

From Research Plots to Prairie Fields: Do Ultra-early Seeding and Enhanced Efficiency Fertilizers Pay?

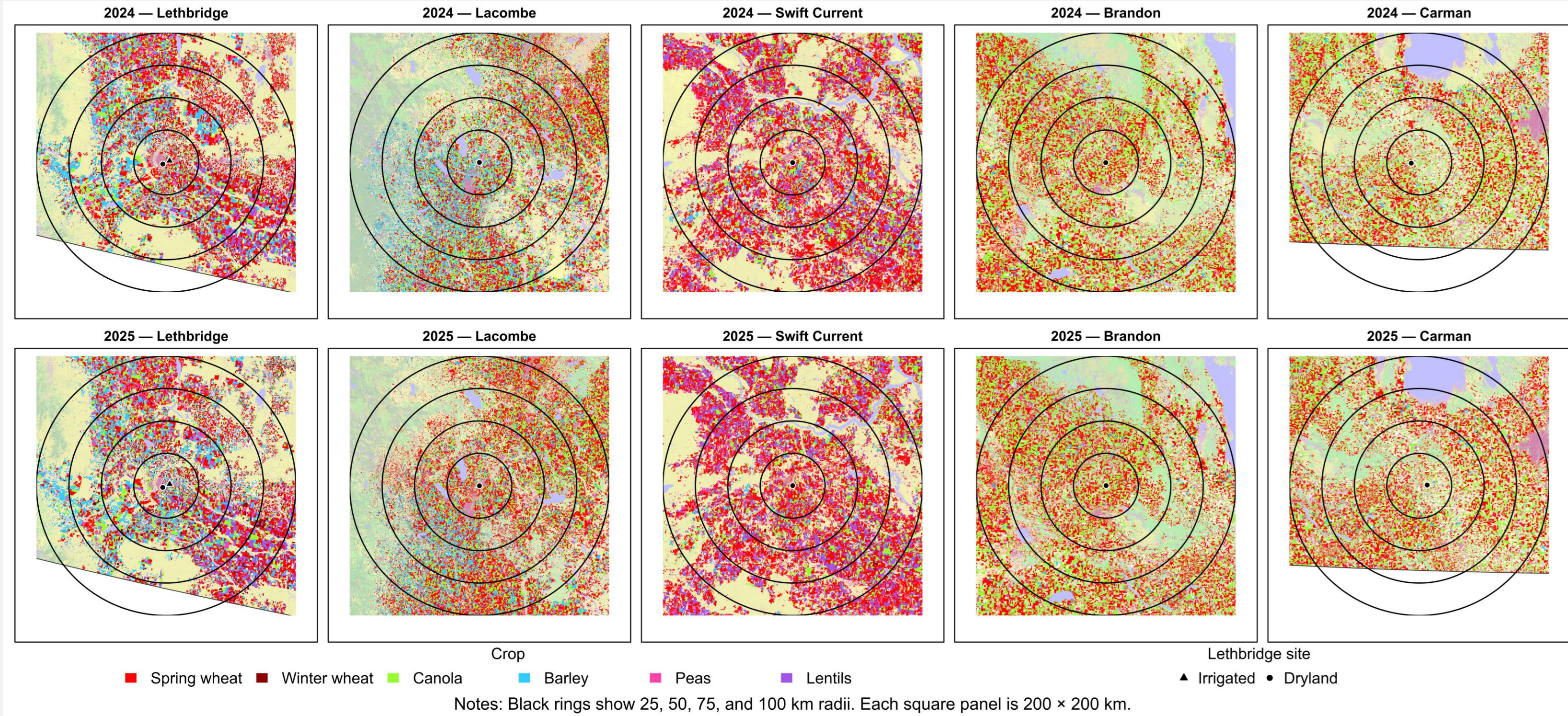
Dr. Devin Serfas

Assistant Professor and RDAR Chair in Applied Agricultural Economics and Risk Management, Department of Resource Economics and Environmental Sociology, Faculty of Agriculture, Life & Environmental Sciences

WHY SEED EARLIER OR CHANGE FERTILIZER?

Introduction

Farmers pay the costs of a new practice before knowing its yield benefit. Ultra-early seeding may improve spring wheat production, while enhanced-efficiency fertilizers (EEFs) may reduce nitrogen losses. Whether either practice pays depends on local growing conditions, fertilizer premiums and the cost of changing the farm's seeding schedule.



Data

Field trial data is supplied by Agriculture and Agri-Food Canada (AAFC) for the 2024–2025 trials comparing two seeding dates and three fertilizers. Local data combined with Environment and Climate Change Canada weather station, AAFC 100m Soil Landscapes of Canada, Annual Crop Inventory satellite data, soil zone specific nitrogen rates, and Saskatchewan RM yields from crop insurance data are used to train the ML model.

Background

Ultra-early seeding can improve wheat yield stability (Toerper et al., 2026). EEF yield benefits vary across environments, with some soil zones showing a marginal advantage over urea (Fast et al., 2023). Few studies have combined regional trials and local experiments to inform nitrogen decisions, although transferring that information can be difficult (Patterson et al., 2025).

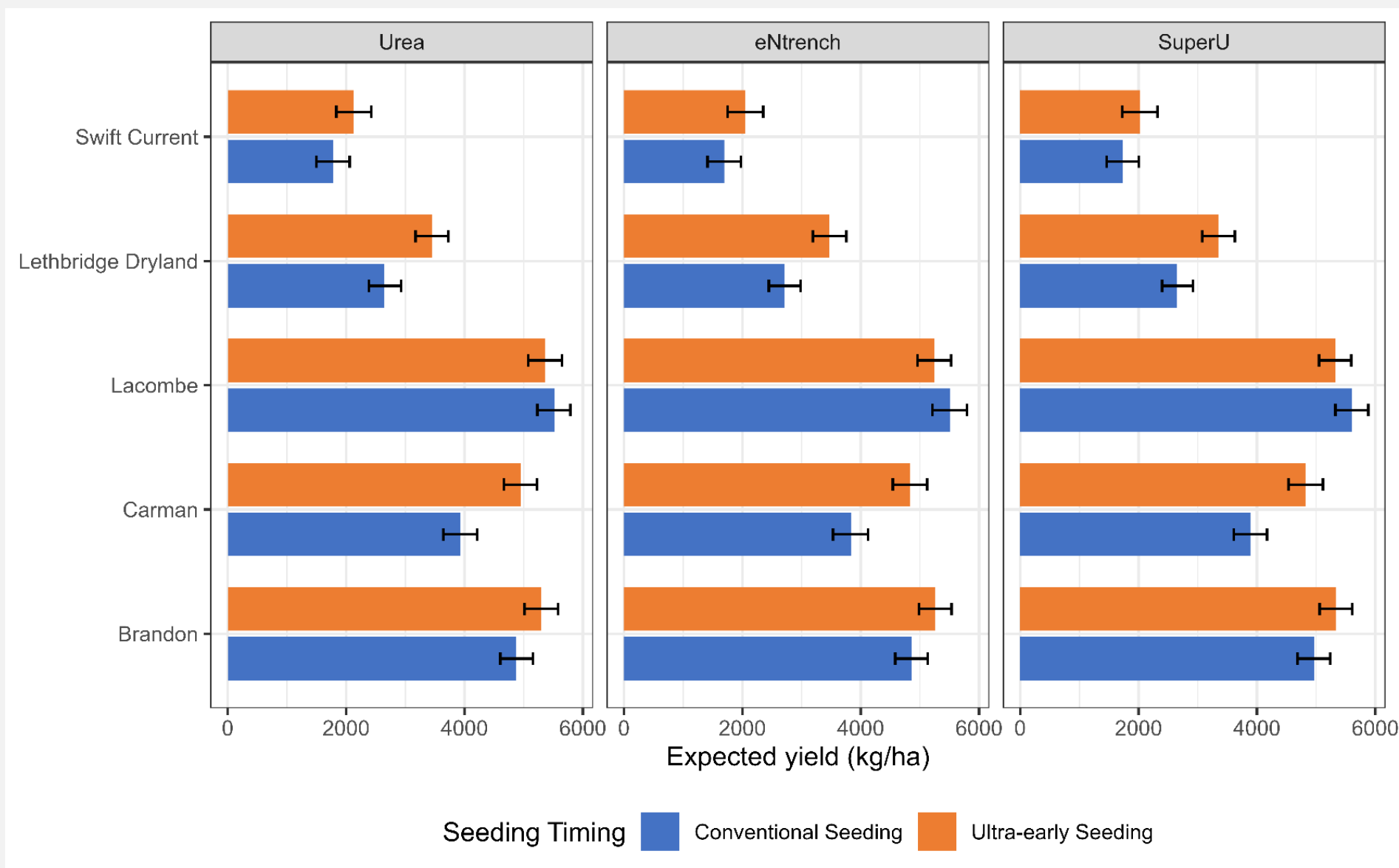
The seeding dates for all field trial locations were approximately between seeding in April versus May, with Lethbridge being March versus April. The fertilizer products considered across the two seeding dates were urea, SuperU, and eNtrench.

Objectives

Compare how seeding date and fertilizer choice affect spring wheat yield, financial returns, and N₂O losses. Determine where these changes are more likely to pay using Saskatchewan rural municipalities (RMs) to train a machine learning (ML) model called BART.

YIELD RESPONSES

Ultra-early seeding increased spring wheat yields across fertilizer types, but the size of the gain varied by location. EEFs produced yields similar to untreated urea. Hence, their price premium are not offset by a yield gain.



Larger yield gains occurred at sites with higher growing degree days. Local conditions matter when applying trial results.

FINANCIAL RETURNS

The increase in financial returns is the change in grain sales minus the change in fertilizer costs from seeding earlier rather than at the conventional date. Estimated returns by location and year are shown below, with totals for a 160-acre field in brackets:

Brandon, MB 2024: +\$72/acre (\$11,520/field) 2025: +\$28/acre (\$4,480/field)	Lethbridge Dryland, AB 2024: +\$129/acre (\$20,640/field) 2025: +\$59/acre (\$9,440/field)
Carman, MB 2024: +\$222/acre (\$35,520/field) 2025: +\$27/acre (\$4,320/field)	Lethbridge Irrigated, AB 2024: +\$52/acre (\$8,320/field) 2025: -\$72/acre (-\$11,520/field)
Lacombe, AB 2024: +\$10/acre (\$1,600/field) 2025: -\$40/acre (-\$6,400/field)	Swift Current, SK 2024: +\$74/acre (\$11,840/field) 2025: +\$11/acre (\$1,760/field)

Earlier seeding increased estimated returns at most locations, but the benefits were smaller in 2025, with losses at Lacombe and Lethbridge Irrigated. These results occurred during an exceptional year for crop production, with farmers harvesting a record spring wheat crop. Estimates do not deduct the cost of delaying another crop to seed spring wheat earlier

Prices: Saskatchewan Crop Planning Guides, Corteva, Manitoba Agriculture and Koch Agronomic Services.

WHAT COULD THIS MEAN FOR YOUR FARM?

ALBERTA - SPRING WHEAT - 2024 & 2025

What could a different practice return?

Find your field, set your yield and nitrogen rate, and compare seeding and fertilizer options.

1 · FIND YOUR FIELD

Crop year

2024

West of meridian

4

Quarter

NE

Range

3

Township

29

Section

21

Find wheat area

NE-21-029-03-W4
2024 · 149.0 mapped wheat acres

2 · YOUR BASELINE

Enter yield for conventional seeding with urea in the selected year.

Yield units

bu/ac

Your wheat yield

47

Applied nitrogen (kg N/ha)

101

Weight on your reported yield

0% 50% 100%

0 10 20 30 40 50 60 70 80 90 100

0% uses the model baseline. 100% uses your yield. Intermediate values blend them on the log scale.

Proceed to treatment results

Field map

Treatment results

Field inputs

How to read results

MAPPED SPRING-WHEAT AREA

NE-21-029-03-W4 · 2024 · 149.0 wheat acres

+

-

Quarter boundary

Mapped spring wheat

Yellow: spring wheat in the selected year's AAFC crop inventory. Cyan: legal quarter boundary. Satellite imagery may be from a different year.

Soil and weather inputs pass the coverage checks. Enter yield and nitrogen, then click Proceed.

Field map

Treatment results

Field inputs

How to read results

TREATMENT COMPARISON

NE-21-029-03-W4 · 2024

Baseline: conventional seeding + urea. Nitrogen: 101 kg N/ha. Your yield weight: 50%.

Adjusted baseline yield

50.6 bu/ac

Largest mean return change

\$56.2/ac

Ultra-early + urea

Mapped spring-wheat area

149.0 acres

Return change (\$/ac)

Yield gain (bu/ac)

Conventional + eNtrench

Conventional + SuperU

Ultra-early + urea

Ultra-early + eNtrench

Ultra-early + SuperU

Points are posterior means; bars are 95% credible intervals for expected effects. They are not prediction intervals for an individual harvest.

Treatment	Yield (bu/ac)	Gain (bu/ac)	Gain 95% CI	Return (\$/ac)	Return 95% CI	P(return > 0)	Field change (\$)
Conventional + urea	50.6	0.0	[0.0, 0.0]	0.0	[0.0, 0.0]	—	0
Conventional + eNtrench	49.2	-1.4	[-8.2, 6.0]	-21.5	[-78.2, 41.7]	20%	-3,205
Conventional + SuperU	50.8	0.2	[-5.5, 6.0]	-10.8	[-58.5, 38.7]	32%	-1,614
Ultra-early + urea	57.3	6.7	[-8.4, 26.6]	56.2	[-71.0, 224.7]	85%	8,370
Ultra-early + eNtrench	56.1	5.4	[-9.5, 25.0]	36.5	[-89.4, 202.0]	69%	5,433
Ultra-early + SuperU	56.8	6.1	[-8.7, 26.1]	39.6	[-85.5, 208.2]	71%	5,894

Download results (.csv)

Return change = additional wheat revenue minus extra fertilizer cost and any entered early-seeding cost. Other costs, quality premiums and subsidies are excluded.

On-Farm Application

- A field trial trained ML model predicts six treatment responses using soil, weather, yield, and applied nitrogen rates.
- A second fitted ML model adjusts their yield level using relationships learned from Saskatchewan RM yields, nitrogen rates, weather, and soil.

Your Yield Weight

The slider adjusts the yield prediction for the baseline practice using urea and conventional seeding.

- At 100%, that baseline equals your entered yield and yield gain differences are proportional to the field trial estimates.
- At 0%, both the field trial and SK RM trained models fully predict the yields for all treatment scenarios.

- This version uses the prepared April/May windows throughout Alberta. A March/April extension is yet to be included.

- These are model-based treatment comparisons, not observed treatment effects on your farm.

- Nitrogen rates are held constant across the six treatment scenarios.

REFERENCES

Fast, A., Strydom, S., Wang, Z., Hernandez-Ramirez, G., Hao, X., Semach, G., Thompson, L., Holzappel, C., Enns, J., Spaner, D., & Beres, B. L. (2023). Integrating enhanced efficiency fertilizers and nitrogen rates to improve Canada Western Red Spring wheat. *Canadian Journal of Plant Science*, 104(2), 144–160. <https://doi.org/10.1139/cjps-2023-0095>

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