Bridging Research to Practice on Nutrient Management and Soil Health in Indiana

BEE KHIM CHIM

17TH OCTOBER 2024

POSITION: CLINICAL ASSISTANT PROFESSOR OF AGRONOMY IN SOIL FERTILITY AND PLANT NUTRIENT MANAGEMENT

PRESENTATION TIMELINE

Introduction/ Experiences

RESEARCH FOCUS

- Research Experiences
- Research Vision
- Advancements in techniques, tools, and methodologies
- Collaboration Opportunities, and Funding Sources

EXTENSION AND TEACHING FOCUS

- Extension Experiences
- Extension Vision
- Strategies, Opportunities
- Success story and ImpactsTeaching Experiences
- Teaching Philosophy

Introduction/ Experience

- From Kuala Lumpur (capital city of Malaysia)
- Malaysian-born Chinese
- Moved to the USA in 2007

Introduction/ Experience

- Bachelor of Science – Biochemistry and Molecular Biology; Oklahoma State University
- Master of Science – Soil Fertility; Oklahoma State University
- Doctor of Philosophy – Agronomy; Virginia Tech
- Postdoctoral Associate Research; USDA–ARS
- Assistant Extension Professor – Agronomist/Crop Production Specialist

How did I start a career as a biochemist and turn out an agronomist??

Fun facts: I speak 4 languages – English, Mandarin, Cantonese, and Malay.

INTRODUCTION/ EXPERIENCE

While being a newbie grad student in Agriculture ....

Lab Manager	Teaching Assistant	Secretary
• Managed instruments in the lab • Screened data from the lab • Trained hourly workers • Trained grad students processing samples in the lab	• Grade homework, exams, assignments, etc. • Prepared class materials • TA Office hours…	• Bookkeeping all accounts • Purchased all lab materials • Travel expenses for my advisor, etc.

Masters Degree – Experience

- Objective: To determine the combined effect of distance between hills and number of seeds planted per hill on maize grain yield and N uptake

Hindawi Publishing Corporation
International Journal of Agronomy
Volume 2014, Article ID 125258, 8 pages
http://dx.doi.org/10.1155/2014/125258

Research Article

Effect of Seed Distribution and Population on Maize (*Zea mays* L.) Grain Yield

Bee Khim Chim, Peter Omara, Natasha Macnack, Jeremiah Mullock, Sulochana Dhital, and William Raun

Department of Plant and Soil Science, Oklahoma State University, Stillwater, OK 74075, USA

Correspondence should be addressed to William Raun; bill.raun@okstate.edu

Received 15 May 2014; Accepted 14 November 2014; Published 9 December 2014

Academic Editor: Othmane Merah

Chim, B.K., P. Omara, J. Mullock, S. Dhital, N. Macnack, and W. Raun. 2014. Effect of seed distribution and population on maize (Zea mays L.) grain yield. Int. J. Agron. doi:10.1155/2014/125258.

Masters Degree - Experience

- **Project involvement:**

Journal of Plant Nutrition, 36:749–761, 2013
Copyright © Taylor & Francis Group, LLC
ISSN: 0190-4167 print / 1532-4087 online
DOI: 10.1080/01904167.2012.754039

NITROGEN FERTILIZER MANAGEMENT FOR IMPROVED GRAIN QUALITY AND YIELD IN WINTER WHEAT IN OKLAHOMA

Yesuf Assen Mohammed, Jonathan Kelly, Bee Khim Chim, Emily Rutto, Kevin Waldschmidt, Jeremiah Mullock, Guilherme Torres, Kefyalew Girma Desta, and William Raun
Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, Oklahoma, USA

From 2002 to date, a long-term field experiment has been conducted at Lake Carl Blackwell, Oklahoma, with different rates and times of nitrogen (N) fertilizer application to determine their effect on grain yield, protein and N uptake of winter wheat. Trend analysis for N rates (0, 50, 100, 150 and 200 kg N ha^{-1}) and orthogonal contrasts for different application times (pre-plant, top-dressed in February and March) were performed. With increasing fertilizer N, wheat grain yield and protein content increased from 2110 kg ha^{-1} to 6783 kg ha^{-1} and from 8.96 to 17.10%, respectively. For grain yield, prot
much more efficient than applyin
different years at the same N rat
making within-year-specific N rat

Keywords: nitrogen, nitroge

Communications in Soil Science and Plant Analysis
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/lcss20

In-Season Prediction of Nitrogen Use Efficiency and Grain Protein in Winter Wheat (Triticum aestivum L.)

Natasha Macnack[a], Bee Chim Khim[b] Jeremiah Mullock[a] & William Raun[a]
[a] Department of Plant and Soil Scie Stillwater, Oklahoma, USA
[b] Department of Crop and Soil Envi Blacksburg, Virginia, USA

Journal of Plant Nutrition, 37:198–208, 2014
Copyright © Taylor & Francis Group, LLC
ISSN: 0190-4167 print / 1532-4087 online
DOI: 10.1080/01904167.2013.859691

Expl Agric. (2013), volume 49 (1), pp. 3–18 © Cambridge University Press 2012
doi:10.1017/S0014479712000981

MAIZE GRAIN YIELD RESPONSE TO THE DISTANCE NITROGEN IS PLACED AWAY FROM THE ROW

By E. RUTTO†‡, J. P. VOSSENKEMPER§, J. KELLY†, B. K. CHIM† *and* W. R. RAUN†

†*Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, OK 74078-6010, USA and* §*Pioneer Hi-Bred, 12937 S US Hwy 281, Doniphan, NE 68832, USA*

(*Accepted 5 October 2012; First published online 16 November 2012*)

SUMMARY

Correct placement of side dress nitrogen (N) fertilizer could increase nitrogen use efficiency (NUE) and maize yield production. Field studies were established to evaluate application of midseason (V8 to V10), variable liquid urea ammonia nitrate (28%), N rates (0, 45, 90 and 134 kg N ha^{-1}) and different application distances (0, 10, 20 and 30 cm) away from the maize row on grain yield and NUE at Haskell and Hennessey in 2009, Efaw in 2010 and Lake Carl Blackwell, Oklahoma in 2009 and 2010. A randomized complete block design with three replications was used throughout the study. Results indicated that maize grain
< 0.05) with N rate, and poor N response was
arying side dress N application distance away
ce maize grain yield and NUE even with no
stribution had better maize grain yields when
0 to 10 cm, and a higher NUE when 45 kg N
low N rates (45 kg N ha^{-1}), increased maize
pplied 0 to 20 cm away from the maize row at
ons, increasing side dress N to 134 kg N ha^{-1}
%, 35%, 10%, 51% at Hennessey, Efaw, LCB

Original Articles

Applied Model for Estimating Potential Ammonia Loss from Surface-Applied Urea

Natasha E. Macnack, Bee K. Chim & William R. Raun

Pages 2055-2063 | Received 16 Nov 2011, Accepted 14 Mar 2012, Published online: 09 Jul 2013
Download citation https://doi.org/10.1080/00103624.2013.794823

EFFECT OF DELAYED EMERGENCE ON CORN (*ZEA MAYS* L.) GRAIN YIELD

Emily Rutto,[1] Cody Daft,[2] Jonathan Kelly,[1] Bee Khim Chim,[1] Jeremiah Mullock,[1] Guilherme Torres,[1] and William Raun[1]
[1]*Department of Plant and Soil Sciences, Oklahoma State University, Stillwater, Oklahoma, USA*
[2]*Pioneer Hi-Bred, Des Moines, Iowa, USA*

Doctor of Philosophy (PhD) – Experience

- Title: Alternative and improved cropping systems for the Mid-Atlantic USA

  Objectives: Increased feed grain production in the region that improved corn management techniques and adoption of alternative feed grains such as grain sorghum.

Published May 5, 2017

CROP ECONOMICS, PRODUCTION & MANAGEMENT

Comparison of Full-Season and Double-Crop Soybean and Grain Sorghum Systems in Central and Southeastern Virginia

Wade Thomason,* Bee Khim Chim, David Holshouser, Harry Behl, Maria Balota, Kang Xia, William Frame, and Tyler Black

Journal of Plant Nutrition

ISSN: 0190-4167 (Print) 1532-4087 (Online) Journal homepage: https://www.tandfonline.com/loi/lpla20

In-season decision support tools for estimating sidedress nitrogen rates for corn in the Mid-Atlantic Coastal Plain

Bee Khim Chim, Tyler Black, Paul Davis & Wade Thomason

To cite this article: Bee Khim Chim, Tyler Black, Paul Davis & Wade Thomason (2017) In-season decision support tools for estimating sidedress nitrogen rates for corn in the Mid-Atlantic Coastal Plain, Journal of Plant Nutrition, 40:20, 2818-2828, DOI: 10.1080/01904167.2017.1382531

To link to this article: https://doi.org/10.1080/01904167.2017.1382531

VirginiaTech
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Doctor of Philosophy (PhD) – Experience

- **Project Involvement:**

Precision Agric (2015) 16:405–424
DOI 10.1007/s11119-014-9385-2

Canopy spectral reflectance can predict grain nitrogen use efficiency in soft red winter wheat

K. Pavuluri · B. K. Chim · C. A. Griffey · M. S. Reiter · M. Balota · W. E. Thomason

Received: 25 September 2019 | Accepted: 21 April 2020 | Published online: 12 July 2020
DOI: 10.1002/csc2.20185

Crop Science

ORIGINAL RESEARCH ARTICLE
Crop Ecology, Management & Quality

Corn yield and soil nitrogen following winter annual cover crops interseeded into soybean

Robert Norris[1] | Bee Khim Chim[1] | Gregory Evanylo[1] | Mark Reiter[2] | Wade Thomason[1]

VirginiaTech
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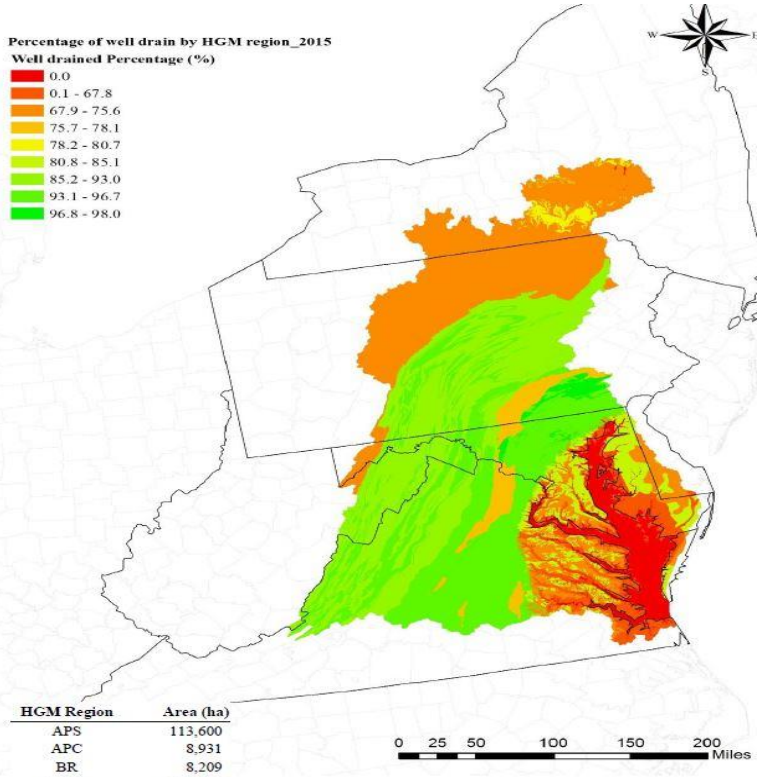
POST DOCTORAL – EXPERIENCE (VIRGINIA TECH)

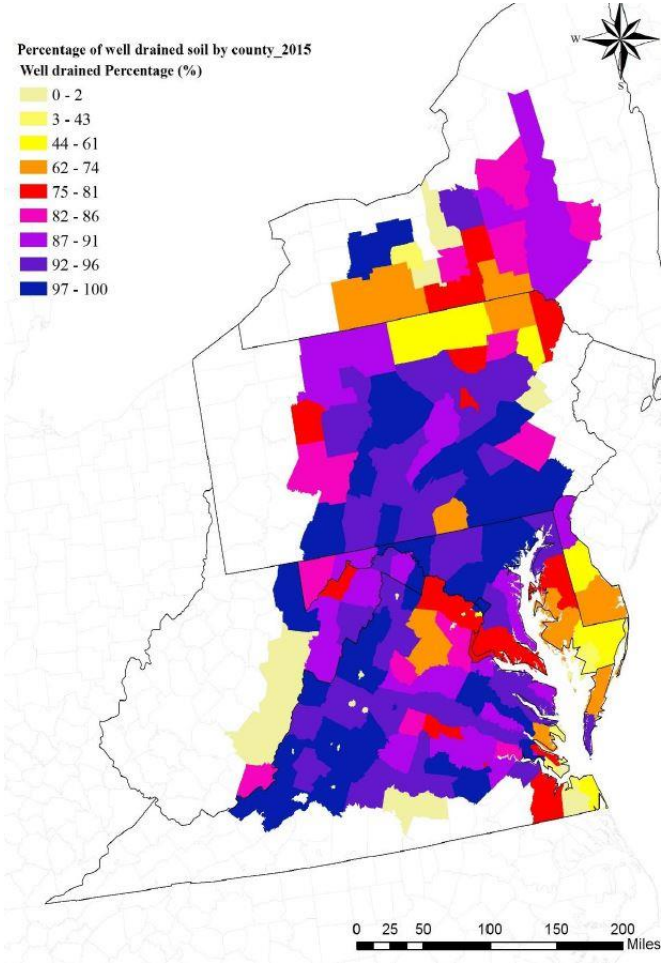
- **Project Involvement:**

  ✓Compile literature review and meta-analysis on tillage practice in the Mid-Atlantic region

  ✓Spatial analysis of tillage best management (N&P) practice implementation in support of the Chesapeake Bay program



HGM Region	Area (ha)
APS	113,600
APC	8,931
BR	8,209
CPD	234,300
CPL	194,088
CPU	195,262
ML	102,206
PCA	67,381
PCR	234,788
VRC	245,426
VRS	215,824



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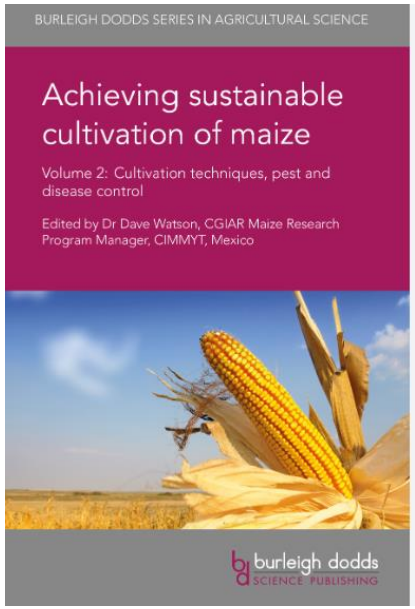
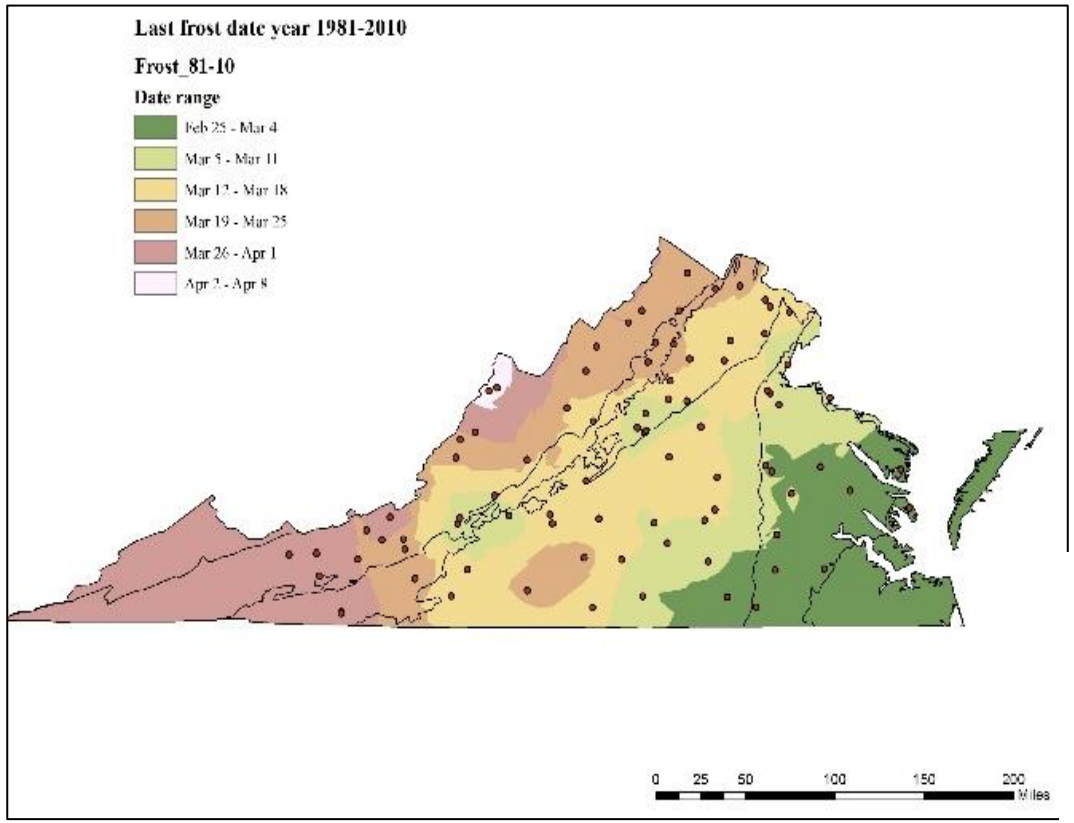
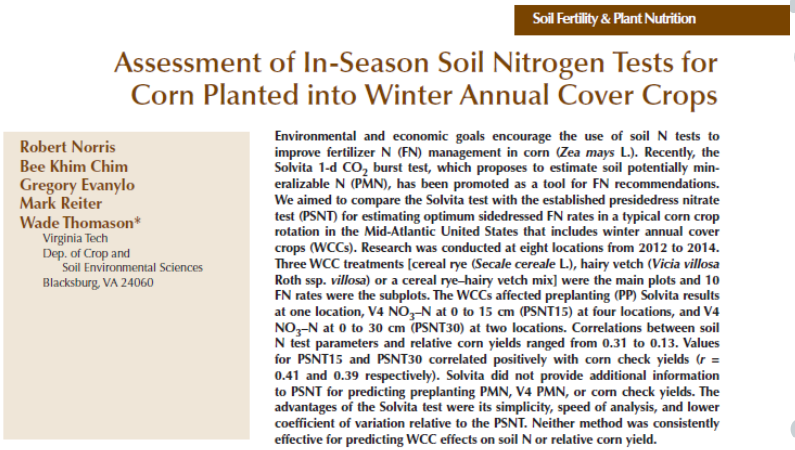
POST DOCTORAL – EXPERIENCE (VIRGINIA TECH)

- **Project Involvement:**





Thomason, W.E., **B.K. Chim**, and M.S. Reiter. 2017. Chapter 5: Zero-tillage cultivation of maize. *In* Dave Watson (ed). Achieving sustainable cultivation of maize Volume 2: Cultivation techniques, pest and disease control. Burleigh Dodds Science Publishing Limited. 81–95. doi:10.19103/AS.2016.0002.06


Soil Fertility & Plant Nutrition

Assessment of In-Season Soil Nitrogen Tests for Corn Planted into Winter Annual Cover Crops

Robert Norris
Bee Khim Chim
Gregory Evanylo
Mark Reiter
Wade Thomason*
Virginia Tech
Dep. of Crop and Soil Environmental Sciences
Blacksburg, VA 24060

Environmental and economic goals encourage the use of soil N tests to improve fertilizer N (FN) management in corn (*Zea mays* L.). Recently, the Solvita 1-d CO_2 burst test, which proposes to estimate soil potentially mineralizable N (PMN), has been promoted as a tool for FN recommendations. We aimed to compare the Solvita test with the established presidedress nitrate test (PSNT) for estimating optimum sidedressed FN rates in a typical corn crop rotation in the Mid-Atlantic United States that includes winter annual cover crops (WCCs). Research was conducted at eight locations from 2012 to 2014. Three WCC treatments [cereal rye (*Secale cereale* L.), hairy vetch (*Vicia villosa* Roth ssp. *villosa*) or a cereal rye–hairy vetch mix] were the main plots and 10 FN rates were the subplots. The WCCs affected preplanting (PP) Solvita results at one location, V4 NO_3–N at 0 to 15 cm (PSNT15) at four locations, and V4 NO_3–N at 0 to 30 cm (PSNT30) at two locations. Correlations between soil N test parameters and relative corn yields ranged from 0.31 to 0.13. Values for PSNT15 and PSNT30 correlated positively with corn check yields (r = 0.41 and 0.39 respectively). Solvita did not provide additional information to PSNT for predicting preplanting PMN, V4 PMN, or corn check yields. The advantages of the Solvita test were its simplicity, speed of analysis, and lower coefficient of variation relative to the PSNT. Neither method was consistently effective for predicting WCC effects on soil N or relative corn yield.

Abbreviations: AONR, agronomically optimum N rate; FN, fertilizer N; PMN, potentially mineralizable N; PP, preplanting; PS, presidedress; PSNT, presidedress nitrate test; PSNT15, V4 NO_3–N at 0 to 15 cm; PSNT30, V4 NO_3–N at 0 to 30 cm; SOM, soil organic matter; TN, total N; WCC, winter cover crop.

Norris, R., **B.K. Chim**, G. Evanylo, M. Reiter, and W. Thomason. 2018. Assessment of in-season soil nitrogen tests for corn planted into winter annual cover crops. Soil Sci. Soc. Am. J. 82:1428–1436. doi: 10.2136/sssaj2018.01.0036

VirginiaTech
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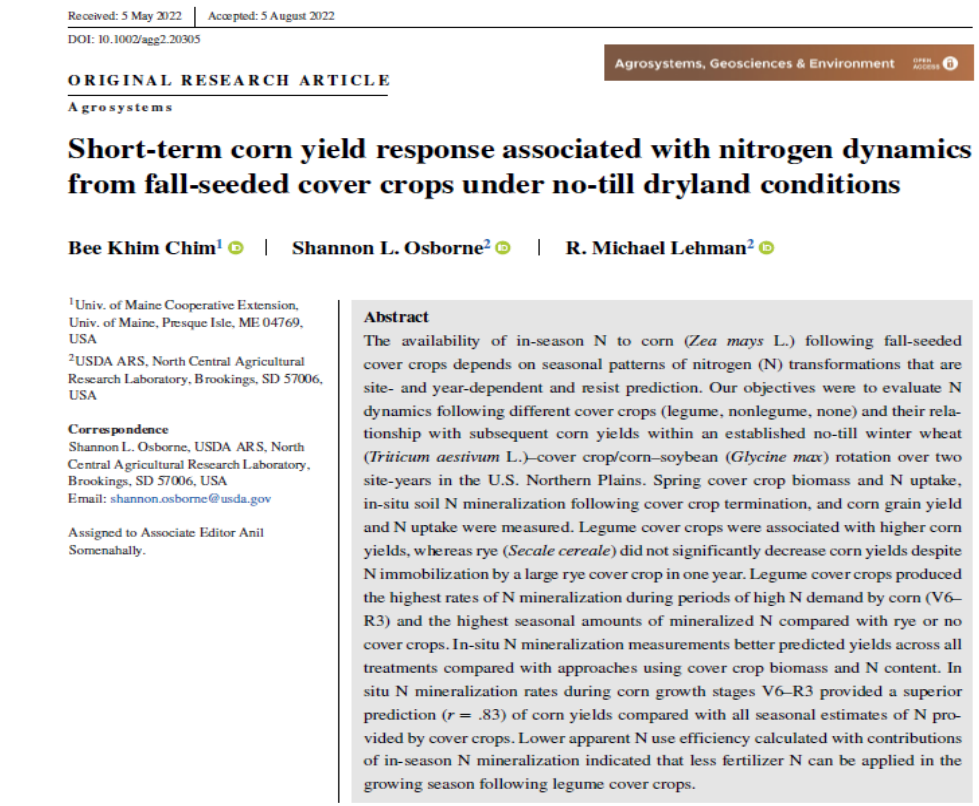
POST DOCTORAL – EXPERIENCE (USDA–ARS)

Main focus: evaluating the impact of cover crops on improving soil health in the Northern corn belt



Received: 5 May 2022 | Accepted: 5 August 2022
DOI: 10.1002/agg2.20305

Agrosystems, Geosciences & Environment

ORIGINAL RESEARCH ARTICLE
Agrosystems

Short-term corn yield response associated with nitrogen dynamics from fall-seeded cover crops under no-till dryland conditions

Bee Khim Chim[1] | **Shannon L. Osborne**[2] | **R. Michael Lehman**[2]

[1]Univ. of Maine Cooperative Extension, Univ. of Maine, Presque Isle, ME 04769, USA
[2]USDA ARS, North Central Agricultural Research Laboratory, Brookings, SD 57006, USA

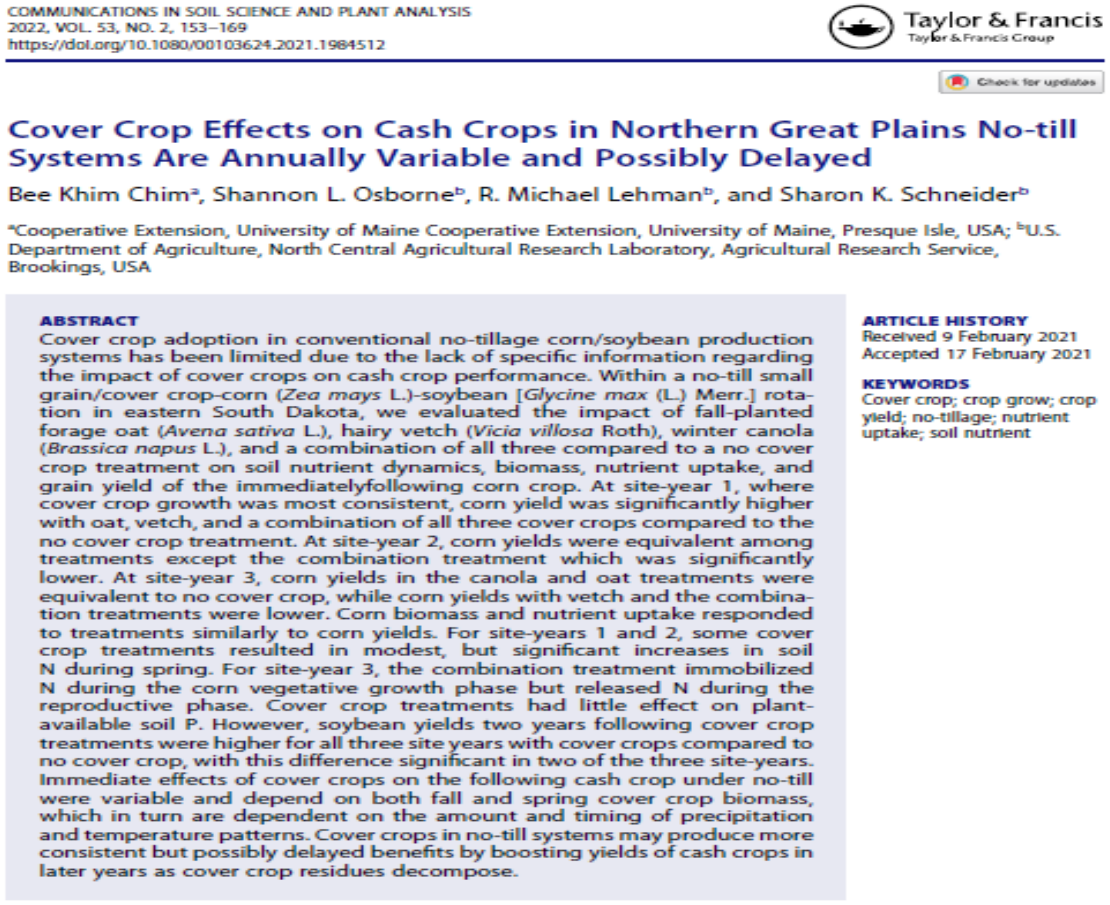
Correspondence
Shannon L. Osborne, USDA ARS, North Central Agricultural Research Laboratory, Brookings, SD 57006, USA
Email: shannon.osborne@usda.gov

Assigned to Associate Editor Anil Somenahally.

Abstract

The availability of in-season N to corn (*Zea mays* L.) following fall-seeded cover crops depends on seasonal patterns of nitrogen (N) transformations that are site- and year-dependent and resist prediction. Our objectives were to evaluate N dynamics following different cover crops (legume, nonlegume, none) and their relationship with subsequent corn yields within an established no-till winter wheat (*Triticum aestivum* L.)–cover crop/corn–soybean (*Glycine max*) rotation over two site-years in the U.S. Northern Plains. Spring cover crop biomass and N uptake, in-situ soil N mineralization following cover crop termination, and corn grain yield and N uptake were measured. Legume cover crops were associated with higher corn yields, whereas rye (*Secale cereale*) did not significantly decrease corn yields despite N immobilization by a large rye cover crop in one year. Legume cover crops produced the highest rates of N mineralization during periods of high N demand by corn (V6–R3) and the highest seasonal amounts of mineralized N compared with rye or no cover crops. In-situ N mineralization measurements better predicted yields across all treatments compared with approaches using cover crop biomass and N content. In situ N mineralization rates during corn growth stages V6–R3 provided a superior prediction (r = .83) of corn yields compared with all seasonal estimates of N provided by cover crops. Lower apparent N use efficiency calculated with contributions of in-season N mineralization indicated that less fertilizer N can be applied in the growing season following legume cover crops.

Chim, B.K., S.L. Osborne, and R.M. Lehman. 2022. Short-term corn yield response associated with nitrogen dynamics from fall-seeded cover crops under no-till dryland conditions. Agrosyst., Geosci., Environ. J. 5:3. e20305. doi: 10.1002/agg2.20305



COMMUNICATIONS IN SOIL SCIENCE AND PLANT ANALYSIS
2022, VOL. 53, NO. 2, 153–169
https://doi.org/10.1080/00103624.2021.1984512

Taylor & Francis
Taylor & Francis Group

Check for updates

Cover Crop Effects on Cash Crops in Northern Great Plains No-till Systems Are Annually Variable and Possibly Delayed

Bee Khim Chim[a], Shannon L. Osborne[b], R. Michael Lehman[b], and Sharon K. Schneider[b]

[a]Cooperative Extension, University of Maine Cooperative Extension, University of Maine, Presque Isle, USA; [b]U.S. Department of Agriculture, North Central Agricultural Research Laboratory, Agricultural Research Service, Brookings, USA

ABSTRACT

Cover crop adoption in conventional no-tillage corn/soybean production systems has been limited due to the lack of specific information regarding the impact of cover crops on cash crop performance. Within a no-till small grain/cover crop-corn (*Zea mays* L.)-soybean [*Glycine max* (L.) Merr.] rotation in eastern South Dakota, we evaluated the impact of fall-planted forage oat (*Avena sativa* L.), hairy vetch (*Vicia villosa* Roth), winter canola (*Brassica napus* L.), and a combination of all three compared to a no cover crop treatment on soil nutrient dynamics, biomass, nutrient uptake, and grain yield of the immediatelyfollowing corn crop. At site-year 1, where cover crop growth was most consistent, corn yield was significantly higher with oat, vetch, and a combination of all three cover crops compared to the no cover crop treatment. At site-year 2, corn yields were equivalent among treatments except the combination treatment which was significantly lower. At site-year 3, corn yields in the canola and oat treatments were equivalent to no cover crop, while corn yields with vetch and the combination treatments were lower. Corn biomass and nutrient uptake responded to treatments similarly to corn yields. For site-years 1 and 2, some cover crop treatments resulted in modest, but significant increases in soil N during spring. For site-year 3, the combination treatment immobilized N during the corn vegetative growth phase but released N during the reproductive phase. Cover crop treatments had little effect on plant-available soil P. However, soybean yields two years following cover crop treatments were higher for all three site years with cover crops compared to no cover crop, with this difference significant in two of the three site-years. Immediate effects of cover crops on the following cash crop under no-till were variable and depend on both fall and spring cover crop biomass, which in turn are dependent on the amount and timing of precipitation and temperature patterns. Cover crops in no-till systems may produce more consistent but possibly delayed benefits by boosting yields of cash crops in later years as cover crop residues decompose.

ARTICLE HISTORY
Received 9 February 2021
Accepted 17 February 2021

KEYWORDS
Cover crop; crop grow; crop yield; no-tillage; nutrient uptake; soil nutrient

Chim, **B.K.**, S.L. Osborne, R.M. Lehman, S.K. Papiernik. 2021. Cover crop effects on cash crops in Northern Great Plains no-till systems are annually variable and possibly delayed. Comm. Soil Sci. Plant Analy. 53:2, 153–169. doi:10.1080/00103624.2021.1984512

Post Doctoral – Experience (USDA–ARS)

USDA Agricultural Research Service

Tarım Bilimleri Dergisi
Tar. Bil. Der.
Dergi web sayfası:
www.agri.ankara.edu.tr/dergi

Journal of Agricultural Sciences
Journal homepage:
www.agri.ankara.edu.tr/journal

On-Farm Assessment of Soil Quality in Low and High Grazing Under Integrated Crop-Livestock System in South Dakota

Atilla POLAT[a], Bee CHİM[b], Sandeep KUMAR[a], Shannon OSBORNE[b]
[a]*Department of Agronomy, Horticulture and Plant Science, South Dakota State University, Brookings, South Dakota 57007, USA*
[b]*Agriculture Research Service-United Stated Department of Agriculture, Brookings, SD*

ARTICLE INFO
Research Article
Corresponding Author: Atilla POLAT, E-mail: atilla.plt@hotmail.com, Tel: +90 (554) 146 87 31
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Received: 13 November 2019 | Accepted: 28 March 2020 | Published online: 16 August 2020
DOI: 10.1002/csc2.20164

Crop Science

ORIGINAL RESEARCH ARTICLE
Crop Ecology, Management & Quality

Root length density of cereal and grain legume crops grown in diverse rotations

Shannon L. Osborne[1] | Bee Khim Chim[1] | Walter E. Riedell[1] | Thomas E. Schumacher[2]

[1]USDA-ARS North Central Research Lab., Brookings, SD 57006, USA
[2]Plant Science Dep., South Dakota State Univ., Brookings, SD 57006, USA

Abstract
The development of crop rotations to support sustainable agriculture depends on understanding how crop rotations affect above- and belowground crop characteristics.

Mycorrhiza (2019) 29:227–235
https://doi.org/10.1007/s00572-019-00884-4

ORIGINAL ARTICLE

Comparative measurements of arbuscular mycorrhizal fungal responses to agricultural management practices

R. Michael Lehman[1] · Shannon L. Osborne[1] · Wendy I. Taheri[1,2] · Jeffrey S. Buyer[3] · Bee Khim Chim[1]

Received: 28 September 2018 / Accepted: 18 February 2019 / Published online: 13 March 2019

90-cm soil depths. Soybean following winter wheat (CPWwS and COWwS) had significantly less root length density than soybean following corn. Soybean grain yield

Field Crops Research 310 (2024) 109361

Contents lists available at ScienceDirect

Field Crops Research

journal homepage: www.elsevier.com/locate/fcr

Diversified grain rotations can be highly and reliably productive in unstable climates

Patrick M. Ewing[a,*,1], Bee K. Chim[b], R. Michael Lehman[a], Shannon L. Osborne[a,*]

[a] *USDA-ARS Integrated Cropping Systems Research Unit, Brookings, South Dakota, USA*
[b] *University of Maine Cooperative Extension, Presque Isle, Maine, USA*

PRESENTATION TIMELINE

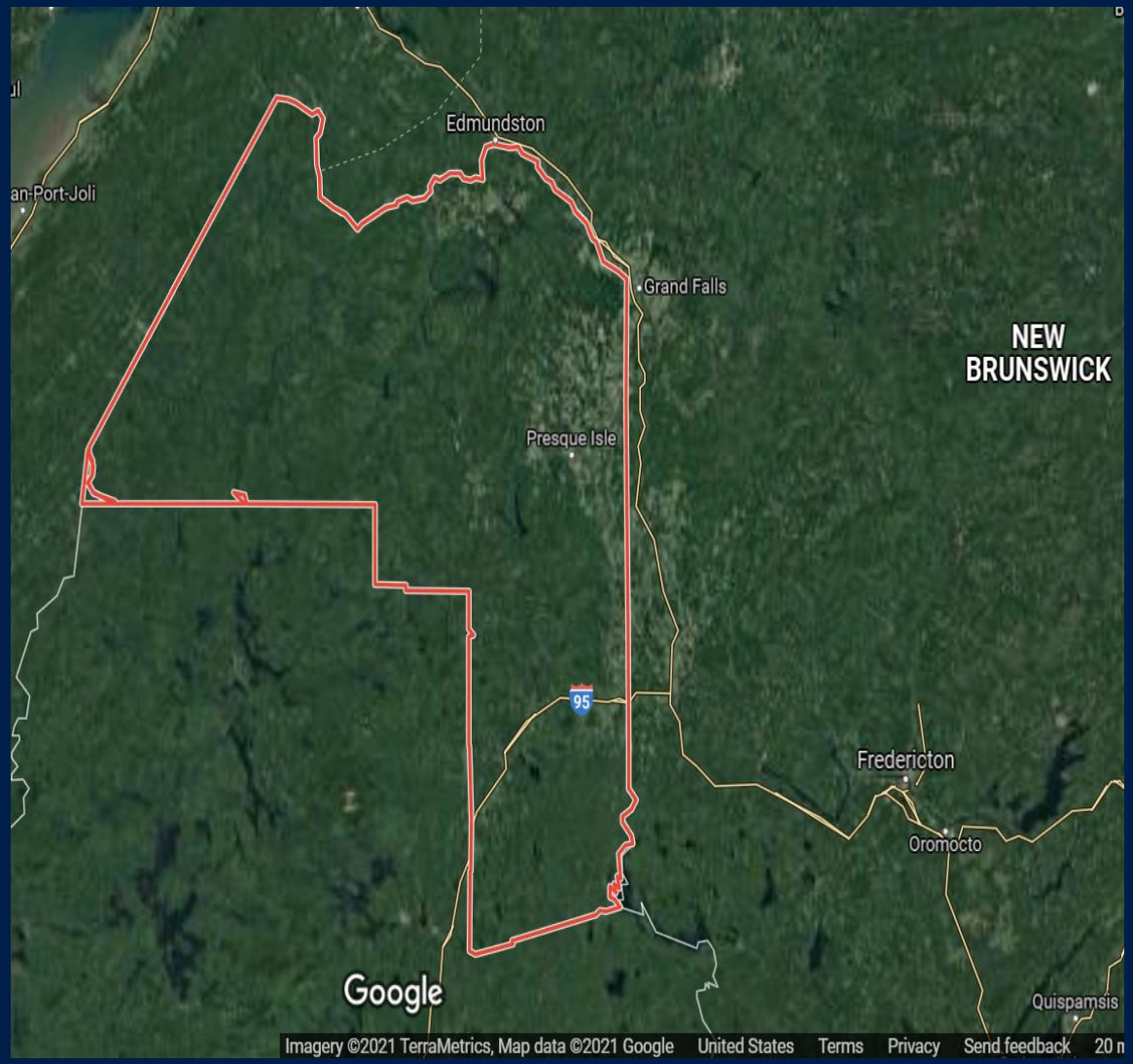
Introduction/ Experiences

RESEARCH FOCUS

- Research Experiences
- Research Vision
- Collaboration Opportunities, and Funding Sources

TEACHING AND EXTENSION FOCUS

- Teaching Experiences and Philosophy
- Extension Experiences
- Extension Vision
- Strategies, Opportunities
- Success story and Impacts



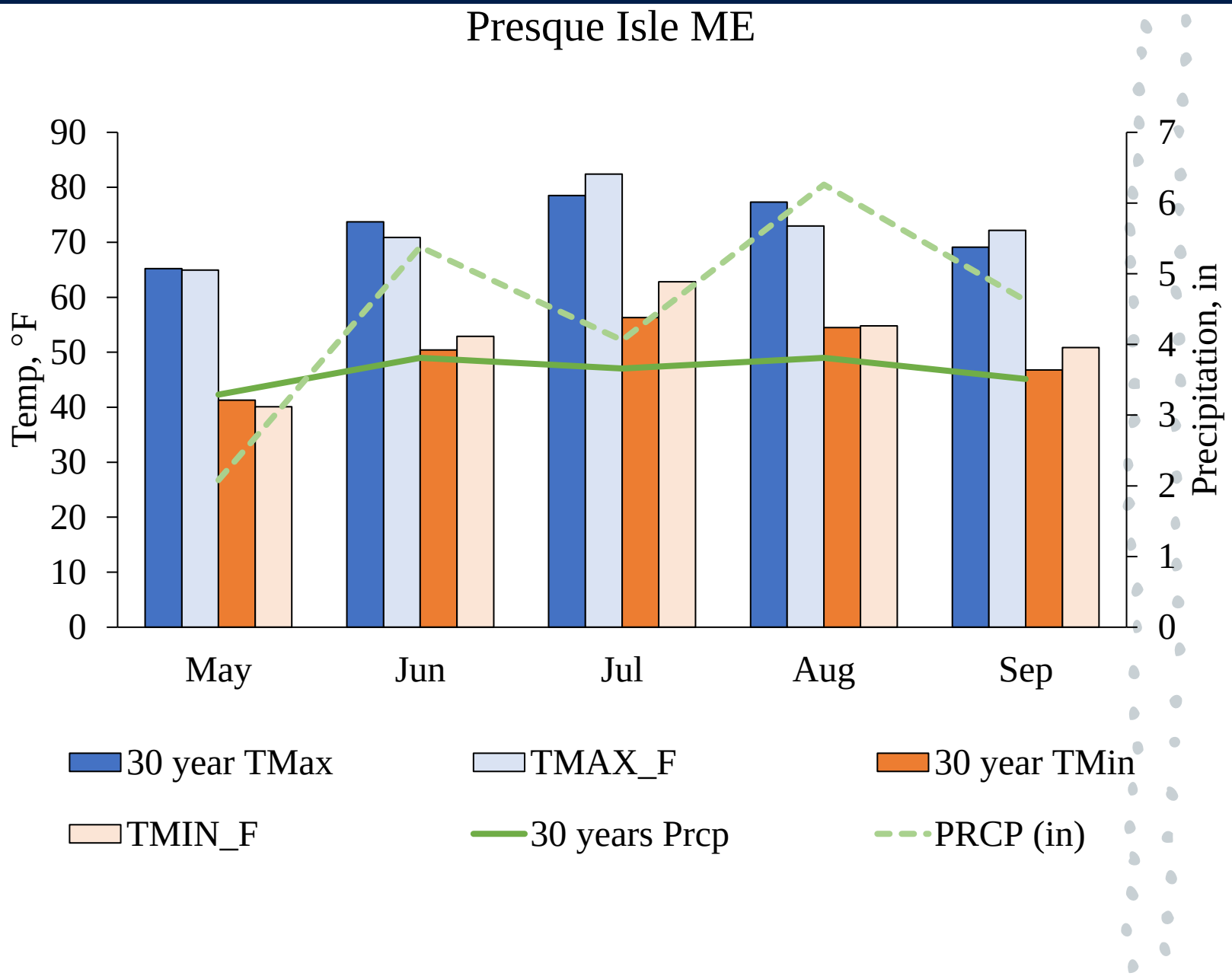
THE UNIVERSITY OF MAINE

Aroostook County

- The largest American county by land area east of the Mississippi River, excluding water.
- Nearly 90% of the land in the County is forest.
- It produced 56,000 acres of potatoes and 8,000 acres of broccoli in 2023. It is worth $540 million in sales.

Temperature and Precipitation in Central Aroostook

- Average temperature – 5.09°C (41°F)
- Average precipitation – 675 mm (22 inches)
- Average snowfall – 2413 mm (95 inches)



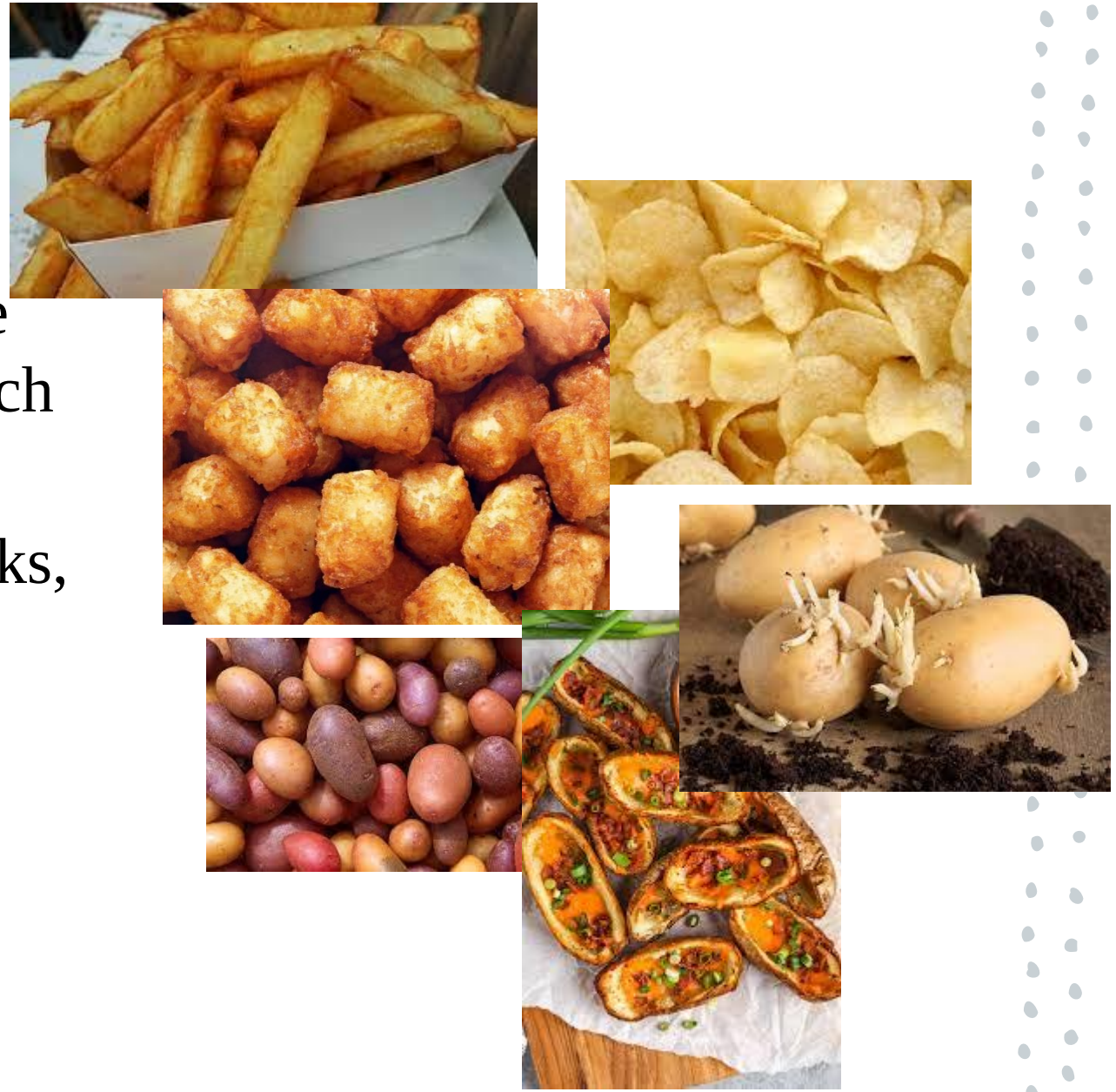
Introduction

- Rotation – 3 years
  - Option 1: Potato–Broccoli–Barley/Oat
  - Option 2: Potato–Barley/ Oat underseed clover/ryegrass/timothy
  - Option 3: Potato–Alfalfa mixture (2 years)
- Rotation – 2 years
  - Option 1: Potato–cover crop mixed
  - Option 2: Potato–Barley/Oat

Introduction

Potato Industry

- 71% of Maine potatoes are in the processing industry, such as french fries, chips, etc.
- 13% of potatoes are in table stocks, such as grocery market
- 16% of potatoes are produced as potato seed for next year
- Changing the past two years



Introduction

- Northern Maine's soils were directly deposited by the glaciers in the forms of clay, clay mixtures, silt, sand, gravel, and boulders.
- Slopes range from 0% to 15% but are dominantly less than 8%.

Photo credit: Bee Chim, 2023

Introduction

- For processing Russet potatoes will need 120 days from planting to vine kill.
- Generally, growers started to plant potatoes in mid-May and finished harvest by early Oct.
- After harvesting, they will plow the ground before the snow, ready for the next spring season.

Photo credit: Bee Chim, 2023

Obstacles and challenges

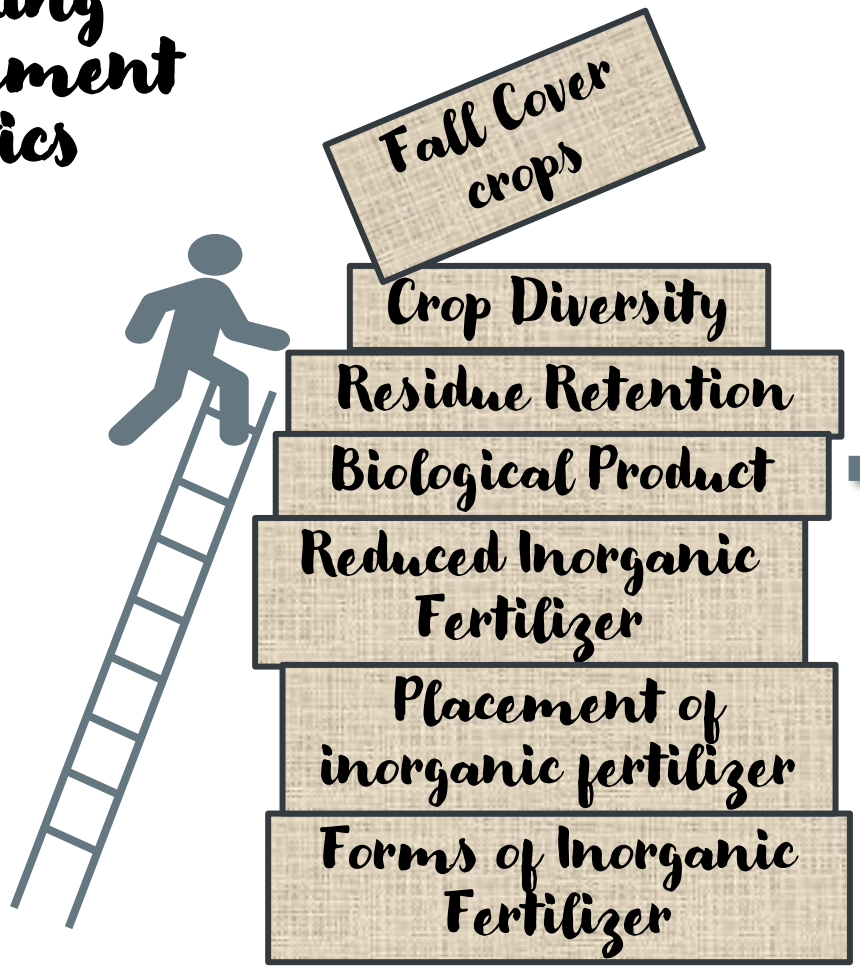
- Soils are bare after crop each year.
- Soil erosion and phosphorus runoff.
- Short growing season.
- Winter wheat and winter barley do not work in this region.
- Fast-growing crops for the fall season.
- For the EQUIP program, all the cover crops must be planted by September 15 (except Sep 30 for winter rye only).


120
Frenchville
St Agatha
anada
Long L
Sinclair
Cross
Lake Twp
Cross Lake
Square Lake
agle Lake
Westmanland

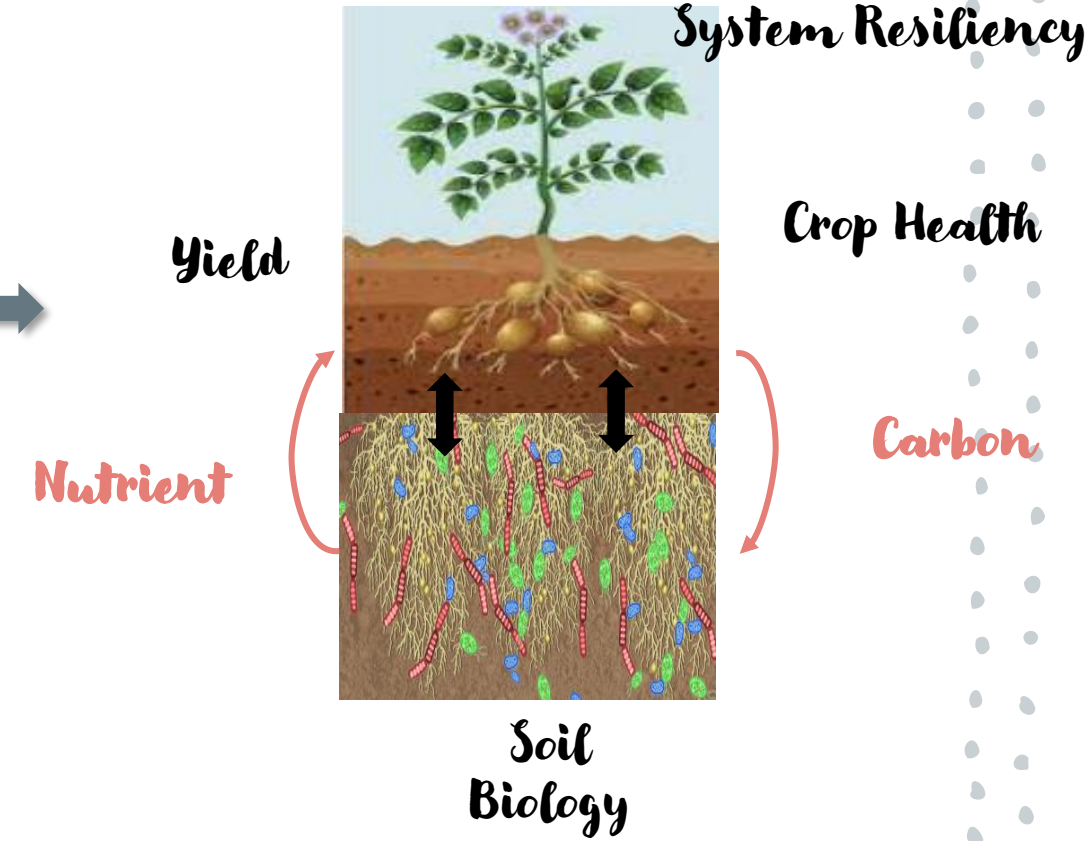

CROSS LAKE WATERSHED-BASED
MANAGEMENT PLAN (2021-2031)
Bourgoin Lake
Long Lake
Black Lake
FRENCHVILLE
ST. AGATHA
FORT KENT
Daigle Pond
Dickey Pond
NEW CANADA
CROSS LAKE TWP
Mud Lake
Cross Lake
SINCLAIR TWP
Friends of CROSS LAKE
MAINE
MARCH 2021

Soil Research Focus at Northern Maine

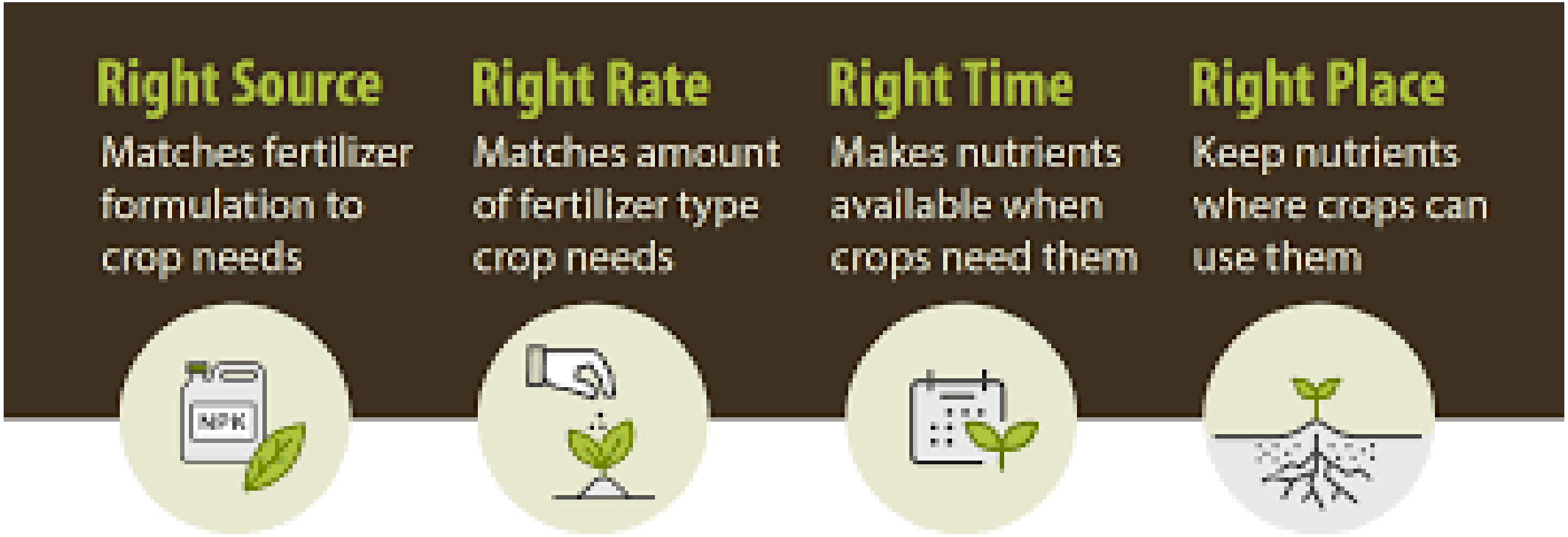
Stacking Management Tactics



Emergent Properties



Best Management Practice Approach (4R)



Looking at different forms/placement of fertilizer approach?

Can we use different forms/placements of Phosphorus fertilizer

Treatments

- ✓ No Phosphorus
- ✓ Control (150 lbs P_2O_5) – 2 x 2 dry bands
- ✓ P (11-37-0) – 2 x 2 liquid bands
- ✓ P (6-24-6) – In-furrow with dry bands

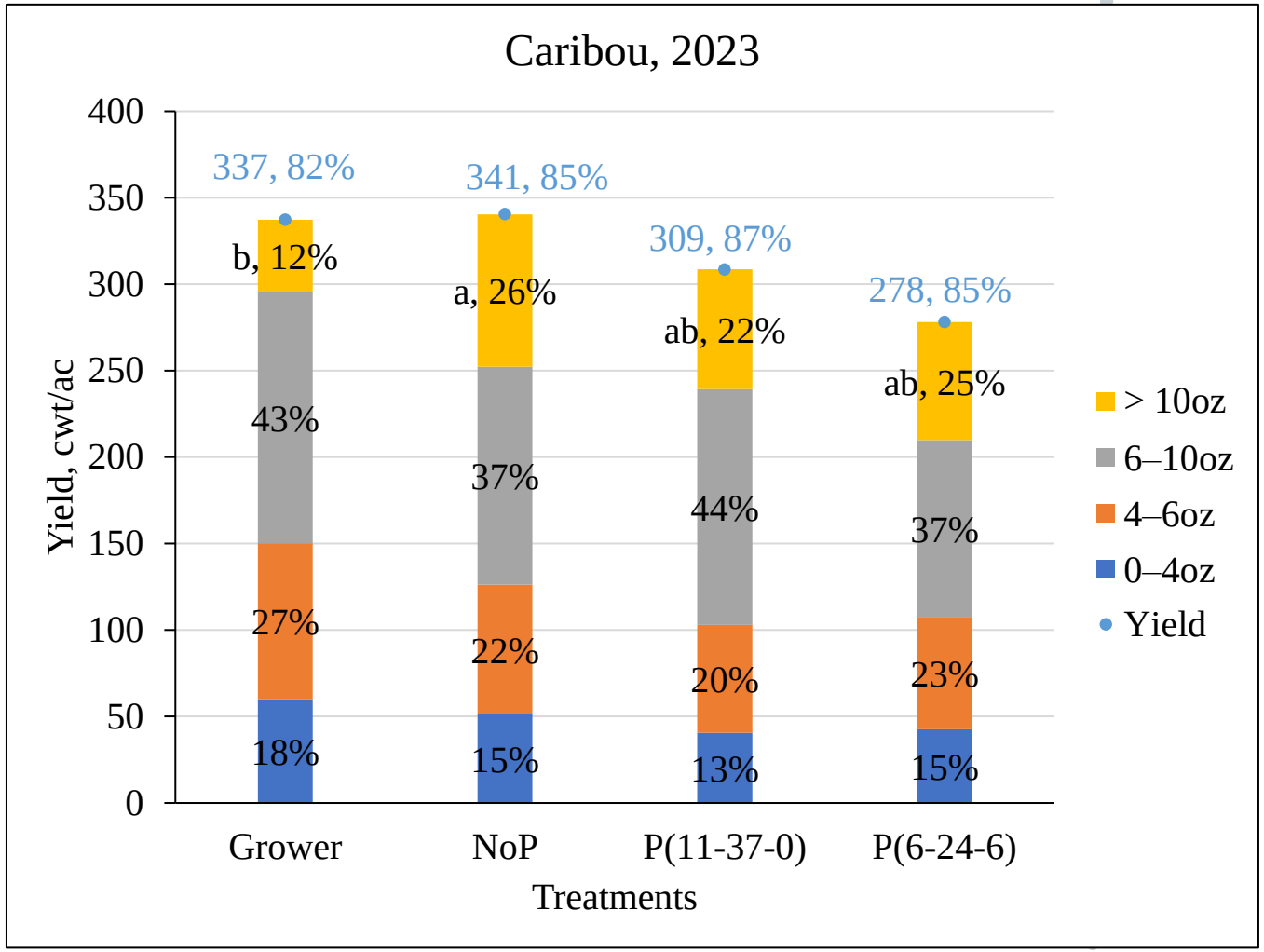
- **Looking at different forms/placement of fertilizer approach?**

- 3 different Phosphorus fertilizer forms – Diammonium Phosphorus (DAP), Liquid Band (11-37-0), Pop-up (6-24-2).
- Tested in 2022–2023
- Testing in different potato varieties

Year	Variety
2022	Atlantic
2022	Caribou
2023	Atlantic
2023	Burbank
2023	Caribou
2023	Snowden

Different forms of phosphorus fertilizer help?

- Treatments are no P fertilizer, standard rate (150 lbs), 11-37-0 (2x2 liquid band), and 6-24-6 (pop-up) in 2022 – 2023.
- There are no statistically significant yield differences in 6 sites/year.
- P(6-24-6) is the highest in 2 out of 6 sites/year
- Grower standard (using DAP in 2x2 band) is the highest in 3 out of 6 sites/year
- No P is the highest yield in 2023, Caribou variety.
- Fried test and specific gravity are not significantly different.



Looking at a reduced rate approach?

If soil test P is medium-high, can we reduce our recommendation by 50 lbs/ac?

Treatments

- ✓ No Phosphorus
- ✓ Reduced Rate (100 lbs P_2O_5)
- ✓ Control (150 lbs P_2O_5)
- ✓ Repeated 2 years in different soil pH and soil P test.

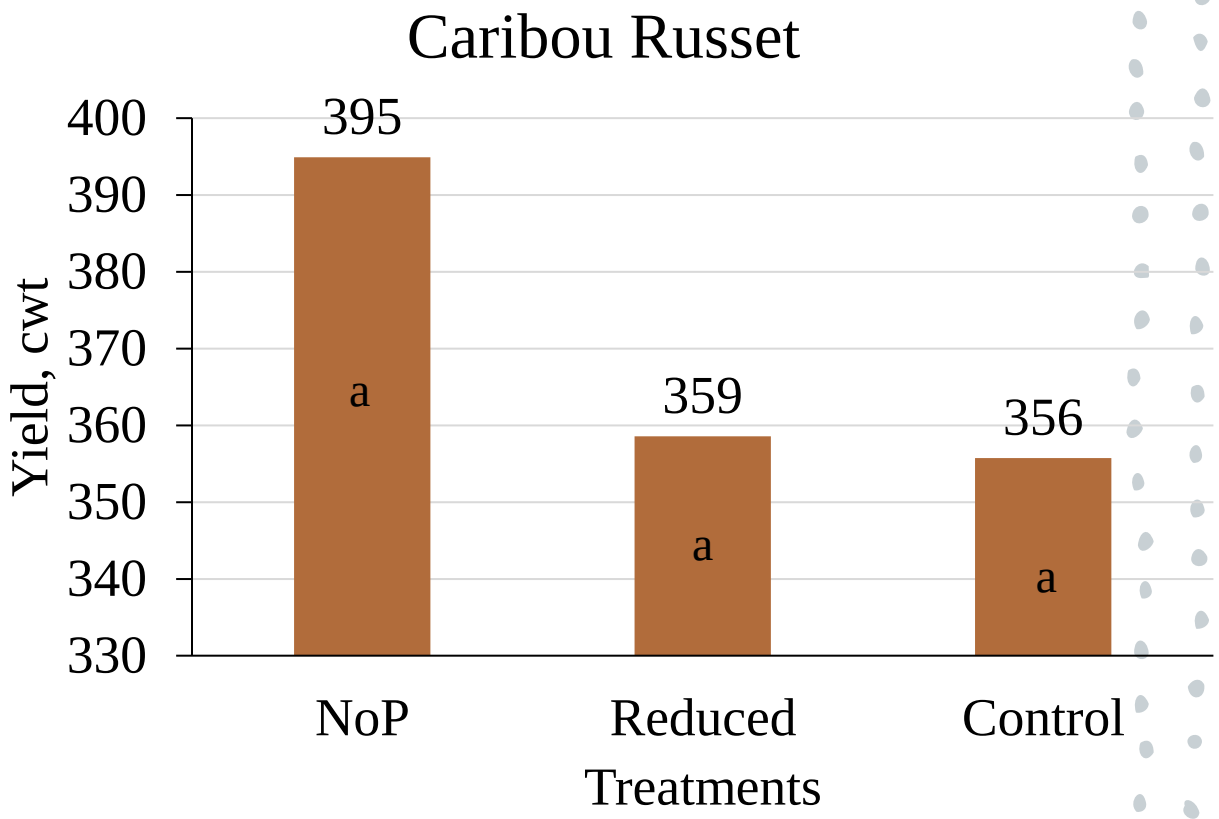
Looking at a reduced rate approach?

- Three different Phosphorus fertilizer rates – No P, reduced, and Control (0, 100, 150 lb/ac)
- Tested in 2022–2023 in 7 different field management
- pH ranged from 5.5–6.4 and soil p ranged from 13.4–34.4 lb/ac.

Loc	pH	Soil P (lb/ac)
A	6.1	34.4
B	5.8	29.5
C	5.5	13.4
D	6.0	18.4
J	6.1	17.2
K	6.4	30.2
L	6.4	31.7

Reduced Phosphorus Recommendation for potato

- ✓ Treatments are no P fertilizer, soil test recommendation rate (150 lb/ac), and Reduced rate (100 lbs/ac)
- ✓ Can we reduce our soil testing lab phosphorus recommendation rate for potato production?
- ✓ No yield response.
- ✓ Plant removal is 50 lbs/ac
- ✓ Fried test and specific gravity are not significantly different.



Looking at a different fertilizer with biological helps?

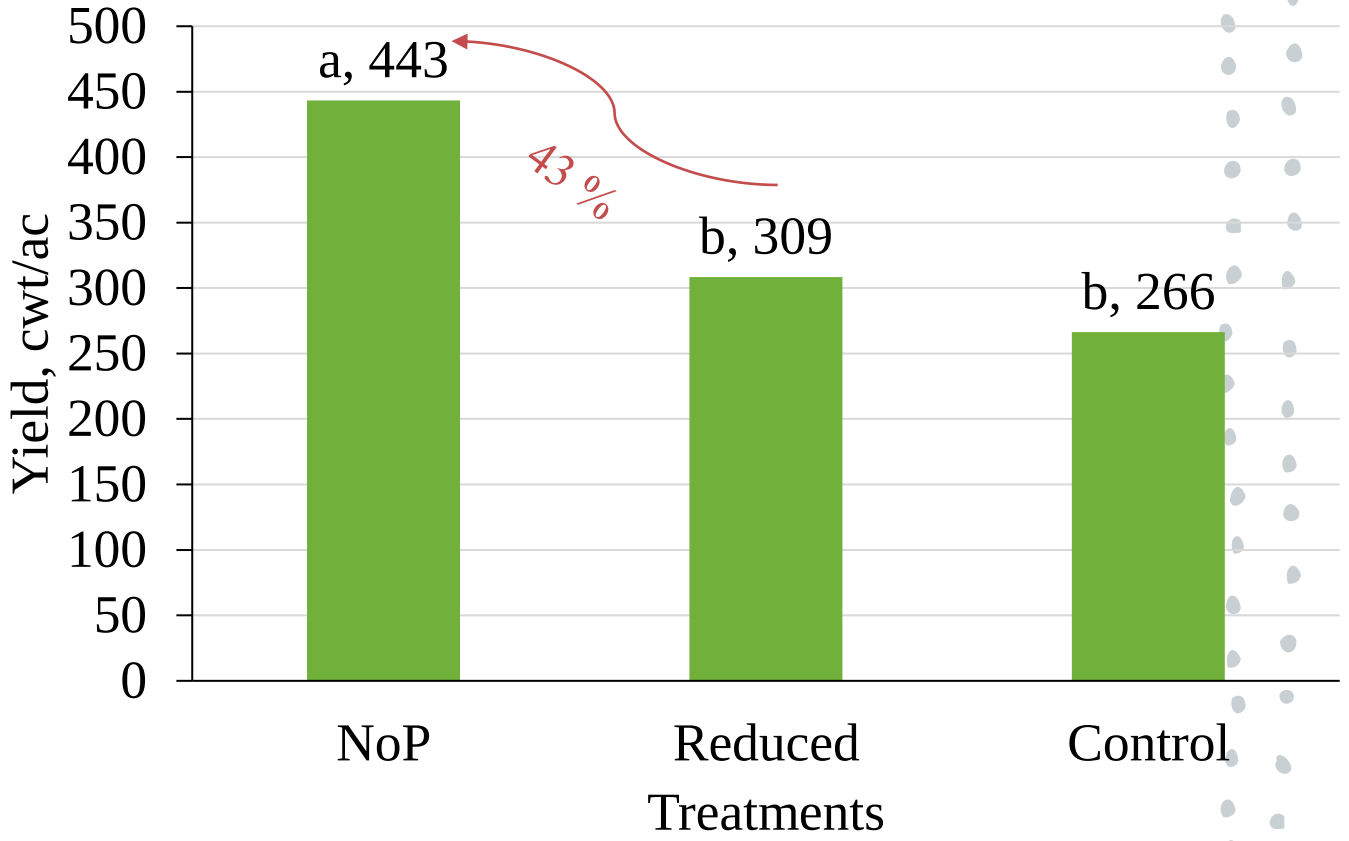
Can we use reduced rates of Phosphorus fertilizer with biological products?

Treatments

- ✓ No Phosphorus
- ✓ Control (150 lbs P_2O_5)
- ✓ Reduced (25% N and P with biological products)

Conclusion – different reduced P with Biological products

- The highest potato yield was no P fertilizer
- This difference was statistically significant, resulting in a remarkable 43% increase in yield.
- Please keep in mind, $17/cwt



Is there anything we have missed?

- P recommendation by potato variety?
- P recommendation by timing? Combination of dry fertilizer and liquid?
- Soil microbiology approach?
- Mixtures of all – dry and liquid fertilizers with biological products?

Managing of Phosphorus using cover crops?

Is there enough time to plant cover crops after potatoes/rotation crops? Especially we have a much shorter growing season.

Treatments

- ✓ Fallow
- ✓ Over-winter crop
- ✓ Winter killed crop

Materials and Methods

- i. Aroostook Research farm at Presque Isle, Maine,
- ii. Rogers Research Farm at Old Town, Maine.
- Split-plot design with 4 cover crop treatments, 5 planting dates, and four replications.
- Cover crop treatments are winter-killed cover crop oat (*Avena sativa*), over-winter cover crop rye (*Secale cereale*), over-winter cover crop rye-herbicide killed at fall, and fallow (no cover crop).

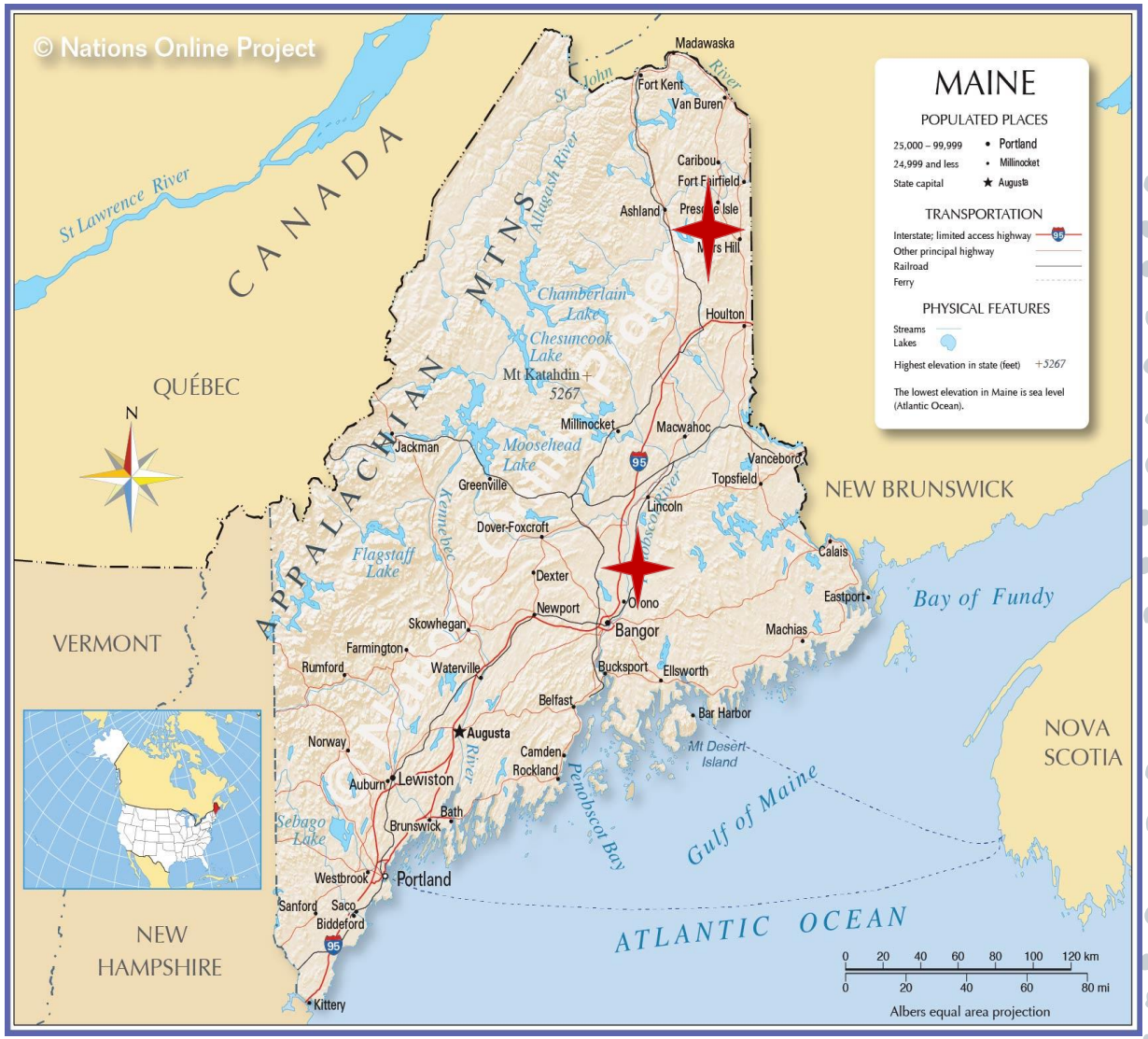
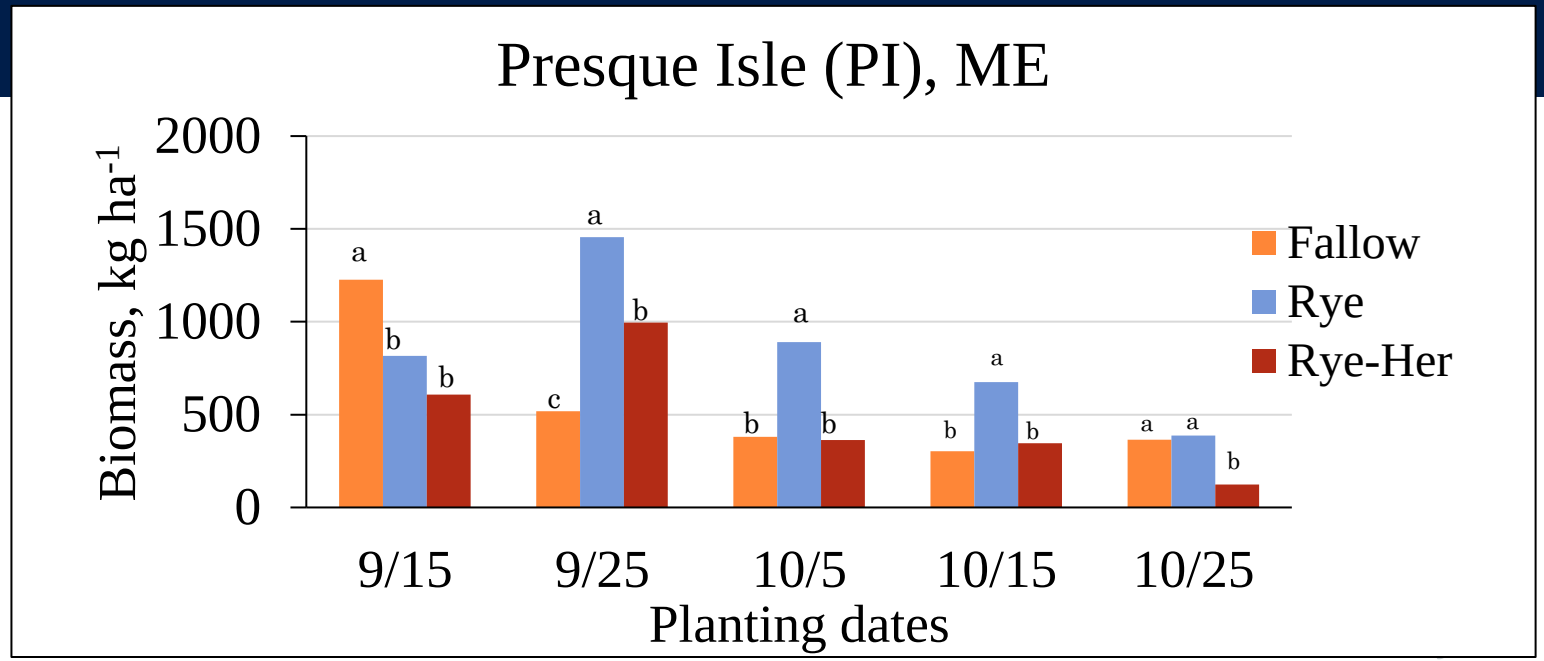
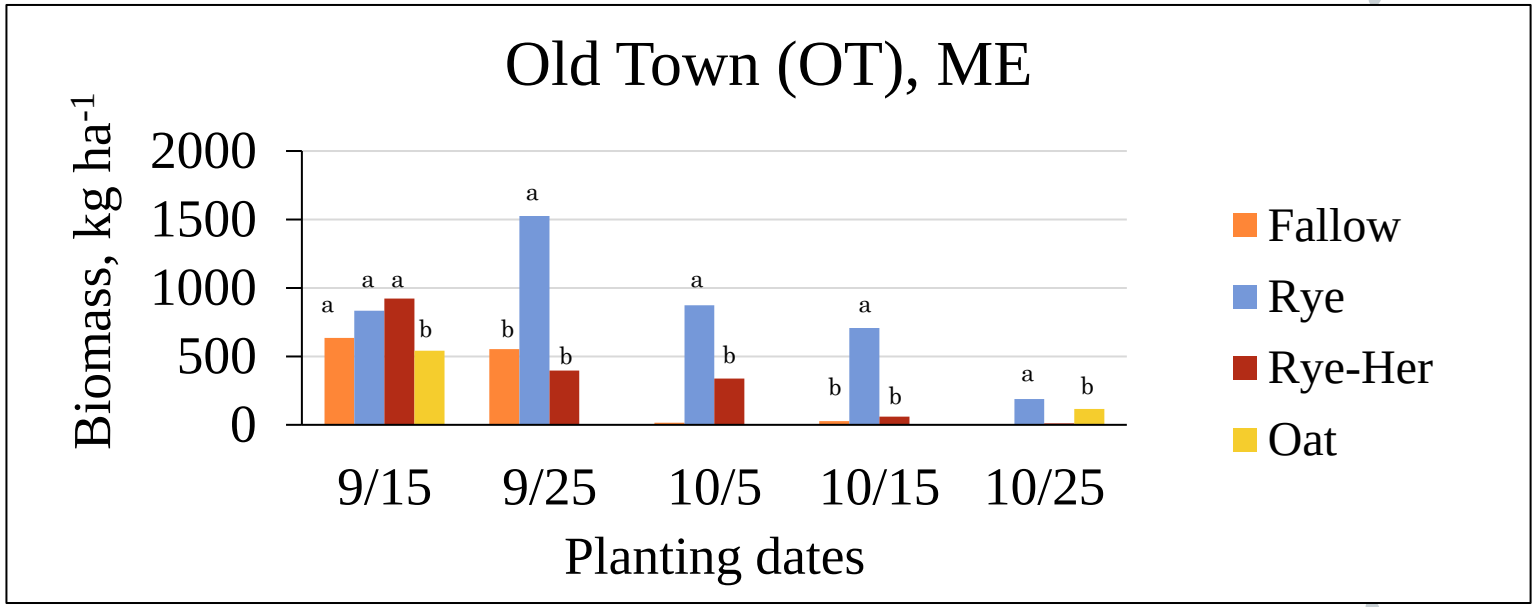


Photo credit: Bee Chim, the photo was taken on Nov 10, 2022.

Results & Discussion

- The optimum planting date for rye is Sep-25, which produced the most biomass in both locations.
- Cover crops did not germinate planting on Oct 25 in both locations.
- Weed biomass was significantly lower Viber shank the field after Sep 25 in PI and Oct 5 in OT.





Conclusion

- There is strong potential to plant cover crops following the potato harvest.
- For optimal growth of winter rye in both study locations, September 25 is identified as the best planting date.
- This practice can be particularly beneficial for weed control.
- Reducing phosphorus (P) application rates in potato production could help mitigate runoff issues.
- Changing phosphorus fertilizer form might be a way to reduce P runoff.
- Implementing a cover crop and utilizing a chisel plow in the spring could further reduce P runoff potential.

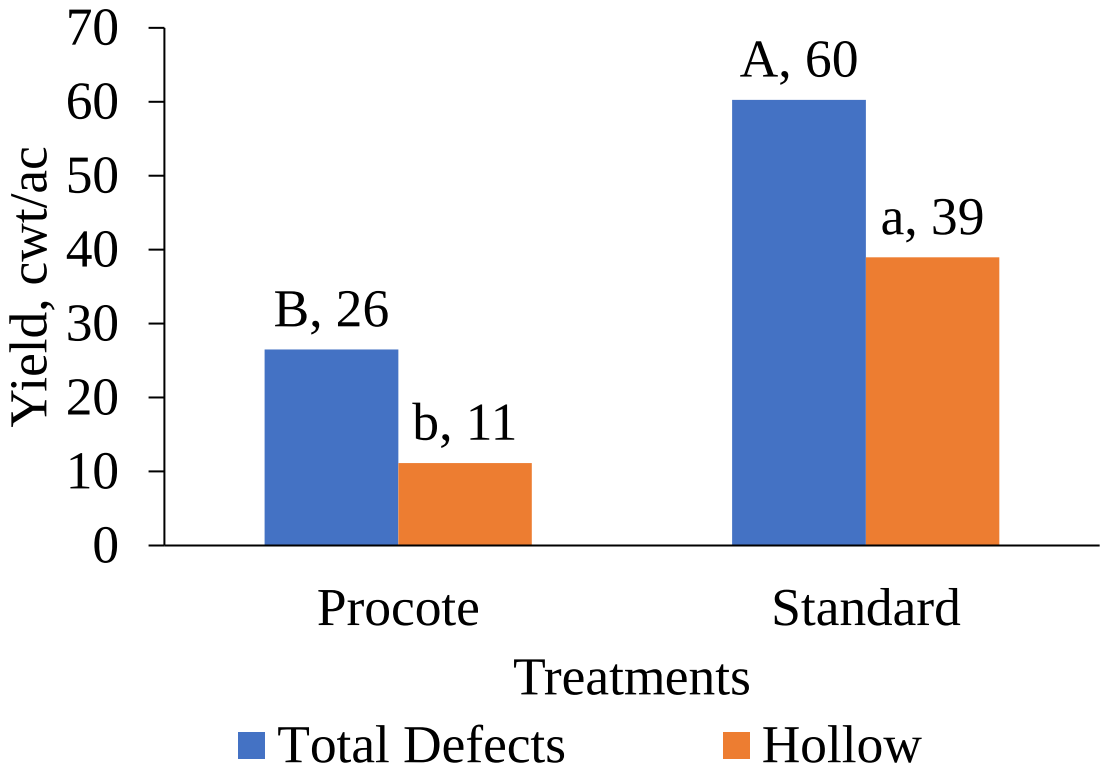
Resilience?

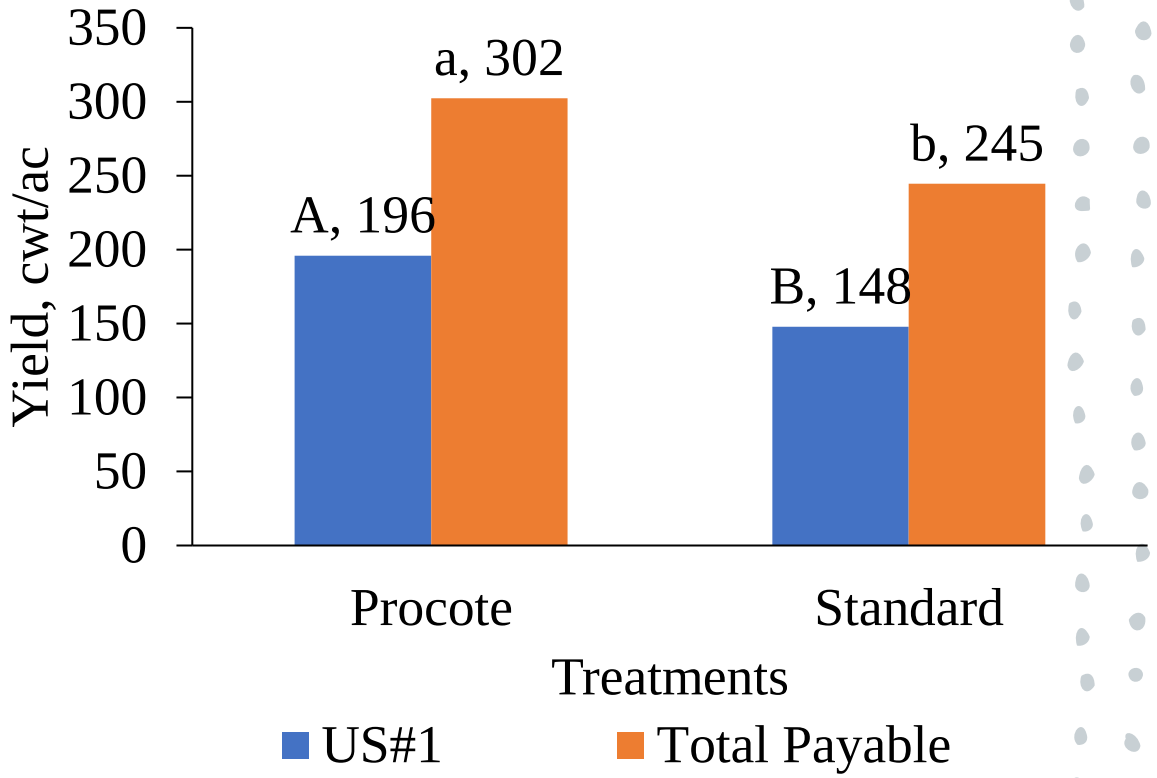
Precipitation in 2023

and 30-years average

Month	2023	30-yr avg
May	2.08	3.29
June	5.38	3.81
July	4.06	3.66
Aug	6.26	3.81
Sep	4.62	3.51
Total	***22.40***	***18.08***

Micronutrients Studies Procote (3lbs B – 8 lbs Zn – 8 lb Mn)





Research Vision

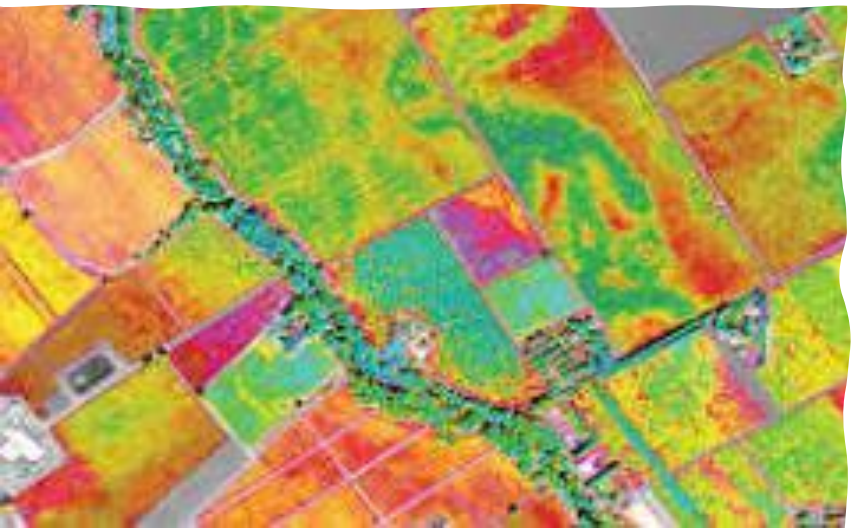
- Need Assessment throughout the State of Indiana

  Crops: Corn, soybean, sorghum, and small grains.

  Revise nutrient management and recommendations

  Micronutrient recommendations, such as Zn, B, Mg, Ca, Mn, etc.

  Field, greenhouse, and growth chamber-based experiments



Research Vision

- Establish a standard protocol for soil health assessment as a baseline across the state, especially for understanding the soil microbiology perspective.
- Provide farmers with science-based recommendations aimed at improving soil fertility, enhancing crop productivity, and mitigating environmental impacts.
- Investigating the impact of soil amendments, cover cropping, and crop rotation on soil health, nutrient cycling, and microbial diversity.

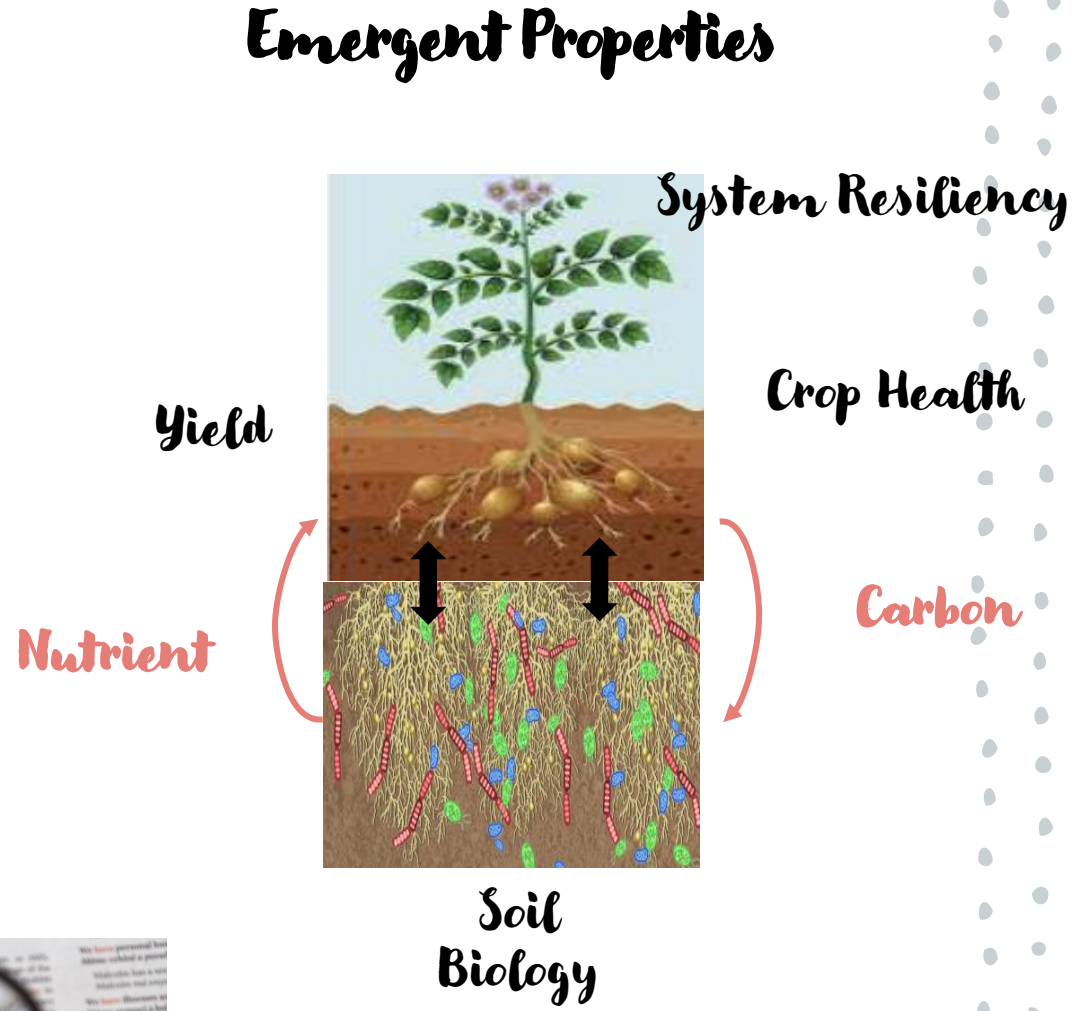
Research Vision

- Nutrient management as a whole rotation
- Sustainable cropping systems to become resilient in extreme weather, e.g. drought, wet, heat, etc.

  Soil physic–rotation crops, and cover crops influence the soil properties;

  Soil chemistry–nutrient recommendation and soil fertility management, especially micronutrients as a system in rotations;

  Soil biology–microbial activities, and microbiome in the rotation cropping system;



Collaboration

- Colleagues: Dr. Shaun Casteel, Dr. Bruce Erickson, Dr. Sylvie Brouder, Dr. Eileen Kladivko, Dr. Roland Wilhelm, etc.
- Opportunities and Interdisciplinary Research Initiatives: USDA - ARS, USDA-NRCS, Department of Ag, Department of Environmental Protection, etc.
- Funding Sources: Commodity boards, such as the Indiana Corn Growers Association, Indiana Soybean Alliance, Indiana Crop Improvement Association, NRCS Conservation Innovation Grants, Agriculture and Food Research Initiative (AFRI – Sustainable Ag), NIFA–Soil Health, etc.

INDIANA CORN GROWERS ASSOCIATION

INDIANA SOYBEAN ALLIANCE

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

ICIA INDIANA CROP IMPROVEMENT ASSOCIATION

USDA NIFA
United States Department of Agriculture
National Institute of Food and Agriculture

PRESENTATION TIMELINE

Introduction/ Experiences

RESEARCH FOCUS

- Research Experiences
- Research Vision
- Advancements in techniques, tools, and methodologies
- Collaboration Opportunities, and Funding Sources

TEACHING AND EXTENSION FOCUS

- Teaching Experiences and Philosophy
- Extension Experiences
- Extension Vision
- Strategies, Opportunities
- Success story and Impacts

Teaching – Experiences

- *Oklahoma State University*
  - ✓ Nutrient Cycling and Environmental Quality
  - ✓ Precision Agriculture
  - ✓ Research Methods
- *Virginia Tech*
  - ✓ World Crops and Systems Laboratory – Co-instructor
  - ✓ Soil fertility and Management
  - ✓ Guess Lecture: Agronomic crops
- *University of Maine – Presque Isle*
  - ✓ Precision Agriculture and Digital Ag
  - ✓ Plant and Crop Sciences

Mentoring

- ***Undergraduate Students***
  - ✓ Equip students with foundation knowledge and skills
  - ✓ Better understand what they learned in class and utilize it in current research
  - ✓ Help them achieve their academic goals and develop the skills
- ***Master Students***
  - ✓ Developing skills in conducting research, data collection and analysis, publishing manuscripts and building networks within the scientific community
  - ✓ Support students' participation in any of the activities such as scholarship application, attending extension, professional meetings, and workshops, to boost their potential and self-confidence while they are teaching or presenting their research.
- ***Ph.D. Students***
  - ✓ Gain experience mentoring undergraduate or master's students in research, experience teaching, writing grant proposals, and presenting research results at field day and conference meetings.
  - ✓ Developing skills in conducting research, data collection and analysis, publishing manuscripts and building networks within the scientific community
  - ✓ Support students' participation in any of the activities such as scholarship application, attending extension, professional meetings, and workshops, to boost their potential and self-confidence while they are teaching or presenting their research.

Oklahoma State University

- 3 undergraduate

UMaine

- 3 graduate students
- 5 undergraduate students
- 9 high school students

Virginia Tech

- 8 graduate students

USDA-ARS

- 2 graduate students

Potential Teaching Courses

Soil Fertility

Soil-Plant nutrient cycling

Agronomic Crops

Soil Health

Extension – Experiences

Extension/commodity board meetings	3 farm board customer focus group meetings 7 commodity group meetings 3 fertilizer check-off meetings
Field days experience	10 field day oral presentations 20 Extension talks; 18 Extension Guest Speakers
Workshop/training	6 Workshops/ conferences 7 demonstrations for producers, middle school, kids, Army National Guard
Extension publication	10 extension publications

Extension – Approach

Long-term goal:

- ✓ Develop relationships with farmers, extension agents, and colleagues at Indiana State and beyond
- ✓ Develop sustainable management practices and region-specific guidelines based on research
- ✓ Have a direct impact on nutrient management and improving soil health for producers in Indiana and the region
- ✓ Build a strong community of extensions, producers, industrials, students, etc.

Extension – Approach

Potential collaboration groups:

- ✓ Extension agents
- ✓ Producers and farmers
- ✓ Industry groups as appropriate, such as Yara, Helena, ICL, Nutrien, Syngenta, etc.
- ✓ Non-profit organizations such as Soil Health Institute (SHI), International Fertilizer Development Center (IFDC), Sustainable Phosphorus Alliance
- ✓ Other scientists (Ag engineers, soil microbiologists, physiologists, ecologists, sociologists, ag economists, AI Computer scientists, etc.)

Building Relationship

- Breakfast FieldReps Group
  - ✓ consists of 25 potato-allied industrial leaders
  - ✓ Meeting monthly from Apr – Oct
  - ✓ UMaine Scientists, Nutrien Ag, Helena, Carovail, Grant Falls Agromart, McCain Processor, Board of Pesticide Control, McCain Fertilizer, Corteva, DASCO, Maine Potato Board, etc.
- Nutrient and soil health Group
  - ✓ 5 nutrient management industrial leaders as an advisory group
  - ✓ Nutrien, DASCO, Agromart, NRCS.

Extension – Approach

- Not only extension publication

  Online platforms (eg. X, LinkedIn, Facebook, YouTube, Podcast, Instagram, etc.)

  Newsletter

  Radio/ podcast

  Your-pace program (mini-courses for sustainable agriculture, such as soil health, nutrient management, digital Ag, etc.)

- Possible funding source

  Commodity crops – eg. Winter wheat, corn, soybean, etc

  USDA – NIFA Women & Minority in STEM (WAMS)

  USDA – NIFA Soil Health




Long-term goal – Strategies for Engaging Stakeholders

Develop relationships with farmers, extension agents or colleagues, Federal and state Governments of Indiana State

Develop a sustainable management practice and region-specific guidelines through innovative and scientific research approaches

Develop a team with community leaders, government agencies, and agriculture producers to identify and address emerging issues and challenges facing the agricultural sector

Impact

- NRCS – Adjusting fall season cover for EQUIP program to Oct 15
- >15% of potato growers are expected to adopt fall season cover crop options following potato or non-potato production.
- In Fiscal Year 2023, NRCS at Aroostook County allocated $3,610,832 for EQUIP contracts, compared to $2,731,110 in 2020.
- A total of 1816 attendees in 31 events since 2021.
- Created Annual Potato Field Day, Crop Health Conference and Sustainable Ag Workshop


Thank you !!

Past Research/Extension Accomplishments

- **Publications**
  26 peer-reviewed manuscripts with 363 citations
  10 extension publications
  >50 abstract publications
- **Scientific training**
  7 MSc students
  4 Ph.D. students
- **Collaborations**
  Local – Department of Environmental Protection (DEP), District Conservationists (DC), NRCS, Department of Agricultural Conservation and Forestry (DACF)
  Scientists – Soil scientist, plant physiologist, soil microbiologist, plant pathologist, computer sciences, biosystem engineer
  Industry – Nutrien Ag Solution, Agromart, FMC, Maine Potato Board (MPB), McCain, etc.
- **Information transfer**
  10 field days
  8 extension training/workshops
- **Funded grants (since 2021):** USDA–CIG, University Internal Grants, Specialty Block Grants, Earmark (a total of 7 grants); industrial grants (a total of 17 grants)