Plant Nutrition Canada

CSSS 2021 JUNE 7 - 10

The Fertility of Canadian Agricultural Soils as a Metric of 4R Practice

Tom Bruulsema, Chief Scientist
Plant Nutrition Canada

Linkages

- Plant Nutrition Canada supports the Nutrient Stewardship programs of Fertilizer Canada, The Fertilizer Institute in the USA and the International Fertilizer Association.

- Its partners include African Plant Nutrition Institute, Scientific Panel on Responsible Plant Nutrition, 4R Solution Project and 4R Research Fund.

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A NEW PARADIGM FOR PLANT NUTRITION

SCIENTIFIC PANEL
ON RESPONSIBLE PLANT NUTRITION

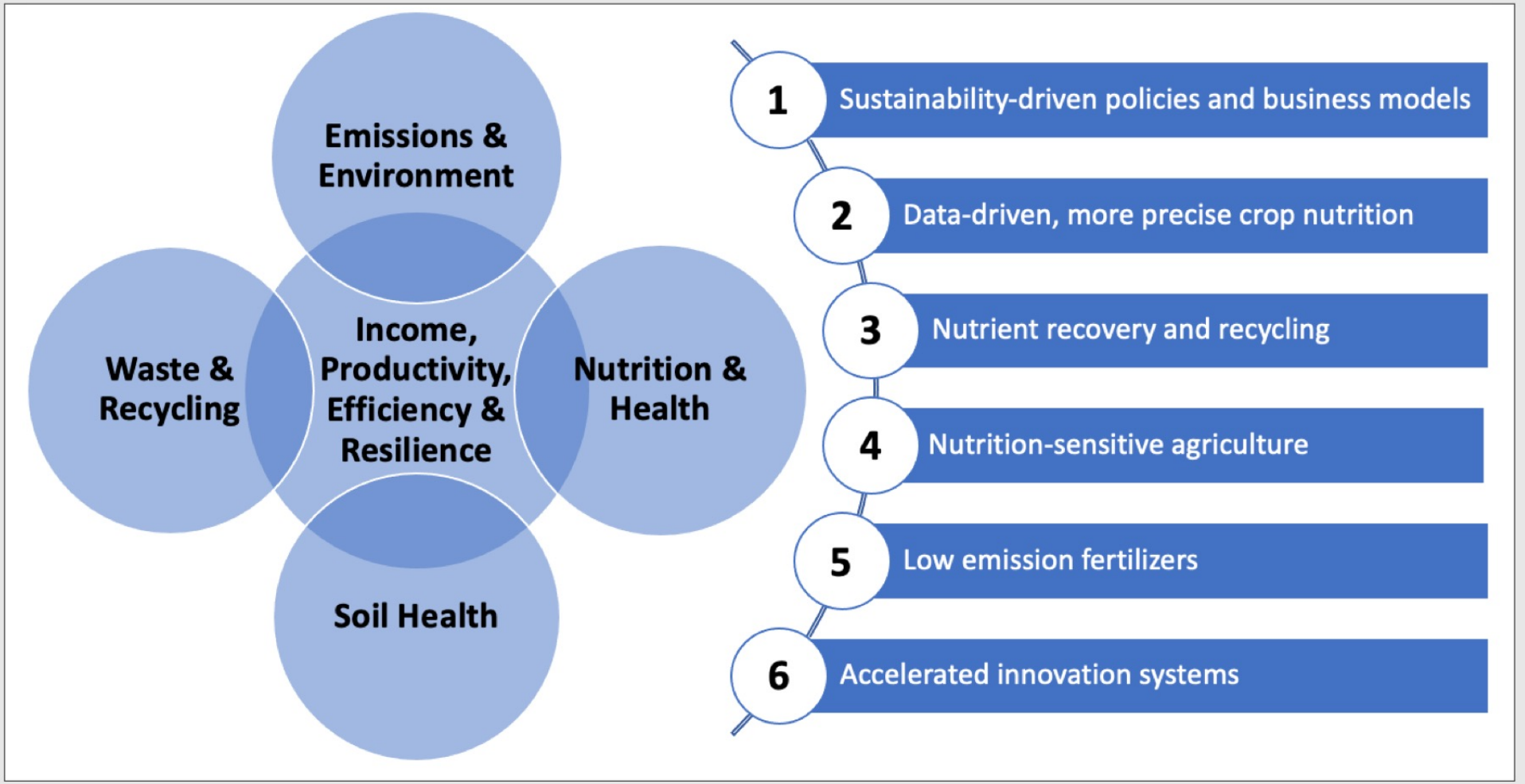

Figure 1. The five interconnected aims of responsible plant nutrition, and six key actions to take.

https://www.sprpn.org

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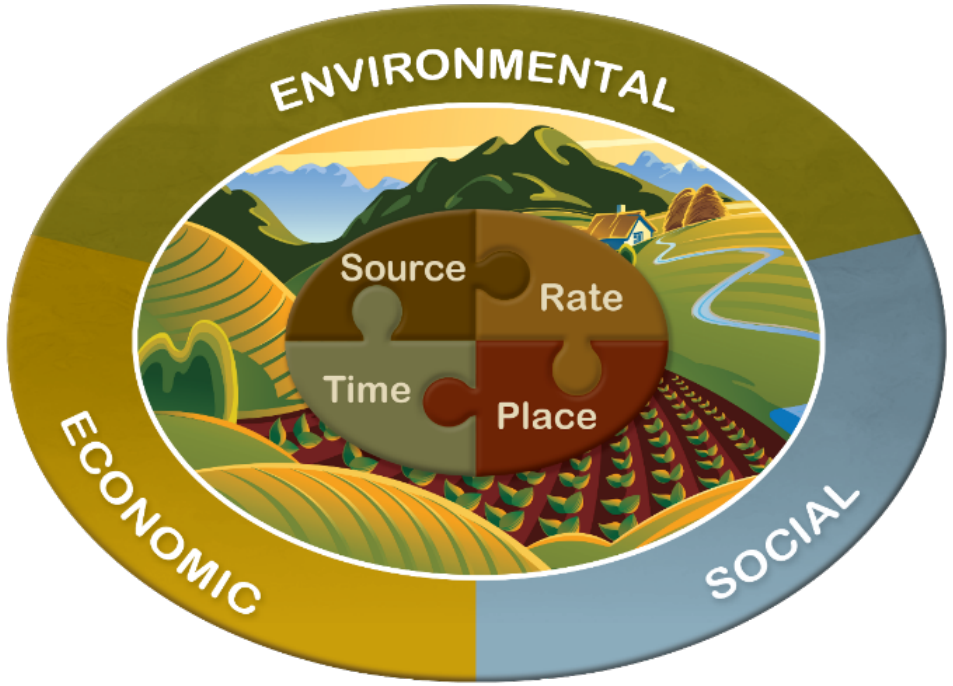
Solution
FERTILIZER CANADA
Co-operative Development Foundation of Canada
SINCE 1947
Global Affairs Canada
Affaires mondiales Canada
Canada-Africa 4R Solution Project
Ghana, Ethiopia, & Senegal
https://4rsolution.org

4R Nutrient Stewardship - Impacts



nutrient stewardship

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

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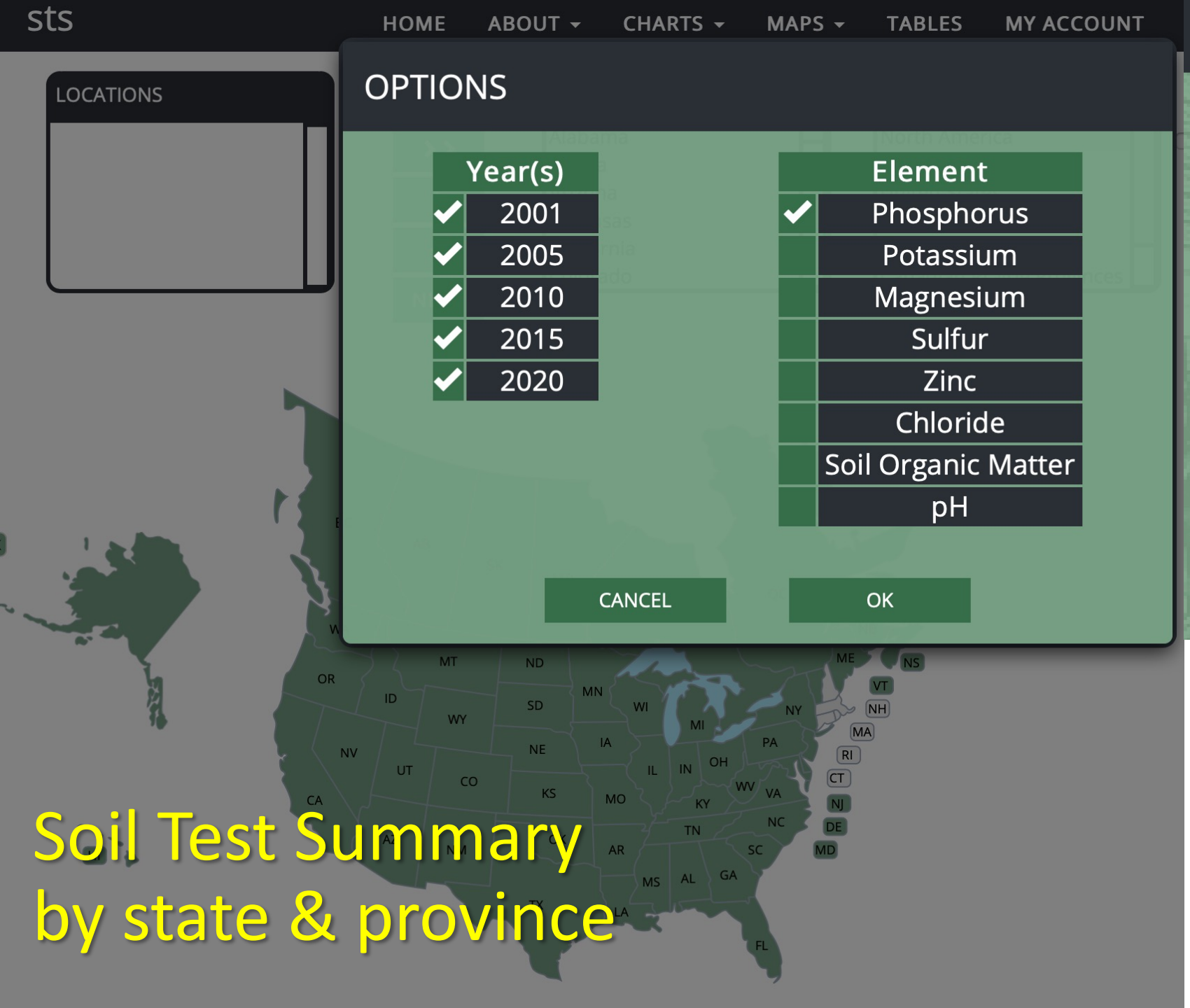

Soil Test Summary by state & province

sts soil test summary

HOME

Soil Test Levels in North America

Create an account to customize your search.

LOG OUT

THE FERTILIZER INSTITUTE

https://soiltest.tfi.org

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Contributing Laboratories 2020

Private Labs – 27

A&L Canada Laboratories Inc.
A&L Great Lakes Laboratories, Inc.
AgroEnviro Lab
AgroLab
AgSource Laboratories, Iowa
AgSource Laboratories, Nebraska
AgSource Laboratories, Wisconsin
AGVISE Laboratories
American Agricultural Laboratory, Inc.
Brookside Laboratories, Inc.
Dairy One Cooperative, Inc.
Farmers Edge Inc., CAN
Farmers Edge Inc., USA
GMS Laboratories, Inc.
Honeyland Ag Services
Midwest Laboratories
Minnesota Valley Testing Laboratories, Inc. (MVTL)
PEI Analytical Laboratories
ServiTech Laboratories
SGS Agri-Food Laboratories Inc.
Sollio Agriculture
Spectrum Analytic Inc.
Stanworth Consultants
Stratford Agri Analysis
Ward Laboratories Inc.
Waters Agricultural Laboratories, Inc.
Waypoint Analytical

Public Labs – 17

Kansas State University Research and Extension, Soil Testing Laboratory
Michigan State University, Soil and Plant Nutrient Laboratory
Mississippi State University Extension Service, Soil Testing Laboratory
North Carolina Department of Agriculture
Oklahoma State University
Pennsylvania State University, Agricultural Analytical Services Laboratory
Rutgers University Soil Testing Laboratory
University of Arkansas Soil Testing and Research Laboratory
University of Connecticut Soil Nutrient Analysis Laboratory
University of Delaware Soil Testing Program
University of Florida Extension Soil Testing Laboratory
University of Georgia Extension Agricultural & Environmental Services Laboratories
University of Kentucky Lexington Soils Laboratory
University of Maine Analytical Laboratory and Maine Soil Testing Service
University of Missouri Soil and Plant Testing Laboratory
University of Vermont Agricultural and Environmental Testing Lab
University of Wisconsin Soil and Forage Laboratory
Virginia Tech Soil Testing Lab

Technical support: Quentin Rund & team at **PAQ Interactive.**

Several former IPNI scientists—including Scott Murrell, Tom Jensen, Rob Mikkelsen, and Mike Stewart—helpfully reviewed procedures and advised on analysis in order to ensure consistency with past summaries. Robert Miller, ALP and Bryan Hopkins, NAPT advised as well.

Financial support: The Fertilizer Institute.

Soil sampling on the rise

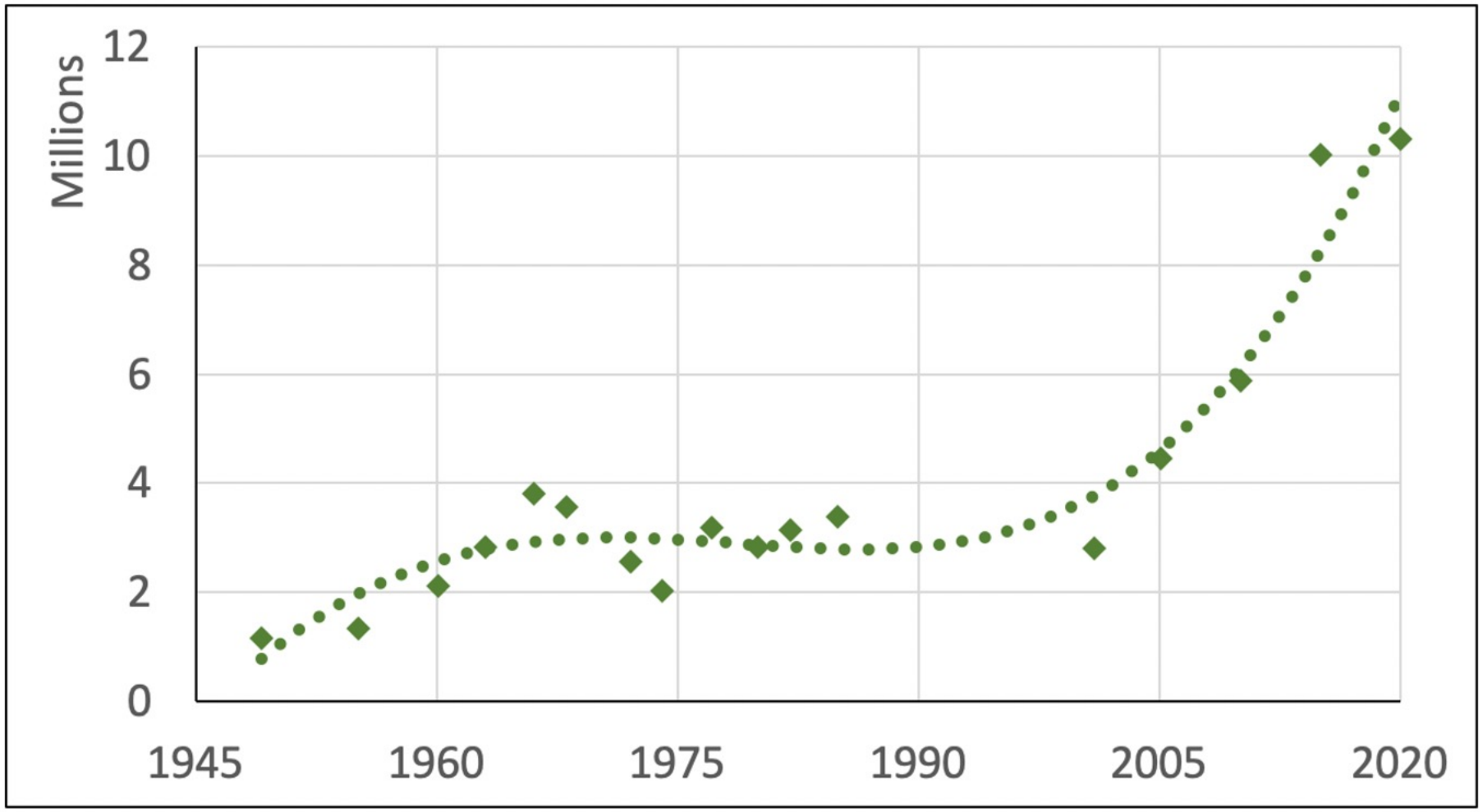

Figure 2. Estimated soil sample volume in the U.S., 1949-2020.

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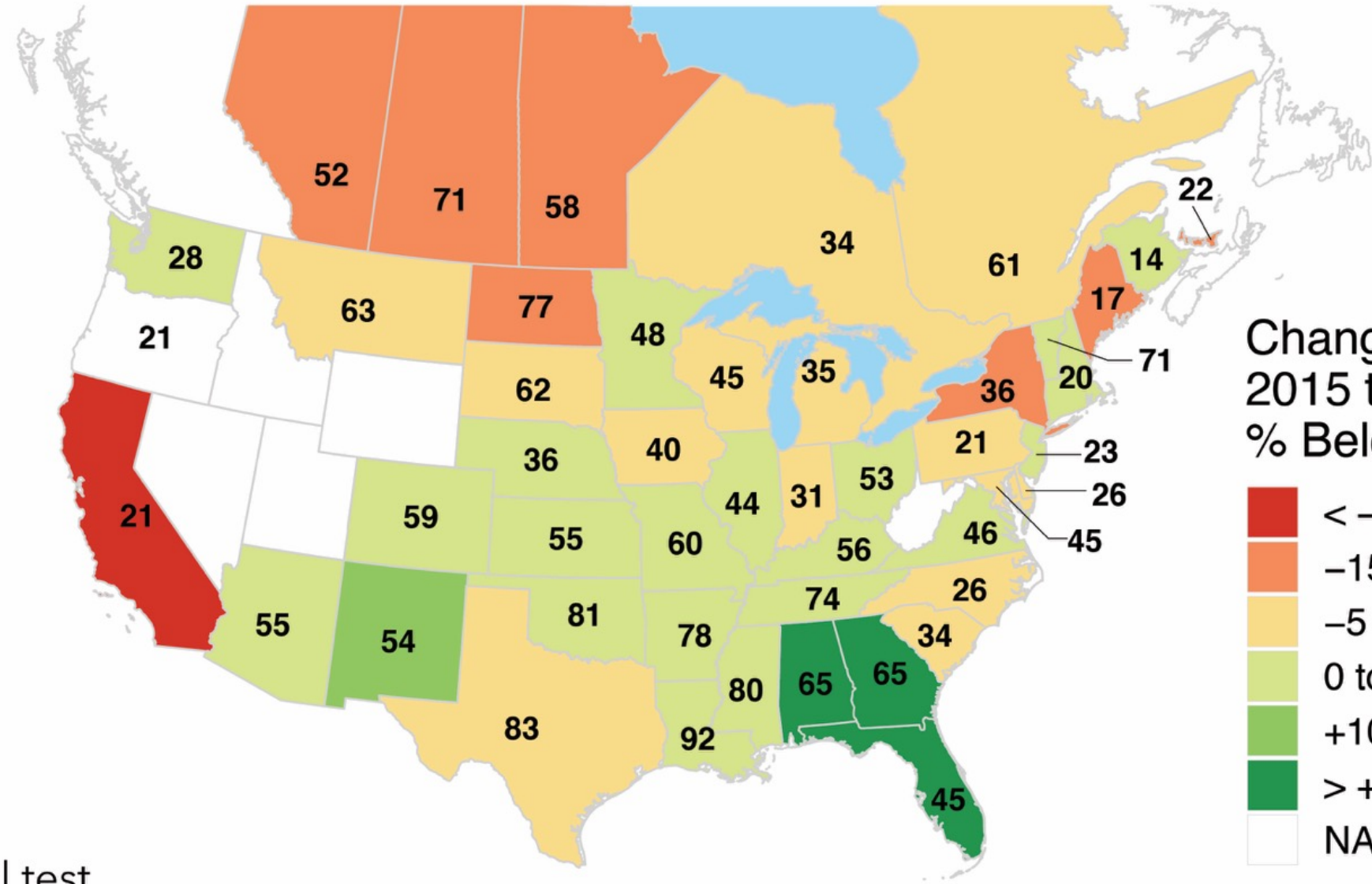
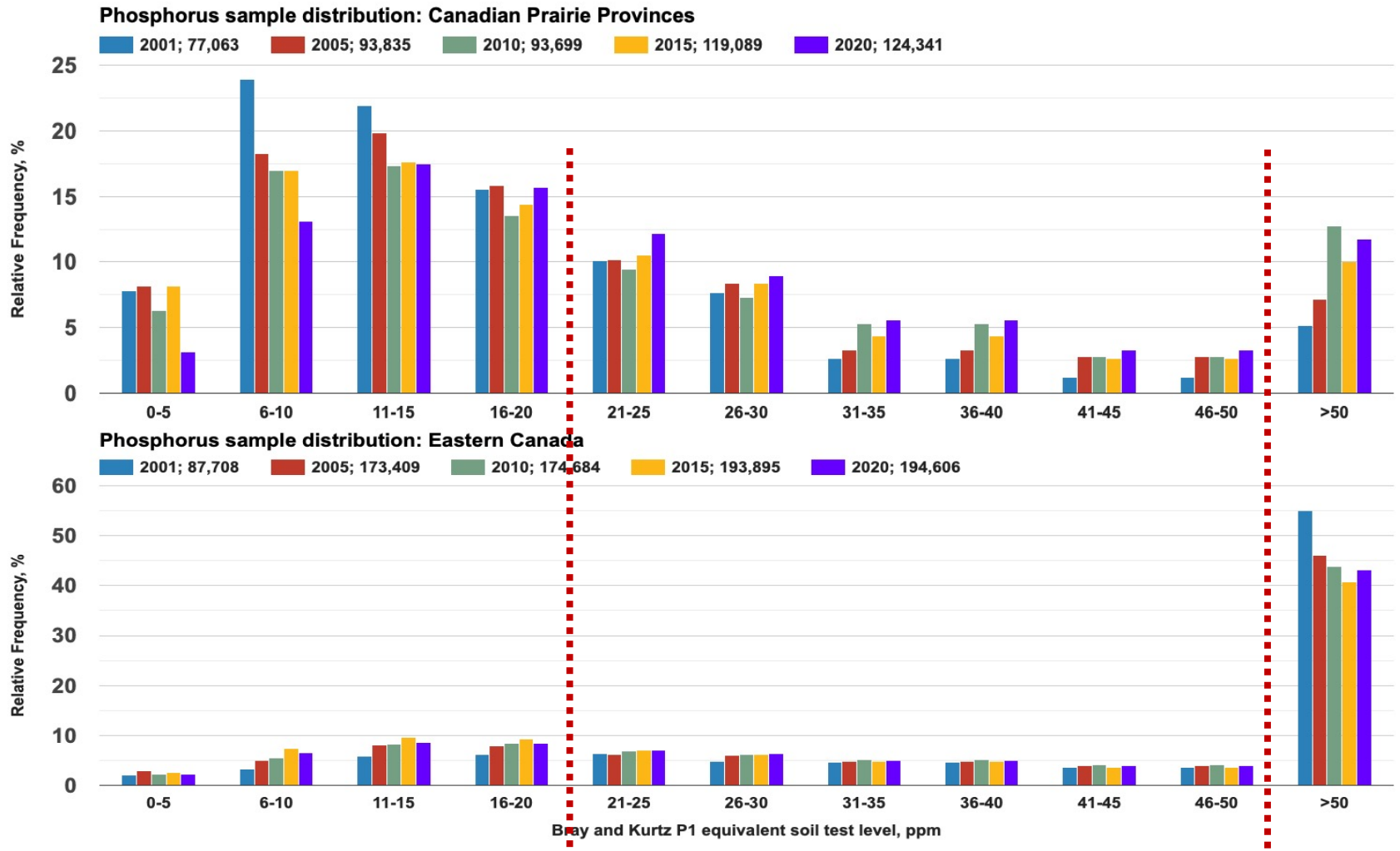
Percent of Samples Testing Below Critical Levels for P in 2020



sts soil test summary

*Only states with 2,000 samples or more are shown on this map

Soil test P – west: low going up, east: high going down



AB, SK, MB
124,341 samples

ON, QC, Atlantic
194,606 samples

15 ---------- Olsen-P, ppm ---------- 38

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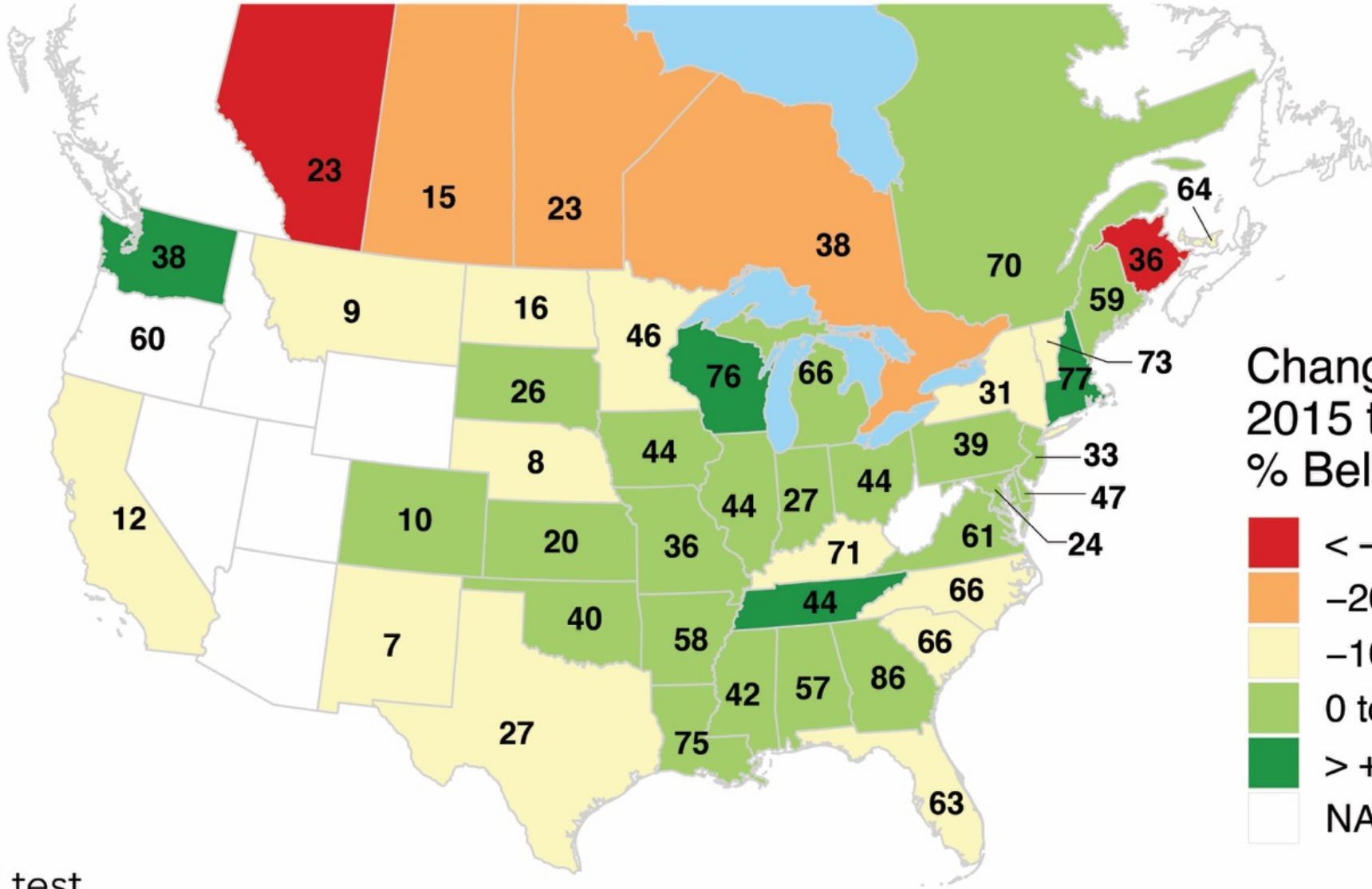
Percent of Samples Testing Below Critical Levels for K in 2020



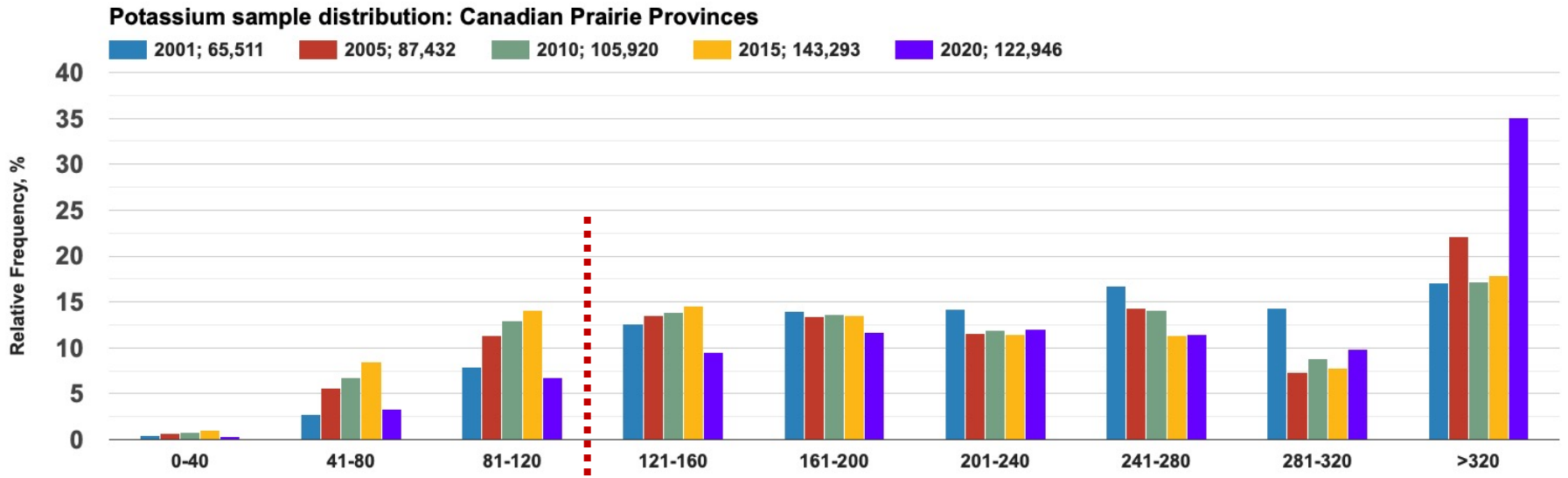
Change from 2015 to 2020, % Below

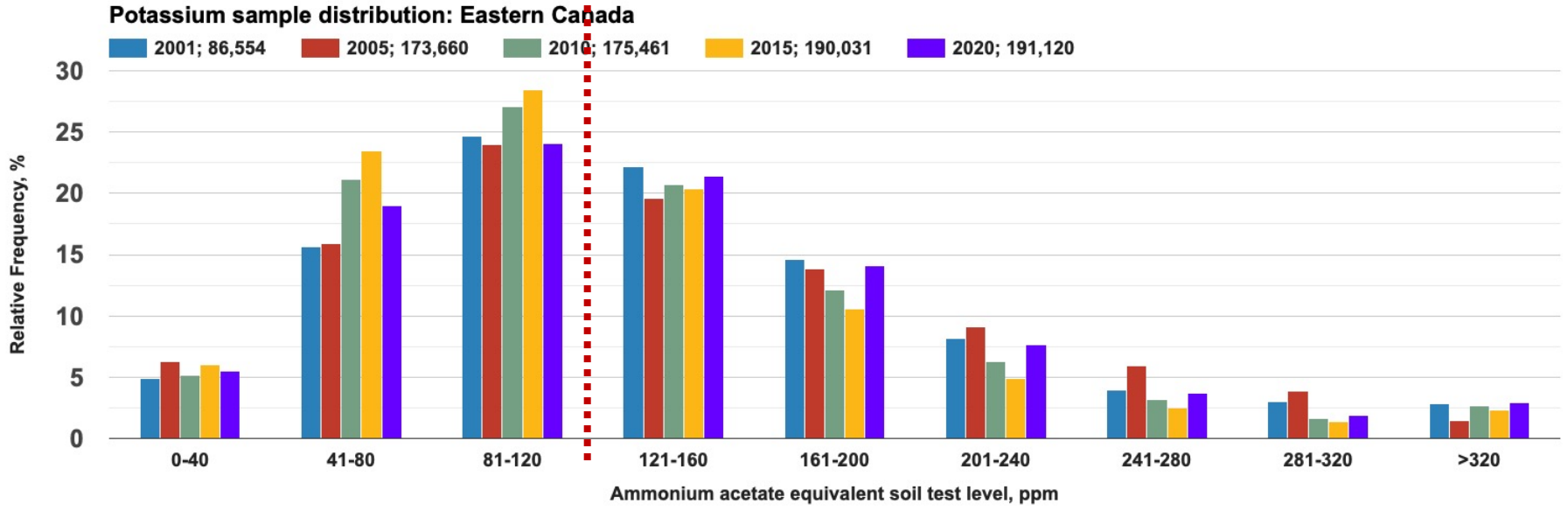
- < –20
- –20 to –10
- –10 to 0
- 0 to +10
- > +10
- NA

sts soil test summary

*Only states with 2,000 samples or more are shown on this map

Soil test K – west: high going higher? east: a lot below critical





AB, SK, MB
122,946 samples

ON, QC, Atlantic
191,120 samples

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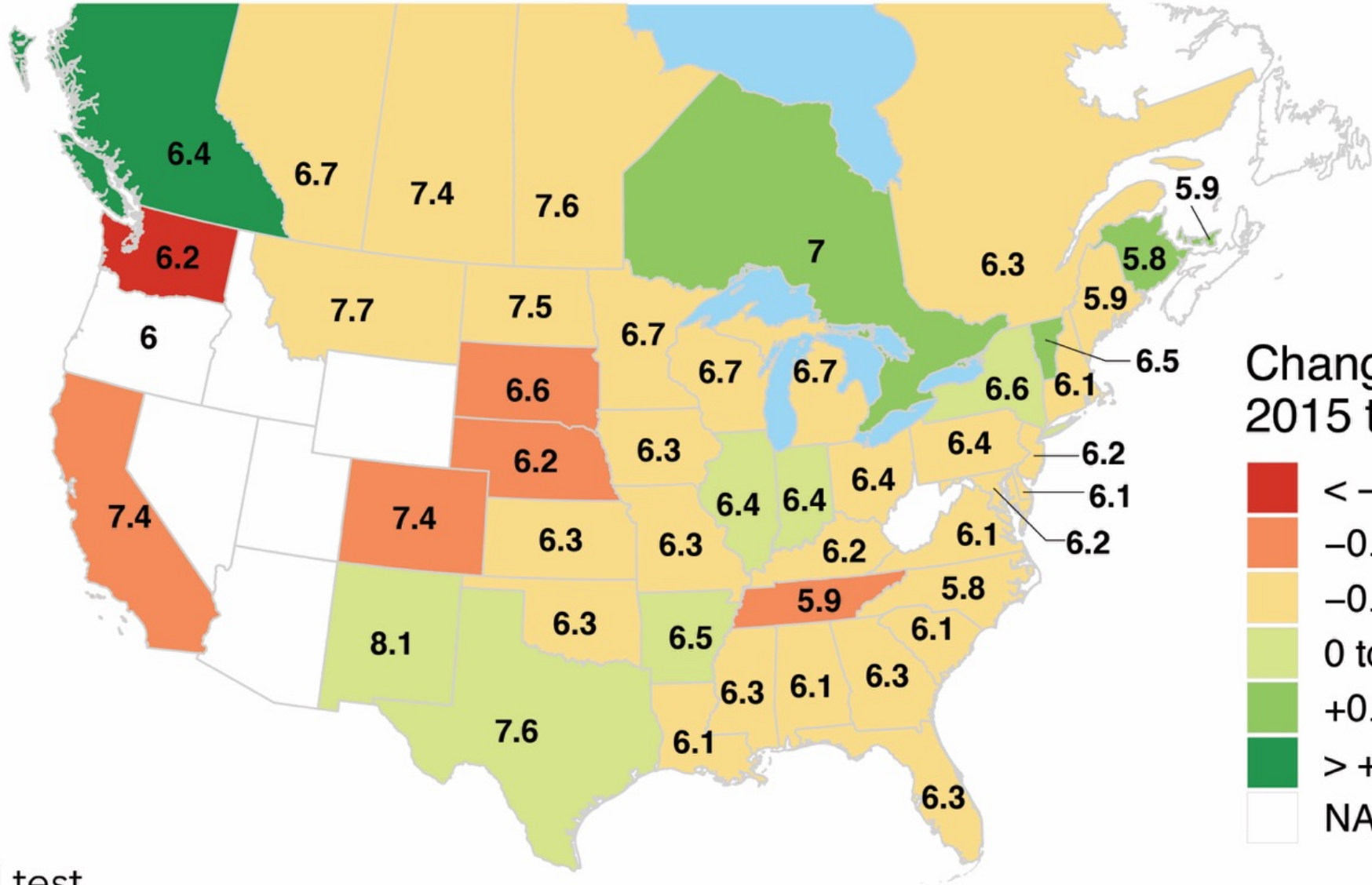
Median Soil Test pH in 2020

Water 1:1 Equivalent



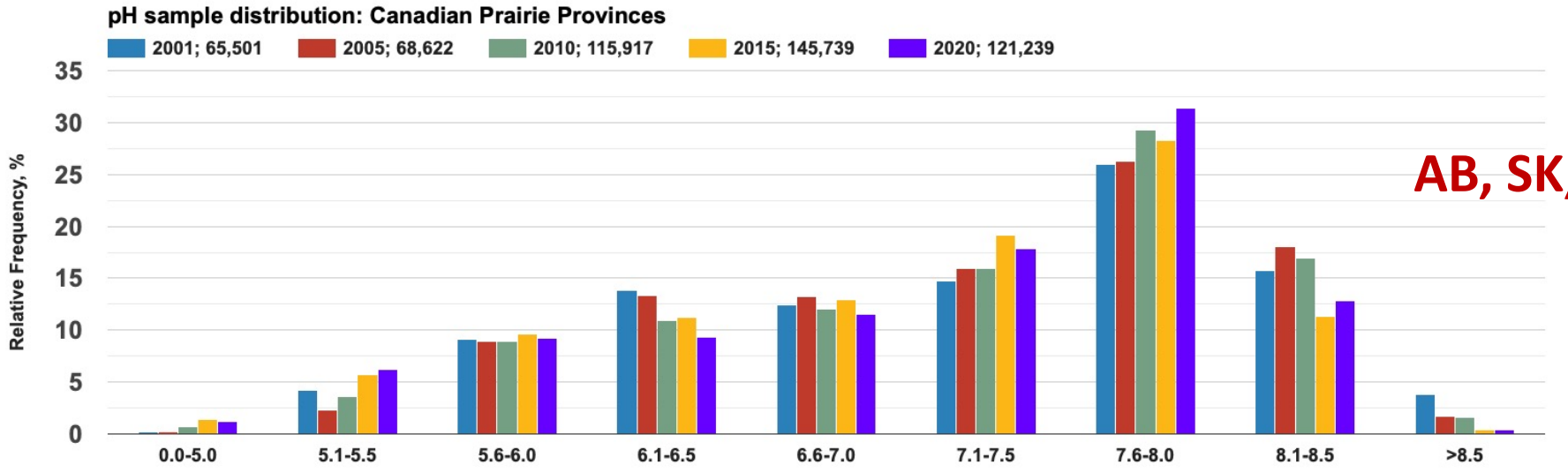
Change from 2015 to 2020

- < –0.3
- –0.3 to –0.15
- –0.15 to 0
- 0 to +0.15
- +0.15 to +0.3
- > +0.3
- NA

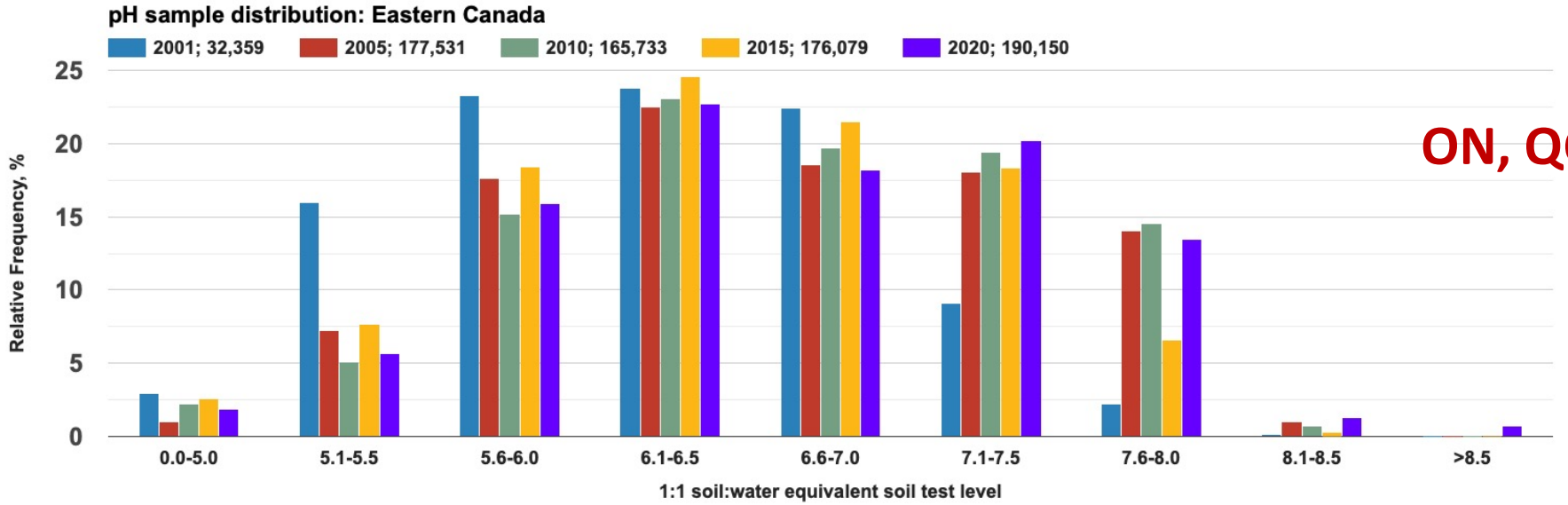
sts soil test summary

*Only states with 2,000 samples or more are shown on this map

Soil pH – west: high edging higher, east: low holding steady



AB, SK, MB



ON, QC, Atlantic

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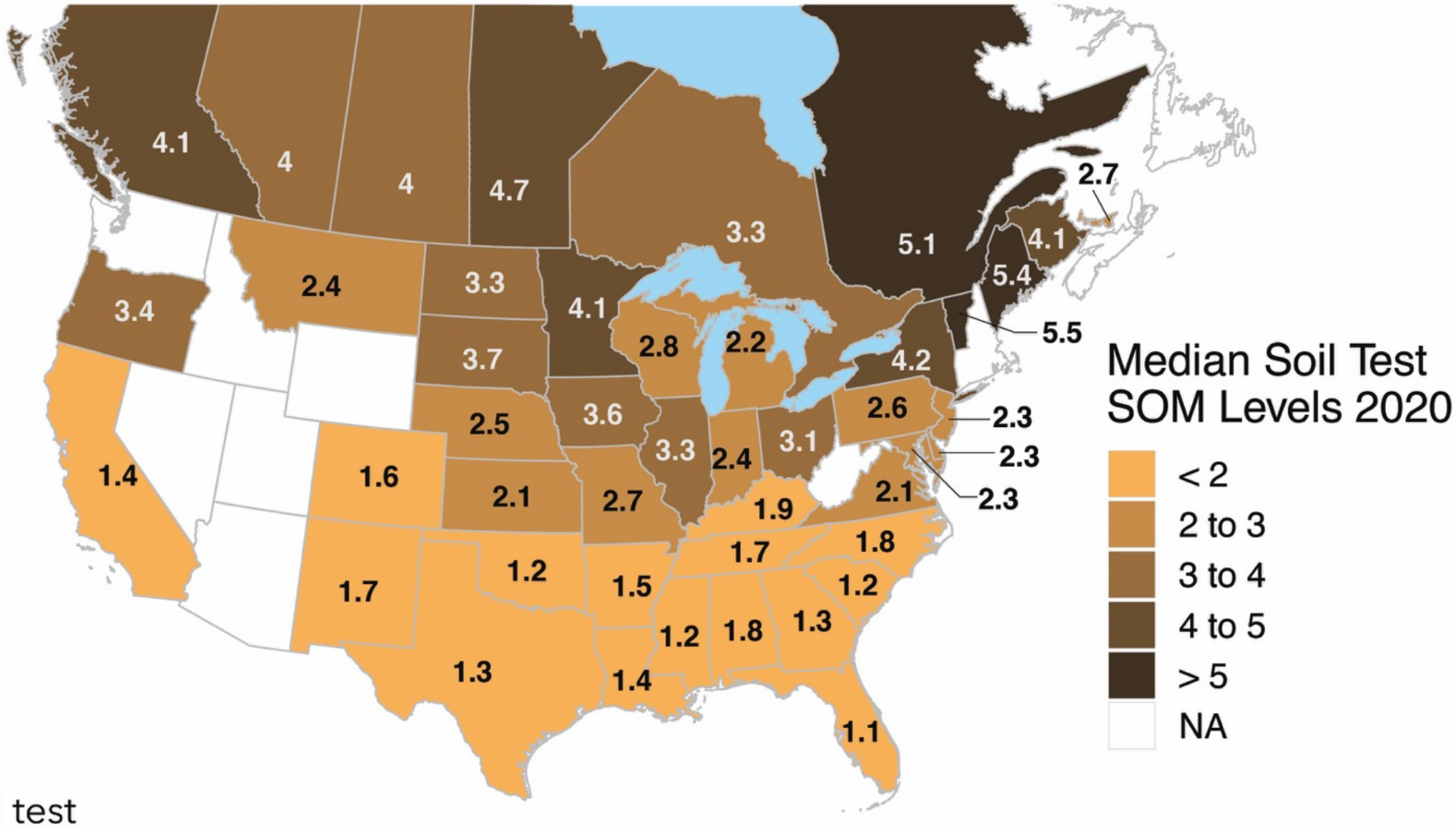
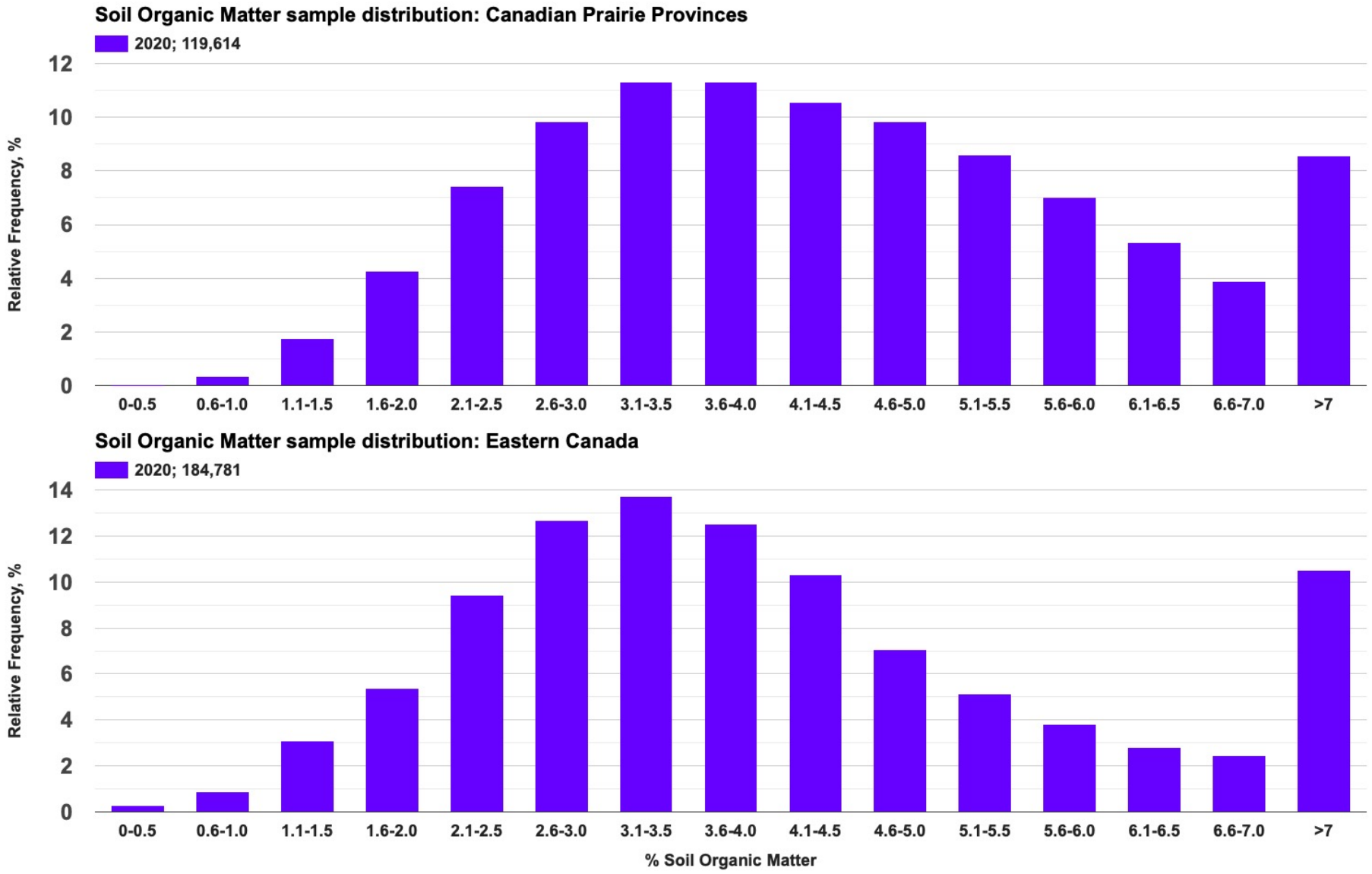
Median Soil Test Soil Organic Matter Levels in 2020, %



sts soil test summary

*Only states with 2,000 samples or more are shown on this map

Soil OM – a broad distribution, west and east



AB, SK, MB
119,614 samples

ON, QC, Atlantic
184,781 samples

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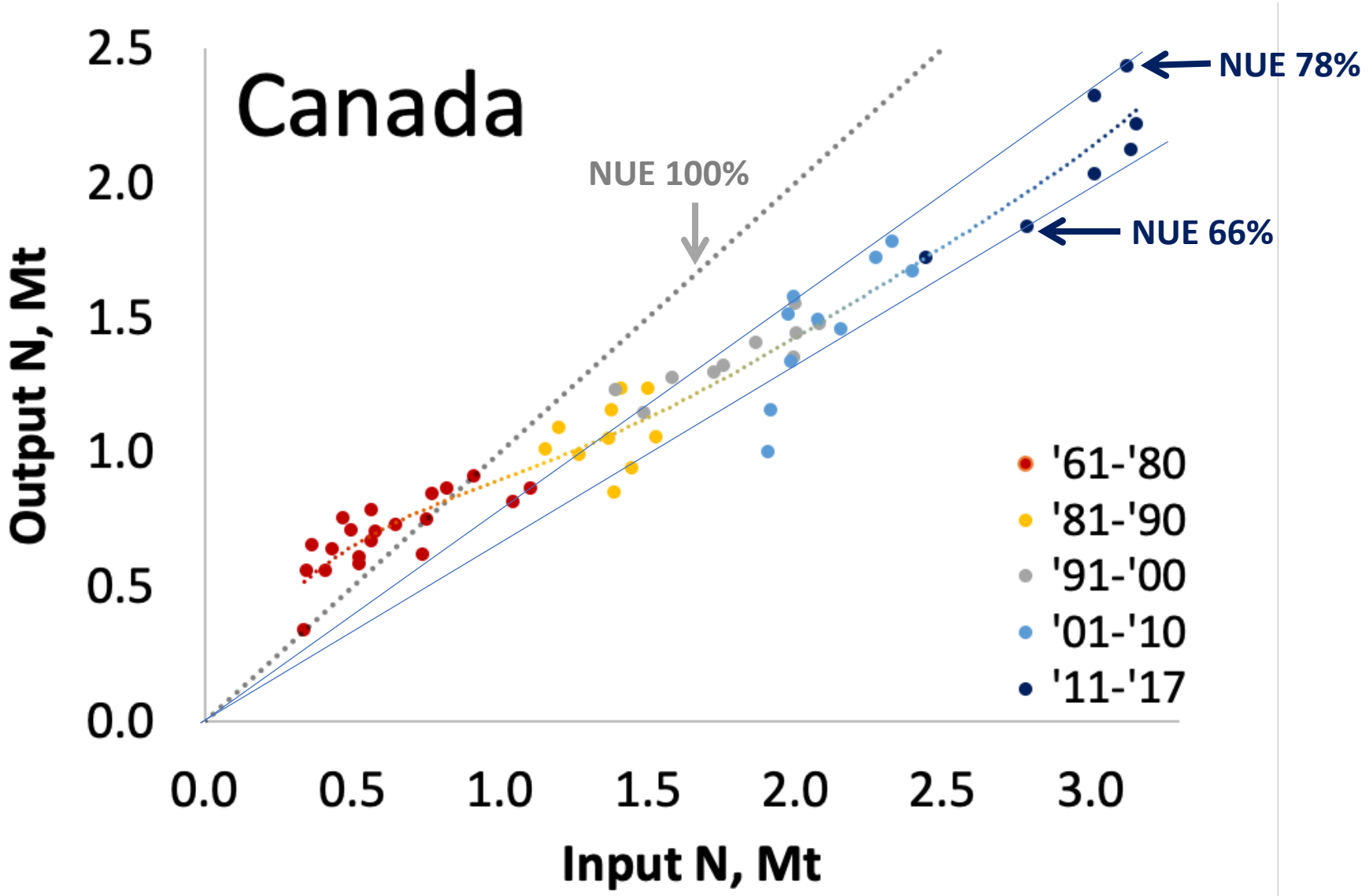
N use efficiency trajectories over 57 years (1961-2017)

Output increasing, NUE stable and > world average



IFA, 2020 – Nutrient Use Efficiency database. Input = fertilizer + fixation + manure; Output = harvest

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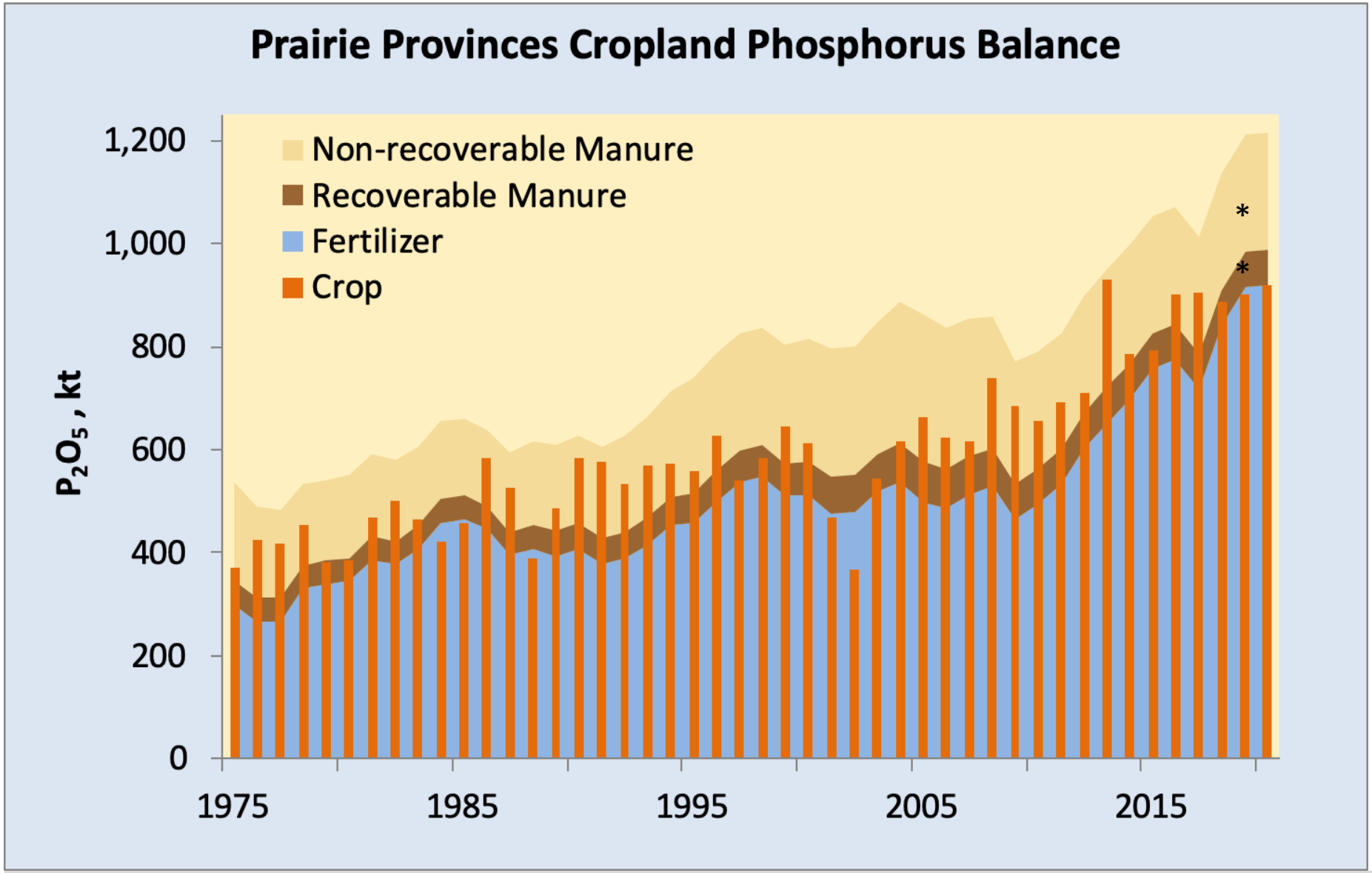

Crop removal of phosphorus often exceeds inputs [NUE>100%]

Calculated from CANSIM data for crops, livestock, and fertilizer using methods of IPNI NuGIS.
** assumes no change in manure P since 2013.*

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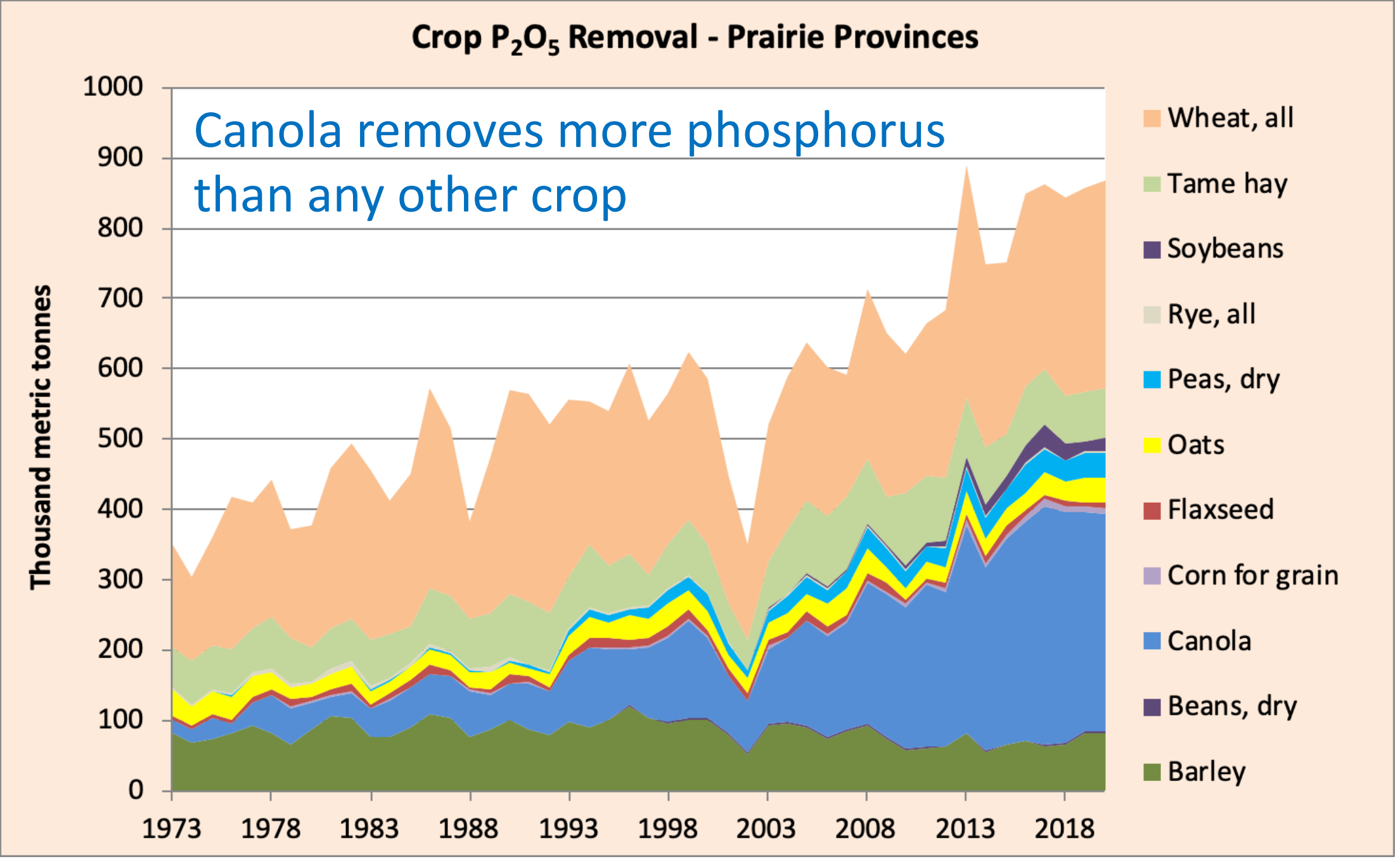

Calculated from CANSIM data using methods of IPNI NuGIS.

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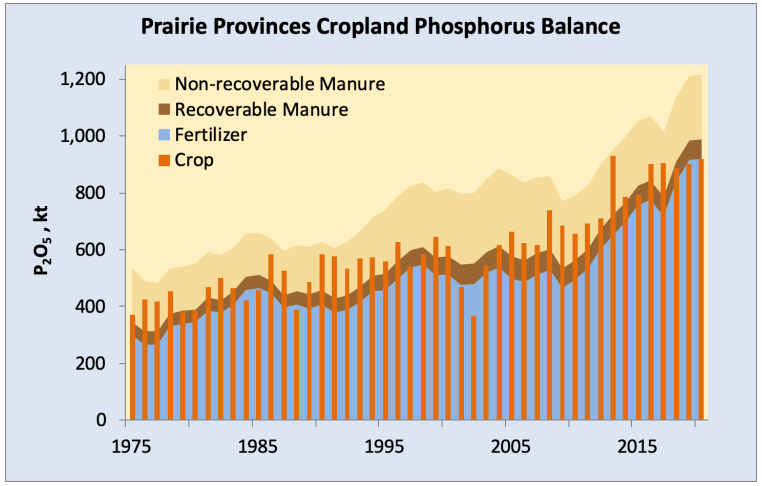
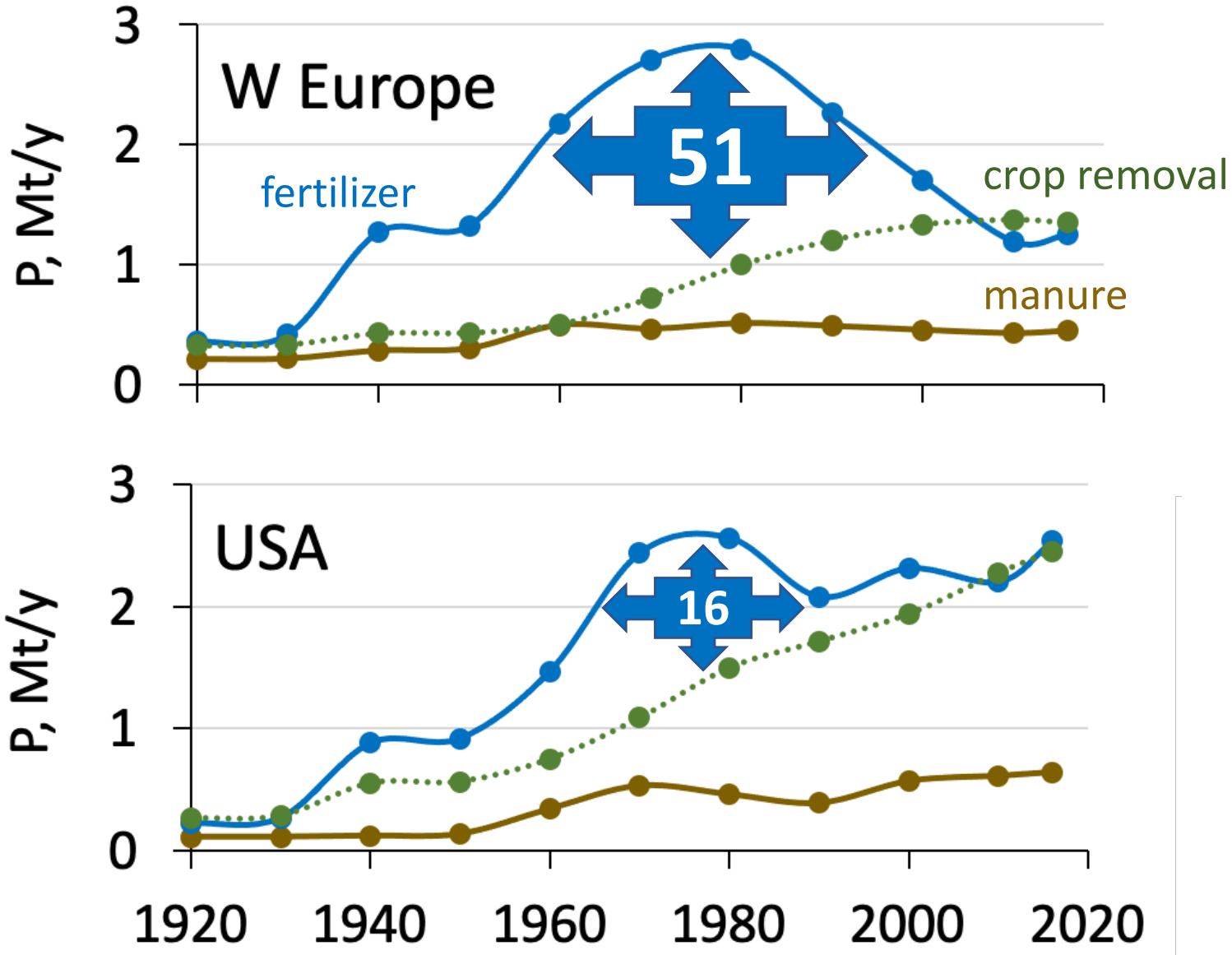
Crop P balances 1920-2016

The **cumulative P surplus** amounts to **51 years** crop removal in Western Europe, and **16 years** in the USA.

The Canadian prairies differ. Likely a **cumulative P deficit**.





Bruulsema et al., 2019. J. Environ. Qual. 48(5). doi: 10.2134/jeq2019.02.0065.

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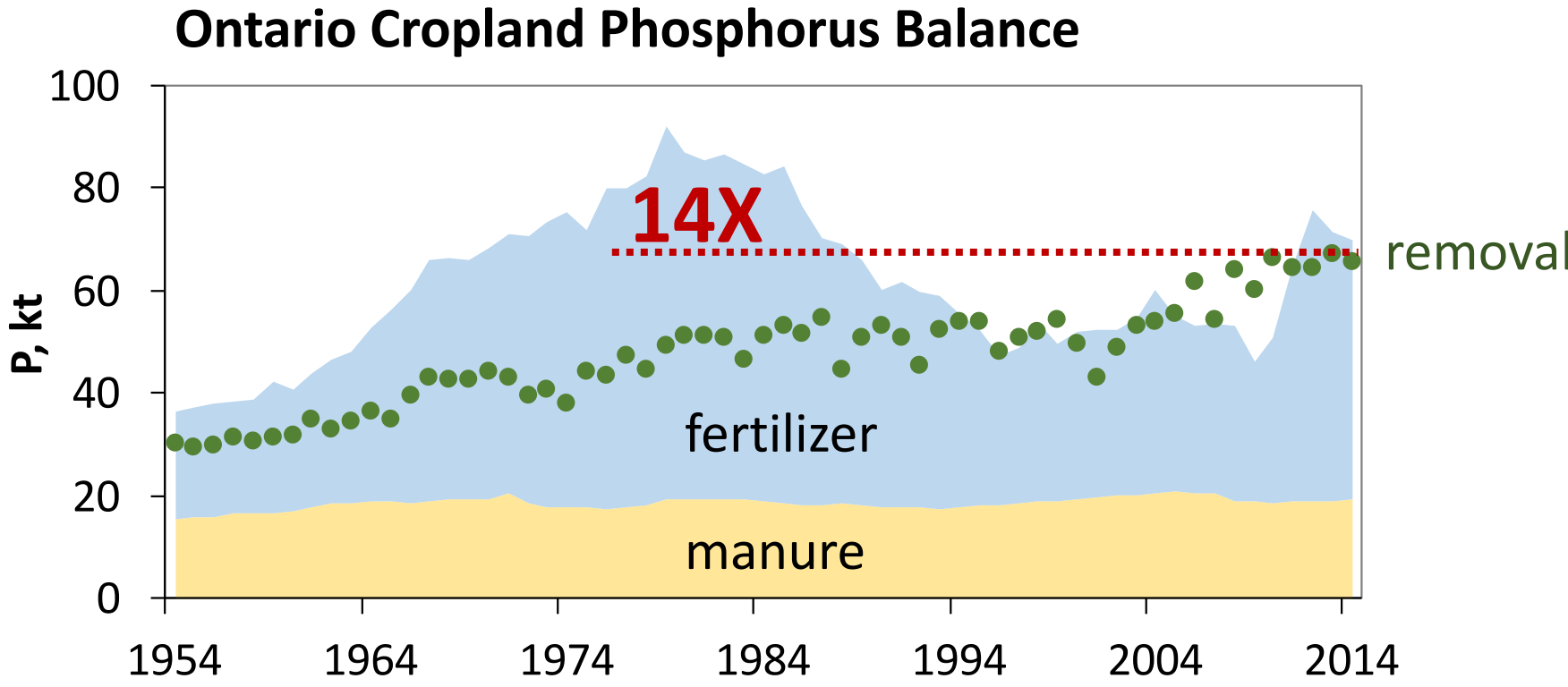
As a multiple of crop removal, Ontario's **cumulative P surplus** is similar to that of the USA.



= > 500 lb P_2O_5 per cropland acre

See Bruulsema et al. (2019) J Environ Qual (for USA, Europe, and Brazil)

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Real Story. Better Decisions.

FERTILIZER USE

Western Canada
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

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Canola in Western Canada – Key Points

NITROGEN

- Source: 24% EEF (14% ESN or SuperU)
- Rate = average 121 lb/A
- Time: 73% applied at planting
- Place: at planting, 30% side banded and 31% mid row banded

PHOSPHORUS

- Source: MAP 70%, MicroEssentials 25%
- Rate = average 34 lb P_2O_5/A
- Time: 89% applied at planting
- Place: 44% seed placed, 31% side-banded and 13% mid-row banded

Much more detail available

Corn in Ontario – Key Points

NITROGEN

- Source: 28% EEF (7% ESN or SuperU)
- Rate = average 172 lb/A
- Time: 3% fall, 34% preplant, 22% at-plant, 39% after planting
- Place: 84% in-soil, 16% broadcast no incorporation

PHOSPHORUS

- Source: MAP 81%, MicroEssentials 6%
- Rate = average 59 lb P_2O_5/A
- Time: 22% fall, 78% spring
- Place: 89% in-soil, 11% broadcast no incorporation

Much more detail available

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

Summary

The Fertility of Canadian Agricultural Soils as a Metric of 4R Practice

1. Industry-supported surveys of outcomes & practices provide useful metrics
2. Soil test P moving slowly in the right directions
3. N use efficiency of Canadian cropland higher than world average
4. Canadian soil testing frequency has opportunity to improve
5. 4R practices contribute more to mitigation of environmental impacts than is widely recognized

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