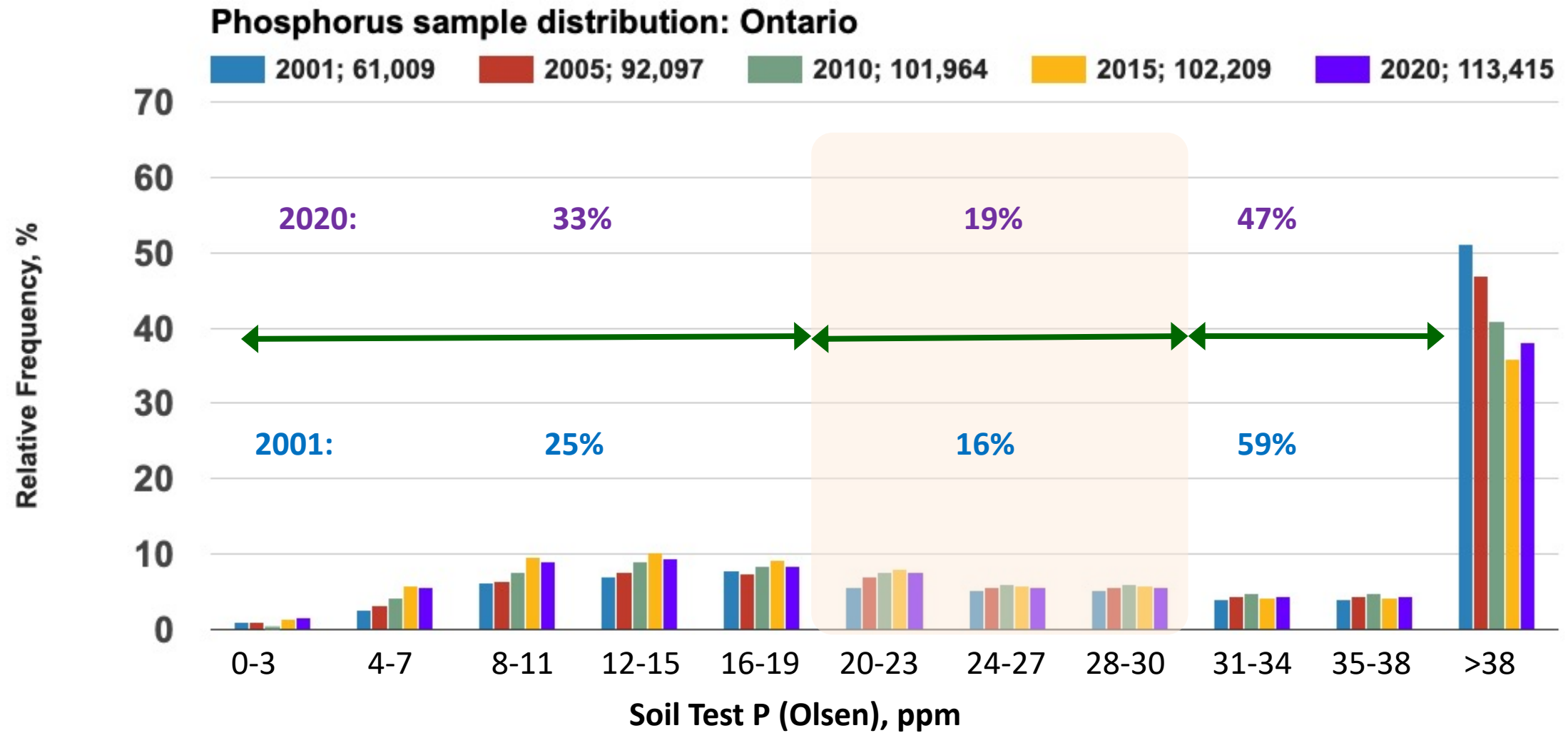
Soil Test Levels
in North America

Create an account to customize your search.

LOG OUT

THE
FERTILIZER
INSTITUTE<http://soiltest.tfi.org>Soil Test Summary
by state & provincePlant
Nutrition
Canada

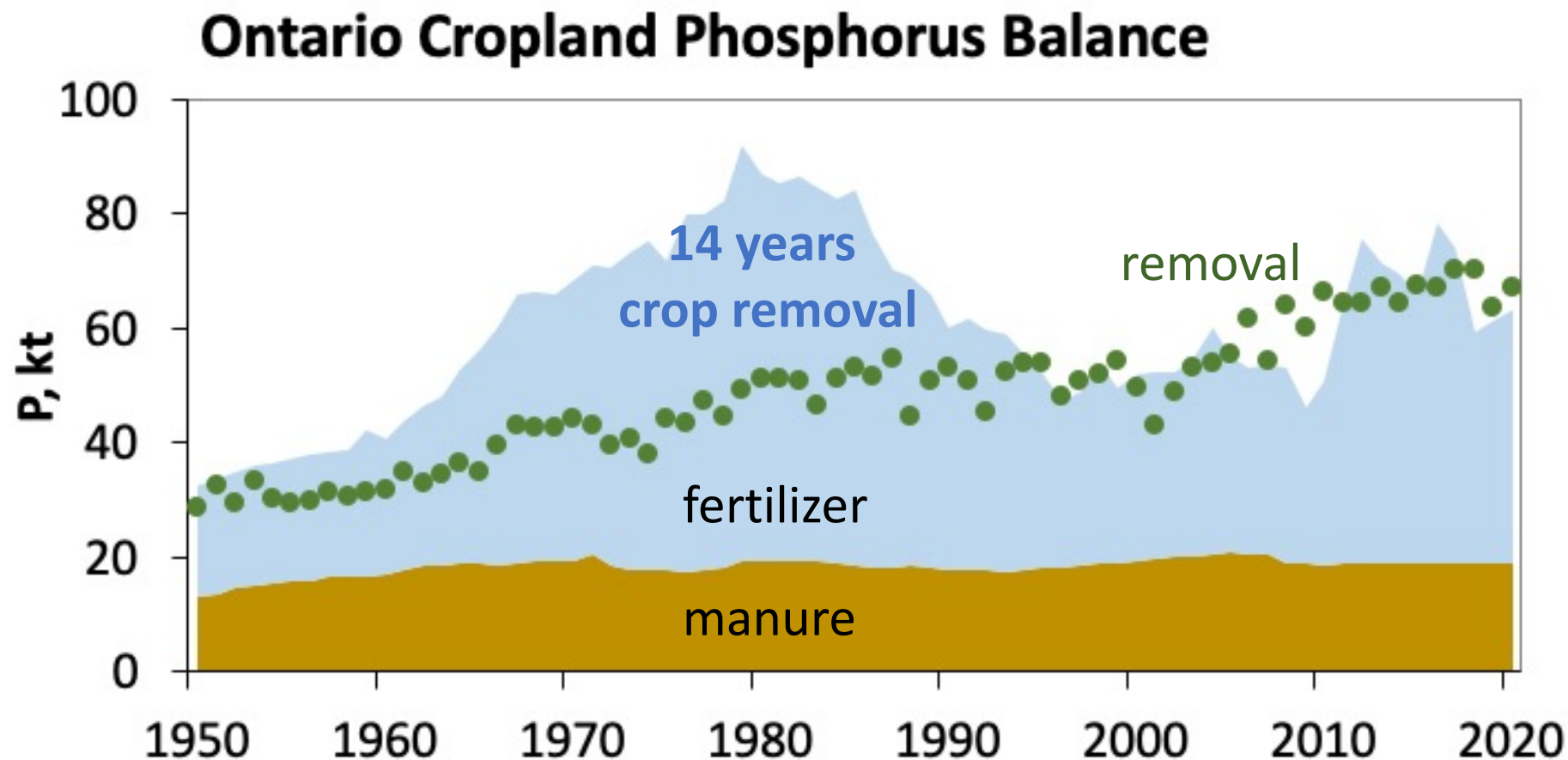
Ontario soil test phosphorus has declined since 2001



<https://soiltest.tfi.org>

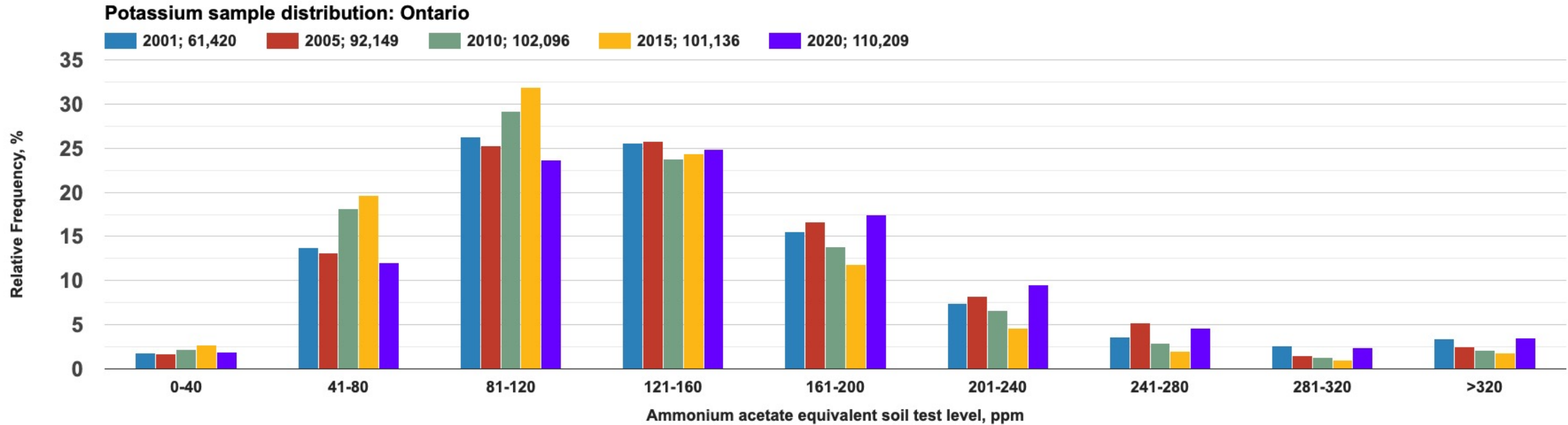
Ontario's
**cumulative P
surplus** amounts
to 14 years crop
removal.

**> 500 lb P₂O₅
per cropland
acre**

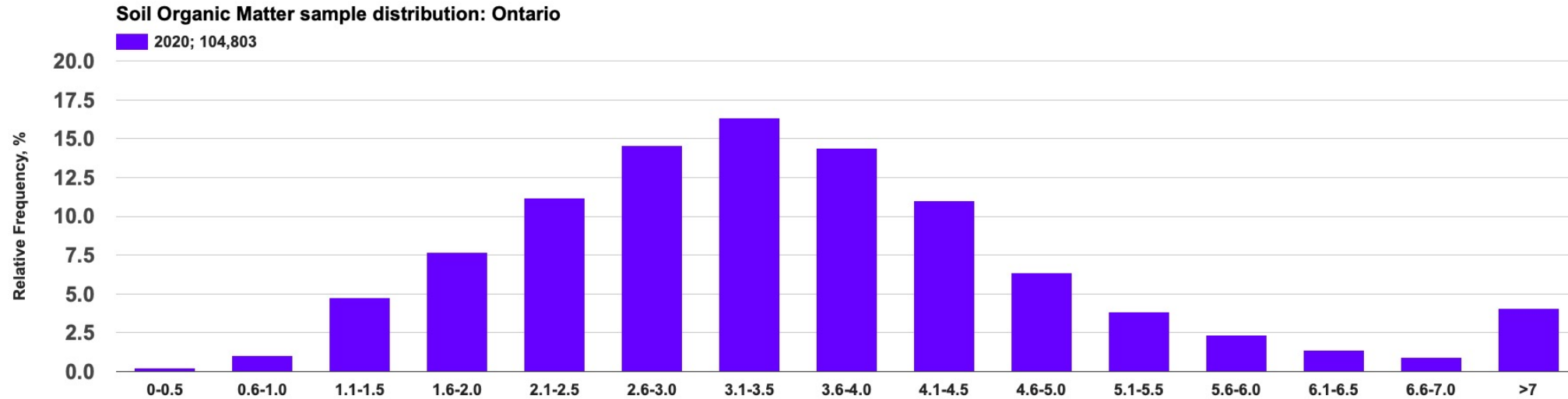


Based on crop, fertilizer, and livestock data from Statistics Canada, and methods from Bruulsema et al., 2019. J. Environ. Qual. 48(5). doi: 10.2134/jeq2019.02.0065.

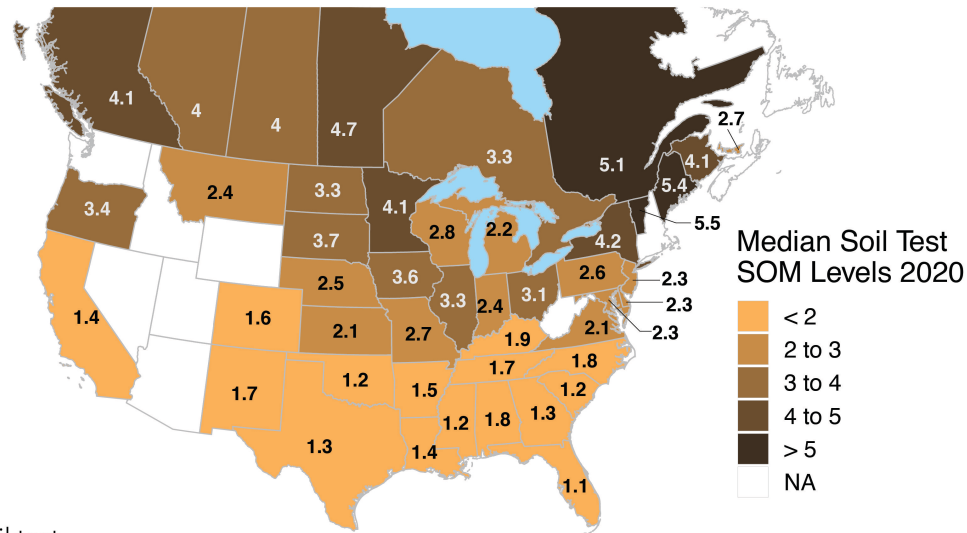
Ontario Soil Test Potassium – down and up



Ontario Soil Organic Matter



Median Soil Test Soil Organic Matter Levels in 2020, %





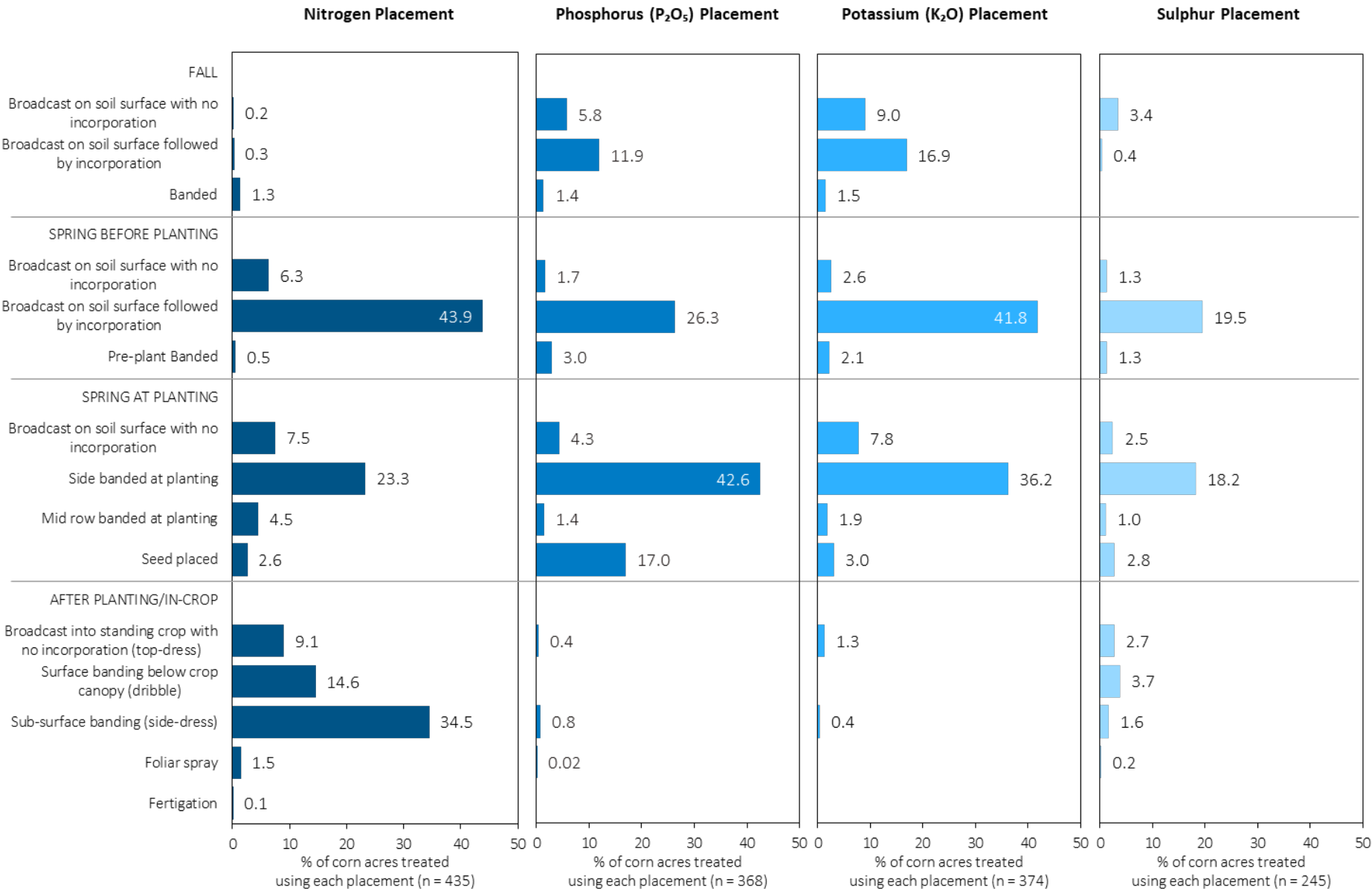
FERTILIZER USE

Ontario
CDN 2020

Fertilizer Canada 4R Fertilizer Use Survey

- 2016-2020
- Key crops in Ontario and Western Canada
- Source x rate x time x place
- N, P, K & S

Fertilizer Placement in Corn - % Crop Acres



Note: Nutrients were defined based on the primary component of each fertilizer type

Made possible through
funding by:



The 4R Certification standards were created by the 4R Ontario Steering Committee in close collaboration with the Nutrient Stewardship Council, the Ohio Agri-Business Association and The Fertilizer Institute in the U.S. to ensure alignment between cross-border efforts to implement 4R Nutrient Stewardship and minimize nutrient losses under the 4R Certification Program. The standards are reflective of the best available science, technology and regulatory requirements for Ontario conditions.

Members of the 4R Ontario Steering Committee represent a diversity of stakeholders including Fertilizer Canada; the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA); the Ontario Agri Business Association (OABA); the Grain Farmers of Ontario; the Ontario Federation of Agriculture; the Christian Farmers Federation of Ontario; Conservation Ontario; The Nature Conservancy – Ohio; the Ministry of the Environment and Climate Change; the International Plant Nutrition Institute; the Ontario Certified Crop Advisor Board; and Ontario agri-retailers.



Right Source @ Right Rate, Right Time, Right Place®

- 4rcertified.ca
- 4rcertification@fertilizercanada.ca
- (613) 230-2600



FERTILIZER CANADA

Program administered by
Fertilizer Canada on behalf of the
4R Ontario Steering Committee



**4R Nutrient Stewardship
Certification Program
in Ontario**





Voluntary program for Ontario agri-retailers
and nutrient service providers implementing
4R Nutrient Stewardship

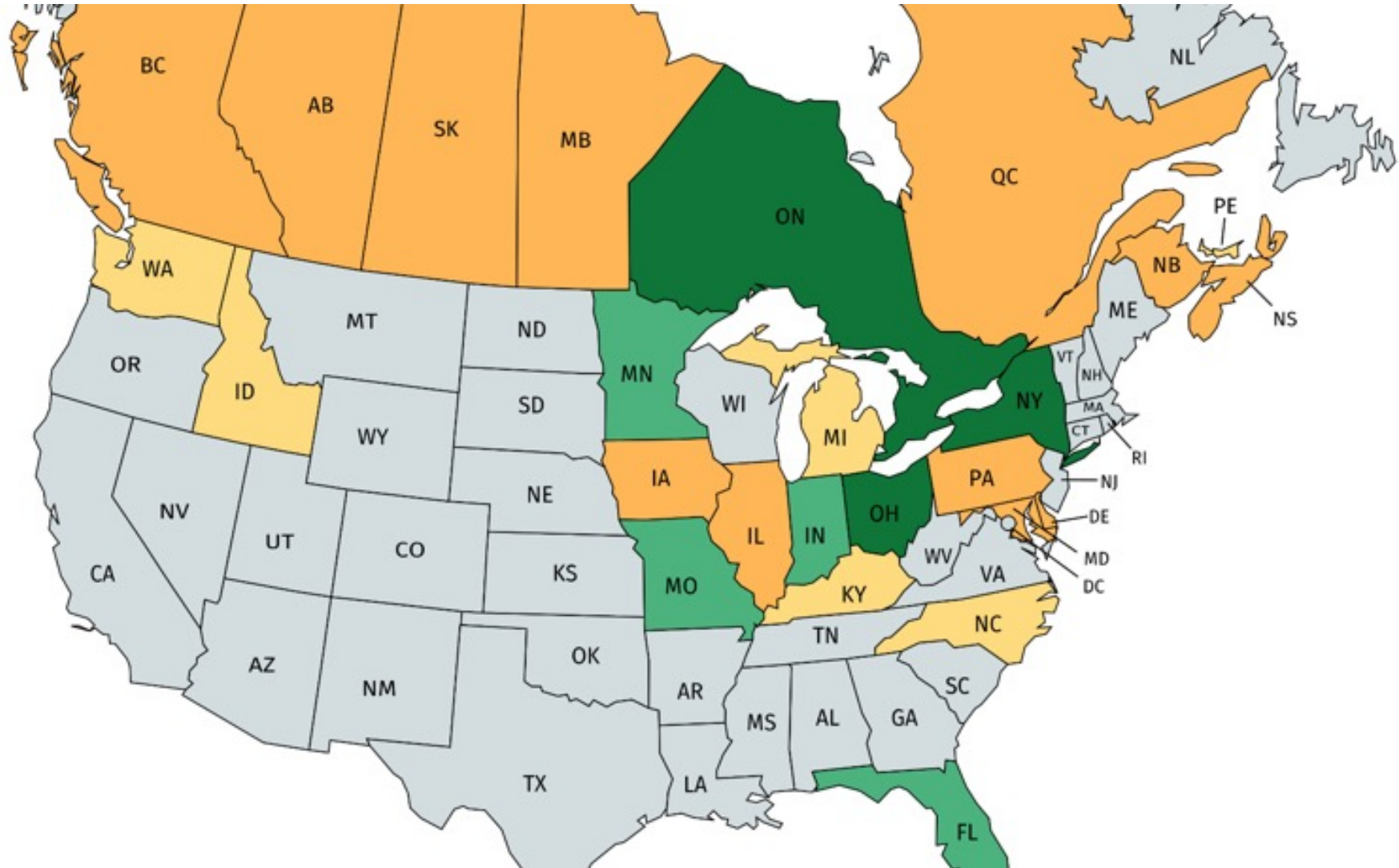
Collaboration – “We All Play a Role”



Growing interest in 4R Certification

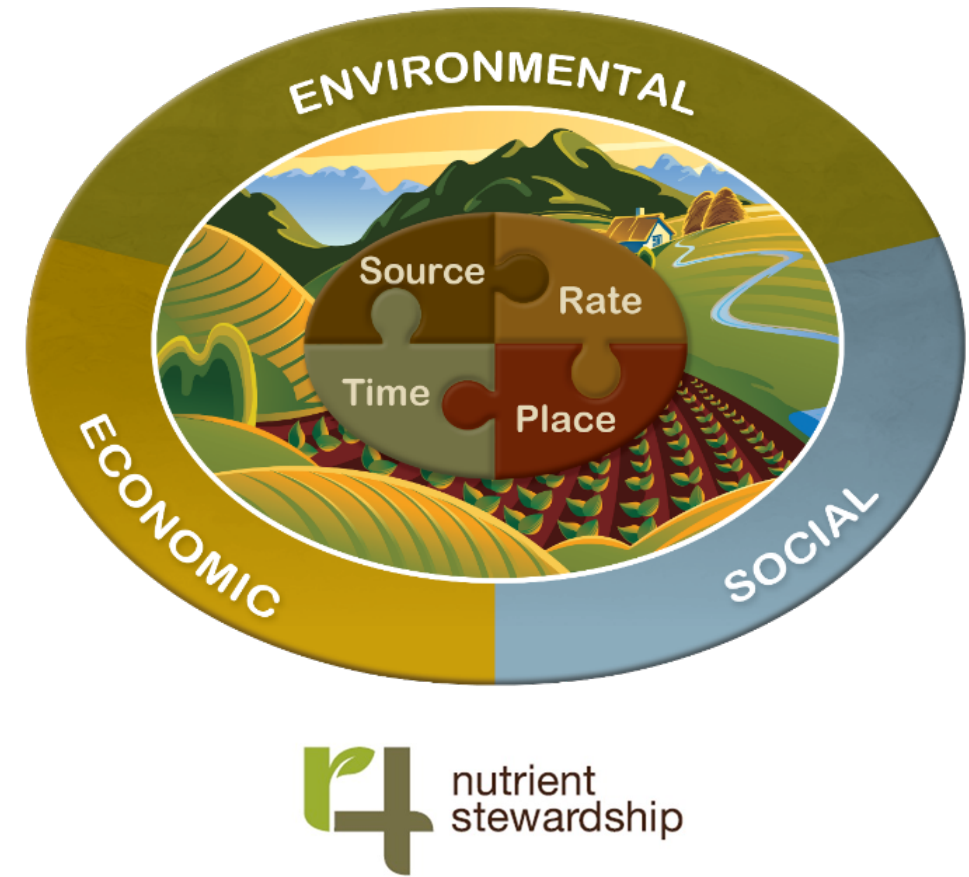
Interest in 4R Programs

-  Current 4R Certification Programs
-  Developing 4R Certification Programs
-  Inquired About 4R Certification
-  Active (broadly adopted) 4R Outreach Programs



Summary

- Soil test, nutrient balance and 4R practices inform crop nutrient management.
- Phosphorus losses to water can be reduced by source, rate, timing, and placement of applied nutrients.
- Collaboration invited in the continuing evolution of 4R!



<https://plantnutrition.ca>