LAKELAND AGRICULTURAL RESEARCH ASSOCIATION

2025

ANNUAL REPORT

LARA

LAKELAND AGRICULTURAL RESEARCH ASSOCIATION

ABOUT LARA

Lakeland Agricultural Research Association (LARA) is a producer-directed organization conducting leading edge applied agricultural research and extension in Northeastern Alberta, serving the Municipal District of Bonnyville, County of St. Paul. and Smoky Lake County. Through applied research, demonstration and extension activities, our objective is to to make producers in Alberta profitable and sustainable through research and extension in the areas of perennial forage, annual crops, specialty crops, environmental conservation and regenerative agriculture.

MISSION

LARA conducts local, innovative, unbiased applied agricultural research and extension throughout the Lakeland to promote sustainable agriculture practices for producers, stakeholders and our rural communities.

VISION

To be a leader in applied agricultural research and extension in Alberta.

www.laraonline.ca

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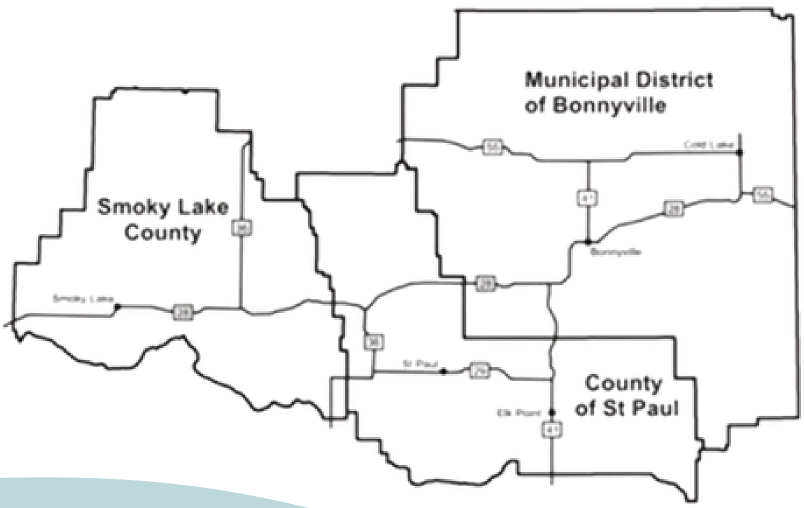
Bonnyville, AB
T9N 2H4

5311 - 50 Avenue
Fort Kent, AB
T0A 1H0



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Communications Coordinator

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Rhys Grant

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Office Administrator

Sharon Robert
Office Administrator

MESSAGE FROM THE CHAIR

This is my second year serving as Chair of LARA, and I am pleased with the progress we continue to make. We have an excellent complement of staff who work great together and with our board.

It was another dry summer in our region, which brought the usual challenges to our agriculture community.

Our research team Lance Ouellette, Angelica Ouellette and Momna Farzand continue to do excellent work carrying out trials and disseminating results to our producers. The ability to take research and turn it into useful, understandable information for producers in as important goal we strive for.

Our Research Technician, Dustin Roth, continues to be a key part of our team. He keeps the equipment running at the research station and helps producers in completing their Environmental Farm Plan (EFP) and other grant opportunities available to farmers. Between Lance and Dustin, LARA helped bring over $1.8 million to producers in our region through various programs and funding opportunities.

We hired Mara Needham this year into our new Marketing & Communications Coordinator position. She has brought over 20 years of experience in radio and marketing to our organization, updating our website and helping improve our online presence. This helps us to connect with producers, stakeholders and the wider community.

Kristy Tetreau continues to excel in her role as Environment & Education coordinator, helping keep our projects organized and moving forward.

Alyssa Krawchuk, as Executive Director, plays a central role in making the organization function day to day. The board brings forward ideas and motions and she determines how to implement them and who will carry them out. She has a tough job and I appreciate what she does.

Thank you to our board of directors, staff, partners, sponsors and members for your continued support of LARA. We are a not-for-profit organization and we rely on grants and funding from various sources and we try to make the most of what we receive.

Sincerely,

Jay Cory
LARA Chair

MESSAGE FROM THE EXECUTIVE DIRECTOR

Lakeland Agricultural Research Association (LARA) has a long history in the Lakeland region. What began as a forage association in 1972, expanded into the LARA we know today in 1991, driven by a dedicated group of producers, government and industry. Our goal has always been to make Alberta's agricultural producer both profitable and sustainable and we are built on the vision that Northeastern Alberta can be and is a leader in agricultural innovation, research and education.

This past year has brought many challenges to the region, including another year of low precipitation and high summer temperatures leading to near drought conditions in some areas. These conditions have a significant impact on grain, forage and livestock producers alike. We noticed the severe impacts in many of our research trials that struggled from high temperatures and a lack of moisture. Through this hardship, at LARA, we seek to directly support our members through our research and extension activities. This can be seen through targeted research projects aimed at developing drought resilient agriculture production and knowledge transfer activities that provide expert advice and knowledge from leaders in the agriculture industry.

Our successes are deeply rooted in collaboration and partnership. We wouldn't be able to provide the research and extension services that we do without the continued trust of our producer members, partners and funders. Their support means that Lakeland region farmers and ranchers have access to the latest in agricultural innovation, research and educational materials.

As the agricultural landscape continues to change and grow, it is more important than ever that those involved in the agriculture industry come together to collaborate, to support and to work towards the sustainability, growth and resilience of agriculture in the Lakeland.

Sincerely,

Alyssa Krawchuk, P.Ag.
Executive Director
Lakeland Agricultural Research Association

MD OF BONNYVILLE UPDATE

"It's supposed to be hard, if it wasn't hard, everyone would do it."

Now doesn't this summarize our Agriculture industry. Each year has its ups and downs, and 2025 was no different. The dry conditions early in the year had producers struggling to source quality and affordable feed for livestock and many wondered if harvest was going to bring low yielding crops. The weather turned around and it was a smooth harvest with average crop yields.

The Shelterbelt program continues to be one of our most successful programs. Residents can purchase a variety of shelterbelts and ornamental tree seedlings at a discounted price. This year's sale is March 11, 2026 at 10 am, make sure to set a reminder so you don't miss out.

Oxeye daisy, scentless chamomile, and burdock continue to be our most prolific weeds. They can cause yield losses in cereal, pulse, forage, and oilseed crops and are hard to control once populations have established. Our weed inspectors were busy this summer assisting landowners with control of known infestations. Our goal is to take a proactive approach and stop invasive weeds before they become established, 1798 inspections were completed on private, industrial, and public lands.

Agriculture is undergoing a technological transformation; with new and emerging technologies the M.D. co-hosted a Drone Spraying workshop with LARA. Attendees were able to learn about the capabilities of drone spraying and how it could potentially be incorporated into their operation once the regulations are updated.

We hosted the provincial Tree Specialist, Toso Bozic to better educate our resident on proper planting and identification of Pests and Diseases. Hosting a yearly tree workshop coincides with our Shelterbelt Program to help residents be successful when planting seedlings from our program. Lastly. The M.D. in conjunction with LARA and the Grazing School for Women hosted a two-day event for women in agriculture.

It's time again for the biannual Agricultural Service Board Rural Beautification tour. The tour showcases the winners of our Rural Beautification contest and local agri-businesses committed to preserving and enhancing the industry. Stay tuned for details later this spring.

The Coyote and Wolf Reduction Program continued in 2025. Trappers and residents participate in the program to reduce predation on livestock. We continue to conduct rat inspections on behalf of the province and are pleased to report that we are still rat free. The M.D. has seen a reduction in beavers affecting road infrastructure and landowner property due to dry conditions over the past three years. Our Beaver Reduction Program enlists local trappers to assist landowners with problem beavers.

If you have any questions, contact the Agricultural Services Department at 780-826-3901.

We want to wish all producers a successful upcoming growing season.

ACKNOWLEDGEMENTS

Without the generous support and commitment of our funding partners, we would not beable to conduct the cutting edge, innovative research or provide the extension events andservices that we do. Thank you to all of our partners, funders and supporters!

Base funding and project provided by

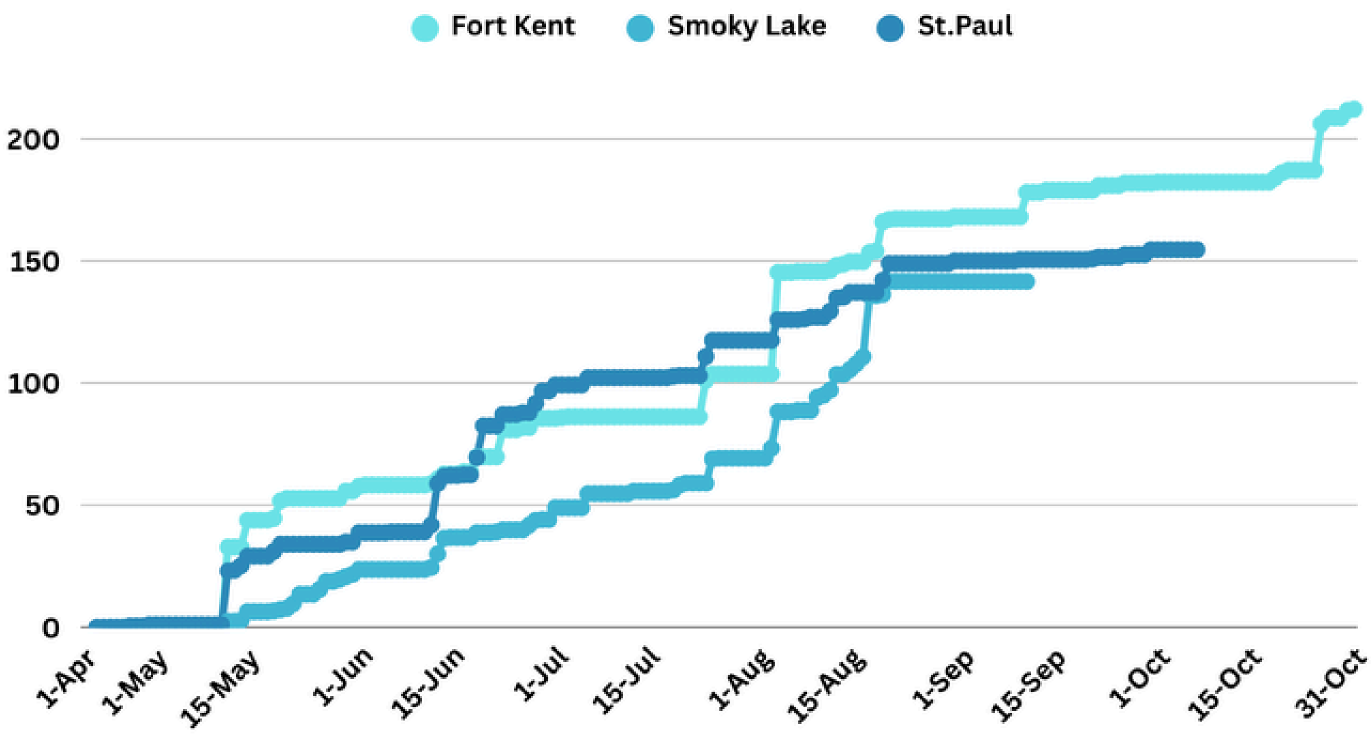
Operational support provided by:

Thank you to:

WEATHER SUMMARY

FORT KENT, ST. PAUL, SMOKY LAKE

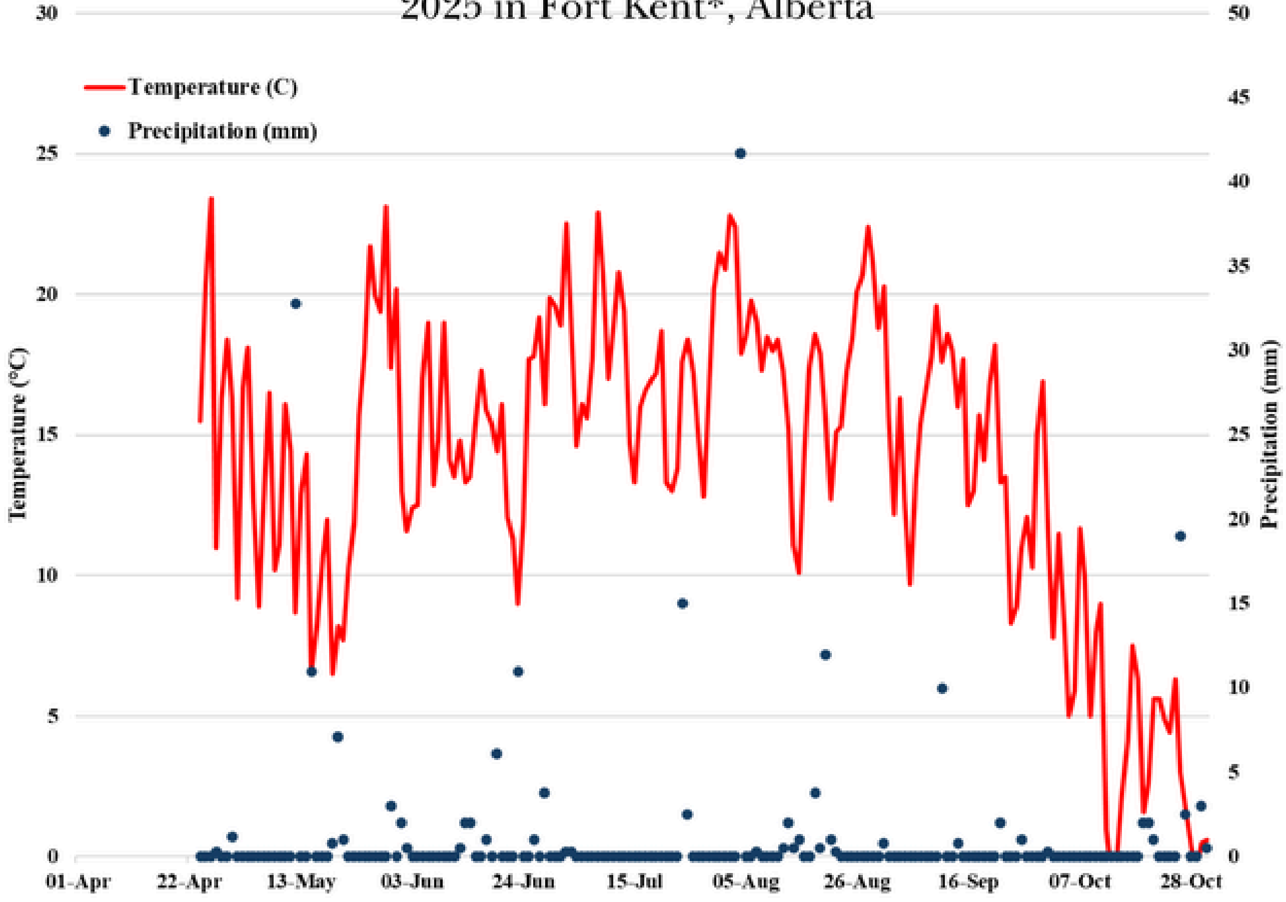
Cummulative precipitation collected* at each LARA agricultural sites from April to October 2025**



*Data collected using WatchDog Wireless weather station 3000 series (Spectrum Technologies 2025)
** Fort Kent (54.312095, -110.616720), Smoky Lake (54.087172, -112.652069)
and St. Paul (54.016063,-111.270817)

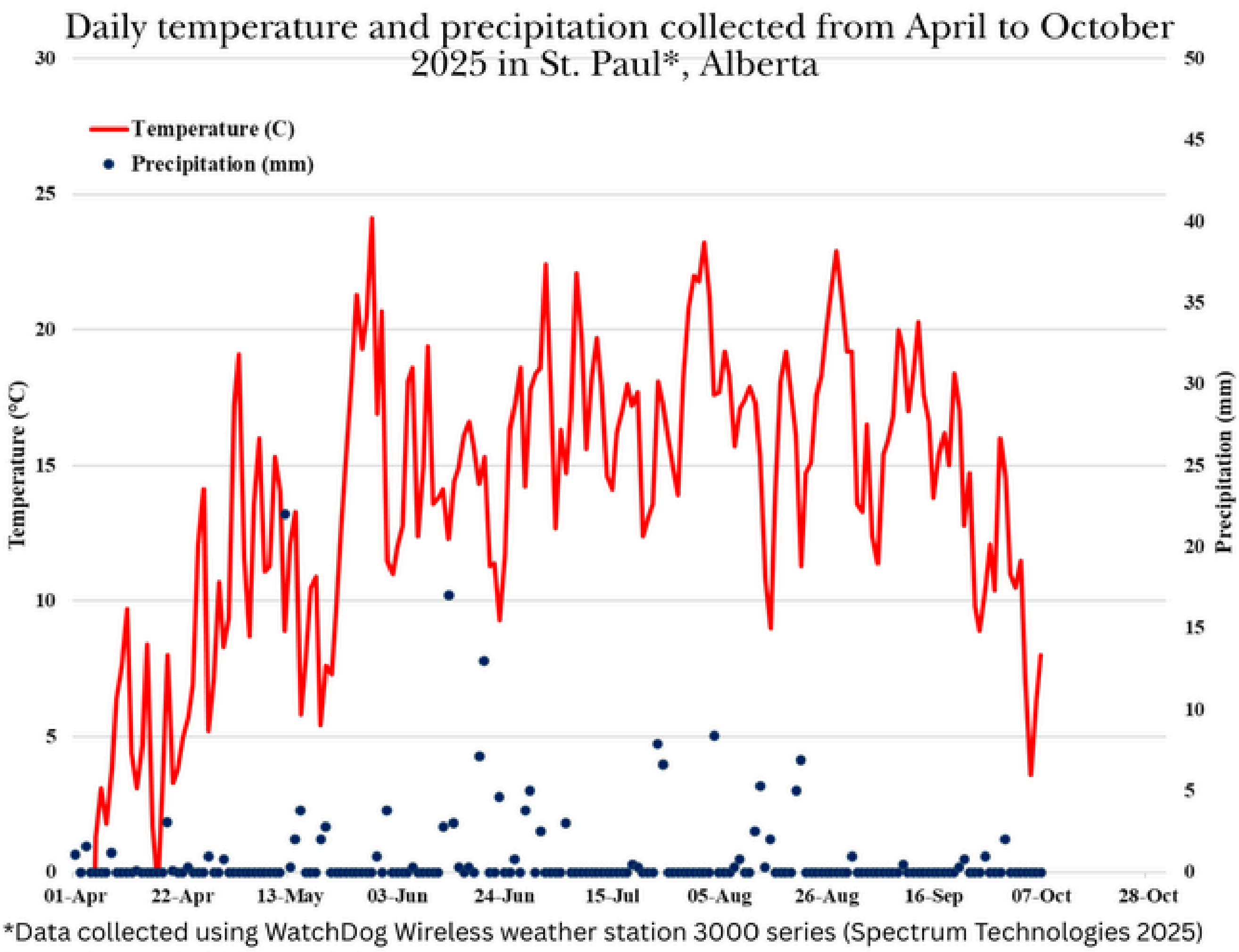
WEATHER SUMMARY
FORT KENT

Daily temperature and precipitation collected from April to October 2025 in Fort Kent*, Alberta



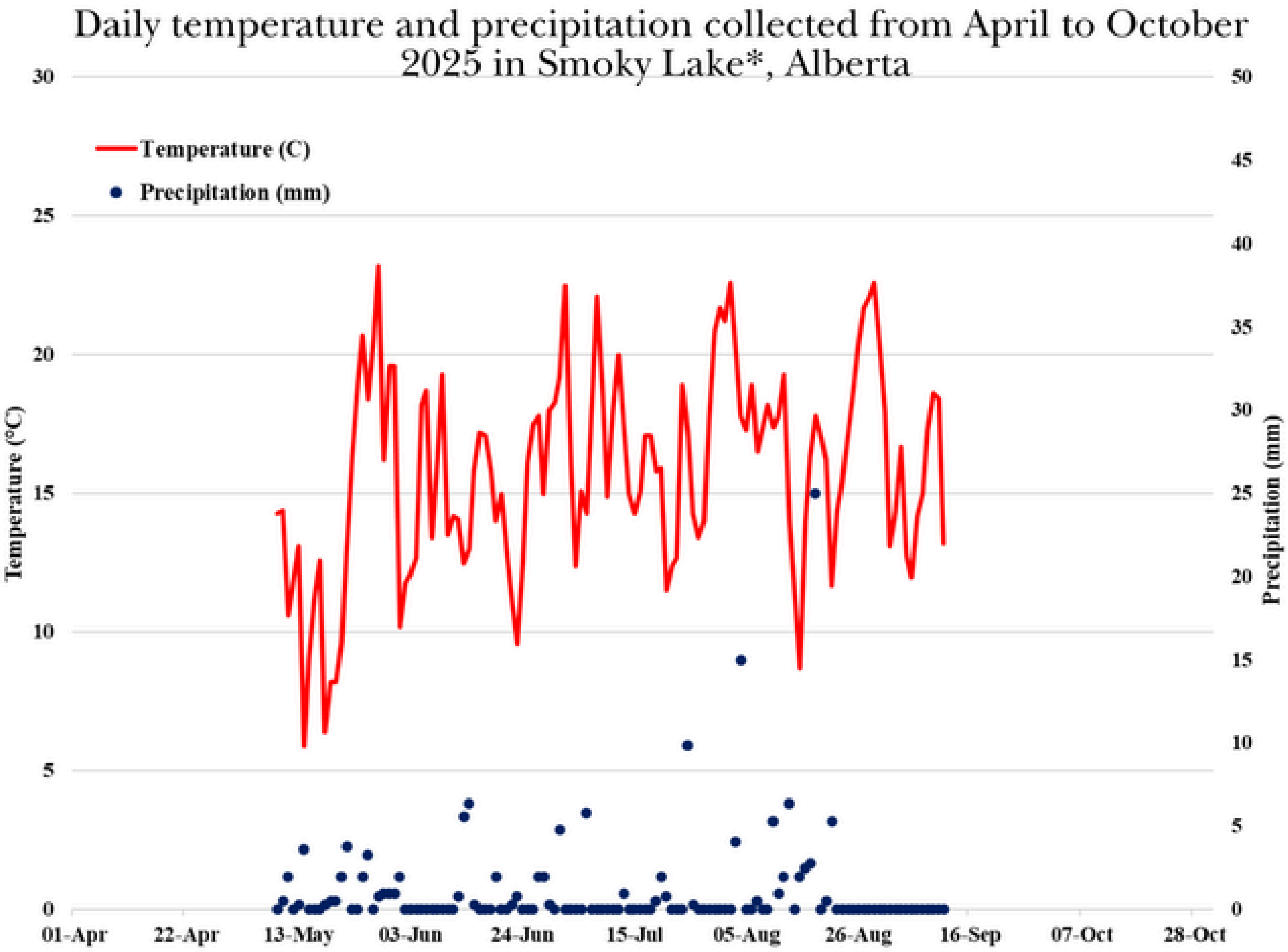
*Data collected using WatchDog Wireless weather station 3000 series (Spectrum Technologies 2025) located at 54.312095, -110.616720.

WEATHER SUMMARY
ST. PAUL



*Data collected using WatchDog Wireless weather station 3000 series (Spectrum Technologies 2025) located at 54.016063,-111.270817.

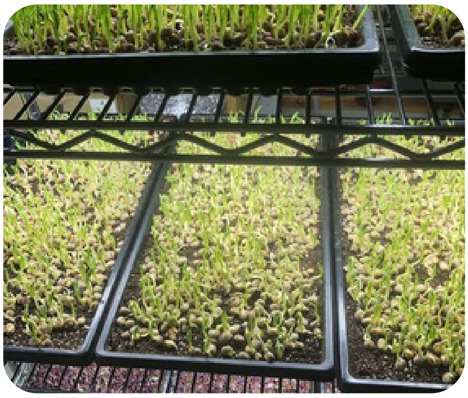
WEATHER SUMMARY
SMOKY LAKE



*Data collected using WatchDog Wireless weather station 3000 series (Spectrum Technologies 2025) located at 54.087172, -112.652069.

Extension

In 2025, the Lakeland Agricultural Resource Association (LARA) delivered a diverse and impactful extension program, offering educational opportunities that ranged from in-person workshops and field tours to webinars and community appreciation events. These initiatives strengthened producer knowledge, supported farm viability, and fostered meaningful connections across the Lakeland region.



The year began on **January 9 with a *Microgreen Workshop* in Vilna** led by Environment & Education Coordinator Kristy Tetreau, welcoming 21 participants.

Throughout January and February, LARA hosted a series of workshops Titled ***Securing Success*** in **Ashmont (18 attendees), Ukrainian National Hall (19 attendees), Elk Point (20 attendees), and Eastborn Community Hall (41 attendees).** These workshops were designed to support producers in navigating the increasingly complex landscape of agricultural and environmental funding programs. Sessions focused on identifying relevant grant opportunities, understanding eligibility requirements, and developing strong, competitive applications. Participants were guided through key components of the application process, including project planning, budgeting, measurable outcomes, and reporting expectations. By demystifying funding programs and providing practical tools and examples, Securing Success empowered producers to confidently pursue financial support for on-farm improvements, environmental stewardship initiatives, and innovation projects. The series strengthened local capacity and reinforced LARA's commitment to connecting producers with the resources needed to enhance long-term agricultural viability in the Lakeland region.

Extension

Seed starting education continued into late winter with workshops at the ***St. Paul District Arts Foundation* (25 attendees) and the *Glendon Public Library* (22 attendees)**. These workshops were designed to help gardeners and small-scale producers get a confident start on the growing season. These hands-on sessions covered seed selection, soil and growing media considerations, lighting and temperature requirements, transplant timing, and early plant care. Participants learned practical techniques to improve germination rates, prevent common issues such as damping off, and successfully transition seedlings from indoor environments to the field or garden. The workshops provided timely, practical knowledge that supports local food production and builds gardening confidence heading into spring.

LARA also expanded virtual learning opportunities throughout the year to increase accessibility and provide flexible learning opportunities for producers across the region. Topics included: ***Cattle Nutrition* webinar (32 attendees)**, a ***Cover Cropping* webinar (34 attendees)**, ***Water Quality and Sprayed Drones* webinar (23 attendees),** and ***Fuel Your Herd* webinar (13 attendees).** These online sessions complemented our in-person events, ensuring that producers could access timely, relevant information in a format that suited their schedules and operations. By offering both virtual and face-to-face programming, LARA continues to broaden its reach and support agricultural producers with practical, research-based knowledge.

The organization's ***Annual General Meeting*, held at the Mallaig Legion Hall, welcomed 27 attendees.**

Extension

Environmental stewardship and business planning remained key priorities in 2025. Three ***Environmental Farm Plan*** workshops, delivered by Dustin Roth and Lance Ouellette, were held in **Ashmont, Smoky Lake and Alexander Hall with 19 participants** completing the sessions. The ***Ranching for Profit*** full-day workshop in **St. Paul attracted 67 participants** and ***Innovation on the Ranch*** **in Bonnyville, with 21 participants** received strong positive feedback, highlighting the ongoing demand for practical farm management education.

In April, LARA hosted two ***Gardening Forums***—one at the **Ukrainian National Hall in Smoky Lake** and one at **Flat Lake Hall—with a combined total of 52 participants.** We welcomed knowledgeable local speakers from across the region who shared practical, experience-based insights tailored to our northern growing conditions. Topics ranged from effective pruning techniques, strategies for growing perennial crops, to learning about the benefits of incorporating native plant species to support pollinators and local biodiversity. These forums fostered community connection, highlighted local expertise, and equipped participants with tools and confidence to strengthen their gardens and local food production efforts.

On June 12, LARA hosted a ***Drone Technology Workshop*** at the **Fort Kent Research Farm,with 12 participants**. Caouette & Sons delivered a comprehensive presentation showcasing both smaller mapping drones used for field scouting and land assessment, as well as larger agricultural drones with the capacity to apply granular and liquid products. Participants learned about practical on-farm applications, efficiency gains, and how drone technology is advancing precision agriculture in our region. The workshop provided producers with valuable insight into emerging tools that support data-driven decision-making and responsible land management.

Extension

Following a foundational riparian webinar delivered in partnership with Cows and Fish, LARA hosted an in-field **Riparian Area Field Day** in **Smoky Lake County,** with **23 participants** attending. The event built on webinar concepts by moving from theory to hands-on learning in a working landscape setting.

Participants began by defining what constitutes a riparian area. Drawing from Cows and Fish materials, we explored how riparian areas are the green zones alongside rivers, streams, lakes, and wetlands where land and water interact. These areas are shaped by water and are characterized by distinct soils and vegetation influenced by higher moisture levels. While they often occupy a small percentage of the landscape, riparian areas are among the most productive and ecologically significant.

The group then identified common riparian plant species, including willows, sedges, rushes, and other water-tolerant vegetation. We discussed how plant community composition reflects site moisture, disturbance history, and management. Particular attention was given to the role of deep-rooted vegetation in stabilizing streambanks, filtering sediment, cycling nutrients, and improving water quality. The afternoon focused on riparian health assessment, using the Cows and Fish Riparian Health Assessment framework.

A highlight of the day was viewing a "Beaver Deceiver" device and learning how it functions. This flow-control structure is designed to prevent beavers from plugging culverts while still allowing them to remain on the landscape. By placing fencing and flow pipes in a way that reduces the sound and feel of running water at the culvert intake, the device discourages dam-building at critical infrastructure points. This approach helps protect roads and crossings while maintaining the ecological benefits beavers provide — including water storage, habitat creation, sediment capture, and improved watershed function.

The event fostered meaningful discussion among producers, landowners, and conservation partners, strengthening local capacity to assess and steward riparian areas
across Smoky Lake County.

Extension

On July 24, July 31, and August 7, LARA hosted a series of Field Days in Smoky Lake, Fort Kent, and St. Paul, welcoming a total of 56 producers.

These events provided valuable opportunities for producers to connect, exchange ideas, and discuss current challenges and innovations within the agricultural sector. Attendees toured LARA's research plots, where our research team presented ongoing trials and shared preliminary findings. At each field trial site, localized weather stations are in place and actively used by our researchers to collect site-specific data, including rainfall, temperature, and growing degree days.

This information strengthens the accuracy and relevance of trial results while also providing valuable insights for producers related to crop development, spray timing, and seasonal decision-making. We also welcomed guest speakers representing funding partners, who provided insight into specific projects and the collaborative efforts supporting agricultural research in the region. These field days reinforced LARA's commitment to applied research, data-driven decision-making, and producer-led learning.

On **July 29, LARA hosted *"Who Darted?" – A Seminar & Workshop* on Remote Drug Delivery Best Practices at the Vilna Cultural Center, with nine participants in attendance.** This full-day workshop focused on the safe, effective, and responsible use of remote drug delivery systems in livestock management. Attendees gained practical knowledge on best practices, regulatory considerations, animal welfare, and proper handling techniques to support both producer safety and herd health. The smaller group setting allowed for meaningful discussion and hands-on learning, reinforcing LARA's commitment to providing practical, responsive education for producers in the Lakeland region.

Extension

On August 13, LARA hosted ***Microbes, Minerals, and Myths* at Flat Lake Hall, with eight participants in attendance.** This full-day event brought together producers and community members to explore the biological and mineral dynamics influencing soil health. Dr. Don Huber, Emeritus Professor of Plant Pathology at Purdue University, presented on shifts in microbial communities, nutrient interactions, and the role of mineral nutrition in plant disease pressure. Dr. Yamily Zavala, Manager of the CARA Soil Health Lab, shared results from the Alberta Benchmark Verification Project, highlighting how different management practices influence long-term soil health parameters. The event encouraged thoughtful discussion around soil biology, nutrient management, and research-based approaches to improving soil resilience.

On August 21, LARA hosted a ***Virtual Fencing Tour* at Nick Kunick's farm with 31 participants** in attendance. Nick provided a hands-on demonstration of moving his herd using virtual fencing collars, showcasing how the technology allows for precise grazing management without traditional physical fencing. Participants learned how increased grazing pressure in a controlled setting can influence plant palatability and utilization, and how extended rest periods following intensive grazing support paddock recovery and overall plant health. Nick also shared insights into how quickly cattle adapt to the collars, highlighting the practical benefits and flexibility this technology offers producers looking to enhance pasture management and operational efficiency.

Extension

On **September 10–11, LARA co-hosted *The Original Grazing School for Women – Fall Workshop* at the Ardmore Community Hall, with 42 attendees.** This two-day event combined classroom learning, hands-on field experience, and networking opportunities designed to empower women in agriculture with practical grazing management skills.

The workshop opened with an evening social focused on succession planning and building connections among participants. Day two featured sessions on fall grazing strategies, calf management at weaning, cattle nutrition, and riparian health. Participants also traveled to LARA's site for hands-on learning, where they explored water source assessment, appropriate riparian setback distances, fencing considerations, and off-site watering system placement. In partnership with Cows & Fish and supported by BCRC, the workshop emphasized practical, science-based management strategies that strengthen pasture health, animal performance, and long-term operational resilience.

The event reinforced LARA's ongoing commitment to supporting women in agriculture through education, collaboration, and leadership development.

BCRC
BEEF CATTLE RESEARCH COUNCIL

Extension

On November 20, LARA hosted ***Fuel Your Herd: Cattle Health and Nutrition Evening* at Eastbourne Community Hall, with 23 participants in attendance.** This producer-focused event explored practical strategies to improve herd health and performance through effective nutrition, planning, and management. Industry speakers shared insights on optimizing cattle health and leveraging innovative tools to support herd productivity. Supper was included, creating an engaging environment for learning, discussion, and networking. The evening reflected LARA's continued commitment to delivering relevant, hands-on education that strengthens livestock operations across the region.

Try Before You Buy: Producer Support Tools

Did you know that LARA offers a try-before-you-buy program designed to help livestock owners explore innovative tools that enhance both herd health and riparian area management? Through this program, producers can borrow two excellent tools — a solar-powered livestock watering system and the Razer Grazer portable fencing unit — for up to one month at no cost. This hands-on opportunity allows producers to see how the systems function under real ranch conditions, evaluate their fit for existing operations, and experience the benefits of improved water quality and grazing management firsthand.

Solar Water Systems - Summer and Winter Systems available!

Solar livestock watering systems pump surface or groundwater to a trough or tank at the point of use. They are ideal for off-site watering where grid power isn't available, reducing the need for livestock to access dugouts or ponds directly. When cattle drink from muddy or stagnant dugouts, water quality and palatability often decline, which can reduce intake and overall performance.

Razer Grazer Portable Fencing - Manage Grazing and Protect Riparian Areas

The Razer Grazer is an all-in-one portable fencing solution that makes rotational grazing and riparian protection easy. Compact and solar-friendly, it allows producers to create temporary paddocks, restrict access to sensitive riparian areas, and direct cattle toward off-site watering systems.

LARA

INNOVATION | RESEARCH | EDUCATION

Contact LARA to reserve (780) 826-7260

Research

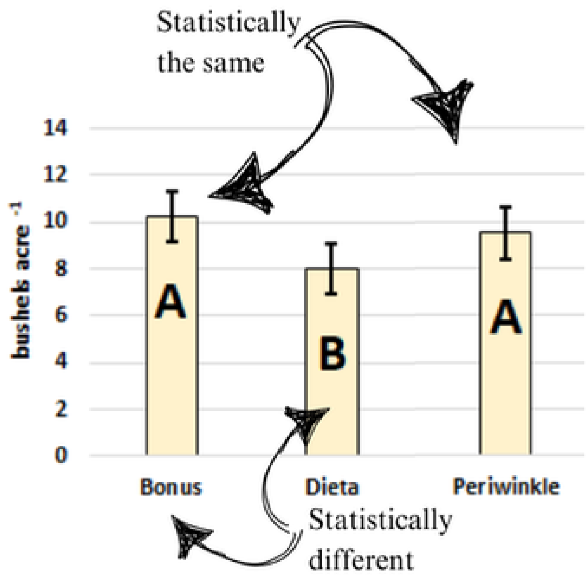
How is the Data Analyzed at LARA?

Statistical analyses are used by the Lakeland Agricultural Research Association to determine differences among treatments in variety trials, proprietary trials and research funded trials. Responses such as emergence, height, florescence, maturity, and yield are considered dependable variables because they are impacted by variables that were not manipulated during the experiment. Unless otherwise stated, soil type, agrochemical applications, drought; and weather parameters such as temperature, humidity, light exposure are generally not controlled during an experimental trial and thus, considered independent. The impact of these independent variables produce measurable effects on the crop that allow us to assess treatment differences.

Statistical analyses are important because:

- They provide a numerical approach to measure the impact of each of the treatments. Therefore, they provide a quantitative answer as to why effects varied according to the treatments applied.
- They can affirm or deny provable statements that may explain the outcomes observed from assessed dependable variables. In other words, thye can establish is a hypothesis is accepted or rejected beyond the observations made in the experiment

When taking assessments out of a treatment plot, numbers vary within that same plot and numbers among treatment plots vary with each other. Thus numbers are not entirely exact, and they are expected to vary within a certain range. We call this the error term. The error term is a number that accounts for variability in the trial and other factors that may have led to an estimation not fully indicative of reality.



This can be explained as follows: lupin variety Bonus yielded 10.28±1.1 bushels per acre whereas lupine variety Periwinkle yielded 9.51±1.1 bushels per acre. The error term here is ±1.1 bushels per acre. One is keen to assume that 10.28 is greater than 9.51 and hence lupin variety Bonus is more yielding. However, if the average yield among all varieties varies between 9 and 11 bushels per acre; there is a chance that under statistical analyses, neither Bonus and Periwinkle surpass each other in yield. Rather, there is a chance that if sown the next growing season the yield will be likely the same. In the graph above, letters are placed at the bottom of columns to highlight difference (or similarity) among treatments. Thus, the same letter indicates treatments had the same statistical value in contrast to those with different letters.

Regional Variety Trials

Cereals - Chronology

Table 1A. Cereal variety trial chronology in three sites across Northeastern Alberta in 2025

Site						Herbicide[c]						
Regional Variety Trial	N[a]	Fertilizer[b]		Seeding[b]		Burndown			In crop			Harvest[d]
Fort Kent	#	Date	Rate[e] lb acre^{-1}	Date	Rate[f] plants ft^{-2}	Date	Name	Rate L acre^{-1}	Date	Name	Rate L acre^{-1}	Date
Oat	36	May 11	90 N 30 P 29 K	May 11	28	May 9	Roundup & Heat LQ	1 & 0.059	June 4	State	0.4	September 16
Canadian Prairie Spring Red Wheat	45	May 11	90 N 30P 29K	May 11	31	May 9	Roundup & Heat LQ	1 & 0.059	June 4	State	0.4	September 16
St. Paul												
Barley	57	May 10	90 N 30 P 29 K	May 10	25	May 9	Roundup & Heat LQ	1 & 0.059	June 15	Buctril M	0.11 kg ac^{-1} [g]	September 3
Canadian Western Red Spring Wheat	57	May 10	90 N 30 P 29 K	May 10	31	May 9	Roundup & Heat LQ	1 & 0.059	June 15	Buctril M	0.11 kg ac^{-1} [g]	September 9
Canadian Prairie Spring Red Wheat[h]	45	May 10	90 N 30 P 29 K	May 10	31	May 9	Roundup & Heat LQ	1 & 0.059	June 15	Buctril M	0.11 kg ac^{-1} [g]	September 18
Triticale	15	May 10	90 N 30 P 29 K	May 10	29	May 9	Roundup & Heat LQ	1 & 0.059	June 15	Buctril M	0.11 kg ac^{-1} [g]	September 18
Winter Wheat	21	September 11	90 N 30 P 29 K	September 11[i]	31	September 12	Roundup & Heat LQ	1 & 0.059	-	-	-	August 27
Smoky Lake												
Oat	36	May 9	90 N 30 P 29 K	May 9	28	May 13	Roundup	1	June 13	Buctril M	0.11 kg ac^{-1} [g]	September 11

[a]Number of experimental units
[b]No till hoe-drill Fabro seeder with side banding (2008) attached to Ford tractor (1998)
[c]R-TechThirty-foot sprayer (2024) attached to John Deere tractor (2010). For clarity, names used are brand names, not chemical
[d]Wintersteiger Classic Plus (2020)
[e]Displayed rates are actuals, not product
[f]Seed treated with Terraxa F4
[g]Compound in solid form
[h]Dessicated September 5 with Reglone ION @ 0.83 L/ac
[i]Seeded in 2024

Regional Variety Trials

Cereals - Barley - St. Paul

Mean values of yield, height, test weight, and tkw in 19 varieties of barley in St. Paul Alberta in 2025

Variety	Yield (% of AAC Synergy) g plot^{-1}		Height cm		Test weight lb bu^{-1}		TKW g/1000 seeds	
AAC Prairie	94%	ab*	81.2	bc	49.8	def	40.2	defg
AAC Stockton	98%	ab	77.1	bcd	51.7	cdef	42.8	bcde
AAC Synergy	100%	ab	76.3	bcde	52.5	cde	44.5	abcd
AB Dram	88%	ab	79.8	bcd	52.7	cde	43.5	bcde
AC Metcalfe	88%	ab	74.8	cde	52.6	cde	42.6	bcde
AS Lafleur	81%	ab	81.8	bc	54.8	bc	44.6	abcd
AS Manon	89%	ab	84.6	b	53.9	bcd	46.5	abc
CDC Armstrong	84%	ab	78.9	bcd	63.8	a	38.6	efg
CDC Austenson	91%	ab	74.8	cde	52.0	cdef	36.3	g
CDC Copeland	79%	b	77.1	bcd	50.2	def	38.6	efg
CDC Pristine	76%	b	78.8	bcd	63.2	a	36.2	g
FB21106	103%	ab	71.8	def	53.0	cde	46.7	abc
FB21704	102%	ab	78.6	bcd	57.4	b	49.1	a
FB22816	87%	ab	81.1	bc	50.3	def	37.2	fg
FB23113	106%	a	75.4	cde	51.7	cdef	47.9	ab
FB23618	97%	ab	76.3	bcde	51.8	cdef	43.3	bcde
Richer	91%	ab	93.1	a	47.9	f	41.8	cdef
SY Stanza	89%	ab	63.6	f	49.3	ef	40.7	defg
TR22669	87%	ab	68.3	ef	52.4	cde	43.5	bcde
Results								
Average	2870.9		77.1		53.2		42.3	
ANOVA p-value	0.0049		<0.0001		<0.0001		<0.0001	
CV%	9.5		3.5		2.6		4.1	

*Values followed by different letters are statistically different (P<0.05)

The check for the Barley trial in St. Paul was AAC Synergy, which is a 2-row malt variety. It is marketed as having a higher yield potential compared to AC Metcalfe and CDC Copeland. Of the 19 varieties tested in St. Paul in 2025, 17 varieties were on par with the check in terms of yield. Two varieties (CDC Copeland, and CDC Pristine) were significantly lower than the check. In terms of plant height, Richer was the tallest. SY Stanza, TR22669, and FB21106 were the shortest. CDC Armstrong and CDC Pristine had the highest grain test weight. Meanwhile, FB21704, FB23113, and AS Lafleur had the highest thousand kernel weight. Based on these results, there would be many good options. However, if we were to recommend one variety apart from the check, it would be FB21704. Yield was comparable to the check.

Regional Variety Trials

Cereals - Oat - Fort-Kent

Mean values of yield, height, test weight, and tkw in 12 varieties of oat in Fort Kent Alberta in 2025								
Variety	Yield (% of CS Camden)		Height		Test weight		TKW	
	g plot^{-1}		cm		lb bu^{-1}		g/1000 seeds	
AAC Fedak	99%	abc*	74.0	b	41.0	ab	44.8	a
AAC Fetch	76%	cd	70.6	bcd	39.2	abc	37.8	c
AAC Wesley	83%	bcd	66.3	cd	39.0	bc	37.9	c
AC Morgan	89%	abcd	76.5	b	41.7	a	39.5	bc
CDC Anson	108%	a	64.5	d	40.0	abc	39.8	bc
CDC Byer	101%	ab	72.2	bc	40.8	ab	39.4	bc
CDC Hank	109%	a	75.4	b	39.6	abc	39.1	bc
CDC Westgate	87%	abcd	94.4	a	38.9	bc	40.5	bc
CS Camden	100%	ab	76.0	b	40.0	abc	40.3	bc
OReBoost	75%	d	75.9	b	38.0	c	45.1	a
OT2152	96%	abcd	72.5	bc	39.1	bc	42.1	ab
OT3125	87%	abcd	66.4	cd	39.1	bc	38.3	bc
Results								
Average	2531.6		73.7		39.7		40.4	
ANOVA p-value	0.0002		<0.0001		0.0017		<0.0001	
CV%	8.8		3.0		2.2		3.5	

*Values followed by different letters are statistically different (P<0.05)

We know that oats are more sensitive to drought conditions compared to wheat and barley, and that certainly influenced the results. In the 2025 growing season, of the twelve varieties tested, nine were not statistically different from the check (CS Camden) in terms of yield. The other three varieties (AAC Fetch, AAC Wesley, OReBoost) were significantly lower than the check. In terms of plant height, again owing to the drought, most varieties were shorter than normal. As such, we did not observe issues with lodging in Fort Kent. The tallest variety was CDC Westgate. The shortest varieties were CDC Anson, AAC Wesley, OT3125, and AAC Fetch. AC Morgan produced the highest test weight. On the other hand, AAC Fedak, OT2152, OReBoost produced the highest thousand kernel weight (TKW). Based on the data from the 2025 growing season in Fort Kent, CDC Anson would be the recommendation. It was on par with the check in terms of yield (and/or slightly higher). It was one of the shorter varieties. Test weight was also on par with the check, while the TKW was middle of the run.

Plant height was amongst the lowest in the group. Grain test weight and TKW, was among the highest. However, since it's a newer variety, seed availability may be difficult. Another good option would be AS Lafleur, which was on par with AAC Synergy (yield, height, test weight, and TKW).

Regional Variety Trials

Cereals - Wheat CPSR - St. Paul

Mean values of yield, height, test weight, and tkw in 15 varieties of CPSR wheat in St. Paul Alberta in 2025

Variety	Yield (% of AAC Brandon)		Height		Test weight	TKW	
	g plot^{-1}		cm		lb bu^{-1}	g/1000 seeds	
AAC Awesome	92%	abc*	83.4	ab	63.3	47.7	a
AAC Brandon	100%	abc	85.5	ab	65.4	39.9	b
AAC Camrose	95%	abc	80.3	bcd	64.5	39.6	b
AAC Galore	85%	abc	81.6	abc	62.0	39.0	b
AAC Goodwin	98%	abc	87.5	a	65.8	38.8	b
AAC Penhold	90%	abc	79.6	bcd	42.9	38.0	bc
AC Andrew	93%	abc	84.5	ab	62.9	37.3	bc
AC Sadash	85%	abc	83.3	ab	62.7	36.9	bc
Alotta	110%	a	83.5	ab	64.8	36.6	bc
Fierce	81%	bc	83.1	ab	57.9	36.6	bc
GP266	79%	bc	78.7	bcd	61.3	36.1	bc
GP267	98%	abc	75.9	cd	62.8	33.5	bcd
HY2152	82%	abc	85.2	ab	62.5	31.8	cd
HY2161	106%	ab	75.1	cd	64.5	31.6	cd
Recoil	72%	c	73.9	d	61.1	29.6	d
Results							
Average	3126.4		81.4		61.6	36.9	
ANOVA p-value	0.0018		<0.0001		0.4907	<0.0001	
CV%	10.5		2.9		15.7	5.8	

*Values followed by different letters are statistically different (P<0.05)

None of the varieties tested in St. Paul in 2025 outyielded the check (AAC Brandon). Only three varieties were significantly different from the check (Fierce, GP266, and Recoil), and they were lower than the check. Recoil was the shortest recorded variety, along with HY2161, GP267, GP266, AAC Penhold, and AAC Camrose. No significant differences were observed in grain test weights. However, AAC Awesome did record the highest thousand kernel weight. Based on the data from the 2025 growing season in St. Paul, AAC Camrose and/or AAC Penhold would be recommended. They are both on par with the check in terms of yield. They are shorter varieties. Thousand kernel weights are middle of the run. AAC Awesome also performed well but was it recorded as a taller variety compared to the other two.

Regional Variety Trials

Cereals - Wheat CWRS - St. Paul

Mean values of yield, height, test weight, and tkw in 22 varieties of CWRS wheat in St. Paul Alberta in 2025								
Variety	Yield (% of AAC Brandon)		Height		Protein	Test weight	TKW	
	g plot^{-1}		cm		%	lb bu^{-1}	g/1000 seeds	
AAC Brandon	100%	a*	83.6	abc	14.8	63.1	32.8	ab
AAC Craven	105%	a	85.6	abc	12.8	64.5	33.0	ab
AAC Darby VB	82%	a	91.8	ab	14.8	59.1	33.1	ab
AAC Oakman VB	92%	a	83.7	abc	13.5	64.8	31.0	ab
AAC Spike	91%	a	81.6	c	16.4	64.2	31.3	ab
AAC Stoughton	103%	a	85.0	abc	12.5	64.2	34.7	ab
AAC Walker	112%	a	86.5	abc	12.2	65.4	32.7	ab
AAC Walsh	108%	a	86.2	abc	14.3	65.4	38.6	a
AAC Westking	104%	a	80.9	c	15.1	63.3	35.9	ab
AAC Wheatland VB	97%	a	84.3	abc	11.9	64.3	35.5	ab
Baker	80%	a	80.3	c	15.0	62.9	31.0	ab
Breadwinner	115%	a	85.3	abc	13.2	64.9	38.3	a
BW1141	98%	a	84.5	abc	14.6	63.0	33.4	ab
BW1143	88%	a	82.9	bc	15.3	63.2	34.7	ab
BW5115	89%	a	78.0	c	16.9	64.1	30.1	b
CDC Power CL Plus	113%	a	83.1	abc	13.8	64.3	31.7	ab
Donalda	87%	a	84.9	abc	15.4	61.8	32.1	ab
Flame	97%	a	84.6	abc	12.9	65.1	33.4	ab
Garde	108%	a	79.8	c	13.2	64.3	29.4	b
LAR19-22824	115%	a	83.5	abc	12.0	64.4	38.7	a
Palisade	85%	a	84.2	abc	16.6	62.5	32.3	ab
Zealand	77%	a	91.9	a	16.7	63.7	33.4	ab
Results								
Average	2572		84.2			63.7	33.5	
ANOVA p-value	0.0037		<0.0001			0.1106	0.0005	
CV%	12.8		3.4			3.0	7.4	

*Values followed by different letters are statistically different (P<0.05)

Like the CPSR trial in St. Paul, none of the varieties in the CWRS trial in St. Paul outyielded the check (AAC Brandon). In terms of plant height, the shortest varieties were AAC Spike, AAC Westking, Baker, BW5115, and Garde. No significant differences were observed for test weight (p=0.1106) and protein (p=0.1681). AAC Walsh, Breadwinner, and Palisade recorded the highest thousand kernel weights. Based on the results from this trial, it is inconclusive which varieties are performing the best. This scenario can happen on drought years. However, keep a close eye on AAC Spike and AAC Westking in the future.

Regional Variety Trials

Cereal - Triticale - St. Paul

Mean values of yield, height, test weight, and tkw in 5 varieties of triticale in St. Paul Alberta in 2025								
Variety	Yield (% of Brevis)		Height		Test weight		TKW	
	g plot^{-1}		cm		lb bu^{-1}		g/1000 seeds	
AB Sunbeam	87%	c*	93.9	b	54.2	b	35.8	b
Brevis	100%	ab	90.3	c	56.7	a	37.5	b
Pronghorn	92%	bc	98.7	a	53.4	b	37.8	b
T301	106%	a	93.3	bc	56.8	a	44.1	a
T317	95%	bc	98.3	a	54.1	b	36.8	b
Results								
Average	2079.0		94.9		55.0		38.4	
ANOVA p-value	0.0018		0.0001		0.0001		0.0002	
CV%	3.7		1.3		1.0		3.1	

*Values followed by different letters are statistically different (P<0.05)

Brevis was the check in the Triticale trial in St. Paul. T301 outyielded the check by 6%. In terms of plant height, the shortest variety was Brevis. The tallest varieties in the trial were Pronghorn and T317. Grain test weight was highest in Brevis and T301. In terms of thousand kernel weight, T301 was the clear winner. Based on the data from the 2025 growing season in St. Paul, T301 would be recommended. It performed the best overall (yield, test weight, height, and TKW). T301 is a dual-purpose, reduced awn spring triticale, and suitable for feed and forage uses. For specific seed availability and purchasing, contact Olds College Field Crop Development Centre or specialized seed retailers in Alberta. Brevis is also another good option.

Regional Variety Trials

Pulses - Chronology

Table 1B. Pulse variety trial chronology in St. Paul Alberta in 2025

Site						Herbicide[c]									
Regional Variety Trial	N[a]	Seeding[b]		Fertilizer[b]		Burndown			In crop			Desiccant			Harvest[d]
St. Paul	#	Date	Rate plants ft^{-2}	Date	Rate[e] lb $acre^{-1}$	Date	Name	Rate L $acre^{-1}$	Date	Name	Rate[f] kg $acre^{-1}$	Date	Name	Rate L $acre^{-1}$	Date
Faba bean	36	May 7	4	May 7	30 P	May 9	Roundup & Heat LQ	1 & 0.059	June 4	Sencor	0.111	September 12	Reglone ION	0.83	September 19
Field pea (yellow and green)	68	May 7	8	May 7	30 P	May 9	Roundup & Conquer	1	June 4	Sencor	0.111	August 12	Reglone ION	0.83	August 25
Lupin	72	May 7	Faba 4 Field Pea 8 Blue Lupin 11 White Lupin 5	May 7	30 P	May 9	Roundup & Conquer	1	June 4	Sencor	0.111	August 12[g], September 12[h]	Reglone ION	0.83	August 26[g], September 19[h]

[a]Number of experimental units
[b]No till hoe-drill Fabro seeder with side banding (2008) attached to Ford tractor (1998)
[c]R-Tech Thirty-foot sprayer (2024) attached to John Deere tractor (2010). For clarity, names are brand names, not chemical
[d]Wintersteiger Classic Plus (2020)
[e]Displayed rates are actuals, not product
[f]Compound in solid form
[g]Field pea and blue lupin
[h]Faba bean and white lupin

Grain Crops

Pulses - Faba Bean

Table 1B-1 Mean values obtained from parameters studied in faba bean varieties sown in St. Paul, Alberta in 2025

Variety	Individual count		Height		Test weight	Thousand seed weight (TSW)	
	Plant m-2		cm		g/L	g	
1142	40.11	ABC	51.00	BCD E	786.1	276.48	D
CDC1089	34.03	ABCD	54.38	BCD	786.1	314.26	C
CDC1310	51.36	A	51.56	BC	776.7	270.9	D
Dosis	17.36	CDE	57.25	BCD E	786.5	337.72	C
Futura	21.78	BCD	58.19	BCD E	783.5	396.37	AB
Hammer	43.34	AB	57.75	B	788.2	384.34	B
Juno	16.67	CDE	56.63	G	770.0	417.88	A
Navi	3.67	E	49.16	A	793.6	-	-
Fabelle	15.34	DE	57.19	BCD	801.6	387.67	B
P-value	0.0006		≤0.0001		0.0937	≤0.0001	
Standard error	5.2		1.2		5.5	8.5	

In general, Faba bean varieties struggled from the extensive rain scarce periods occurring in the growing season. It is possible drought may have exacerbated the difference in parameters studied across the varieties planted. Number of plants per squared metre, height and thousand seed weight varied significantly across nine faba bean varieties sown in St. Paul (Table 1B-1), whereas test weight was statistically the same. CDC 1310 Faba bean variety individuals were more numerous compared to those individuals from the Navi faba bean variety. Faba bean individuals were as statistically numerous as those found in CDC 1310, 1142, CDC 1089, and Hammer (Table 1B-1). Navi faba bean plants were the tallest in comparison to the other eight faba bean varieties. In contrast, the shortest faba bean plants were observed in plots sown to the Juno faba bean variety. Thousand seed weight (TSW) was heaviest in plants from the Juno variety compared to lightest TSW found in plants from the Dosis and the CDC 1089 faba bean varieties (Table 1B-1). Statistically similar to Juno faba beans, Futura faba beans TSW was also among the heaviest.

There was barely enough Navi faba beans to estimate a proper mean TSW value. Hammer faba bean plants produced the greatest yield compared to those plants from the Navi variety (Table 1B-1). All but 1142 and Navi faba bean plants produced yield statistically similar to that brought out by Hammer faba bean individuals.

In comparison to Fabelle faba bean (control), all faba bean varieties with the exception of Navi, had significantly more plants according to mean values calculated (Table 1B-1). Navi faba bean plants were taller than the control. This is likely because there were fewer stands at each plot and therefore lack of intra specific competition from other faba bean plant stands caused Navi faba bean individuals to gain height advantage. However, Fabelle faba bean individuals were still significantly taller than Juno faba bean plant stands (Table 1B-1).
Thus, all other varieties were as tall as Fabelle plant individuals. Juno and Futura seem to produce heavier TSW compared to that recorded from the Fabelle variety. Yield produced from Hammer faba bean stands in the end was statistically similar to that produced by the control variety plant stands.

Overall, Fabelle faba bean variety plants may emerge in low numbers, have average height and TSW but yield obtained is still competitive compared to those from other faba bean varieties tested. As such, Fabelle is still a safe choice to grow faba beans and to some extent, Hammer, CDC 1089, Dosis, CDC 1310, Futura, Juno and CDC 1310 can be acceptable alternatives.

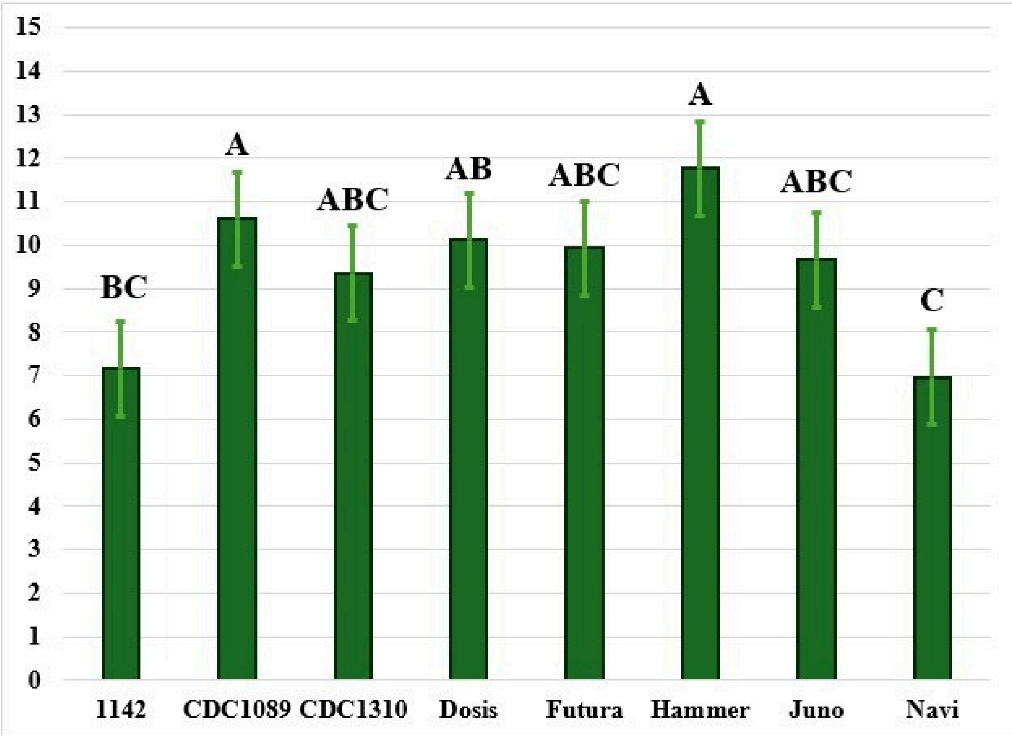


Figure 1B-1. Faba bean mean yield in bu acre-1 collected from 17 varieties in St. Paul, Alberta in 2025.

Grain Crops

Pulses - Field Pea

Yellow Field Pea

Plots sown to CDC Bound had the greatest number of field pea individuals per squared metre compared to other field pea varieties such as CDC Amarillo and PS Boost. However, AAC Harrison, AAC McMurphy, CDC 5791, CDC 5845, CDC Canuck, CDC Engage, CS ProStar, DL 995-96, LAP 23-14, LAP 23-17 and LN 4228 varieties had individual plant count statistically on par compared to plant number recorded from CDC Bound (Table 1B-2).

Table 1B-2 Mean values obtained from parameters studied in yellow and green field pea varieties sown in St. Paul, Alberta in 2025

Variety	Individual count		Height		Test weight	Thousand seed weight (TSW)	
	Plant m-2		cm		g/L	g	
Yellow field pea							
AAC Harrison	191.36	ABC	52.56	BCDE	831.96	177.32	CDE
AAC McMurphy	156.25	ABC	53.78	BCD	829.06	212.71	A
CDC 5791	205.44	AB	54.50	BC	832.00	189.03	BC
CDC 5845	171.17	ABC	53.28	BCDE	831.70	186.40	BCD
CDC Bound	245.45	A	52.66	BCDE	822.80	177.54	CD
CDC Canuck	132.25	ABCD	56.72	B	837.06	196.88	AB
CDC Engage	136.11	ABC	46.03	G	824.00	147.04	F
CS ProStar	132.25	ABCD	61.59	A	825.46	171.70	DE
DL 995-96	160.45	ABC	54.34	BCD	829.26	148.04	F
LAP 23-14	203.06	AB	50.25	DEF	821.20	182.69	BCD
LAP 23-17	200.70	AB	54.31	BCD	841.80	183.64	BCD
LN 4228	212.67	AB	50.72	CDEF	834.86	208.16	A
PS Boost	93.45	CDE	61.59	A	826.90	159.77	EF
CDC Amarillo	50.17	DE	52.13	CDE	836.66	177.71	CD
Green field pea							
CDC Huskie	138.06	ABC	49.16	EFG	819.40	159.99	EF
LAP 23-4	106.78	BCDE	47.63	FG	832.94	177.40	CD
CDC Limerick	38.03	E	51.69	CDEF	824.86	178.37	CD
P-value	0.0008		≤0.0001		0.511	≤0.0001	
Standard error	13.86		1.5		6.2	5.8	

On a different note, CS ProStar field pea variety individuals were significantly taller than all other varieties sown in St. Paul. CDC Engage field pea individuals were the shortest and individuals from LAP23-4 had heights statistically the same as those measured for CDC Engage individuals (Table 1B-2).

Yield varied across field pea varieties (P=0.0008, Figure 1B-2). Most yielding variety was PS Boost. Moreover, LAP 23-17, DL 995-96, CS ProStar, CDC 5845. CDC 5791, AAC McMurphy and AAC Harrison yielded statistically on par compared to the bushel acre^{-1} value obtained from PS Boost individuals.

Least yielding yellow field pea varieties were CDC Amarillo and LN 4228. Weight from a thousand seeds (TSW) was heaviest from CDC McMurphy and LN 4228 field pea plant varieties. Similarly, TSW in CDC Canuck, was statistically the same to that in the aforementioned varieties. In contrast, field pea varieties such as CDC Engage and DL 995-96 produced the lightest TSW weights. These weights were similar in statistical terms to that found in CDC Huski and PS Boost. Test weight was statistically the same among all varieties seeded.

The check for yellow field pea varieties was CDC Amarillo. Compared to this field pea variety, CDC Bound had more plants per squared metre, whereas CS ProStar and LN 4228 were 15% taller. AAC McMurphy and LN 4228 seeds were heavier in groups of thousand compared to CDC Amarillo (Table 1B-2). Finally, yield in CDC Amarillo was toppled by yield produced from PS Boost individuals (Figure 1B-2). Overall, PS Boost is likely the most yielding because it produces more seeds than other varieties as shown by it yield, and also had greater yielding potential as shown by it recorded mean height. Thus, it can be concluded that PS Boost is an acceptable option for field pea yield, especially during the particular dry conditions experienced during the growing season.

Green Field Pea

CDC Huskie field pea individuals were the most numerous among those varieties compared and produced heavier thousand seed weights compared to those from the CDC Limerick green field pea variety (Table 1B-2).

There were no differences among green field pea varieties neither in height, test weight (Table 1B-2) or yield (Figure 1B-2). Results indicated that green field pea varieties were on par in terms of yield, test weight and height in comparison to the check (CDC Limerick) and there is potential for yield advantage from CDC Huskie individuals as they can grow taller.

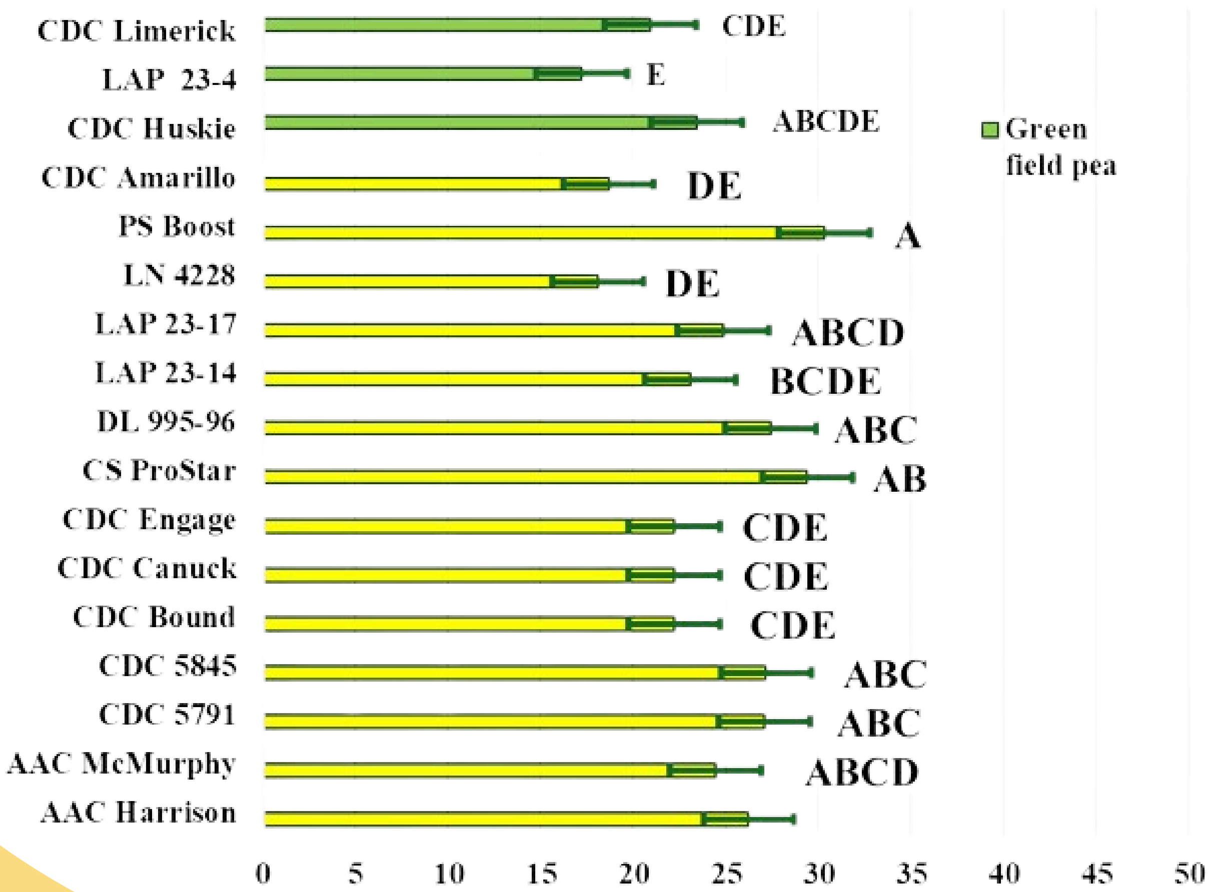


Figure 1B-2. Field pea yield in bu acre-1 collected from 17 varieties in St. Paul, Alberta in 2025.

Grain Crops

Pulses - Lupin

Lupin trials are generally composed of four pulse species: yellow field pea, white lupin, blue lupin and faba bean. In this way, lupin productivity is tested against other widely known pulse species in the province. As for the lupin varieties, five varieties were tested for wide leaf lupin and seven varieties for narrow leaf lupin.

Wide leaf lupin varieties tested are Dieta, which is the most studied here in Canada and thus the one with most potential for commercialization. It has been shown to grow well all over the province except in the Central region, because its growth and development goes further than the length of the growing season. Other wide leaf varieties such as UK1 and UK2 are originated from the United Kingdom. The maturity of these varieties can occur much later after the end of the growing season, so they are being tested to see if maturity can appear sooner, given current climate conditions in the province. Finally, Cer1 as well as Cer2 are new French varieties brought for testing.

Narrow leaf lupin varieties such as Lunabor and Probor, are originated from Europe. These two have the most attention by researchers from Lakeland College because they have shown adaptability and yield potential. Lima varieties (Lima1, Lima2 and Lima3) are varieties shipped from Australia which were tried this year by LARA.

Yellow Pea in Lupin Trial
Yellow field pea varieties showed statistically the same mean number of individuals compared to other varieties sown in lupin and faba bean (Table 1B-3). Yellow pea individuals from the Carver variety were significantly taller than those from the LN4228 variety. More nodules were found in yellow pea plant roots in comparison to those counted in lupin plant roots.

Among yellow pea varieties however, nodulation rating was statistically the same (Table 1B-3).

Thousand seed weight (TSW) in LN4228 yellow pea was the heaviest compared to those thousand seed bunches weighed from Carver and Lewochko varieties (Table 1B-3). Like nodulation, yield was the same among yellow pea varieties but is significantly differ from yield obtained from lupin and faba bean plant stands ($P \leq 0.0001$, Figure 1B-3).

Wide Leaf Lupin
Mean number of individuals and mean height in wide leaf lupin were the same statistically (Table 1B-3). Like most pulses, lupin is a poor competitor against other grassy and broadleaf plant species.

Wide leaf lupins were heavily impacted by presence on annual ryegrass (Lolium multiflorum L.), quackgrass (Elymus repens L.) and lambs quarters (Chenopodium album L.) in the field. Annual ryegrass and quackgrass proliferated aggressively despite the few precipitation events.

Nodulation ratings in lupin roots were difficult to assess. Nodules were hard to find in narrow leaf lupin plant roots. Many nodes were not present and those present were vary scarce and not fully formed; possibly due to the inoculant used or both the inoculant and plant intolerance to drought.

Cer2 wide leaf lupin had the heaviest lot of thousand seeds compared to Cer1, UK1 and UK2 varieties (Table 1B-3). This was difficult to measure because yield from wide leaf lupin plants overall was scarce. In other words, by the time of harvest, lupin seeds collected from varieties of this species were hardly greater than a human fist. This explains the low yield in Figure 3C-1. Compared to Dieta wide leaf lupin (control), varieties from the same species were statistically the same. Thus, results indicated that wide leaf lupin is extremely sensitive to drought and will not prosper in the face of water scarcity.

Narrow Leaf Lupin

As for narrow leaf lupin, number of plants per meter squared were greater in the Lima1, Lima3, Lunabor and Boregine varieties compared to the Probor variety from the same species (Table 1B-3). Nor1 narrow leaf lupin plants were the tallest compared to plants from varieties such as Lima1, Lima2, Lima3, and Probor. Height in Nor1 plant stands however was statistically the same as those from Lunabor and Boregine varieties (Table 1B-3).

Like wide leaf lupin, nodulation in narrow leaf lupin roots was negatively impacted. There were very little nodules and many of them were not fully formed. Similarly to wide leaf lupin it is possible that the inoculant added to the seeds is likely a work in progress and like the plant, very sensitive to rain shortage in the summer.

Thousand seed weight in Lima1 and Lima3 narrow leaf lupin was heavier than that weighed in Nor1 narrow leaf lupin. Yield in narrow leaf lupin was also compromised by drought and interspecific competition from annual ryegrass, quackgrass, and lambs' quarter. Although yield in narrow leaved lupin was greater than wide leaf lupin, some narrow leaf lupin varieties struggled to produce yielding seed. Lima2 and Probor narrow leaf lupin plants had less individuals and due to the low number of seeds, thousand seed weight had to be extrapolated.

Compared to other narrow leaved lupin varieties, Boregine (the control) had more plants than the Probor variety; taller than Probor plants and all plants from the Lima varieties; with same nodulation ratings as the other varieties. Lot of thousand seeds was as statistically heavy as other varieties except Nor1, whose thousand seed weight was lighter. As a final note, Boregine plants yielded the same as the other varieties (Figure 1B-3), but Lima1 plants were more yielding. Narrow leaf lupin has shown that it could be planted and taken to harvest at promising yields.

Nevertheless, planting should be carried out with caution as it is poorly competitive with weeds and does not produce acceptable yields at the behest of drought.

Table 1B-3 Mean values obtained from parameters studied in yellow field pea, narrow leaf lupin, wide leaf lupin and faba bean varieties sown in St. Paul, Alberta in 2025

Species / Variety	Individual count		Height		Nodulation		Thousand seed weight (TSW)	
	Plant m-2		cm		1-13 scale		G	
Yellow field pea								
Carver	158.02	A	54.3	A	11.25	BC	172.55	F
LN4228	164.60	A	48.62	BC	10.68	C	208.65	E
Lewicki	164.60	A	50.80	AB	11.50	ABC	167.77	F
Wide leaf lupin								
Cer1	50.32	E	33.25	FGH	5.50	D	262.07	CD
Cer2	51.40	E	32.43	GH	6.25	D	302.29	B
UK1	59.07	E	34.38	FG	6.25	D	266.16	CD
UK2	69.42	DE	35.08	FG	5.25	D	270.01	CD
Dieta	55.77	E	35.85	FG	5.25	D	277.37	BC
Narrow leaf lupin								
Lima1	139.43	ABC	29.35	H	6.00	D	141.20	G
Lima2	108.28	BCD	29.18	H	5.00	D	135.76	GH
Lima3	149.28	AB	32.88	FGH	5.00	D	142.59	G
Nor1	111.55	BCD	41.05	DE	5.50	D	114.96	H
Lunabor	126.85	ABC	37.56	EF	5.00	D	119.85	GH
Probor	73.85	DE	34.40	FG	5.25	D	121.86	GH
Boregine	140.52	AB	40.28	E	6.25	D	132.10	GH
Faba bean								
219-16	94.07	CDE	45.69	CD	12.25	ABC	248.71	D
Fabelle	74.92	DE	45.75	C	12.50	AB	354.82	A
Snowbird	59.6	E	48.88	BC	13.00	A	367.03	A
P-value	0.0009		≤0.0001		≤0.0001		0.0009	
Standard error	19.6		1.8		0.6		10.4	

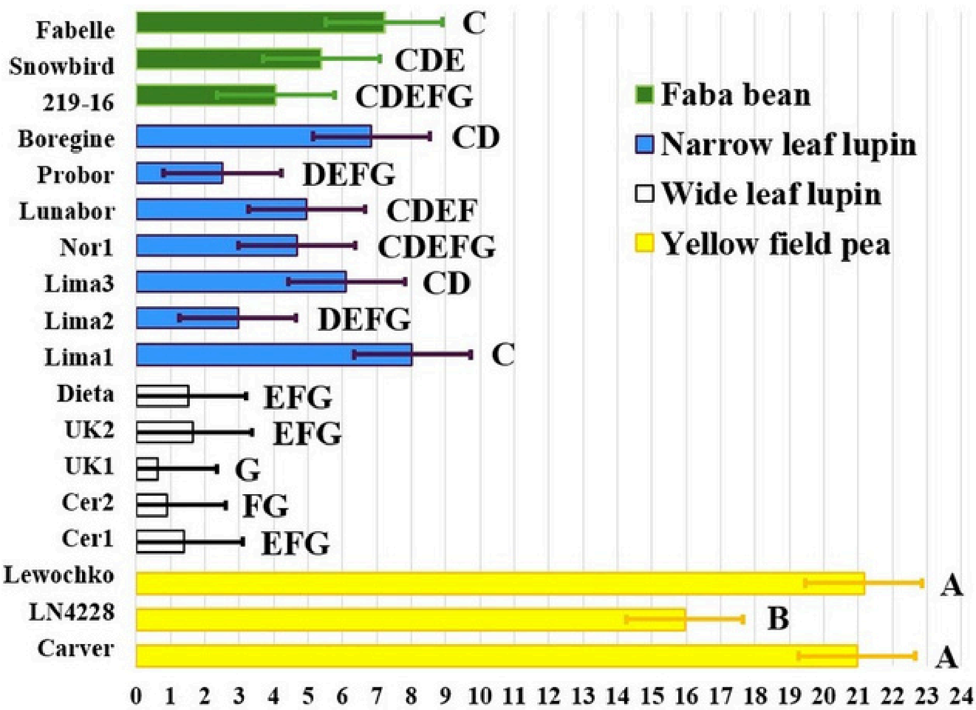


Figure 1B-3. Yellow pea, faba bean, wide leaf as well as narrow leaf lupin mean yield in bu acre-1 from varieties planted in St. Paul, Alberta in 2025.

Grain Crops

Proprietary - Effect of NuEarth Soil Products on Wheat Development & Yield - Chronology

Table 2. Proprietary cropping trial chronology in St. Paul, Alberta in 2025

Site / Trial Name	N[a]	Seeding[b]		Fertilizer[b]		Herbicide[c] Burndown			Herbicide[c] In crop			Herbicide[c] Dessicant			Product Application[d]			Harvest[e]
St. Paul	#	Date	Rate lb acre^{-1}	Date	Rate[f] lb acre^{-1}	Date	Name	Rate L acre^{-1}	Date	Name	Rate[g] kg acre^{-1}	Date	Name	Rate L acre^{-1}	Date	Name	Rate L acre^{-1}	Date
Impact of NuEarth soil products on wheat yield & development	15	June 3	113[h]	June 3	Refer to Section 2C	May 9	Roundup & Heat LQ	1 & 0.059	June 15	Buctril M	0.11	September 9	Boron + pH Balancer	2 + 1L/100 gal/ac	August 5	Thio	1	September 25

[a]Number of experimental units
[b]No till hoe-drill Fabro seeder with side banding (2008) attached to Ford tractor (1998)
[c]R-Tech Thirty-foot sprayer (2024) attached to John Deere tractor (2010). For clarity, names are brand names, not chemical. Maintenance application not conducted to procure survivorship of clover species
[d]Hand sprayed with 1.5m backpack sprayer
[e]Wintersteiger Classic Plus (2020)
[f]Displayed rates are actuals, not products
[g]Compound in solid form
[h]Seed treated with Vibrance Quattro @ 325 ml/ac
[e]In-crop herbicides not used to observe allelopathic effect
[f]Displayed rates are actuals, not product

Grain Crops

Proprietary - Effect of NuEarth Soil Products on Wheat Development & Yield

NuEarth products, applications and measurements occurred during the growing season of 2025 in plots of 5.75m in width by 12.2m in length. Crop used for this experiment was AAC Wheatland Canadian Western Red Spring (CWRS) wheat with 99% germination rate and a TKW of 40.8g. Seeding was performed with a No-till hoe Fabro seeder with side banding and liquid kit (2008) attached to ford tractor 1720 (1998). Side banding fertilization was calculated to attain a yield goal of 65 lb/acre. BRIX after application, leaf extraction for macro and micronutrient analysis, plant height, yield, test weight, moisture, protein content and thousand kernel weight (TKW) were taken from each plot.

Treatments consisted of the following:

- Treatment 1, growing standard: Seed treated with Vibrance Quatro, Urea and MAP for N and P respectively
- Treatment 2: NuEarth seed dressing, N reduced to 90% and fertilizer coated with OMEX TNT starter at 4.5 gal/acre and liquid side banding with 1:3 residue digestor:distilled water dilution
- Treatment 3: same as treatment 2 seed, N dressing minus the residue digestor
- Treatment 4: similar to treatment 2 but instead of the residue digestor, OMEX TNT starter mixed with NuEarth HDI were applied as liquid side banding. Mixture was diluted at the same ratio as the residue digestor.
- Wheat plants seeded in treatment 2 and 3 underwent a B and a Ca blend foliar application before flowering stage.
- An extra treatment was added (Treatment 5), where wheat seed was coated with NuEarth seed dressing. No fertilizers or extra amendments were added to this treatment.

The experiment was set as a complete random block design with three replicates. An analysis of variance was conducted. Each treatment was considered a fixed effect whereas replicates were stated as random. Variables were number of emergent plants per m, BRIX readings before and after foliar application and its difference; content of macronutrients such as N, P, K, Ca, S, and Mg and micronutrients such as Al, B, Cu, Fe, Mn, Na and Zn; plant height, yield, test weight, moisture, protein content and TKW. All analyses of variance were performed in SAS 9.4 (SAS Institute, 2008) using PROC MIXED. Significance was assessed at a confidence level of 0.05. LSD analysis was used to compare means for each parameter among treatments. No transformations were done as values were statistically normal (Anderson-Darling $P>0.05$).

Number of emergent plants ($P<0.0001$), height ($P<0.0001$), and N content ($P=0.0099$) differed among treatments (Table 2A-1). Number of emergent plants was significantly greater in wheat under treatments 3 and 4 compared to wheat plants grown under standard practices (treatment 1) and wheat side banded with residue digestor dilution (treatment 2).

It is possible the residue digestor may be having an influence in reducing emergence as wheat that was side banded with either OMEX TNT (treatment 3) or OMEX TNT plus liquid HDI (treatment 4) had greater number of emergent plants. All treatments had greater emergence than wheat grown to only NuEarth seed dressing (treatment 5).

Despite height in wheat there was no lodging found in any plots. This is likely attributed to the variety itself since AAC Wheatland lodging rating is categorized as very good. Further experiments may be required to gain a most robust perspective on lodging.
Taller plants were observed in wheat seeded to applications outlined for treatment 3 compared to plants sown in treatments 2 and 4 plots (Table 2A-2).

Mean height in wheat from treatment 3 plots were statistically the same as height averaged from wheat plants sown to grower standards (Table 2A-2). Plant heights were the same in treatment 2 and 4 meaning that despite a foliar application in treatment 2, plants did not gain any height advantage in comparison to wheat plants left unsprayed in treatment 4.

N content in leaves was greater in wheat grown in treatment 3 plots. However, content was statistically the same as that found in leaves from wheat planted in plots from treatment 2 and plots sown to growing standards. This shows that NuEarth and OMEX TNT starter coatings for seed and fertilizer respectively may be contributing for wheat to accumulate more N in their leaves and thus increase photosynthesis.

It also shows that HDI side banding applied in treatment 4 plots may have impacted N content in wheat leaves. N content in wheat sown in treatment 4 plots was lower compared to N content extracted from plants sown in treatment 3.

In contrast to emergent plant number, height and N content; BRIX difference before and after foliar application, yield, test weight, TKW, protein content, macronutrient content such as Ca, K, Mg, P, and S as well as micronutrients such as Al, B, Cu, Fe, Mn, Na, and Zn were statistically the same across treatments (Table 2A-2)

In conclusion, the nuEarth products used for each treatment did have an influence in emergent plants, height and nitrogen storage in plant leaves, but more data needs to be gathered in order to observe differences in yield. Moreover, other factors such as drought and seeding later in the season may have influenced yield and thus may explain lower yield values compared to the expected 65 bu/acre target. Moreover, other factors such as drought and seeding later in the season may have influenced yield and thus may explain lower yield values compared to the expected 65 bu/acre target

Table 2A-1. Plants per m (N=45), height (N=300) and N content (N=15) mean values taken from CWRS wheat AAC Wheatland subjected to different NuEarth product formulations for development and yield

Treatment	Emergence		Height		N	
	Plants m^{-1}		cm		%	
1	37.78	BC	76.14	AB	6.13	AB
2	31.44	CD	74.97	B	6.14	AB
3	48.56	AB	77.73	A	6.17	A
4	57.78	A	74.77	B	5.97	BC
5	19.89	D	72.26	C	5.80	C
Standard Error	4.1		1.7		0.01	

[a]Analysis of variance in yield as bu/acre shows difference between treatment 5 and the other treatments (p=0.0018). however, since treatment 5 was an unfertilized treatment and all other treatments were statistically the same, this analysis was not included in the table.

Table 2A-2. Mean values for yield, BRIX, test weight, thousand kernel weight (TKW), protein, macronutrient and micronutrient content taken from CWRS wheat AAC Wheatland subjected to different NuEarth product formulations for development and yield (N=15).

Parameter	Treatment	1	2	3	4	5	Standard error	P-value
Yield[a]	Bu $acre^{-1}$	36.99	37.78	44.37	38.15	26.44	3.9	0.13
BRIX								
before foliar application		20.67	18.44	21.06	19.72	19.11	1.3	0.11
after foliar application		12.89	12.22	12.67	12.78	12.78	0.6	0.94
Difference (after-before)		-7.78	-6.22	-8.39	-6.94	-6.33	1.3	0.54
Test weight	lb/bu	62.49	62.31	63.16	62.29	62.37	0.4	0.48
TKW	g	37.18	36.28	36.81	36.45	39.71	1.0	0.10
Protein	%	15.57	15.02	15.14	15.47	14.45	0.4	0.26
Macronutrients								
Ca		0.47	0.48	0.45	0.49	0.52	1.8×10^{-2}	0.18
K		5.54	5.72	5.57	5.20	5.59	0.20	0.29
Mg		0.25	0.27	0.25	0.25	0.26	1.1×10^{-2}	0.52
P		0.70	0.67	0.60	0.59	0.60	1.9×10^{-2}	0.33
S		0.39	0.39	0.38	0.37	0.36	8.8×10^{-3}	0.15
Micronutrients								
Al		175.67	214.33	179	205	229.67	30.7	0.69
B		7.82	8.77	7.95	10.11	7.83	0.7	0.24
Cu		8.23	8.02	7.26	8.37	9.01	0.8	0.54
Fe		375.00	441.67	359.33	440.33	478.67	68	0.71
Mn		85.33	99.33	91.67	97.33	94.33	10.9	0.72
Na		1.67×10^{-2}	1.33×10^{-2}	1.00×10^{-2}	1.33×10^{-2}	1.00×10^{-2}	2.6×10^{-3}	0.39
Zn		59.33	57.33	51.33	56.67	65.33	7.3	0.15

Silage Variety Trials

Barley, Oats, Wheat & Triticale and Fall Rye - Chronology

Table 3. Cereal silage trial chronology in St. Paul Alberta in 2025

Site						Herbicide[c]						
Regional Variety Trial	N[a]	Fertilizer[b]		Seeding[b]		Burndown			In crop			Harvest[d]
St. Paul	#	Date	Rate[e] lb $acre^{-1}$	Date	Rate[f] plants ft^{-2}	Date	Name	Rate L $acre^{-1}$	Date	Name	Rate[g] kg $acre^{-1}$	Date
Feed barley	24	May 10	90 N 30 P 29 K	May 10	28	May 9	Roundup & Heat LQ	1 & 0.059	June 15	Buctril M	0.11	July 29
Oat	18	May 10	90 N 30 P 29 K	May 10	28	May 9	Roundup & Heat LQ	1 & 0.059	June 15	Buctril M	0.11	July 29
Triticale/wheat	21	May 10	90 N 30 P 29 K	May 10	33	May 9	Roundup & Heat LQ	1 & 0.059	June 15	Buctril M	0.11	July 29
Fall Rye	18	September 11	90 N 30 P 29 K	September 11[h]	23	September 12	Roundup & Heat LQ	1 & 0.059	-	-	-	July 2

[a]Number of Experimental Units
[b]No till hoe-drill Fabro seeder with side banding (2008) attached to Ford tractor (1998)
[c]R-Tech Thirty-foot sprayer (2024) attached to John Deere tractor (2010). For clarity, names used are brand names, not chemical
[d]R-Tech Alfalfa Omega self-propelled forage harvester (circa 1980)
[e]Displayed rates are actuals, not product
[f] Seed treated with Terraxa F4
[g]Compound in solid form
[h]Seeded in 2024

Silage Variety Trials

Barley, Oats, Wheat & Triticale and Fall Rye

Partners:

- Sustainable Canadian Agricultural Partnership
- Results Driven Agriculture Research
- Alberta Seed Processors
- Alberta Beef Producers
- Alberta-British Columbia Seed Growers
- Government of Alberta
- Government of Canada

Objectives:

1. To identify the highest-yielding cereal forage varieties (fall rye, spring barley, oats, triticale, and wheat) for whole-plant forage production in Northeastern Alberta.
2. To identify the cereal forage varieties with the best feed quality (fall rye, spring barley, oats, triticale, and wheat) for cattle in Northeastern Alberta.

Background:

A crucial aspect of crop production is variety selection, as new varieties are continually being introduced. Access to current and comprehensive forage variety yield and quality data is essential for Alberta producers. Previous experience with cereal production and the Regional Variety Trials has demonstrated that selecting the best variety can increase production by approximately 15%, corresponding to an average gain of $25 per acre.

Variety selection decisions are informed by experience, neighboring producers, and publications such as the Alberta Seed Guide (seed.ab.ca).

However, there has been a lack of comprehensive whole-plant annual forage data to support cropping decisions for forage production.The purpose of this trial is to provide producers with up-to-date,
detailed information on annual forage variety yield and quality for silage, greenfeed, or swath grazing in Northeastern Alberta (crop zones 3 and 5) and across the province.

Material & Methods:

Silage trials were conducted in the County of St. Paul and involved five crop types: fall rye, spring barley, oats, spring wheat, and triticale. Each trial block was established using a randomized complete block design (RCBD) with three replicates to reduce experimental error. Spring wheat and triticale were seeded within the same block. Individual plots measured 1.15 m × 6 m.

Seeding was performed using a LARA five-row zero-till small-plot drill, with blended fertilizer side-banded at the time of seeding. Hand weeding was carried out throughout the growing season to maintain weed-free trial conditions.

Prior to harvest, crop height and stage of maturity were recorded. For forage quality analysis, plant material was collected from the inner three rows of each plot prior to harvest and chopped into approximately 2.5 cm (1-inch) lengths using a paper cutter. Approximately 400 g of this freshly chopped forage was dried and submitted to a laboratory for quality analysis. Harvesting was carried out when crops reached the desired harvest stage using a LARA alfalfa–Omega self-propelled forage harvester, and total plot weight was recorded at harvest.

For dry matter determination, a separate subsample consisting of 1 kg of freshly harvested material was collected from each plot after harvest and dried to a constant weight.

Data for forage dry matter yield and quality parameters were subjected to analysis of variance (ANOVA), and treatment means were compared using the least significant difference (LSD) test at the 0.05 probability level with the agricolae (version 1.3-7) package in R (version 4.3.2). Agronomic details for the trials are presented in the chronology table.

Results & Discussion:

Barley

This year, a total of eight barley varieties were grown at the site in St. Paul County. The trial was harvested when most varieties had reached the soft dough stage, approximately 80 days after seeding. Although no statistically significant differences were detected among varieties, most yielded around or above 5 t ac^{-1} when moisture was adjusted to 65%. The highest-yielding variety was AB Maximizer at 5.67 t ac^{-1}, while the lowest-yielding variety was AAC Lariat at 4.9 t ac^{-1}. CDC Austenson was used as the check variety. AB Maximizer, FB21106, and FERGUSON produced yields that were 7%, 1%, and 1% higher than the check, respectively, whereas all other varieties yielded less than the check.

In terms of forage quality, most varieties met the nutritional requirements of beef cattle from mid-gestation through lactation. Crude protein (CP) values ranged from 10.20% to 11.47% across varieties, while total digestible nutrients (TDN) varied between 66.03% and 68.25%. For reference, recommended dietary CP levels for beef cattle are 7% during mid-gestation, 9% during late gestation, and 11% during lactation. Similarly, TDN requirements generally follow the 55-60-65 guideline, with cows requiring approximately 55% TDN during mid-gestation, 60% during late gestation, and 65% during lactation. For more detailed information, please refer to Table 3a-1 & 2.

Table 3a-1. Forage dry matter (DM) yield, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and total digestible nutrients (TDN) for all Barley varieties.

Treatment	DM Yield (t/ac)		CP (% DM)		NDF (% DM)		ADF (% DM)		TDN (% DM)	
AB Maximizer	5.67	a	10.77	a	42.77	a	23.80	a	67.23	a
FB21106	5.33	a	10.20	a	42.90	a	23.00	a	67.70	a
FERGUSON	5.33	a	11.33	a	42.27	a	22.23	a	67.87	a
CDC Austenson	5.30	a	11.37	a	42.17	a	21.93	a	67.50	a
CDC Durango	5.20	a	11.40	a	41.75	a	22.00	a	68.25	a
FB23618	5.17	a	11.47	a	43.00	a	23.03	a	66.47	a
WCI Fortify	5.00	a	10.57	a	44.27	a	25.10	a	66.03	a
AAC Lariat	4.90	a	11.13	a	42.03	a	22.97	a	67.23	a
Pr (>F)	0.7387		0.7922		0.9607		0.6195		0.4259	

Note : Significance Codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Table 3a-2. Forage starch content (Starch) and in-vitro true digestibility (IVTD30) for all Barley varieties.

Treatment	Starch (% DM)		IVTD30 (% DM)	
AB Maximizer	30.60	a	68.07	ab
FB21106	31.30	a	68.13	ab
FERGUSON	31.77	a	68.90	a
CDC Austenson	30.10	a	67.97	ab
CDC Durango	31.70	a	68.50	ab
FB23618	29.03	a	67.17	ab
WCI Fortify	28.80	a	65.93	b
AAC Lariat	31.07	a	67.83	ab
Pr (>F)	0.675		0.4543	

Note : Significance Codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Oats

A total of six oat varieties were grown in the trial this year at the St. Paul site. The trial was harvested when most varieties reached the milk stage. Significant differences among varieties were observed for dry matter (DM) yield, which ranged from 2.74 to 3.56 t ac^{-1} (at 65% moisture). AAC Wesley was the highest-yielding variety, while ORe Ruminantor was the lowest-yielding. CDC Baler served as the check variety. AAC Wesley was the only variety to exceed the check, yielding 2% higher, whereas all other varieties produced lower yields than CDC Baler.

Forage quality was generally adequate across all varieties. Crude protein (CP) concentrations exceeded 11% for all entries, meeting the nutritional requirements of lactating beef cattle. Total digestible nutrient (TDN) concentrations for most varieties were sufficient to meet the energy requirements of beef cows from mid-gestation through lactation, with values ranging from 62.4% to 68.17%. Detailed results are provided in Table 3a-3 & 4.

Table 3a-3. Forage dry matter (DM) yield, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and total digestible nutrients (TDN) for all Oats varieties.

Treatment	DM Yield (t/ac)		CP (% DM)		NDF (% DM)		ADF (% DM)		TDN (% DM)	
AAC Wesley	3.56	a	11.37	a	46.97	c	25.97	c	68.17	a
CDC Baler	3.48	a	12.20	a	53.47	a	30.87	ab	62.40	e
CDC Endure	3.27	ab	11.70	a	48.83	bc	26.57	bc	66.30	b
CDC Westgate	3.25	ab	11.97	a	51.50	ab	29.90	abc	64.20	cd
ORe Boost	2.81	b	11.33	a	54.27	a	32.07	a	63.47	de
ORe Ruminator	2.74	b	11.93	a	51.50	ab	27.90	abc	65.07	bc
Pr (>F)	0.02687*		0.3537		0.001765**		0.06185.		3.522e-05***	

Note : Significance Codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Table 3a-4. Forage starch content (Starch) and in-vitro true digestibility (IVTD30) for all Oats varieties.

Treatment	Starch (% DM)		IVTD30 (% DM)	
AAC Wesley	16.23	a	64.12	a
CDC Baler	6.27	e	63.24	ab
CDC Endure	13.60	b	63.87	a
CDC Westgate	7.87	de	63.78	a
ORe Boost	9.53	cd	61.84	b
ORe Ruminator	10.43	c	63.08	ab
Pr (>F)	5.942e-06***		0.1432	

Note : Significance Codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Wheat & Triticale

During the 2025 growing season, four triticale and four spring wheat varieties were evaluated at the St. Paul site. The trial was harvested when most varieties reached the late milk stage. Significant differences in forage dry matter (DM) yield were observed among varieties, with yields ranging from 3.85 to 5.28 t ac^{-1} (at 65% moisture). The triticale variety T301 produced the highest forage yield, while the spring wheat variety Alotta had the lowest yield. AC Sadash served as the check variety in this trial. Five varieties, T301, AB Sunbeam, Trical Surge, T317, and AAC Galore, yielded 18, 16, 11, 8, and 5% more than the check, respectively. In contrast, 15FOR36 and Alotta yielded 3 and 14% less than AC Sadash, respectively.

Regarding forage quality, most varieties met the crude protein (CP) requirements of lactating beef cows, with CP concentrations ranging from 10.43 to 11.90%. Similarly, most varieties provided sufficient total digestible nutrients (TDN) to meet the nutritional requirements of beef cattle from mid-gestation through lactation, with values ranging from 61.43 to 67.33%. For more detailed information, please refer to Table 3a-5 & 6.

Table 3a-5. Forage dry matter (DM) yield, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and total digestible nutrients (TDN) for all Wheat & Triticale varieties.

Treatment	DM Yield (t/ac)		CP (% DM)		NDF (% DM)		ADF (% DM)		TDN (% DM)	
T301	5.28	a	10.87	abc	49.73	b	27.43	bc	65.23	a
AB Sunbeam	5.19	a	10.43	c	48.83	b	28.33	bc	65.77	a
Trical Surge	4.98	ab	11.13	abc	54.33	a	30.27	ab	62.27	b
T317	4.84	ab	10.50	bc	48.13	b	26.60	bc	66.27	a
AAC Galore	4.68	ab	11.67	ab	48.93	b	27.23	bc	66.00	a
AC Sadash	4.47	bc	11.73	a	47.07	b	26.87	bc	67.33	a
15FOR36	4.35	bc	11.90	a	55.60	a	33.17	a	61.43	b
Alotta	3.85	c	11.33	abc	46.77	b	25.90	c	66.70	a
Pr (>F)	0.008164**		0.1217		0.003698**		0.015*		0.0005657***	

Note : Significance Codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Table 3a-6. Forage starch content (Starch) and in-vitro true digestibility (IVTD30) for all Wheat & Triticale varieties.

Treatment	Starch (% DM)		IVTD30 (% DM)	
T301	7.13	cd	62.58	a
AB Sunbeam	10.60	ab	62.84	a
Trical Surge	3.63	e	60.17	b
T317	9.00	bc	63.64	a
AAC Galore	10.80	ab	63.33	a
AC Sadash	12.77	a	64.36	a
15FOR36	4.90	de	59.67	b
Alotta	9.67	abc	64.57	a
Pr (>F)	0.0002368***		0.002572**	

Note : Significance Codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Fall Rye

This year, fall rye was included for the first time in the regional silage trials, with seven varieties evaluated. Dry matter (DM) yields ranged from 3.14 to 3.85 t ac^{-1} (at 65% moisture), with SU Performer yielding the least and KWS Aviator the most. AC Hazlet served as the check variety in this trial. KWS Aviator was the only variety to exceed the check, yielding 7% more, while all other varieties yielded less than AC Hazlet.

Regarding forage quality, most varieties met the crude protein (CP) requirements of beef cattle only until late gestation, with CP concentrations ranging from 7.40 to 10.03%. However, all varieties provided more than 65% total digestible nutrients (TDN), sufficient to meet the nutritional demands of beef cows during lactation. For more detailed information, please refer to Table 3a-7 & 8.

Table 3a-7. Forage dry matter (DM) yield, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and total digestible nutrients (TDN) for all Fall Rye varieties.

Treatment	DM Yield (t/ac)		CP (% DM)		NDF (% DM)		ADF (% DM)		TDN (% DM)	
KWS Aviator	3.85	a	8.00	bc	46.97	abc	27.60	ab	67.13	ab
AC Hazlet	3.59	a	7.40	c	49.53	a	29.00	ab	66.37	b
KWS Serafino	3.38	a	9.10	ab	46.60	abc	30.20	a	67.13	ab
KWS Trebiano	3.38	a	9.65	a	44.65	c	25.50	b	68.85	a
Cossani	3.19	a	10.03	a	45.67	c	26.87	ab	67.30	ab
KWS Receptor	3.16	a	9.10	ab	49.15	ab	29.85	a	66.10	b
Performer	3.14	a	9.80	a	46.07	bc	27.70	ab	67.23	ab
Pr (>F)	0.4021		0.006841**		0.06751.		0.1542		0.1751	

Note : Significance Codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Table 3a-8. Forage starch content (Starch) and in-vitro true digestibility (IVTD30) for all Fall Rye varieties.

Treatment	Starch (% DM)		IVTD30 (% DM)	
KWS Aviator	5.13	ab	64.09	ab
AC Hazlet	4.97	ab	61.93	c
KWS Serafino	6.10	ab	63.91	ab
KWS Trebiano	6.90	a	65.67	a
Cossani	6.73	a	64.52	ab
KWS Receptor	4.50	ab	62.82	bc
Performer	6.27	ab	64.35	ab
Pr (>F)	0.2028		0.03411*	

Note : Significance Codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Forage & Livestock Research

Chronology

Table 4. Lakeland Agricultural Research Association (LARA) forage and livestock research trials chronology in Fort Kent, Alberta in 2025

Site / Trial Name	N[a]	Seeding[b]		Fertilizer[b]		Herbicide[c]						Product Application[d]			Harvest[e]
						Burndown			In crop						
Fort Kent	#	Date	Rate plants ft^{-2}	Date	Rate[f] lb acre^{-1}	Date	Name	Rate L acre^{-1}	Date	Name	Rate L acre^{-1}	Date	Name	Rate lb acre^{-1}	Date
Evaluation of early seeded winter cereals as a drought mitigation strategy															
Early	24	April 23	Refer to section 3B	April 23	90 N 30 P 29 K	-	-	-	June 9	Buctril M	0.4	-	-	-	Refer to section 3B
Late	24	May 13	Refer to section 3B	May 13	90 N 30 P 29 K	-	-	-	June 9	Buctril M	0.4	-	-	-	Refer to section 3B
Performance evaluation of two-row and six-row forage barley mixtures	68	May 11	28[g]	May 11	90 N 30 P 29 K	May 30	Roundup	1	-	-	-	-	-	-	July 24
Integrated use of organic and inorganic fertilizers for forage barley production in Northeastern Alberta	44	May 30	28[g]	May 30	Refer to section 3C	May 30	Roundup & Heat LQ	1 & 0.059	-	-	-	-	-	-	August 12
Boosting copper in cereal silage															
Wheat	16	May 30	33[h]	May 30	90 N 30 P 29 K	May 30	Roundup & Heat LQ	1 & 0.059	June 9	Buctril M	0.4	July 14	Copper Sulfate	0.1-0.5	August 12
Barley	16	May 30	28[h]	May 30	90 N 30 P 29 K	May 30	Roundup & Heat LQ	1 & 0.059	June 9	Buctril M	0.4	July 14	Copper Sulfate	0.1-0.5	August 7
Oat	16	May 30	28[h]	May 30	90 N 30 P 29 K	May 30	Roundup & Heat LQ	1 & 0.059	June 9	Buctril M	0.4	July 14	Copper Sulfate	0.1-0.5	August 1

[a]Number of experimental units
[b]No till hoe-drill Fabro seeder with side banding (2008) attached to Ford tractor (1998)
[c]R-Tech Thirty-foot sprayer (2024) attached to John Deere tractor (2010)
[d]Hand sprayed with 1.5m backpack sprayer
[e]R-Tech Alfalfa Omega self-propelled forage harvester (circa 1980)
[f]Displayed rates are actuals, not product
[g]Seed treated with Vibrance Quattro @ 325 ml/ac
[h]Seed treated with Terraxa F4

Forage & Livestock Research

Evaluation of early seeded multiple cuts winter cereals for livestock feed as a drought management strategy in Alberta.

Background:

The Lakeland region of Alberta experienced one of the driest years since 2002, leaving many agricultural producers scrambling for feed and water resources for livestock and harvesting crops that were yielding as low as 30% of normal yields. As a result, many pastures were overgrazed in the fall of 2021 as producers searched for ways of extending available feed sources. Overgrazed pastures tend to produce less the following year and require additional management strategies that include reduced grazing days to ensure long-term recovery.

Winter cereals seeded in fall have been shown to provide an early season grazing opportunity for livestock producers. This could allow for delayed turnout into stressed perennial pastures, thus providing more recovery time for those forages. A second option is to seed winter cereals in the spring, which prevents the cereals from entering a reproductive stage, meaning that these winter cereals would remain vegetative through summer and fall. Current research into spring seeded winter cereals has focused on seeding during typical seeding times when temperatures are over 10°C.

Recent research conducted by Agriculture and Agri-Food Canada in Lethbridge has shown that as long as soil temperatures are between 2-6°C, spring wheat can be sown and produce commendable yields when compared to spring wheat sown when soil temperatures are over 10°C. This research was replicated by seven Applied Research Associations (ARA) across Alberta over a four-year period and found similar results.

Seeding early during drought conditions could allow these cereals to utilize early spring moisture from snow melt that might not be available later in the spring. However, this concept has not yet been evaluated for use in winter cereals for forage production.

Objectives:

i. Provide unbiased, regional information regarding the establishment, dry matter yield and nutritional quality of early spring seeded winter cereals for production as livestock feed in Northeastern Alberta.
ii. To compare the establishment, dry matter yield and nutritional quality of early spring seeded winter cereals (soil temperatures between 2-6°C) with winter cereals seeded at soil temperatures above 10°C.
iii. To determine the additional forage yield achieved throughout the summer by seeding winter cereals early (soil temperatures between 2-6°C) in a simulated grazing environment.

Materials and Methods:

The trial was carried out at the LARA research farm (54° 18'N, 110° 37'W; NE 25-61-5-W4) in Fort Kent, Alberta. The project was seeded in a randomized complete block design (RCBD) with four replications of ten treatments. TAZA was seeded as check.

Table 3b-1. Treatment list for the project.

Winter Wheat	Winter Triticale	Fall Rye
AAC Coldfront	AB Provider	AC Hazlet
AAC Wildfire	AB Bronco	KWS Serafino
Pintail	Tadeus	SU Performer

Plots were 1.15 m wide by 7.5 m in length and harvested area was a minimum of 6 m squared. Varieties were seeded to a depth 1.5 inches due to dry soil conditions (please see Table 3b-2 for more details). The appropriate fertilizer was applied based on soil tests taken in the fall of 2024. Fertilizer was side banded at seeding. Hand weeding occurred when necessary to control any weeds that were not killed by the herbicide, such as grassy weeds. Harvest took place when each plot was at least 30 cm tall on average. Forage shorter than this could not efficiently be harvested with the forage harvester due to the nature of the flail. Regrowth on the plots was harvested throughout the summer when regrowth was at least 30 cm tall.

Table 3b-2. Timeline for project activities.

Activity	Date
Early Seeding (soil temperature at 2°C)	April 23, 2025
Late Seeding (soil temperatures at 12°C)	May 08, 2025
First Harvest (Early Seeded Block-Cut 1)	June 09, 2025
First Harvest (Late Seeded Block-Cut 1)	June 18, 2025
Final Harvest (Early Seeded Block-Cut 4)	Sep 10, 2025
Final Harvest (Late Seeded Block-Cut 3)	Sep 12, 2025

Results & Discussion:

Overall, the late-seeded treatment produced higher total yields than the early-seeded treatment. Even though some early-seeded varieties were harvested four times during the grazing season, compared with only three for the late-seeded varieties, the late-seeded plots still produced more biomass. The early-seeded treatment was planted on April 23, 2025, but the site did not receive rainfall until May 12, 2025. In contrast, the late-seeded treatment was planted on May 8, 2025, and received rain later that same week, giving the varieties in the late-seeded treatment a better opportunity for establishment and growth.

All winter wheat, winter triticale, and fall rye varieties in both the early- and late-seeded treatments were harvested at least twice, with some winter triticale and fall rye varieties producing additional cuts. The first cut in the early-seeded treatment was taken on June 09, 2025, six weeks after seeding, with the final harvest on September 10, 2025, approximately three months later. In the late-seeded treatment, the first cut occurred on June 18, 2025, five weeks after seeding, and the final cut was taken on September 12, 2025, also around three months after the first cut. Thus, both treatments provided approximately three months of productive forage and repeated grazing opportunities from June through September.

In the early-seeded treatment, the check variety TAZA produced the highest biomass at 1.59 $t\,ac^{-1}$, but in the late-seeded treatment, it yielded the lowest at 1.25 $t\,ac^{-1}$, while AB Bronco led the late-seeded yields with 2.00 $t\,ac^{-1}$. Detailed values for all varieties are presented in Tables 3b-3 and 4.

Table 3b-3. Total dry matter yield (ton/acre) by varieties in early seeded treatment.

Variety	Cut 1		Cut 2		Cut 3		Cut 4		Total
TAZA	0.28	bc	0.10	e	0.26	c	0.95	a	1.59
Tadeus	0.29	b	0.40	cd	0.20	c	0.25	b	1.14
AB Provider	0.47	a	0.60	a	-		-		1.07
AC Hazlet	0.22	bc	0.46	bcd	0.36	ab	-		1.04
KWS Serafino	0.13	c	0.54	ab	0.36	ab	-		1.03
SU Performer	0.19	bc	0.52	abc	0.27	bc	-		0.98
AB Bronco	0.29	b	0.16	e	0.42	a	-		0.87
Pintail	0.34	ab	0.39	cd	-		-		0.73
AAC Wildfire	0.33	ab	0.38	d	-		-		0.71
AAC Coldfront	0.29	b	0.36	d	-		-		0.65
Pr (>F)	0.01413*		7.271e-08***		0.001572**		0.008536**		

Note: Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'; -: No regrowth.

Table 3b-4. Total dry matter yield (ton/acre) by varieties in late seeded treatment.

Variety	Cut 1		Cut 2		Cut 3		Total
AB Bronco	0.57	a	1.43	a	-		2.00
Tadeus	0.54	a	0.78	c	0.65	a	1.97
KWS Serafino	0.15	cd	1.10	abc	0.52	b	1.77
AC Hazlet	0.25	cd	1.10	abc	0.39	cd	1.74
AB Provider	0.33	bc	1.38	ab	-		1.71
AAC Wildfire	0.28	bcd	1.33	ab	-		1.61
AAC Coldfront	0.46	ab	1.14	abc	-		1.60
SU Performer	0.13	d	1.02	bc	0.43	bc	1.58
Pintail	0.22	cd	1.32	ab	-		1.54
TAZA	0.20	cd	0.77	c	0.28	d	1.25
Pr(>F)	0.0002314***		0.01138*		7.901e-05***		

Note: Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'; - : No regrowth.

Crude protein (CP) levels in the early- and late-seeded treatments ranged from 13.21-16.6% and 12.95-19.67%, respectively, across all cuts (Table 3b-5). Both ranges are high enough to satisfy the nutritional requirements of lactating beef cows. For reference, dietary CP levels of 7%, 9%, and 11% are recommended to meet the nutrient requirements of beef cows during mid-gestation, late gestation, and lactation, respectively.

Similarly, total digestible nutrients (TDN), a common measure of feed energy, follow the 55-60-65 rule, where beef cows in mid-pregnancy, late pregnancy, and post-calving require 55%, 60%, and 65%, respectively. In both early- and late-seeded treatments, TDN was highest in the first two cuts and declined in subsequent cuts, ranging from 61.6-64.47% and 61.54-67.15%, respectively.

As expected, acid detergent fiber (ADF) and neutral detergent fiber (NDF) were lower in the first two cuts compared to subsequent cuts in both early- and late-seeded treatments. ADF ranged from 31.36-35.10% in the early-seeded and 27.92-35.12% in the late-seeded treatment, while NDF ranged from 47.24-56% and 46.61-55.56%, respectively (Table 3b-5).

Regarding other macro- and micro-nutrients (as detailed in the tables Table 3b-6 & 7 included in this report), the ranges observed in both early- and late-seeded treatments across all cuts met the nutritional requirements for various categories of beef cattle at different points during the growing season. The only exception was copper (Cu), which consistently remained below the recommended level of 10 mg $kg^{-1,}$ the amount required by most beef cattle.

Overall, there was a notable difference in yields between treatments, but forage quality remained high in both early- and late-seeded plots. The yield differences observed between early- and late-seeded treatments highlight the importance of snowmelt coupled with timely rainfall for early growth and establishment in a rain-fed system. In the previous year, soil moisture from snowmelt, combined with early-season rainfall, favored strong growth in the early-seeded treatment, resulting in higher overall biomass than the late-seeded plots. This year's results differed: although some soil moisture was available from snowmelt, limited rainfall in the first few weeks after seeding likely reduced early growth, which could explain why the late-seeded treatment ultimately produced higher biomass once rain occurred. This suggests that, while snowmelt provides some early moisture, timely rainfall shortly after seeding is the key factor determining crop success in rain-fed systems.

In conclusion, early seeding can take advantage of snowmelt and extend the grazing season, but carries risks if soils are cold or early-season rainfall is limited. Growers should base seeding decisions on local soil conditions, expected rainfall, and variety characteristics to optimize both yield and forage quality.

Table 3b-5. Average brix, crude protein (CP), total digestible nutrients (TDN), acid detergent fiber (ADF), and neutral detergent fiber (NDF) by harvest number and seeding date treatment.

	Early										Late									
	Brix		CP		TDN		ADF		NDF		Brix		CP		TDN		ADF		NDF	
	%		%		%		%		%		%		%		%		%		%	
Cut 1	4.95	c	16.6	a	64.47	a	31.36	b	47.24	c	5.45	a	19.67	a	67.15	a	27.92	a	46.61	c
Cut 2	5.85	c	14.61	b	64.2	a	31.71	b	51.19	b	4.33	ab	14.46	b	62.84	b	33.45	b	49.67	b
Cut 3	7.58	b	13.21	b	61.6	b	35.10	a	53.82	a	5.55	a	12.95	b	61.54	c	35.12	a	55.56	a
Cut 4	18.31	a	14.51	b	63.89	a	32.11	b	56.00	a	-		-		-		-		-	
Pr (>F)	<2.2e-16***				6.106e-05***		6.09e-05***		1.099e-07***				1.093e-13***		1.247e-15***		1.246e-15***		4.084e-10***	

Note: Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'; - : missing value

Table 3b-6. Average calcium (Ca), phosphorus (P), potassium (K), and magnesium (Mg) by harvest number and seeding date treatment.

	Early								Late							
	Ca		P		K		Mg		Ca		P		K		Mg	
	%		%		%		%		%		%		%		%	
Cut 1	0.38	a	0.27	ab	2.15	a	0.24	a	0.37	a	0.27	b	2.46	a	0.27	a
Cut 2	0.28	b	0.30	a	2.17	a	0.19	b	0.30	b	0.30	a	2.59	a	0.23	ab
Cut 3	0.27	b	0.31	a	2.12	ab	0.18	b	0.24	b	0.27	b	2.19	b	0.21	b
Cut 4	0.25	b	0.31	a	1.77	b	0.16	b	-		-		-		-	
Pr (>F)	1.438-05***		0.06539		0.1302		0.0001216***		0.0001677***		0.01731*		0.008461**		0.04434*	

Note: Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'; -: missing value.

Table 3b-7. Average copper (Cu) and zinc (Zn) by harvest number and seeding date treatment.

	Early				Late			
	Cu		Zn		Cu		Zn	
	mg kg^{-1}		mg kg^{-1}		mg kg^{-1}		mg kg^{-1}	
Cut 1	6.00	b	31.32	ab	6.11	a	29.87	a
Cut 2	5.56	b	26.92	b	5.38	b	25.62	b
Cut 3	6.12	b	31.90	ab	5.76	ab	24.25	b
Cut 4	7.60	a	37.37	a	-		-	
Pr (>F)	0.004959**		0.05009.		0.06684.		0.01824*	

Note: Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'; -: missing value, mg kg^{-1}: milligram per kilogram.

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Forage and Livestock Research

Integrated use of organic and inorganic fertilizers for forage barley production in Northeastern Alberta

Background:

Barley (*Hordeum vulgare* L.) is one of the most widely grown annual forage crops in Alberta and has better feed quality than oats, wheat, or triticale. Given its major role in cattle feed, producers rely heavily on intensive applications of synthetic fertilizers to increase barley yield and quality. Consequently, the cost of synthetic fertilizers constitutes a large proportion of the total variable cost of forage barley production in Alberta. Moreover, the overuse of synthetic or chemical inputs can pose a serious threat to environmental quality. In addition, injudicious application of synthetic fertilizers does not guarantee long-term productivity on many soils due to rapid soil quality degradation, highlighting the need for more sustainable alternatives.

Compared with inorganic fertilizers, organic fertilizers contribute to a more sustainable improvement in soil fertility; however, nutrients derived from organic sources may not be as readily available to plants. In this context, the combined use of organic and inorganic nutrient sources could be a feasible approach to improving and maintaining soil fertility compared to the use of either source alone. Partial substitution of inorganic fertilizers with organic nutrient sources may also help producers reduce the cost of forage barley production in Alberta. Numerous experimental studies from different regions of the world have shown that replacing up to 50% of inorganic fertilizers with organic amendments such as cattle manure, poultry manure, biochar, and compost can enhance crop yield and quality.

However, no in-depth study has examined the effects of this integrated nutrient management practice on forage barley production in northeastern Alberta. Therefore, the proposed study was conducted to fill this knowledge gap with the following principal objectives.

Objectives:

i. To evaluate the impact of soil incorporation of different organic fertilizers such as compost, biochar, cattle manure, and their combination with synthetic fertilizers on forage barley yield.
ii. To evaluate the impact of soil incorporation of different organic fertilizers such as compost, biochar, cattle manure, and their combination with synthetic fertilizers on forage barley quality.
iii. To compare the economic feasibility of organic versus inorganic nutrient sources in Northeastern Alberta.

Materials and Methods:

The trial was carried out at the LARA research farm (54° 18'N, 110° 37'W; NE 25-61-5-W4) in Fort Kent, Alberta, during the 2025 growing season. Before seeding, soil samples were taken to a depth of 0-6 and 6-12 inches to determine the nutrient level at Element Lab, Edmonton. AB Maximizer, one of the top-yielding forage barley cultivars in the Lakeland region, was utilized in this trial. Seeding rate (g/plot) was calculated using the formula: 1000 kernel weight*(desired plants/m2/1000) *plot area m2*(100/germination%) *1.05. The factor 1.05 was used during calculations to take care of seedling mortality. Desired plant density was set to 300 plants/m^2 for all plots.

Table 3c-1. Description of treatments applied in the present study.

Treatment	Application Rate
Control	No fertilizer
Synthetic fertilizer	133:24:13 lbs/acre NPK
Biochar	1 ton/acre
Compost	2.5 ton/acre
Manure	5 ton/acre
Synthetic fertilizer + biochar at 3:1 ratio	100:18:10 lb/acre NPK + 0.25 ton/acre
Synthetic fertilizer + compost at 3:1 ratio	100:18:10 lb/acre NPK + 0.63 ton/acre
Synthetic fertilizer + manure at 3:1 ratio	100:18:10 lb/acre NPK + 1.25 ton/acre
Synthetic fertilizer + biochar at 1:1 ratio	67:12:7 lb/acre NPK + 0.5 ton/acre
Synthetic fertilizer + compost at 1:1 ratio	67:12:7 lb/acre NPK + 1.25 ton/acre
Synthetic fertilizer + manure at 1:1 ratio	67:12:7 lb/acre NPK + 2.5 ton/acre

The experiment was planted in a randomized complete block design (RCBD) with four replications of each treatment. Organic fertilizers (Biochar, compost, and manure) were incorporated into the plots manually a day before seeding. Synthetic fertilizers were side banded during seeding. The LARA Fabro five-row seeder was used for seeding with 9" row spacing. Hand weeding occurred throughout the growing season to maintain the experimental area weed-free. The net plot size was 6.9 m2 (1.15 m by 6 m). Harvesting was done when barley grains were at the soft dough stage. Individual plots were harvested with the LARA Alfalfa-Omega self-propelled forage harvester. For each treatment plot, ~ 400 g of freshly chopped forage (sub-sample) was dried to a constant weight and sent to A & L Canada Laboratories Inc. for quality analysis. A second sub-sample of ~ 250 g of freshly harvested material was taken from each plot and dried to a constant weight for dry matter calculations. The data for forage DM yield and each of the quality parameters were subjected to analysis of variance (ANOVA), and means were subsequently compared by the least significant difference (LSD) test at ≤0.05 probability level using the agricolae (version 1.3-7) package of the R (4.3.2) software.

Results and Discussion:

The results indicated that the fertilizer treatments had a significant effect on forage DM yield. Among the four top-yielding treatments, three involved biochar applied either alone or in combination with inorganic fertilizer, while one used compost alone, and all outperformed the full recommended dose of synthetic fertilizer (133:24:13 lb ac^{-1} NPK). The highest forage biomass (4.00 t ac^{-1}) was obtained from 75% of the recommended inorganic fertilizer (100:18:10 lb ac^{-1} NPK) combined with 0.25 t ac^{-1} of biochar. Plots treated with the full recommended dose of compost (2.5 t ac^{-1}) produced the second-highest yield (3.8 t ac^{-1}), followed by plots receiving 50% of the recommended inorganic fertilizer (67:12:7 lb ac^{-1} NPK) + 0.5 t ac^{-1} of biochar, and plots that received the full recommended dose of biochar (1.0 t ac^{-1}), both yielding 3.62 t ac^{-1}.

The plots receiving full recommended inorganic fertilizer dose produced 3.58 t ac^{-1} of DM yield. All other treatments, including even the one that received the full recommended dose of manure (5 t ac^{-1}), produced lower yields than these top-performing treatments. As expected, the lowest yield (2.98 t ac^{-1}) was recorded in the control treatment, which received no fertilizer (Fig 3c-1).

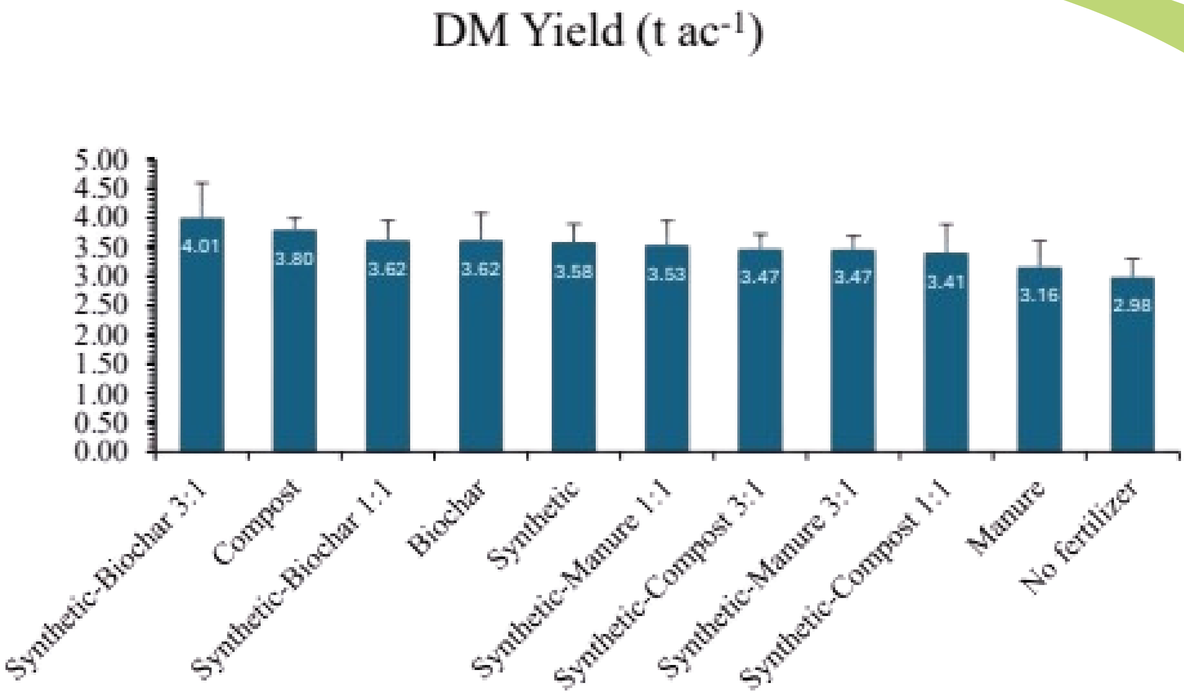

Figure 3c-1. Effects of different fertilizer treatments on forage barley dry matter (DM) yield.

In terms of forage quality, crude protein (CP) levels were also significantly influenced by the fertilizer treatments. Overall, CP content ranged from 10.42% to 11.70% across all treatments, which is sufficient to meet the protein requirements of beef cows during mid-gestation and lactation. For reference, dietary CP levels of 7%, 9%, and 11% are recommended for beef cattle during mid-gestation, late gestation, and lactation, respectively. Total digestible nutrients (TDN), which provide a simple estimate of feed energy, follow the 55-60-65 rule, where beef cows in mid-pregnancy, late pregnancy, and post-calving require 55%, 60%, and 65% TDN, respectively. All treatments produced TDN levels above 65%, indicating they would meet the energy requirements of beef cows after calving. The fiber fraction of forage barley was not significantly affected by the fertilizer treatments, as indicated by ADF and NDF values that ranged from 21.61 to 23.93% and 44.41 to 47.06%, respectively (3c-2). Most treatments also produced adequate amounts of essential macro-minerals, including calcium (Ca), magnesium (Mg), potassium (K), and sodium (Na) (Table 3c-3). However, none of the treatments supplied sufficient copper (Cu), zinc (Zn), or manganese (Mn) to fully meet the recommended requirements for beef cattle (Table 3C-4). Copper and zinc concentrations were below the recommended levels of 10 mg kg^{-1} and 30 mg kg^{-1}, respectively, while manganese concentrations were below 20 mg kg^{-1} across treatments. These results may indicate a potential risk of micronutrient deficiency, suggesting that free-choice mineral supplementation containing Cu, Zn, and Mn may be required for beef cattle consuming this forage.

Table 3c-2. Forage crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), and total digestible nutrients (TDN) for all fertilizer treatments.

Treatment	CP (% DM)		ADF (% DM)		NDF (% DM)		TDN (% DM)	
No Fertilizer	10.49	b	23.10	a	47.06	a	70.91	a
Synthetic Fertilizer	11.70	a	22.24	a	45.00	a	71.58	a
Biochar	10.53	b	22.58	a	44.45	a	71.31	a
Compost	10.69	b	21.61	a	44.41	a	72.10	a
Manure	10.42	b	22.17	a	44.53	a	71.63	a
Synthetic Fertilizer: Biochar 3:1	11.13	ab	23.62	a	46.30	a	70.50	a
Synthetic Fertilizer: Biochar 1:1	10.56	b	23.93	a	45.72	a	70.26	a
Synthetic Fertilizer: Compost 3:1	10.93	b	22.99	a	45.28	a	70.99	a
Synthetic Fertilizer: Compost 1:1	10.58	b	22.48	a	45.28	a	71.39	a
Synthetic Fertilizer: Manure 3:1	10.84	b	22.61	a	45.27	a	71.29	a
Synthetic Fertilizer: Manure 1:1	10.94	b	23.83	a	46.43	a	70.34	a
Pr (>F)	0.044*		0.662		0.846		0.661	

Note : Significance Codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Table 3c-3. Forage calcium (Ca), phosphorous (P), potassium (K), magnesium (Mg), and sodium (Na) content for all fertilizer treatments.

Treatment	Ca (% DM)		P (% DM)		K (% DM)		Mg (% DM)		Na (% DM)	
No Fertilizer	0.24	a	0.11	ab	1.11	a	0.18	a	0.25	abcd
Synthetic Fertilizer	0.25	a	0.11	ab	1.20	a	0.17	a	0.25	abcd
Biochar	0.22	a	0.10	b	1.10	a	0.17	a	0.22	d
Compost	0.27	a	0.12	a	1.17	a	0.17	a	0.23	bcd
Manure	0.24	a	0.11	ab	1.15	a	0.18	a	0.23	cd
Synthetic Fertilizer: Biochar 3:1	0.25	a	0.11	ab	1.19	a	0.17	a	0.28	abcd
Synthetic Fertilizer: Biochar 1:1	0.23	a	0.11	ab	1.14	a	0.18	a	0.29	a
Synthetic Fertilizer: Compost 3:1	0.23	a	0.11	ab	1.12	a	0.17	a	0.29	abc
Synthetic Fertilizer: Compost 1:1	0.24	a	0.10	b	1.21	a	0.18	a	0.26	abcd
Synthetic Fertilizer: Manure 3:1	0.24	a	0.11	ab	1.16	a	0.18	a	0.29	abcd
Synthetic Fertilizer: Manure 1:1	0.24	a	0.10	b	1.19	a	0.17	a	0.29	ab
Pr (>F)	0.918		0.617		0.796		0.984		0.182	

Note : Significance Codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Table 3c-4. Forage copper (Cu), zinc (Zn), iron (Fe), and manganese (Mn) content for all fertilizer treatments.

Treatment	Cu (mg kg^{-1})		Zn (mg kg^{-1})		Fe (mg kg^{-1})		Mn (mg kg^{-1})	
No Fertilizer	3.52	a	15.56	a	104.72	a	12.83	e
Synthetic Fertilizer	2.52	c	16.52	a	94.81	a	18.94	a
Biochar	3.09	abc	14.86	a	97.93	a	13.79	de
Compost	3.26	ab	16.69	a	102.16	a	15.43	bcde
Manure	3.19	ab	15.76	a	115.23	a	14.75	cde
Synthetic Fertilizer: Biochar 3:1	3.24	ab	15.56	a	102.41	a	18.86	a
Synthetic Fertilizer: Biochar 1:1	3.03	abc	15.76	a	114.53	a	16.67	abcd
Synthetic Fertilizer: Compost 3:1	3.19	ab	14.52	a	105.58	a	17.16	abc
Synthetic Fertilizer: Compost 1:1	3.24	ab	15.89	a	104.16	a	17.32	abc
Synthetic Fertilizer: Manure 3:1	2.83	bc	14.89	a	97.83	a	18.00	ab
Synthetic Fertilizer: Manure 1:1	2.89	bc	15.25	a	108.67	a	16.40	abcd
Pr (>F)	0.103		0.953		0.772		0.00445**	

Note: Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'; mg kg^{-1}: milligram per kilogram.

In conclusion, replacing 25% of the recommended inorganic fertilizer dose with 0.25 t ac^{-1} of biochar increased yield by approximately 10% compared to the full recommended inorganic fertilizer dose. However, the economic feasibility of this practice is questionable, as inorganic fertilizer costs around $100 per acre, whereas replacing 25% of the recommended dose with 0.25 t ac^{-1} of biochar may cost up to $475 per acre. Although biochar provides several benefits, including improved nutrient and moisture retention, its high cost makes this substitution economically impractical under the conditions of this study. By contrast, the second-highest yielding treatment, which received the full recommended dose of compost (2.5 t ac^{-1}), surpassed the yield of the full recommended dose of synthetic fertilizer by almost 6%. Applying 2.5 t ac^{-1} of compost costs approximately $150 per acre, making it a more cost-effective option. While compost is still more expensive than inorganic fertilizer, it offers additional advantages by improving soil fertility on a sustainable basis.

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Forage and Livestock Research

Performance Evaluation of Two-Row and Six-Row Forage Barley Mixtures

Background:

Many areas in Alberta have experienced some of the worst droughts in recent years. Severe and sustained drought is particularly stressful for beef cattle operations, which rely heavily on sufficient and timely rainfall to grow forage for their herds. Many perennial grass and legume forage species enter dormancy when faced with heat and water shortages. Therefore, selecting suitable drought-tolerant forage species is of prime importance during periods of frequent rainfall deficiencies. Spring cereals used as annual forages tend to perform better during hot and dry years when most perennial forages are less suited. Barley is one of the most common annual cereal forage crops in Alberta, offering better feed quality than oats, wheat, or triticale.

In 2024, a field trial was established at the LARA Research Farm in Fort Kent, Alberta, to investigate whether mixed cultivation of two-row and six-row barley in varietal seed mixtures could increase forage yield and nutritional quality compared to their component varieties grown in pure stands. The treatments included two two-row varieties (AB Maximizer and AAC Lariat) and two six-row varieties (AB Tofield and AB Standswell) grown both in pure stands and in twelve possible binary mixtures with 1:1, 1:3, and 3:1 seeding ratios. CDC Austenson was included as a check variety. The results indicated that mixed cultivation of a high-yielding two-row variety with a low-yielding six-row variety in a 3:1 seeding ratio could increase overall forage dry matter (DM) yield and nutritional quality, providing a diet capable of meeting the dietary requirements of different classes of beef cattle. However, as this study was conducted in a single environment during one growing season, the ability to draw broad conclusions was limited.

Further research is needed to explore how variety selection, seeding ratios, and trials under diverse environmental conditions affect the potential of these mixtures to stabilize forage productivity and quality over time.

Consequently, the same study was replicated in the 2025 growing season with the following principal objectives.

Objectives:

i. To determine the performance of two-row and six-row barley pure stands as well as their mixtures in three seeding ratios (1:1, 1:3, and 3:1) for forage dry matter (DM) yield.
ii. To determine the performance of two-row and six-row barley pure stands as well as their mixtures in three seeding ratios (1:1, 1:3, and 3:1) for forage nutritional quality.
iii. To assess the effect of weather conditions on forage DM yield and quality of two-row and six-row barley mixtures.

Materials and Methods:

The trial was carried out at the LARA research farm (54° 18'N, 110° 37'W; NE 25-61-5-W4) in Fort Kent, Alberta, during the 2025 growing season. Before seeding, soil samples were taken to a depth of 0-6 and 6-12 inches to determine the nutrient level at Element Lab, Edmonton. The treatments were comprised of 2 two-row (AB Maximizer and AAC Lariat) and 2 six-row (AB Tofield and AB Standswell) varieties in pure stands as well as in twelve possible binary mixtures of 1:1, 1:3, and 3:1 seedling ratio (Table 3d-1 & 2). CDC Austenson was seeded as a check variety. Seeding rate (g/plot) was calculated using the formula: 1000 kernel weight*(desired plants/m^2/1000) *plot area m^{2*} (100/germination%) *1.05. The factor 1.05 was used during calculations to take care of seedling mortality. Desired plant density was set to 300 plants/m^2 for all plots.

Table 3d-1. Variety list for the project.

Two-Row	Seeding Rate (lb/acre)	Six-Row	Seeding Rate (lb/acre)
AB Maximizer	149	AB Tofield	134
AAC Lariat	149	AB Standswell	111

Table 3d-2. Treatment list for the project.

Treatment	% Two-Row Inclusion	% Six-Row Inclusion
AAC Lariat	100	0
AB Maximizer	100	0
AB Standswell	0	100
AB Tofield	0	100
AAC Lariat-AB Standswell 1:1	50	50
AAC Lariat-AB Standswell 1:3	25	75
AAC Lariat-AB Standswell 3:1	75	25
AAC Lariat-AB Tofield 1:1	50	50
AAC Lariat-AB Tofield 1:3	25	75
AAC Lariat-AB Tofield 3:1	75	25
AB Maximizer-AB Standswell 1:1	50	50
AB Maximizer-AB Standswell 1:3	25	75
AB Maximizer-AB Standswell 3:1	75	25
AB Maximizer-AB Tofield 1:1	50	50
AB Maximizer-AB Tofield 1:3	25	75
AB Maximizer-AB Tofield 3:1	75	25

The experiment was planted in a randomized complete block design (RCBD) with four replications of 17 treatments. LARA Fabro five-row seeder was used for seeding with 9" row spacing. Plots were seeded to a depth of 1-1.5" depending on soil conditions and available moisture. As per the soil test, the recommended rate of fertilizers was side banded during seeding. Hand weeding occurred throughout the growing season to maintain the experimental area weed-free. The net plot size was 6.9 m^2 (1.15 m by 6 m). Harvesting was done when barley grains were at the soft dough stage. Individual plots were harvested with the LARA Alfalfa-Omega self-propelled forage harvester. For each treatment plot, ~ 400 g of freshly chopped forage (sub-sample) was dried to a constant weight and sent to A & L Canada Laboratories Inc. for quality analysis. A second sub-sample of ~ 250 g of freshly harvested material was taken from each plot and dried to a constant weight for dry matter calculations. The data for forage DM yield and each of the quality parameters were subjected to analysis of variance (ANOVA), and means were subsequently compared by the least significant difference (LSD) test at ≤0.05 probability level using the agricolae (version 1.3-7) package of the R (4.3.2) software.

Results & Discussion:

We did not observe any significant differences in yield among the treatments (Fig 3d-1 & Table 3d-3). Across all 16 treatments, including monocultures of two two-row and two six-row varieties as well as 12 binary mixtures established at 1:1, 1:3, and 3:1 seeding ratios, no treatment surpassed the check variety in yield. On average, the check variety CDC Austenson produced 3.01 t ac^{-1} of forage DM yield. The two-row varieties grown in monoculture, as well as their mixtures with six-row varieties at a 3:1 seeding ratio, produced yields close to, but slightly below, those of the check variety CDC Austenson. In contrast, six-row varieties grown in monoculture, particularly AB Standswell and AB Tofield, produced the lowest forage biomass (Fig 3d-1). This year represented the second year of the three-year study, and growing conditions were much drier than last year, leading most varieties to yield 25-30% below their full potential. In the first year (2024), which was wetter than the second year (2025), certain binary mixtures, particularly combinations of two-row and six-row varieties at a 3:1 seeding ratio, outperformed both monocultures and the check variety.

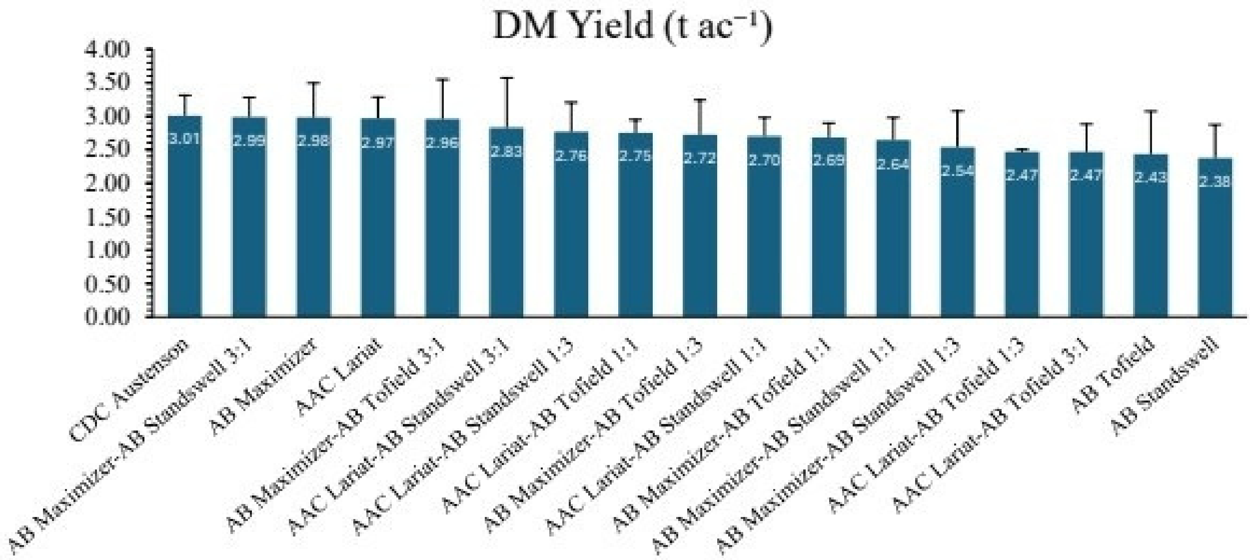

Figure 3d-1. Forage dry matter (DM) yield for variety mixtures and monocultures.

As a general guideline, dietary crude protein (CP) levels of 7%, 9%, and 11% are recommended to meet the nutrient requirements of beef cows during mid-gestation, late gestation, and lactation, respectively. All monocultures and mixtures evaluated in this study contained CP levels of approximately 11% or higher, which is sufficient to meet the requirements of lactating beef cattle. Similarly, total digestible nutrients (TDN), the simplest method for estimating feed energy, follow the 55-60-65 rule, where beef cows in mid-pregnancy, late pregnancy, and post-calving require 55%, 60%, and 65%, respectively. Our results showed that all monocultures and mixtures contained more than 65% TDN, indicating they would meet the energy demands of lactating beef cattle. Overall, most monocultures and mixtures contained adequate levels of magnesium (Mg; 0.19–0.3%), potassium (K; 0.78–0.91%), sodium (Na; 0.23– 0.37%), sulfur (S; 0.12–0.15%), iron (Fe; 113.83–191.77 mg kg^{-1}), and manganese (Mn; 35.76–59.98 mg kg^{-1}) to meet the requirements of beef cows during gestation and lactation (Table 3d-4 & 5). However, none of the monocultures or mixtures contained sufficient copper (Cu) or zinc (Zn) to meet the recommended requirements for beef cattle, which are 10 mg kg^{-1} for Cu and 30 mg kg^{-1} for Zn. Therefore, free-choice mineral supplementation, particularly of Cu and Zn, would be necessary when these feeds are included in beef cattle diets.

Table 3d-3. Forage dry matter (DM) yield, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and total detergent fiber (TDN) for all cropping treatments.

Treatment	DM Yield (% of Check)		CP (% DM)		NDF (% DM)		ADF (% DM)		TDN (% DM)	
CDC Austenson	100	a	11.60	bcd	47.10	a	22.69	ab	71.23	bc
AB Maximizer – AB Standswell 3:1	99	ab	11.67	bc	45.66	ab	21.63	abc	72.10	abc
AB Maximizer	99	ab	11.61	bcd	45.40	ab	21.61	abc	72.10	abc
AAC Lariat	99	ab	10.89	d	45.62	ab	22.01	abc	71.75	abc
AB Maximizer – AB Tofield 3:1	98	ab	11.90	abc	44.84	ab	21.26	abc	72.34	abc
AAC Lariat – AB Standswell 3:1	94	ab	11.29	cd	46.38	a	22.84	ab	71.10	bc
AAC Lariat – AB Standswell 1:3	92	ab	11.29	cd	44.59	ab	20.90	bc	72.62	ab
AAC Lariat – AB Tofield 1:1	91	ab	11.66	bcd	45.10	ab	22.17	abc	71.63	abc
AB Maximizer – AB Tofield 1:3	91	ab	11.52	bcd	43.71	ab	21.17	abc	72.41	abc
AAC Lariat – AB Standswell 1:1	90	ab	11.23	cd	46.56	a	22.74	ab	71.19	bc
AB Maximizer – AB Tofield 1:1	89	ab	11.88	abc	46.31	ab	22.41	abc	71.45	abc
AB Maximizer – AB Standswell 1:1	88	ab	11.77	abc	45.64	ab	21.90	abc	71.83	abc
AB Maximizer – AB Standswell 1:3	84	ab	11.50	bcd	46.96	a	22.78	ab	71.15	bc
AAC Lariat – AB Tofield 1:3	82	ab	11.38	bcd	46.53	a	23.42	a	70.65	c
AAC Lariat- AB Tofield 3:1	82	ab	11.44	bcd	45.40	ab	22.24	abc	71.58	abc
AB Tofield	81	ab	12.16	ab	45.89	ab	22.68	ab	71.23	bc
AB Standswell	79	b	12.43	a	42.37	b	20.44	c	72.98	a
Pr (>F)	0.5638.		0.0614.		0.559		0.405		0.404	

Note : Significance Codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Table 3d-4. Forage calcium (Ca), phosphorous (P), potassium (K), magnesium (Mg), and sodium (Na) content for all cropping treatments.

Treatment	Ca (% DM)		P (% DM)		K (% DM)		Mg (% DM)		Na (% DM)	
CDC Austenson	0.34	abcd	0.10	abc	0.87	a	0.22	defg	0.23	bc
AB Maximizer – AB Standswell 3:1	0.28	d	0.10	bc	0.81	a	0.21	fg	0.23	c
AB Maximizer	0.27	d	0.10	abc	0.87	a	0.19	g	0.25	abc
AAC Lariat	0.31	bcd	0.12	a	0.79	a	0.26	abcd	0.29	abc
AB Maximizer – AB Tofield 3:1	0.27	d	0.11	ab	0.79	a	0.23	cdefg	0.29	abc
AAC Lariat – AB Standswell 3:1	0.40	abc	0.10	bc	0.87	a	0.26	abcde	0.26	abc
AAC Lariat – AB Standswell 1:3	0.31	bcd	0.10	abc	0.87	a	0.25	abcdef	0.29	abc
AAC Lariat – AB Tofield 1:1	0.35	abcd	0.10	bc	0.85	a	0.25	abcde	0.26	abc
AB Maximizer – AB Tofield 1:3	0.31	abcd	0.10	bc	0.82	a	0.28	ab	0.35	a
AAC Lariat – AB Standswell 1:1	0.42	a	0.10	bc	0.90	a	0.25	bcdef	0.24	bc
AB Maximizer – AB Tofield 1:1	0.35	abcd	0.11	abc	0.89	a	0.30	a	0.37	a
AB Maximizer – AB Standswell 1:1	0.29	cd	0.11	ab	0.91	a	0.21	fg	0.25	abc
AB Maximizer – AB Standswell 1:3	0.34	abcd	0.10	bc	0.78	a	0.22	efg	0.24	bc
AAC Lariat – AB Tofield 1:3	0.40	ab	0.09	c	0.90	a	0.29	ab	0.32	abc
AAC Lariat – AB Tofield 3:1	0.34	abcd	0.10	abc	0.89	a	0.25	abcdef	0.25	abc
AB Tofield	0.39	abc	0.09	c	0.79	a	0.27	abc	0.33	ab
AB Standswell	0.33	abcd	0.11	ab	0.88	a	0.24	bcdef	0.26	abc
Pr (>F)	0.112		0.0934.		0.962		0.00147**		0.346	

Note : Significance Codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Table 3d-5. Forage copper (Cu), zinc (Zn), iron (Fe), and manganese (Mn) content for all cropping treatments

Treatment	Cu (mg kg-1)		Zn (mg kg-1)		Fe (mg kg-1)		Mn (mg kg-1)	
CDC Austenson	3.04	ab	18.43	ab	160.70	abcd	41.08	cde
AB Maximizer – AB Standswell 3:1	2.77	abc	17.91	ab	161.36	abcd	39.75	de
AB Maximizer	2.70	bc	15.48	b	148.10	abcd	35.76	e
AAC Lariat	2.72	bc	18.22	ab	140.03	bcd	39.02	de
AB Maximizer – AB Tofield 3:1	2.50	bc	18.11	ab	160.78	abcd	40.40	cde
AAC Lariat – AB Standswell 3:1	2.63	bc	19.78	ab	146.17	abcd	50.35	abcd
AAC Lariat – AB Standswell 1:3	2.65	bc	20.41	ab	132.90	cd	42.19	cde
AAC Lariat – AB Tofield 1:1	2.44	bc	20.25	ab	113.83	d	56.11	ab
AB Maximizer – AB Tofield 1:3	2.64	bc	17.97	ab	153.23	abcd	44.57	bcde
AAC Lariat – AB Standswell 1:1	2.60	bc	20.68	a	168.29	abc	48.59	abcd
AB Maximizer – AB Tofield 1:1	2.87	abc	17.14	ab	150.47	abcd	45.26	abcde
AB Maximizer – AB Standswell 1:1	3.31	a	17.90	ab	191.77	a	39.90	cde
AB Maximizer – AB Standswell 1:3	2.76	abc	19.34	ab	162.97	abcd	44.54	bcde
AAC Lariat – AB Tofield 1:3	3.03	abc	18.08	ab	177.35	abc	50.95	abcd
AAC Lariat – AB Tofield 3:1	2.40	c	19.37	ab	145.45	abcd	47.54	abcde
AB Tofield	2.60	bc	18.59	ab	183.99	ab	59.98	a
AB Standswell	2.65	bc	20.42	ab	146.98	abcd	52.22	abc
Pr (>F)	0.365		0.93		0.342		0.0303*	

Note: Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'; mg kg-1: milligram per kilogram.

We also performed a direct comparison of the two-row and six-row varieties used in this study. Overall, two-row varieties yielded approximately 20% more than six-row varieties (Table 3d-6). On average, two-row varieties produced 2.98 t ac^{-1} of forage DM, whereas six-row varieties produced 2.40 t ac^{-1}. In terms of forage quality, six-row varieties had higher CP (12.30%) and TDN (72.11%) than two-row varieties, which contained 11.25% CP and 71.23% TDN (Table 3d-6); almost similar trends were observed last year.

Table 3d-6. Mean dry matter (DM) yield, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and total digestible nutrients (TDN) for two-row and six-row varieties used in the present study.

Type	DM Yield (tons/ac)		CP (% DM)		ADF (% DM)		NDF (% DM)		TDN (% DM)	
Check	3.01	a	11.60	ab	22.69	a	47.09	a	71.23	a
Two-Row	2.98	a	11.25	b	21.81	a	45.51	a	71.91	a
Six-Row	2.40	b	12.30	a	21.56	a	44.13	a	72.11	a
Pr (>F)	0.002148**		0.009106**		0.5471		0.2191		0.5465	

Note: Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Table 3d-7. Mean calcium (Ca), phosphorus (P), potassium (K), magnesium (Mg), and sodium (Na) content for two-row and six-row varieties used in the present study.

Type	Ca (%DM)		P (% DM)		K (% DM)		Mg (% DM)		Na (% DM)	
Check	0.34	a	0.10	a	0.87	a	0.22	a	0.23	a
Two-Row	0.29	a	0.11	a	0.83	a	0.23	a	0.27	a
Six-Row	0.36	a	0.10	a	0.83	a	0.25	a	0.29	a
Pr (>F)	0.1268		0.3307		0.8725		0.2217		0.3934	

Note: Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Table 3d-8. Mean copper (Cu), zinc (Zn), iron (Fe), and manganese (Mn) content for two-row and six-row varieties used in the present study.

Type	Cu (mg kg^{-1})		Zn (mg kg^{-1})		Fe (mg kg^{-1})		Mn (mg kg^{-1})	
Check	3.04	a	18.44	a	160.70	a	41.08	ab
Two-Row	2.71	a	16.85	a	144.10	a	37.39	b
Six-Row	2.62	a	19.20	a	165.48	a	55.54	a
Pr (>F)	0.1741		0.2887		0.494		0.001558**	

Note: Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'; mg kg-1: milligram per kilogram.

In conclusion, this study demonstrates that two-row barley varieties generally produce higher forage DM yields than six-row varieties, while six-row varieties may provide slightly higher forage quality in terms of CP and TDN. Mixing and planting two-row and six-row barley at a 3:1 ratio allows farmers to capture both high yield and improved forage quality, benefits that may be lost when planting either variety in monoculture.

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Forage and Livestock Research

Copper enrichment in fodder wheat, barley and oats – An option to improve cattle productivity

Background:

Many cattle consuming locally produced forages are susceptible to copper (Cu) deficiency in Alberta. A significant challenge for livestock producers in several parts of the province, including the Lakeland region, is that Cu concentrations in both soils and locally produced forages (e.g., hay and silage) are too low to meet animal health and performance targets. Cows experiencing insufficient Cu supply have low conception rates and often suffer weight loss unless Cu supplementation is provided.

Under average conditions, beef cattle require a daily intake of approximately 10 mg kg^{-1} Cu in ration dry matter. However, if cattle are exposed to high levels of sulfates in drinking water, this requirement increases to 20–25 ppm (BCRC, 2017). Cu supplementation via injections or free-choice mineral kits can help correct deficiencies in cattle but may not be sufficient when animals are fed Cu-deficient forages grown on soils with low Cu levels.

Therefore, it is important to note that the Cu content of forage crops grown in the Lakeland region of Alberta is generally below the established levels required for cattle production, although molybdenum (Mo) levels are very low (data retrieved from feed analysis reports of MD of Bonnyville, County of St. Paul, and Smoky Lake County). In this context, there is a critical need to increase the Cu content of locally grown forages, particularly wheat (*Triticum aestivum* L.), barley (*Hordeum vulgare* L.), and oats (*Avena sativa* L.), which are the most susceptible to Cu deficiency.

Enhancing the Cu content of forage crops through foliar-applied Cu amendments presents a promising and cost-effective approach to improving cattle health and productivity. However, this technique has not been widely adopted in the region due to limited technical information on foliar Cu fertilization of forage crops. Consequently, a field investigation was conducted at the LARA Research Farm during the 2025 growing season to assess the response of fodder wheat, barley, and oats grown on grey-wooded soil to varying levels of foliar Cu fertilizer, with the following principal objectives:

Objectives:

i. To provide regional and unbiased information regarding the effect of different rates of copper sulfate (CuSO4) foliar application on forage dry matter yield of wheat, barley and oats.
ii. To investigate the effect of different rates of CuSO4 foliar application on forage nutritive value of wheat, barley and oats.
iii. To increase Cu content of forage wheat, barley and oats to improve animal performance and productivity.
iv. To determine any antagonism between Cu, zinc (Zn) and iron (Fe) concentration.
v. To determine the adequate concentration of Cu foliar spray to correct Cu deficiency without leaf bronzing in forage wheat, barley and oats when grown in a grey-wooded soil.

Materials and Methods:

The trial was conducted at the LARA Research Farm (54°18′N, 110°37′W; NE 25-61-5-W4) in Fort Kent, Alberta, during the 2025 growing season. Prior to seeding, soil samples were collected from depths of 0–6 and 6–12 inches to determine nutrient levels at Element Lab, Edmonton. Seeding rate (g/plot) was calculated using the formula: 1000 kernel weight*(desired plants/m2/1000) *plot area m2*(100/germination%) *1.05.

The factor 1.05 was used during calculations to take care of seedling mortality. The desired plant density was set at 300 plants/m² for barley and oats, and 350 plants/m² for wheat.

The experiment comprised 3 cereal species (wheat, cv. Alotta; barley, cv. AB Maximizer; and oats cv. CDC Endure) and 4 Cu spray concentrations, representing a total of (3x4) 12 treatments. The Cu was applied in the sulfate form (CuSO4.5H_2O; 25% Cu).

The Cu treatments (T) are as follows:

Treatment	Product (CuSO4.5H_2O)	Water Volume
Control	0	0
0.1 lb Cu/acre	0.4 lb/acre	10 gallons per acre
0.3 lb Cu/acre	1.2 lb/acre	10 gallons per acre.
0.5 lb Cu/acre	2.0 lb/acre	10 gallons per acre.

The experiment was planted in a randomized complete block design (RCBD) with four replications of 12 treatments. Seeding was carried out using a LARA Fabro five-row seeder with 9" row spacing. Plots were seeded to a depth of 1-1.5" depending on soil conditions and available moisture. Based on soil test results, the recommended rate of fertilizers was side banded during seeding. All Cu treatments were mixed with water and applied at a rate of 10 gallons (37.85 liters) of water per acre. Spraying was carried out when each crop reached the booting stage, using a backpack sprayer under windless conditions. Hand weeding occurred throughout the growing season to maintain the experimental area weed free. The net plot size was 6.9 m^2 (1.15 m by 6 m). Harvesting was carried out when barley grains reached the soft dough stage, and wheat and oats reached the late milk stage. Individual plots were harvested with LARA Alfalfa-Omega self-propelled forage harvester. For each treatment plot, approximately 400 g of chopped forage (subsample) was dried to a constant weight and submitted to A & L Canada Laboratories Inc. for quality analysis.

A second subsample of approximately 250 g of freshly harvested material was collected from each plot and dried to a constant weight for dry matter calculations. The data for forage DM yield and each of the quality parameters were subjected to analysis of variance (ANOVA) and means were subsequently compared by the least significant difference (LSD) test at ≤0.05 probability level using the agricolae (version 1.3-7) package of the R (4.3.2) software.

Oats

Foliar Cu applications significantly increased the Cu content of silage oats by up to approximately 174% relative to the control. As expected, silage Cu concentrations increased linearly with increasing foliar Cu rates. The highest Cu application rate (0.5 lb Cu ac^{-1}) resulted in a Cu concentration of 8.04 mg kg^{-1}, whereas the control plots (no Cu application) contained 2.93 mg kg^{-1}. Intermediate application rates of 0.1 and 0.3 lb Cu ac^{-1} produced Cu concentrations of approximately 3.61 and 6.51 mg kg^{-1}, respectively (Fig 3e-1).

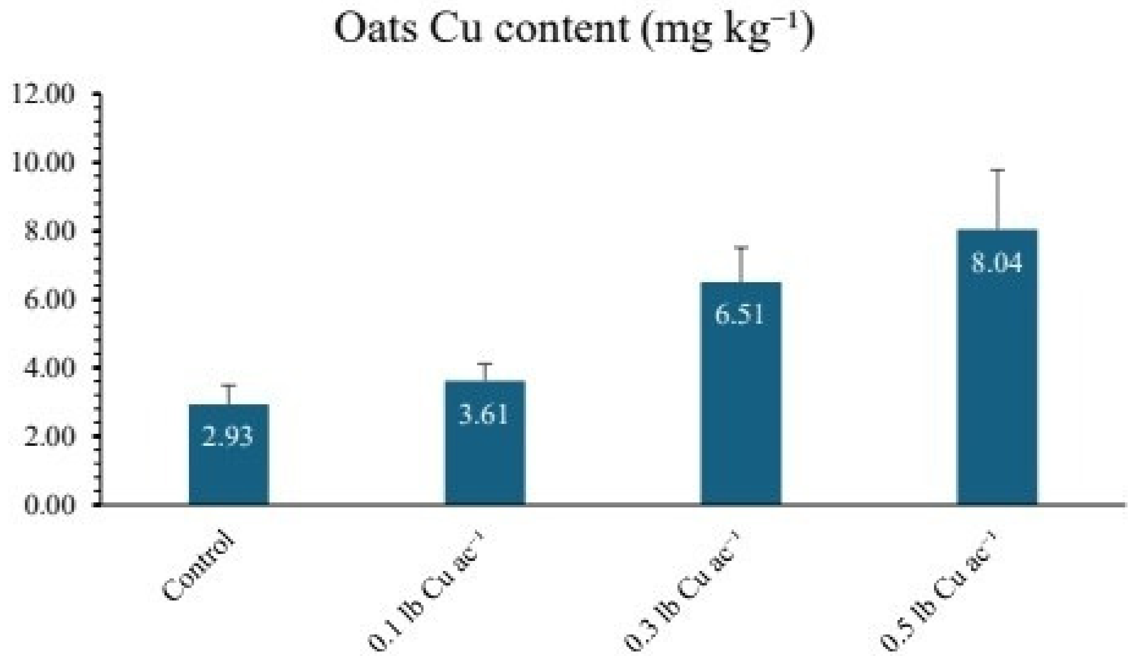

Figure 3e-1. Oats Cu content as influenced by different foliar Cu application rates.

Except for Cu, most silage quality attributes were not significantly influenced by the different Cu treatments applied; however, the values obtained remained within adequate ranges to meet the nutritional requirements of the various beef cattle categories. In Cu-treated plots, crude protein (CP) ranged from 12.4% to 12.7%, while total digestible nutrients (TDN) ranged from 65.71% to 66.19%, both of which are sufficient to meet the requirements of lactating beef cattle. Compared with the control, Cu-treated plots showed slightly higher ADF and NDF values; however, these differences were not statistically significant. On average, the control plots contained 28.81% ADF and 51.53% NDF, whereas in Cu-treated plots, ADF and NDF ranged from 29.16% to 29.76% and 51.82% to 52.72%, respectively (Table 3e-1).

It is well established that antagonistic interactions can occur among Zn, Cu, Fe, and Mn. In this study, Zn levels were below the range considered adequate (~30 mg kg^{-1}) for beef cattle; however, this was not due to Cu application, as the untreated control plots also showed low Zn (21.3 mg kg^{-1}). Cu treatments did not cause statistically significant changes in the Fe, Mn, or Zn content of the silage (Table 3e-3). Untreated control plots contained, on average, 21.3 mg kg^{-1} Zn, 127.85 mg kg^{-1} Fe, and 66.28 mg kg^{-1} Mn, whereas Cu-treated plots had Zn, Fe, and Mn concentrations ranging from 19.8 to 22.35 mg kg^{-1}, 130.01 to 153.27 mg kg^{-1}, and 58.46 to 68.75 mg kg^{-1}, respectively, indicating that foliar Cu applications.

In terms of forage DM yield, no significant differences were observed between the Cu-treated plots and the untreated control plots, indicating that foliar Cu fertilization @ 0.1-0.5 lb Cu ac^{-1} can enhance the Cu concentration of silage oats (by up to 174%) without adversely affecting forage productivity. The control plots produced an average forage DM yield of 1.96 t ac^{-1}, whereas yields in the Cu-treated plots ranged from 1.81 to 1.85 t ac^{-1}.

Among the Cu-treated plots, the 0.5 lb Cu ac^{-1} treatment resulted in the numerically highest yield, while the 0.3 lb Cu ac^{-1} treatment produced the lowest (Table 3e-1).

Table 3e-1. Forage dry matter (DM) yield, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and total digestible nutrients (TDN) of fodder oat under different Cu treatments.

Treatment	DM Yield (t/ac)		CP (% DM)		NDF (% DM)		ADF (% DM)		TDN (% DM)	
Control	1.96	a	12.14	a	51.53	a	28.81	a	66.46	a
0.1 lb Cu/acre	1.82	a	12.70	a	52.72	a	29.26	a	66.11	a
0.3 lb Cu/acre	1.81	a	12.40	a	52.57	a	29.16	a	66.19	a
0.5 lb Cu/acre	1.85	a	12.63	a	51.82	a	29.76	a	65.71	a
Pr (>F)	0.7634		0.65		0.907		0.885		0.884	

Note : Significance Codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Table 3e-2. Forage calcium (Ca), phosphorous (P), potassium (K), magnesium (Mg), and sodium (Na) content of fodder oat under different Cu treatments.

Treatment	Ca (% DM)		P (% DM)		K (% DM)		Mg (% DM)		Na (% DM)	
Control	0.39	a	0.14	a	1.15	a	0.29	a	0.57	a
0.1 lb Cu/acre	0.37	a	0.15	a	1.18	a	0.27	a	0.54	a
0.3 lb Cu/acre	0.37	a	0.15	a	1.25	a	0.28	a	0.51	a
0.5 lb Cu/acre	0.33	a	0.15	a	1.09	a	0.24	a	0.51	a
Pr (>F)	0.387		0.964		0.388		0.21		0.84	

Note : Significance Codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Table 3e-3. Forage copper (Cu), zinc (Zn), iron (Fe), and manganese (Mn) content of fodder oat under different Cu treatments.

Treatment	Cu (mg kg^{-1})		Zn (mg kg^{-1})		Fe (mg kg^{-1})		Mn (mg kg^{-1})	
Control	2.93	b	21.23	a	127.85	a	66.28	a
0.1 lb Cu/acre	3.61	b	21.24	a	153.27	a	60.43	a
0.3 lb Cu/acre	6.51	a	22.35	a	144.80	a	68.75	a
0.5 lb Cu/acre	8.04	a	19.80	a	130.01	a	58.46	a
Pr (>F)	5.24e-05***		0.67		0.544		0.352	

Note: Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'; mg kg^{-1}: milligram per kilogram.

Wheat

The experiment demonstrated a significant increase in Cu content (71% higher than the control) in plots that received foliar Cu fertilization. The highest average Cu concentration (7.08 mg kg^{-1}) was recorded with CuSO4 applied @ 0.5 lb Cu ac^{-1}, while the lowest value (4.15 mg kg^{-1}) was observed in the untreated control plots. Foliar applications of 0.3 and 0.1 lb Cu ac^{-1} resulted in intermediate Cu concentrations of 6.70 and 5.37 mg kg^{-1}, respectively (Fig 3e-2).

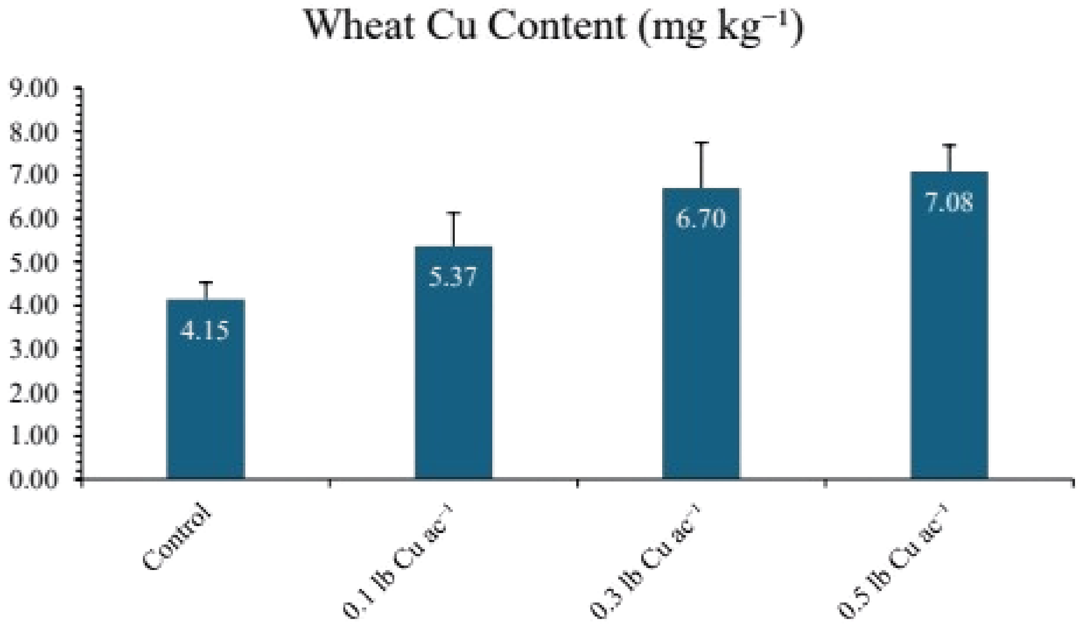

Figure 3e-2. Wheat Cu content as influenced by different foliar Cu application rates.

With regard to wheat silage quality, apart from Cu, none of the other attributes examined were significantly affected by foliar Cu fertilization (Table 3e-4, 5 & 6); similar trends were observed in silage oats. In the plots sprayed with CuSO4, CP and TDN levels ranged from 10.81% to 11.10% and 67.15% to 68.82%, respectively, both of which are sufficient to meet the nutritional requirements of lactating beef cattle. Notably, the highest Cu application rate resulted in numerically lower ADF and NDF values; however, these differences were not statistically significant.

Concerning Zn, Fe, and Mn contents, although Cu applications can potentially negatively affect these micronutrients, the concentrations measured in the Cu-treated plots did not decline drastically. In these plots, Zn, Fe, and Mn concentrations ranged from 18.15-20.24, 120.04-129.58, and 50.69-55.78 mg kg^{-1}, respectively. In the control plots, Zn, Fe, and Mn concentrations averaged 21.04, 126.56, and 53.73 mg kg^{-1}, respectively (Table 3e-6).

Regarding dry matter yields, foliar application of CuSO4 did not result in significant differences compared to the control. Across treatments, DM yield ranged from 3.49 to 3.60 t ac^{-1}, with the highest yield observed at 0.3 lb Cu ac^{-1} and the lowest at 0.5 lb Cu ac^{-1} (3e-4).

Table 3e-4. Forage dry matter (DM) yield, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and total digestible nutrients (TDN) of fodder wheat under different Cu treatments.

Treatment	DM Yield (t/ac)		CP (% DM)		NDF (% DM)		ADF (% DM)		TDN (% DM)	
Control	3.50	a	11.30	a	50.75	ab	26.37	a	68.36	a
0.1 lb Cu/acre	3.50	a	10.81	a	51.30	a	27.93	a	67.15	a
0.3 lb Cu/acre	3.60	a	11.10	a	50.30	ab	26.83	a	68.00	a
0.5 lb Cu/acre	3.49	a	11.10	a	47.87	b	25.79	a	68.82	a
Pr (>F)	0.2473		0.885		0.182		0.363		0.362	

Note : Significance Codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Table 3e-5. Forage calcium (Ca), phosphorous (P), potassium (K), magnesium (Mg), and sodium (Na) content of fodder wheat under different Cu treatments.

Treatment	Ca (% DM)		P (% DM)		K (% DM)		Mg (% DM)		Na (% DM)	
Control	0.18	a	0.14	a	0.85	a	0.23	a	0.01	a
0.1 lb Cu/acre	0.19	a	0.15	a	0.90	a	0.23	a	0.01	a
0.3 lb Cu/acre	0.20	a	0.15	a	0.90	a	0.23	a	0.01	a
0.5 lb Cu/acre	0.17	a	0.15	a	0.86	a	0.22	a	0.01	a
Pr (>F)	0.216		0.913		0.214		0.746		0.325	

Note : Significance Codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'

Table 3e-6. Forage copper (Cu), zinc (Zn), iron (Fe), and manganese (Mn) content of fodder wheat under different Cu treatments.

Treatment	Cu (mg kg^{-1})		Zn (mg kg^{-1})		Fe (mg kg^{-1})		Mn (mg kg^{-1})	
Control	4.15	c	21.04	a	126.56	a	53.73	a
0.1 lb Cu/acre	5.37	b	18.15	a	129.58	a	50.87	a
0.3 lb Cu/acre	6.70	a	19.90	a	126.61	a	55.78	a
0.5 lb Cu/acre	7.08	a	20.24	a	120.04	a	50.69	a
Pr (>F)	0.000401***		0.614		0.83		0.709	

Note: Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'; mg kg^{-1}: milligram per kilogram.

Barley

Despite the absence of a statistically significant overall treatment effect, foliar CuSO4 application resulted in a nearly twofold (approximately 93%) numerical increase in silage barley Cu concentration compared with the untreated control. The highest mean Cu concentration (6.65 mg kg^{-1}) was recorded with CuSO4 applied @ 0.3 lb Cu ac^{-1}. In contrast, the control plots, which did not receive any Cu application, had the lowest mean Cu content (3.45 mg kg^{-1}), highlighting the effect of foliar Cu fertilization on increasing Cu levels in the forage. Foliar applications of 0.5 and 0.1 lb Cu ac^{-1} resulted in mid-range Cu concentrations of 6.56 and 4.75 mg kg^{-1}, respectively (Table 3e-3).

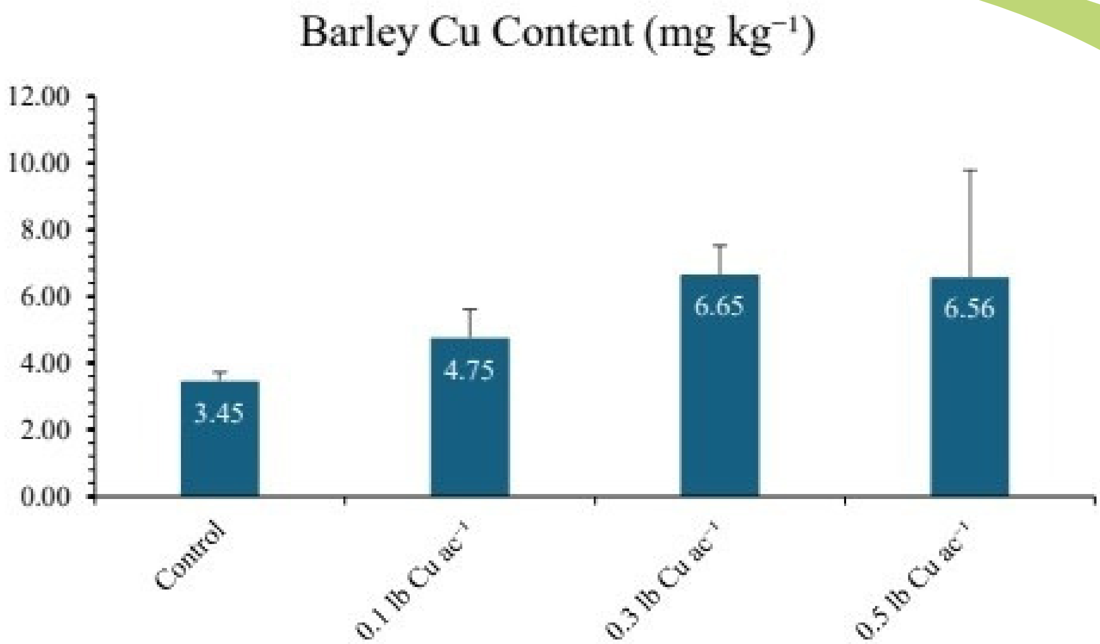

Figure 3e-3. Barley Cu content as influenced by different foliar Cu application rates.

In contrast to silage wheat and oats, the TDN level of silage barley was significantly influenced by foliar Cu treatments. The highest mean TDN (70.92%) was observed in the control plots, while Cu-treated plots showed slightly lower values ranging from 69.06% to 70.84%; these levels remain sufficient to meet the energy requirements of lactating beef cattle. Foliar Cu applications also significantly influenced fibre content, as reflected in ADF and NDF values. Control plots recorded the lowest ADF (23.08%) and NDF (45.65%), whereas Cu-treated plots showed slightly higher values (ADF 23.18–25.47% and NDF 46.65–49.57%), indicating that foliar Cu treatments increase the fiber fractions in forage barley (Table 3e-7).

As mentioned earlier, there was a possibility of observing antagonistic interactions among Cu, Zn, Fe, and Mn. However, none of the Cu application rates significantly reduced Zn, Fe, or Mn levels. On average, the control plots contained 17.8 mg kg^{-1} Zn, 95.81 mg kg^{-1} Fe, and 35.13 mg kg^{-1} Mn. In Cu-treated plots, Zn, Fe, and Mn concentrations ranged from 17.00 to 17.72 mg kg^{-1}, 86.23 to 95.98 mg kg^{-1}, and 30.75 to 32.89 mg kg^{-1}, respectively, indicating that foliar Cu applications did not adversely affect the levels of these micronutrients (Table 3e-9).

Similar to silage oats and wheat, foliar applications of Cu did not significantly affect the DM yield of silage barley. The highest forage biomass (2.96 t ac^{-1}) was observed with CuSO4 applied @ 0.1 lb Cu per acre, while the lowest DM yield (2.84 t ac^{-1}) occurred with 0.5 lb Cu ac^{-1}. The 0.3 lb Cu ac^{-1} treatment produced the second highest yield (2.89 t ac^{-1}), and the untreated control plots produced the second-lowest yield (2.86 t ac^{-1}). Overall, these results indicate that foliar Cu applications had only minor effects on forage DM yield (Table 3e-7).

Table 3e-7. Forage dry matter (DM) yield, crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), and total digestible nutrients (TDN) of fodder barley under different Cu treatments.

Treatment	DM Yield (t/ac)		CP (% DM)		NDF (% DM)		ADF (% DM)		TDN (% DM)	
Control	2.86	a	12.74	a	45.65	b	23.08	b	70.92	a
0.1 lb Cu/acre	2.96	a	12.20	b	46.65	b	23.18	b	70.84	a
0.3 lb Cu/acre	2.89	a	12.29	ab	49.57	a	25.45	a	69.08	b
0.5 lb Cu/acre	2.84	a	12.17	b	49.53	a	25.47	a	69.06	b
Pr (>F)	0.8977		0.109		0.0213*		0.0173*		0.0175*	

Note : Significance Codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Table 3e-8. Forage calcium (Ca), phosphorous (P), potassium (K), magnesium (Mg), and sodium (Na) content of fodder barley under different Cu treatments.

Treatment	Ca (% DM)		P (% DM)		K (% DM)		Mg (% DM)		Na (% DM)	
Control	0.28	a	0.12	a	0.89	a	0.26	a	0.32	a
0.1 lb Cu/acre	0.28	a	0.12	a	0.88	a	0.26	a	0.33	a
0.3 lb Cu/acre	0.31	a	0.12	a	0.87	a	0.27	a	0.34	a
0.5 lb Cu/acre	0.30	a	0.12	a	0.85	a	0.28	a	0.35	a
Pr (>F)	0.837		0.899		0.953		0.746		0.976	

Note : Significance Codes : 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'.

Table 3e-9. Forage copper (Cu), zinc (Zn), iron (Fe), and manganese (Mn) content of fodder barley under different Cu treatments.

Treatment	Cu (mg kg^{-1})		Zn (mg kg^{-1})		Fe (mg kg^{-1})		Mn (mg kg^{-1})	
Control	3.45	b	17.80	a	95.81	a	35.13	a
0.1 lb Cu/acre	4.75	ab	17.39	a	86.23	a	31.16	a
0.3 lb Cu/acre	6.65	a	17.72	a	95.98	a	32.89	a
0.5 lb Cu/acre	6.56	a	17.00	a	89.89	a	30.75	a
Pr (>F)	0.111		0.959		0.842		0.178	

Note: Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'; mg kg^{-1}: milligram per kilogram.

Conclusions

Overall, the findings demonstrate that foliar application of CuSO4 at rates of 0.3 to 0.5 lb Cu per acre successfully increased the Cu concentration of silage wheat, barley, and oats by approximately two- to threefold compared with the control where no Cu was applied.

Although dry matter yield was 20-30% lower than expected due to extremely dry growing conditions in Northeastern Alberta, foliar Cu fertilization itself did not cause any additional reductions in yield or other quality characteristics.

It is well established that growing and finishing cattle require a minimum of 10 mg Cu kg^{-1} in their diet to maintain adequate mineral status. In this study, foliar application of CuSO4 increased Cu concentrations from 2.93 to 8.04 mg kg^{-1} in oats, from 4.15 to 7.08 mg kg^{-1} in wheat, and from 3.45 to 6.65 mg kg^{-1} in barley; however, these levels remain below the threshold needed to fully satisfy the animals' Cu requirements. These results indicate that although foliar Cu application at the rates used can substantially enhance silage Cu content, additional Cu supplementation is still necessary to ensure cattle receive adequate dietary Cu to support optimal growth, health, and productivity. Although it is possible that foliar Cu rates higher than 0.5 lb Cu ac^{-1} could increase silage Cu concentrations to 10 mg kg^{-1} or more, such increases may markedly reduce other essential micronutrients (Zn, Fe, and Mn) and negatively impact dry matter yield. Therefore, foliar CuSO4 applications within the 0.3-0.5 lb Cu ac^{-1} range appear both effective and agronomically safe.

Because this study was conducted during a single growing season that was unfortunately extremely dry, further experimentation over at least two additional years is needed to validate these findings and strengthen the recommendations.

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Renegerative Agriculture

Improving relative forage quality during stubble grazing with low-growing clovers as relay crops - Chronology

Table 5. Lakeland Agricultural Research Association (LARA) cropping forage trial chronology in Fort Kent, Alberta in 2025

Site / Trial Name	N[a]	Seeding[b]			Fertilizer[b]		Herbicide[c]						Harvest
							Burndown			In crop			
Fort Kent	#	Date	Rate lb acre^{-1}		Date	Rate[d] lb acre^{-1}	Date	Name	Rate L acre^{-1}	Date	Name	Rate L acre^{-1}	Date
Improving relative forage quality during stubble grazing with low-growing clovers as relay crops	24	May 30	Barley	104.47[e]	May 30	90 N 30 P 29 K	May 29	Roundup	1	-	-	-	Refer to Section 4
			Clover: Subterranean	10									
			Clover: White	5									

[a]Number of experimental units
[b]No till hoe-drill Fabro seeder with side banding (2008) attached to Ford tractor (1998)
[c]R-Tech Thirty-foot sprayer (2024) attached to John Deere tractor (2010). For clarity, names are brand names, not chemical. Maintenance application not conducted to procure survivorship of clover species
[d]Displayed rates are actuals, not products
[e]Seed treated with Vibrance Quattro @ 325 ml/ac

Renegerative Agriculture

Improving relative forage quality during stubble grazing with low-growing clovers as relay crops

Collaborators:

Lakeland Agricultural Research Association (lead)
Lakeland College
Gateway Research Association

Background:

Stubble grazing is currently a widespread practice in central Alberta, which enables livestock producers to make use of alternative forage resources (i.e. cereal crop stubble) in the fall and prior to winter feeding practices (corn, swath, or bale grazing). Most stubble grazing scenarios involve cattle feeding on a mixture of straw, chaff, grains (left over from combine), and weeds. As such, the quality of the feed can vary considerably. In general, straw and chaff contain low amounts of protein, energy, calcium and magnesium. Additionally, most stubble grazing scenarios occur prior to weaning, where cows still have high energy and protein requirements as they are still lactating. Thus, there is a need to improve forage quality in this timeframe.

This project aims to introduce white clover, subterranean clover as a relay crop in feed barley. The study will consider a few factors that will promote successful outcomes. The first factor will be to investigate the impact of clover species on weed suppression (at both harvest timings). The second factor will be to investigate the impact of clover species on soil available nitrogen to the following crop. The study will measure if there are significant interactions between such factors (clover species, soil available nitrogen, and harvest timing).

Objectives:

i. Evaluate the impact of feed barley+ clover species (white or subterranean clover) on silage yield and quality.
ii. Evaluate the impact of feed barley+ clover species (white or subterranean clover) on grain yield and quality.
iii. Determine cereal+clover intercrop combination(s) that will improve forage yield and quality during the stubble grazing period.
iv. Produce a reliable estimate of the potentially mineralizable N (nitrogen credit) derived from cereal+clover relay crop systems.
v. Determine which relay crop system (cereal+clover combination(s) and harvest timing) will bring the highest economic return to grain and livestock producers.

Materials & Methods:

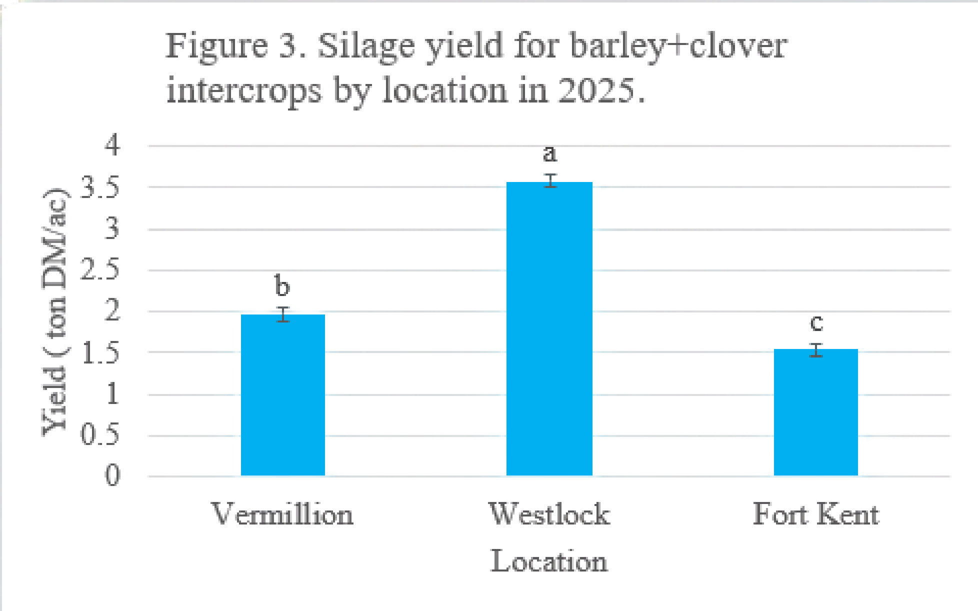
1. Feed barley underseeded with white clover (harvested at silage timing)
2. Feed barley underseeded with white clover (harvested at grain timing)
3. Feed barley underseeded with subterranean clover (harvested at silage timing)
4. Feed barley underseeded with subterranean clover (harvested at grain timing)
5. Feed barley (harvested at silage timing)
6. Feed barley (harvested at grain timing)

Figure 1: Subterranean clover intercropped with feed barley.
Photo taken July 10th, 2025.

Figure 2: Subterranean clover intercropped with feed barley. Silage harvest. Photo taken August 8th, 2025.

Results and Discussion

Silage yield



Barley silage yields were significantly different by location (Figure 3; $p<0.0001$). Westlock had the highest silage yields at 3.58-ton DM/ac, followed by Vermillion (1.97-ton DM/ac) and Fort-Kent (1.54-ton DM/ac). The addition of clovers did not significantly increase silage yields ($p=0.8510$). Silage yield differences were likely due to environmental conditions, where Westlock received more early season rain than Vermillion and Fort-Kent.

Silage quality

		Vermillion		Westlock		Fort Kent		Pr(>F)
CP	%	10.4	b	10.2	b	11.8	a	5.809e-08***
TDN	%	74.3	a	68.3	c	72.2	b	7.268e-10***
NEG	%	1.14	a	1.04	b	1	b	1.071e-07***
NEM	%	1.87	a	1.71	b	1.72	b	5.571e-09***
Calcium	%	0.201	c	0.323	a	0.242	b	3.207e-11***
Phosphorus	%	0.121	c	0.163	b	0.196	a	8.37e-14***
RFV		190	a	176	a	133	b	6.519e-10***
Potassium	ppm	1.13	b	1.29	a	1.28	a	0.007489**
Magnesium	%	0.145	b	0.127	c	0.191	a	8.99e-12***

Stubble yield (above-ground biomass) was not significantly different with the addition of clovers (p=0.2865), nor across different locations (p=0.0869)(Figure 5). Additionally, whether you removed the biomass during silage, or kept it for grain, it did not influence the total amount of stubble harvested (p=0.5598). It did, however, influence the quality of that stubble, with the silage plots displaying higher quality stubble in September.

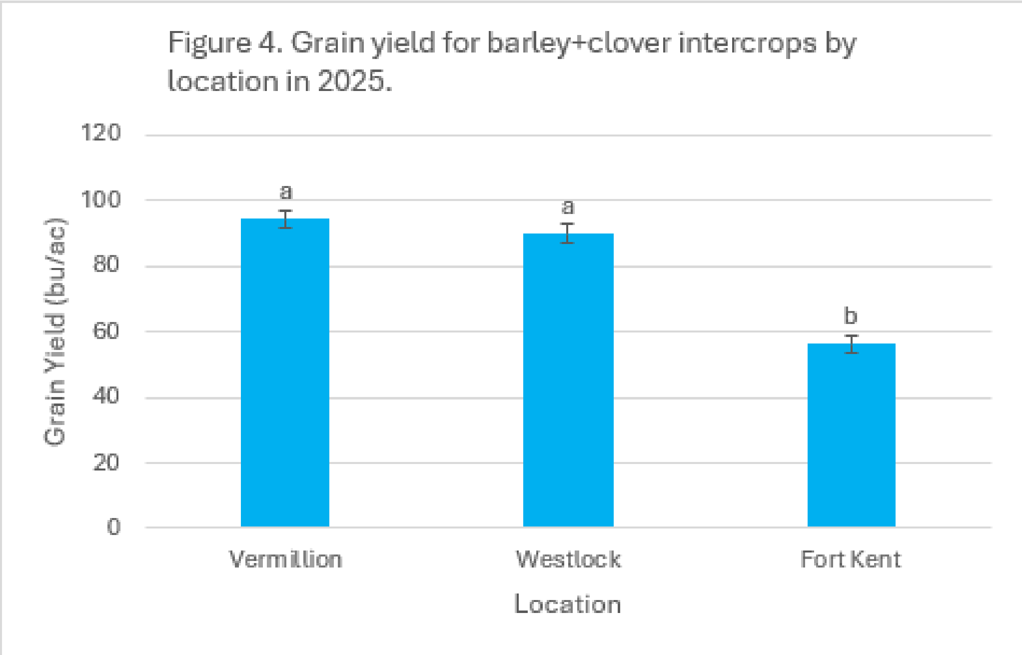
Stubble quality (by biomass removal)

		Silage Kept		Silage Removed		Pr (>F)
%CP	%	6.65	b	9.04	a	0.0008102***
%TDN	%	52.6	b	58.2	a	6.052e-15***
NEG	%	0.54	b	0.7	a	7.875e-15***
NEM	%	1.25	b	1.41	a	8.698e-15***
Phosphorus	%	0.0539	b	0.0861	a	<2.2e-16***
RFV		73.9	b	103.7	a	<2e-16***

Feed test results from the stubble/regrowth in 2025 demonstrated that the stubble quality improved when the barley was silaged and left to regrow. That was true for crude protein, TDN, NEG, NEM, phosphorus and RFV. However, there was no significant effect on calcium, magnesium, copper, and zinc. This effect may have been heightened because of the early season drought conditions followed by the arrival of late season moisture (mid-August). This likely improved regrowth and stubble quality in August. Under similar conditions, the recommendation would be that it is better to silage the barley crop, and to graze the regrowth+stubble in September. These results were consistent across all three site locations.

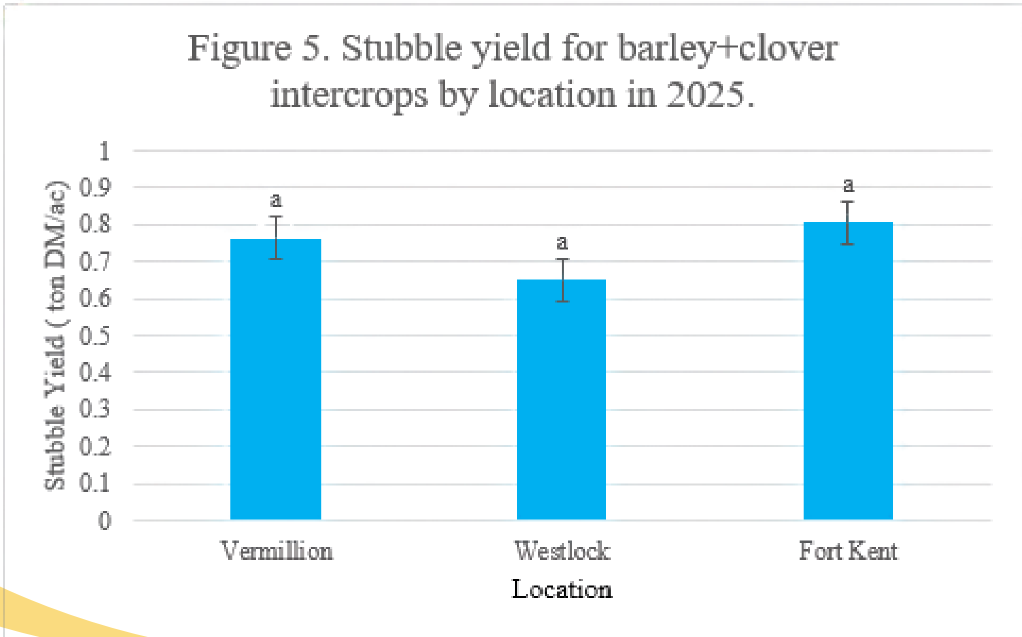
Silage feed test results indicated that all tested nutrients were significant by location (p<0.05). Crude protein, potassium, magnesium, and phosphorus content were highest in Fort-Kent. Total digestible nutrients, net energy gain and net energy maintenance were highest in Vermillion. Relative feed value was highest in Vermillion and Westlock. The addition of clovers did not influence nutrient content in silage. This was likely owing to the drought, but also the staging of the clovers at silage timing.

Grain yield



Barley grain yields were significantly different by location ($p<0.0001$). Vermillion had the highest grain yields at 94±2.7 bu/ac, followed by Westlock (90±2.7 bu/ac) and Fort-Kent (56±2.7) (Figure 4). The addition of clovers did not significantly impact silage yields ($p=0.1203$) in 2025. On a positive note, despite the drought conditions, clovers did not decrease barley grain yield in 2025. Thousand kernel weights and test weights followed the same trends.

Stubble yield

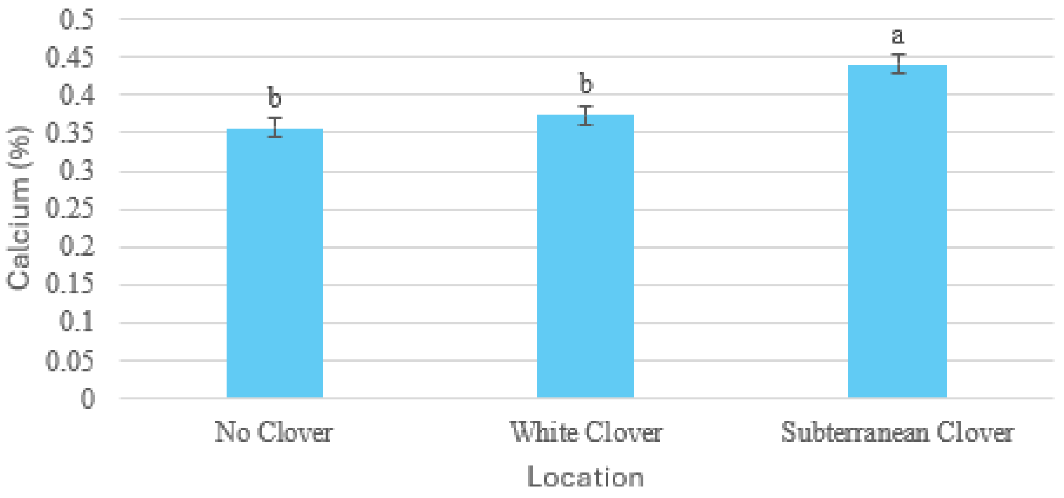


Stubble quality (by location)

		Vermillion		Westlock		Fort Kent		Pr(>F)
%CP	%	5.89	c	7.87	b	9.78	a	4.444e-13***
%TDN	%	52.8	b	60.1	a	53.3	b	<2.2e-16***
NEG	%	0.522	b	0.8	a	0.537	b	<2.2e-16***
NEM	%	1.24	b	1.48	a	1.26	b	<2.2e-16***
Phosphorus	%	0.0546	b	0.0792	a	0.0762	a	4.676e-13***
Magnesium	%	0.167	b	0.115	c	0.237	a	<2.2e-16***
Copper	ppm	3.67	c	5.46	b	7.28	a	3.04e-09***
Zinc	ppm	16.4	b	18	b	27.5	a	5.076e-11***
RFV		69.8	c	116.2	a	80.3	b	<2e-16***

Stubble quality

Figure 6. Stubble calcium content for barley+clover intercrops by clover type in 2025.



In 2025, apart from calcium, the addition of clovers did not improve stubble quality. Subterranean clover significantly improved calcium content in the stubble ($p<0.0001$, Figure 6). The effect was most observed in the Vermillion and Ft-Kent locations (western locations). White clover, on the other hand, did not show such promise. This was likely owing to poor emergence during drought conditions. Subterranean clover is better adapted to drought conditions compared to white clover. We hypothesized that clovers would improve crude protein content in the stubble. Our results showed that this was not the case in the 2025 growing season ($p=0.2498$). Again, this was likely due to persistent drought conditions.

Conclusion

This was year 1 of the project. We are scheduled to run the same experiment for three more years. The main take-aways from Year 1, was that if the silage was removed, the stubble was of higher quality. That is what we expected out of a dry year, but we were surprised to see that it was true for all nutrients tested.

Based on one year of data, on a dry year, the recommendation is to silage, and to graze the regrowth in the fall. The addition of subterranean clover did not improve silage or stubble yield. However it did improve calcium content in the stubble, which is very important for pregnant cows.

We will need to adjust the seeding rate on the white clover. It is not known to do well in dry conditions such as what we had in 2025, but we do want to increase the seeding rate, and see if we get a better establishment in future years.

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Renegerative Agriculture

Impact of allelopathic cover crops and its termination method in subsequently planted cash crops - Chronology

Table 6. Lakeland Agricultural Research Association (LARA) cropping trials chronology in two sites across Northeastern Alberta in 2025

Trial Name / Site	N[a]	Seeding[b]		Fertilizer[b]		Herbicide[c] Burndown			Harvest[d]
Impact of allelopathic cover crops and its termination method in cash crops grown subsequent season[e]	#	Date	Rate lb acre^{-1}	Date	Rate[f] lb acre^{-1}	Date	Name	Rate L acre^{-1}	Date
Fort Kent	88	June 5	50	June 5	90N 30P 29K	May 10	Roundup	1	October 9
St. Paul	88	June 5	50	June 5	90N 30P 29K	May 9	Roundup	1	October 8

[a]Number of experimental units
[b]No till hoe-drill Fabro seeder with side banding (2008) attached to Ford tractor (1998)
[c]R-Tech Thirty-foot sprayer (2024) attached to John Deere tractor (2010). For clarity, names are brand names, not chemical
[d]Wintersteiger Classic Plus (2020)

Renegerative Agriculture

Impact of allelopathic cover crops and its termination method in subsequently planted cash crops

More than 60% of weed management is through recurring herbicide applications, leading increased instances of weed resistance. Allelopathy is the influence, usually detrimental, of one plant on another, where toxic substances are released when a plant dies, or produced through decaying tissue (Zimdahl R.L., 2018). These secondary metabolites may establish direct or indirect harmful or beneficial effects (Reigosa et al., 2006). Allelopathy can affect the growth and yield of another crop (Batish et al., 2001), b) develop autotoxicity, meaning chemicals expelled from plant residues of a species can hinder the growth of seedlings of the same species (Yu and Matsui, 1997). Thus, if managed properly, allelopathy can be a great alternative in weed management.

This study is preliminary and novel, because a) weed species and number of individuals per species will be evaluated within the allelopathic cover crop as well as the subsequent cash crops such as wheat, canola and peas and b) it aims to evaluate if allelopathy is affected if cover crops as well as cover crop mixtures are roller-crimped or incorporated in the soil before the cash crop is seeded. This research is unique because allelopathy is still an untouched subject for many growers. Extending knowledge through this project might increase grower interest in using allelopathic crops as another way to induce more weed suppression.

In the following growing season, cash crops such as canola, wheat and peas will be seeded as monocrop at each site respectively. Much like the first study year, soil samples will be collected for chemical analysis, a burndown herbicide application will be broadcasted before seeding and fertilization will be adjusted to target yields such as 40, and 50, for canola and wheat respectively (Government of Alberta 2024), as peas will not be fertilized. Harvest per plot will be weighed and recorded.

Objectives

This study aims to explore in further detail the allelopathic effects of Rye, ryegrass, Hairy vetch and Sunflower and mixtures between these cover crops (Rye + ryegrass, Rye + Hairy vetch, Rye + Sunflower, ryegrass + Hairy vetch, ryegrass + Sunflower and Hairy vetch + Sunflower). This study is preliminary, because a) weed species and number of individuals per species will be evaluated within the allelopathic cover crop as well as the subsequent cash crops such as wheat, canola and peas and b) it aims to evaluate if allelopathy is affected if cover crops as well as cover crop mixtures are roller-crimped or incorporated in the soil before the cash crop is seeded.

Materials & Methods:

The experiment was located at two sites in Lakeland Agricultural Research Association. These sites are St Paul (54°5'N, 110°15'W), and Fort Kent (54°18'N, 110°37'W). In 2024, aside from the herbicide burndown treatments there were no further applications of herbicide for the rest of the growing season. Rye (Secale cereal L), Annual ryegrass (Lolium multiflorum L.), Hairy vetch (Vicia villosa L.), Sunflower (Helianthus annus L.) were sown at 4.9, 4.5, 20.2 and 1.3 g m2 and mixtures of these crops (Rye + ryegrass, Rye + Hairy vetch, Rye + Sunflower) were also sown. Except for Sunflower, the seeding rate of all other cover crop species was doubled. The experiment was set up as a four replicate, complete random design.

The split plot factor is the cover crop termination style: roller crimped or incorporated. An untreated control, where no cash crop is seeded will also be included. In 2025, canola was sown on both sites. For future reference, 2024 will be named cover crop season whereas 2025 will be stated as cash crop season.

For both study years, a quadrat of 25X25 cm was situated randomly across the plot. Every second week of the months of June, July, and August, weed species and number of weeds per species were counted in one of these quadrats (species richness). Quadrat selection was random. For both cover crop and cash crop season, biomass was taken out of this one quadrat and separated at the end of the growing season (end of August, early September).

In the cover crop season, biomass was separated as cover crop, and weeds. For the cash crop season, biomass will be taken before the cash crop harvest and separated as weeds, cash crops and if present, cover crop plants. In 2024, hand weeding was conducted to remove Canada thistle (Cirsium arvense L. Scop.) and wild oat (Avena fatua L.) in the plots. This was because (a) Canada thistle has a thick and sturdy root system that may bend the blades of the mower used for roller crimped plots and (b) Wild oat spread quickly across fields; since we are not using maintenance herbicides during the growing season, wild oat becomes a threat for the outcomes of the experiment. In 2025, hand weeding was only conducted for wild oat. In both seasons, hand weeding was conducted, either by a stirrup hoe and/or a wheel stirrup hoe in aisles between seed plots around the first week of June.

At the end of the cover crop season, half of the plots were incorporated with a rototiller, and the other hand were mowed. Both Farm king C4560 rototiller for incorporation and Farm king mower for roller crimping were attached to a John Deere tractor (2010). In the absence of a roller crimper, a Farm king 528 mower was used to cut down the upper biomass of the cover crops and spread with a rake across the plot.

The experiment was set up as a four replicate, split-block plot analysis. Main factor was the cover crop species/ mixes, and the split block factor is the termination method at the end of the season. A cover crop season and a cash crop season factor is included as fixed because it is intentionally rotated every season as to mimic what producers would likely do in the field. Random effects considered will be replicate (i.e., block), as well as repeated measures (sample periods) at each plot for weed counts occurring every month after cover crop seeding. Interactions between fixed effects and random effects were considered random. Table 5-1 provides a breakdown of the effects studied in this experiment.

Table 5-1. Effects studied in the impact of allelopathic cover crop and its termination method in subsequently planted cash crops

Fixed	Random
Crop season	Site
• Cover crop season	• St. Paul
• Cash crop season	• Fort Kent
Termination method	
• Incorporated	Replicates (block)
• Roller-crimped	
Cover crop species/mixes	
• Annual ryegrass	
• Annual ryegrass + Hairy vetch	
• Annual ryegrass + Rye	
• Annual ryegrass + Sunflower	
• Hairy vetch	
• Hairy vetch + Rye	
• Hairy vetch + Sunflower	
• Rye	
• Rye + Sunflower	
• Sunflower	
Sampling period	
• June	
• July	
• August	

Interaction	
Fixed	Random
Crop season X Termination method	Replicates X Crop season
Crop season X Cover crop species/mixes	Replicates X Termination method
	Replicated X Cover crop species/ mixes
Cover crop species mixes X Termination method	Replicates X Crop Season X Cover crop species/mixes X Termination method

Repeated measurement
Crop season X Cover crop species/mixes X Termination method X Sampling Period

The variables were: cover crop biomass, weed biomass, number of weed individuals in general and per species as well as total number of weed species. In the cover crop season, competition indexes were evaluated such as relative neighbour effect (RNE), land equivalent and actual yield loss (AYL) index. In the cash crop year, yield, cash crop biomass and RNE for weeds was evaluated.

The relative neighbour effect (RNE) is the ratio used to compare competency of a plant in a community. It is computed by taking the biomass of a weed or a group of weeds in a treatment and subtracting the weed biomass obtained in the control treatment. Followed by this, the difference is divided by either the weed biomass from either the treatment or the control, whichever one is greater.

I adapted this concept to see if there was a difference in grain yield in canola among incorporated and among roller-crimped treatments. Thus, I used canola grain yield from a treatment, subtracted the canola grain yield from the control (either unseeded roller crimped or unseeded incorporated) and divided by the grain yield of either the treatment or the control, whichever value was greater. I did the same for canola biomass.

All analysis were performed in Statistical Analysis Systems SAS Institute Inc (2008) using PROC MIXED. If the interactions between site and treatment were not significant (i.e., Z-test>0.05), data for both sites were combined. Significance was assessed at a confidence level of 0.05. Moreover, LSD analysis was used to compare means for each parameter among control treatments to observe their impact on variables from fixed effects. In 2024 transformations were used for certain response as stated in tables. Transformed data was then back transformed for table display.

Results

Canola yield, canola biomass, and weed biomass

Table 5-2. P-values obtained compiling yield, biomass of canola and weed as well as number of weeds and weed species from data obtained in 2024 and 2025 in Fort Kent and St. Paul (N=176). Trials in 2024 were sown to Annual ryegrass (*Lolium multiflorum* L), Hairy vetch (*Vicia villosa* L.), Rye (*Secale cereale* L.) and Sunflower (*Helianthus annus* L.) and mixtures between these cover crop species. In 2025, same trial was sown uniformly to canola (*Brassica spp.*).

Effect	Canola yield[a]	Biomass: Canola	Biomass: Weed[a]	Relative neighbour effect: Canola oilseed RNEc	Relative neighbour effect: Canola biomass RNEb	Relative neighbour effect: Weed RNEw	Weed: Number[b]	Weed: Species[c]
Crop season							0.01	0.04
Cover crop species/mixes	0.80	0.96	0.02	0.20	0.99	0.36	4.00×10^{-4}	0.08
Termination method	0.79	0.80	0.50	0.65	0.32	0.34	0.13	0.78
Crop season X Cover crop							0.68	0.60
Crop season X Termination period							0.01	0.30
Cover crop species/mixes X Termination period	0.67	0.90	0.57	0.98	0.97	0.77	0.67	0.66
Crop season X Cover crop species/mixes X Termination method X Sample period							$\leq 1.00 \times 10^{-4}$	$\leq 1.00 \times 10^{-4}$

[a]Inverse transformation
[b]Inverse transformation
[c]Logarithminc transformation

Data showed no difference between St. Paul and Fort Kent sites (P=0.24). This means data could be pooled and analysed as a single set. As such, yield was the same across cover crop species and mixes, termination methods (roller crimped vs incorporated) and interaction between cover crop and termination method effects (Table 5-2). A miscalculation in the seeding rate of canola may have caused this. Canola was sown ten times more than the recommended seeding rate. This overseeding incident may have acted as a blanketing effect, hindering potential differences among main and split block effect treatments.

Although there was no difference among sites, separate analyses showed that in Fort Kent cover crop species/ mixes, termination method and interaction between these treatments had no effect in canola yield (P=0.92,0.11 and 0.32 respectively). In contrast, in St. Paul, cover crop species/mixes effect influenced canola yield (P=2.0 X10^{-4}), as well as termination of the cover crop treatment (P=0.04). Interaction among these effects however had no impact on canola yield (P=0.30). Indeed, yield was 16 bu acre^{-1} in control plots (plots that were unseeded in the cover crop season).

Plots previously sown to Annual ryegrass yield 12 bu acre. This yield was 25% greater than mixtures of Annual ryegrass + Sunflower and Hairy vetch and 33% more compared to plots sown to Sunflower and mixtures of Rye + Sunflower. Moreover, canola yield obtained from plots previously sown to Annual ryegrass was statistically the same as yield from canola sown in plots planted to Annual ryegrass + Hairy vetch, Annual ryegrass + Rye, Hairy vetch + Rye, Hairy vetch + Sunflower and Rye the year prior. Plots that were roller crimped in the cover crop season had 18% more yield than plots that were incorporated. It can be argued that in Fort Kent there were more weeds than in St. Paul. Thus, a combined effect of over seeding plus greater weed pressure in Fort Kent, may have caused for differences to be imperceptible through statistical analysis.

Weed biomass overall were impacted by cover crop species and mixes but neither by termination method nor cover crop X termination method interaction (Table 5-2). In general terms, plots sown to Annual ryegrass + Rye had the least amount of weed biomass compared to other cover mixes and cover crop treatments (Figure 5-1). In contrast, plots sown to Hairy vetch has more weed biomass and such biomass was as statistically as heavy as that collected from unseeded plots (control). Moreover, plots sown to Hairy vetch + Sunflower, Rye, and Annual ryegrass + Sunflower, had just as much weed biomass as that found in control plots and plots sown to Hairy vetch.

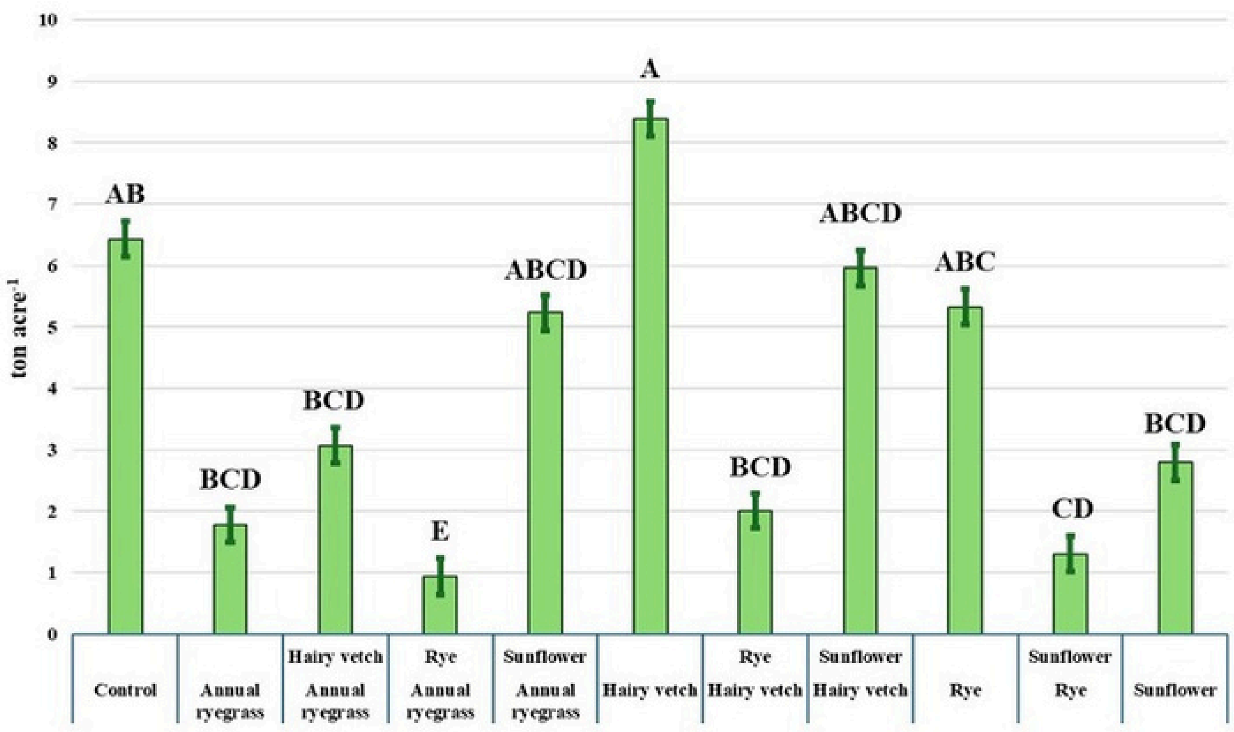

Figure 5-1. Weed biomass sampled in canola seeded plots in 2025 that were previously sown to cover crop species and cover crop mixes in 2024 in St. Paul and Fort Kent. N=176.

For canola yield, the relative neighbour effect for yield (RNEc), canola biomass (RNEb) and weed biomass (RNEw) were the same across cover crop species and mixes, termination method and interaction between these effects (Table 5-2).

Weed individuals and weed species

Weed individuals were analysed as per plot, per month, per year. Year here is regarded as the cover crop season in 2024, where cover crop treatments were sown and terminated and the cash crop season in 2025, where canola was sown in all plots. An all-inclusive analysis showed the growing season influenced number of weed individuals and number of weed species (Table 5-2). Our results show that the weed community is malleable depending on the cover crop and cash crop sown. As such, more weeds were found in the cover crop year compared to the cash crop year.

This is probably because (a) residues from allelochemicals from the previous cover crop season plus allelochemicals released from canola plants may be impacting weed number. In contrast to number of weed individuals, there were more weed species in the year where canola was sown that in the year when cover crops were planted. Probably, cover crops planted hindered the growth of certain weed species. These weed species thus thrived in the cash crop year because there were less or no cover crop plants in the plots, and potential cover crop residues were less effective to suppress weeds due to decomposition.

Moreover, cover crop species and cover crop mixtures among these species impacted number of weeds (P=4.00 x10-4) but not number of weed species (P=0.08). Plots with more weeds were those left unseeded (control). Statistically similar to the control, plots sown to Sunflower and mixtures of Sunflower + Hairy vetch had as many weed individuals as those counted in the control. On the other hand, weed individuals were scarce in plots sown to Rye + Sunflower, Rye and Annual ryegrass + Rye. In addition, weed individuals in plots sown to Annual ryegrass + Hairy vetch, and Hairy vetch +Rye were statistically the same as those found in plots sown from Rye and sown with Rye mixtures with either Sunflower or Annual ryegrass (Figure 5-2).

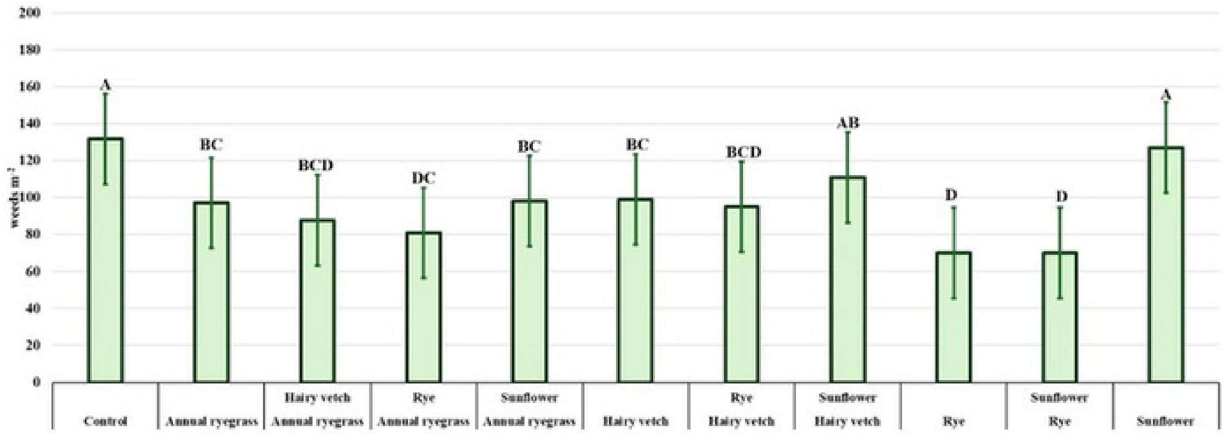

Figure 5.2. Number of weed individuals found at each cover crop species/mixes treatment effect N=528. Number of weeds were allotted were counted during three sample periods in the cover crop season (2024) and the cash crop season (2025). Different letters indicate significance across treatments.

The interaction between crop season and termination method influenced number of weeds (Table 5-3). Mean values show that there is no difference in termination method during the cover crop year, which makes sense because termination occurred at the end of the season. However, in the cash crop period, more weeds were found in plots that were roller crimped compared to plots that were terminated through incorporation. The possible explanation is likely that glyphosate had more soil contact in plots that were incorporated versus those that were roller crimped. Hence, more weed control may have occurred twofold, (a) by allelochemical residue from previous cover crops (b) by allelochemicals expelled from canola plant stands and (c) by glyphosate application at burndown. Since glyphosate tends to act on a short period of time and thus maintenance sprays in the middle of the season are necessary, it is likely that cover crop residue and canola plants may have increased weed suppression through allelopathy.

Moreover, number of weeds shifted through time. In the cover crop year, weed number was at its highest in June, then weed number significantly reduced by July and stays the same significantly by August, shortly before termination. In other words, cover crops are seeded after glyphosate burndown and fertilizer application, weed number increased due to nutrient application but eventually allelopathy and cover crop smothering played a role. In turn, weed number was reduced and plateaued by the end of the season. In the cash crop year, weed individuals seemed to increase in number from June to August, shortly before harvest. This is likely cover crop residue decomposition. Decomposition through out the year could potentially increase organic carbon and nitrogen in the soil. In turn, the availability of carbon and nitrogen may have provided enough nutrient availability for weeds and hence there is an increase in weed number in the cash crop at the end of the season before canola grain was collected. Number of weeds in August was significantly lower as that found in the beginning of the cover crop year in June. This is likely weed inter and intraspecific competition among each other as well as with canola plants.

Weed species also varied through time. However, in the cover crop year, weed species number was the same during the who cover crop season. In the cash crop year this was different. Weed species number in June was as statistically low as that found in the previous cover crop season. Then, it increased to a maximum in July to finally drop in August. All weed species unable to flourish in the cover crop season were able to do so in the cash crop season. Weed species number consequently dropped by August due to competition among weeds and with canola plant stands.

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Table 5-3. Weed number of individuals and weed species in the cover crop season (2024) sown to annual ryegrass (*Lolium multiflorum* L), hairy vetch (*Vicia villosa* L.), rye (*Secale cereale* L.) and sunflower (*Helianthus annus* L.) and mixtures between these cover crop species as well as the cash crop season (2025) which was sown uniformly to canola (*Brassica spp.*) N=176

Effect	Number of individuals			Species		
Crop season						
Cover crop season	114.21	23.3	**A**[a]	2	0.5	**B**
Incorporated	115.39	25.4	A[b]	2	0.5	A
Roller crimped	113.03	25.4	A	2	0.5	A
Cash crop season	79.85	23.3	**B**	3	0.5	**A**
Incorporated	67.57	25.4	C	3	0.5	A
Roller crimped	100.16	25.4	B	3	0.5	A

[a]Letters in bold different from each other represent significance between means
[b]Letters different from each other represent significance between means

Since both weed number and number of weed species were affected by an interaction of crop season X The following is a summary description of weed individuals and weed species changes occurring at each month in the cover crop season, the cash crop season and comparing cash crop with cover crop season.

Cover crop year

June

Each plot showed few weed species but there were many individuals counted per species. This is likely an early response to cover crop growth, where only a few weed species were able to grow along cover crop plants while others were deterred through allelopathy (Figure 5-3 a and b).

July

More weeds were found in the control plots incorporated compared to those sown in Annual ryegrass + Rye incorporated. It can be argued that by the middle of the cover crop season, Annual ryegrass and Rye mixes were the most effective in suppressing weed proliferation (Figure 5-3 a and b).

August

Control plots and plots sown to Sunflower that were terminated through incorporation had more weed individuals than mixes of Annual ryegrass + Rye terminated in the same way. By this time of the year, it is established that Annual ryegrass and Rye are the best cover crop mixture for weed suppression. No differences were found in roller crimped plots (Figure 5-3 a and b).

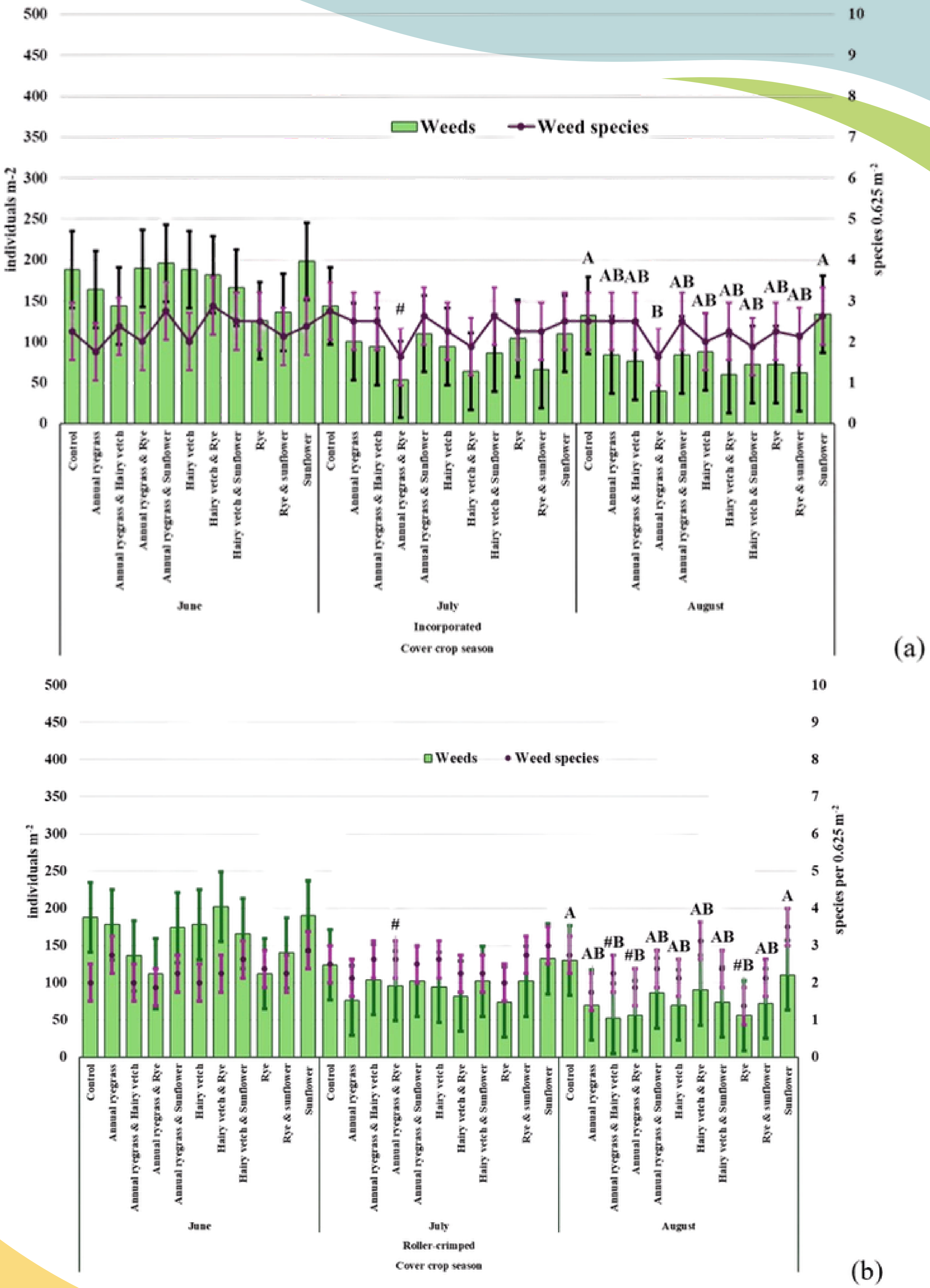


Figure 5-3a and b. Weed individuals and weed species counted in the cover crop season at three sample periods in 2024 in Fort Kent and St. Paul. (a) # =significantly different than control in the same sample period (b) letters different from each other denote significant difference among treatments within the same sample period. N=176.

Cash crop year

June

There were two more weed species in the cash crop year in plots previously sown to Annual ryegrass+ Sunflower and later incorporated compared to those sown to Rye and incorporated in the previous cover crop year. It is possible that Rye impeded the growth of certain weed species early in the cash crop year, while others were effectively managed with glyphosate. The allelopathic impact of Rye is thus greater compared to that from mixes of Annual ryegrass and Sunflower early in the cash crop season and it seems to be an appropriate choice to reduce weeds for subsequent cash crops (Figure 5-4 a and b).

July

Unseeded (control) plots and plots planted to Hairy vetch + Sunflower and roller crimped had more weeds in the following cash crop year than plots from the same treatments but instead, incorporated (Figure 5-4 a and b).

- Control>Hairy vetch + Sunflower

There were more weeds found in the cash crop year in plots previously sown to Annual ryegrass and incorporated compared to previously incorporated crops sown to Rye. Rye is thus a potent cultural strategy for weed suppression compared to Annual ryegrass IF BOTH ARE TERMINATED THROUGH INCORPORATION (Figure 5-5).

Moreover, in the cash crop year, previously roller crimped plots, the control (unseeded in the cover crop year) was significantly weedier compared to crops sown to canola in the cash crop year and sown the year prior to Rye +Sunflower, Rye, Hairy vetch, Hairy vetch + Rye and Sunflower and terminated by roller crimping (Figure 5-4 a and b).

Less weeds were found in previously roller crimped plots sown to Annual ryegrass and Annual ryegrass mixes compared to the control in the cash crop year. Roller crimped Annual ryegrass is less effective for weed suppression the following cash year than crops sown to Annual ryegrass+Sunflower, Rye and Rye+Sunflower (Figure 5-4 a and b).

Within canola plants sown in the cash crop year, plots sown to Hairy vetch+Sunflower and roller crimped in the cover crop year seemed to have a weaker suppression effect against weeds in contrast to roller crimped plots sown to Annual ryegrass mixes as well as those plots sown to Hairy vetch+Rye and Hairy vetch in the same year (Figure 5-4 a and b).

Canola does not benefit from roller crimped Sunflower. Plots sown to Rye+Sunflower, Rye and Annual ryegrass+Sunflower and roller crimped in the prior cover crop year, reduced more weeds in the cash crop year than roller crimped Sunflower plots in the same cover crop year. However, Rye+ Sunflower roller crimped plots seem to have lasting weed suppressing impact in the following cash crop year compared to those plots in the cover crop year, sown and roller crimped to Annual ryegrass and Hairy vetch+ Sunflower (Figure 5-5).

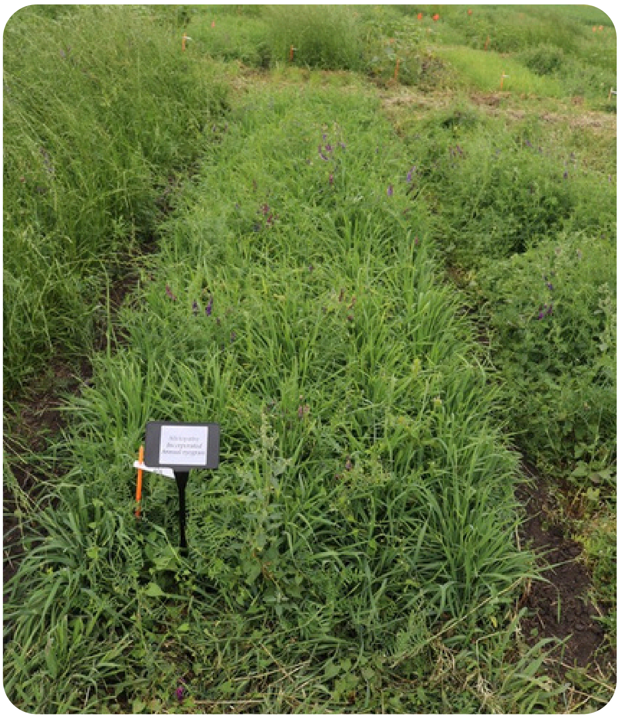
August
By August, plots that in the cover crop year were sown to Sunflower and incorporated suppressed less weeds than those plots which underwent the same termination but sown to Annual ryegrass + Hairy vetch, Annual ryegrass +Rye, Rye + Sunflower, Hairy vetch and Rye the following year, when all plots were sown to canola. Similarly, incorporated Annual ryegrass + Hairy vetch plots had a greater weed suppressing effect within canola stands compared to plots sown to Hairy vetch + Sunflower and eventually incorporated in the cover crop year (Figure 5-3).

Roller crimping of Annual ryegrass + Hairy vetch, Hairy vetch and Hairy vetch + Sunflower in the cover crop year negatively impacts weed suppression for the following in the cash crop year, compared to plots sown to the same cover crop treatments but rather incorporated. It is possible that residue left in the cover crop year due to roller crimping reduce burndown herbicide contact to the soil and in turn protected upcoming weed emergence in the cash crop year. Further, presence of weeds may have been accentuated by fertilizer input to the canola crop in the cash crop year (Figure 5-4 a and b).

Weeds in the cash crop year mere numerous in plots that were unseeded and roller crimped the previous cover crop year in contrast to roller crimped plots sown to Rye mixed with either Hairy vetch or Sunflower (Figure 5-4 a and b).

Hairy vetch + Sunflower plots that were roller crimped in the cover crop year had more weeds in the following cash crop year compared to plots, also roller crimped and sown to either Hairy vetch + Rye, Annual ryegrass, Annual ryegrass mixes, Hairy vetch, Rye + Sunflower, Sunflower and Rye (Figure 5-4 a and b).

Finally, previously roller crimped plots sown to Hairy vetch + Rye in the cover crop year had greater weed suppressing potential among canola plants in the following cash crop year compared to those plots likewise roller crimped and sown to Hairy vetch alone (Figure 5-4 a and b).



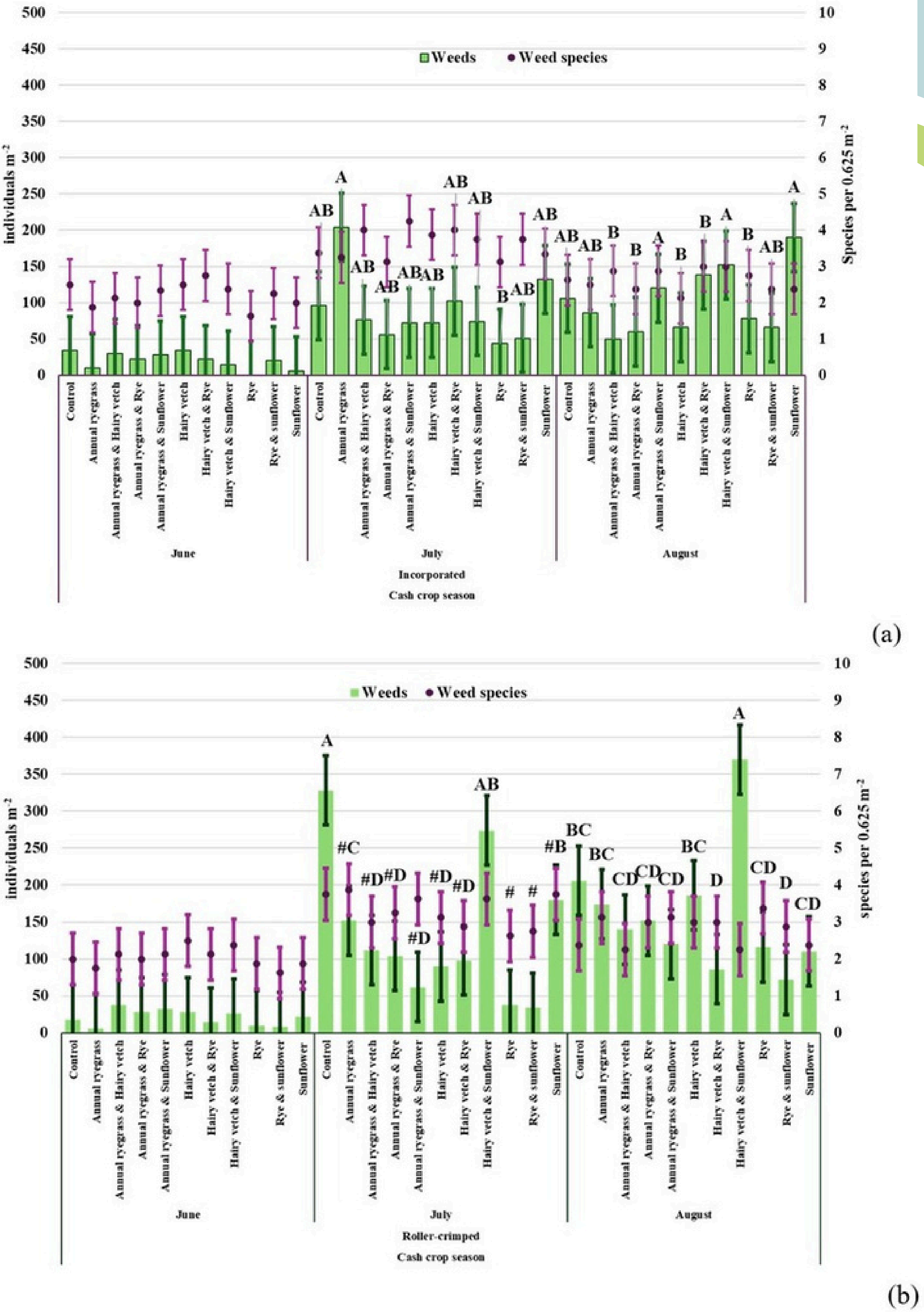


Figure 5-4 a and b. Weed individuals and weed species counted in the cash crop season at three sample periods in 2025 in Fort Kent and St. Paul. (a) letters different from each other denote significant difference among treatments within the same sample period. (b) # =significantly different than control in the same sample period. Letters different from each other denote significant difference among treatments within the same sample period. N=176.

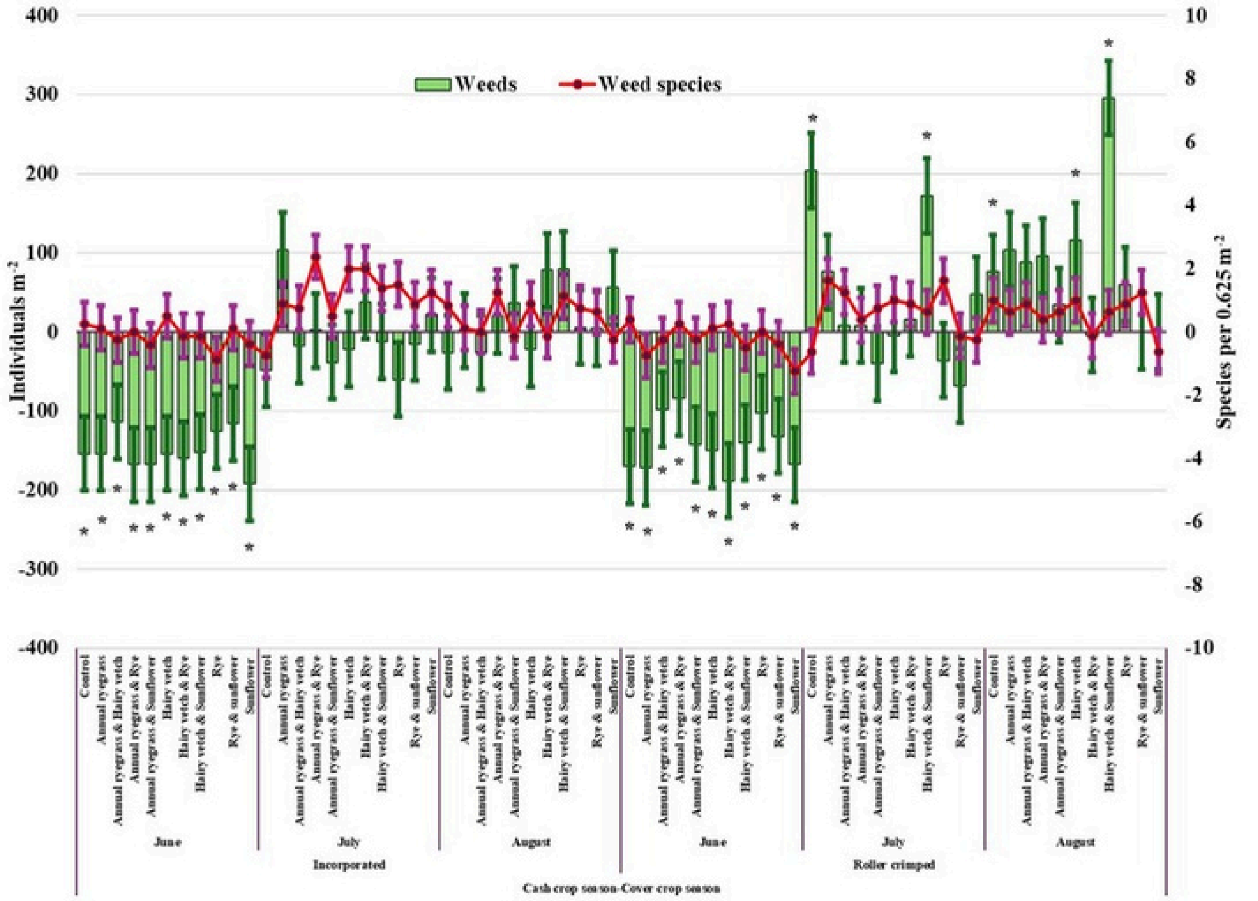


Figure 5-5. Differences (Roller crimped-incorporated) in Weed individuals and weed species computed from counts performed at three sample periods in 2025 in Fort Kent and St. Paul in the cash crop season. *=difference in weeds between cash crop season and cover crop season is significant within the same sample period. N=176.

Comparing the cash crop year to the cover crop year

June

Overall, all treatments had less weeds in the cash crop period than in the cover crop period. On incorporated plots, differences between cash crop year and cover crop year in treatments sown to Annual ryegrass+ hairy, Rye+ Sunflower and Rye+ vetch showed smallest differences in weeds, between the cash crop year and the cover crop year.

Weeds in plots sown to canola in the cash crop year and previously sown to Annual ryegrass + Rye, Annual ryegrass + Hairy vetch and Rye and incorporated, also reported smaller differences:

- There were less weeds in these plots during the cover crop year
- This is likely an offset caused by glyphosate application in the cash crop

July

Roller crimped control plots were weedier in the cover crop year compared to the cash crop year. This means cover crop residue was long lasting and it allowed for weed suppression to take place in the cash crop year.

Weeds in plots sown to Hairy vetch+ Sunflower and terminated through roller crimping were more numerous in the cash crop year (Figure 5-6), among canola plants than in the cover crop year among Hairy vetch and Sunflower stands (Figure 5-6). This shows that Hairy vetch and Sunflower are more effective in reducing weeds by smothering than by allelopathy. Moreover, it seems that allelopathy is not long lasting and other factors need to be acquired to procure weed suppression in cash crop years.

Compared to incorporated plots sown to mixes of Annual ryegrass as well as Hairy vetch and Hairy vetch + Rye in the cover crop year, these same plots in the cash crop year had more weed species. This means that likely weeds that were suppressed in the cover crop year were able to emerge in the absence of cover crops seeded. Moreover, it is possible that residues by this time during the growing season already decomposed and therefore was no more allelopathic effect from the cover crops sown the year prior canola seeding.

Like June in the cash crop year, plots that in the cover crop year were sown to Annual ryegrass + Sunflower and incorporated had more weed species than those in plots that were sown to Rye and incorporated. In July however, the same contrast rather occurred in plots sown to Rye + Sunflower and later incorporated.

August

In the cash crop year (Figure 5-6), crops previously sown first to Hairy vetch + Sunflower, Hairy vetch and Annual ryegrass, and subsequently roller crimped were weedier than these same plots the cover crop year (Figure 5-6). Thus, roller crimping of Hairy vetch + Sunflower as well as monocrops of Hairy vetch and Annual ryegrass does not improve weed suppression for the following cash crop year.

Weed species number counted in the cash crop period, among canola stands, was greater in roller crimped plots previously sown to Hairy vetch + Rye in contrast to plots previously planted to Rye and terminated likewise in the same cover crop year. Canola planted in plots previously sown to Sunflower and later roller crimped were surrounded by more weed species than canola planted in plots sown to Annual ryegrass, Rye and Annual ryegrass + Rye and terminated in the same manner in the cover crop year.

By the end of the cash crop year growing season, roller crimped plots sown to Rye in the previous cover crop year had more weed species in contrast to number of weed species counted when the cover crop was up before roller crimping. In roller crimped plots, residue decomposition is slower conversely to residues integrated into the upper soil layers (incorporation). It is likely that the allelopathic effect of Rye was waning as Rye residues were slowly decomposing.

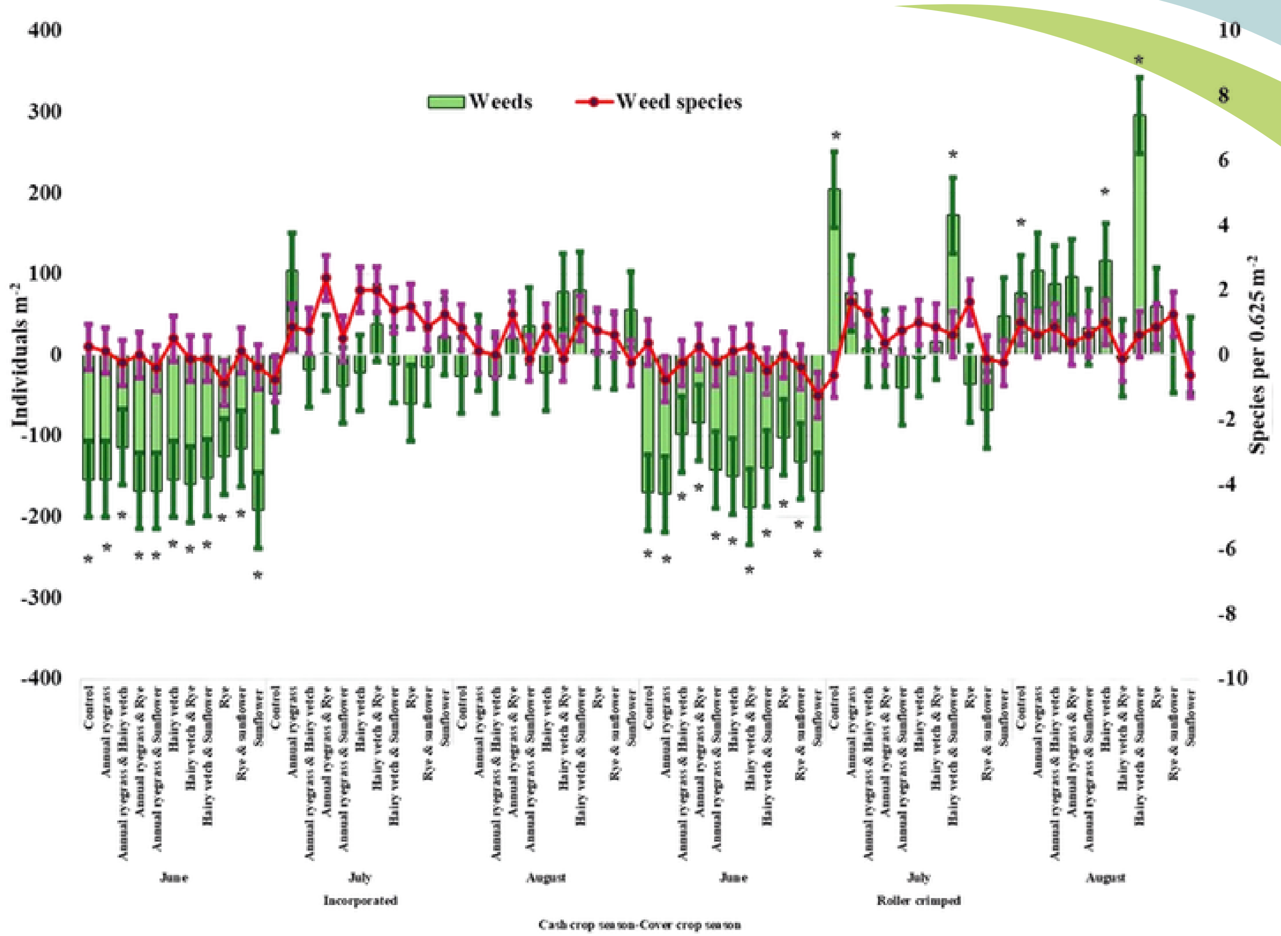


Figure 5-6. Differences (Cash crop season -Cover crop season) in Weed individuals and weed species computed from counts performed at three sample periods in 2025 in Fort Kent and St. Paul. *=difference in weeds between cash crop season and cover crop season is significant within the same sample period. N=176.

Conclusions

- No changes in yield across sites
  - However, St. Paul showed differences across cover crop spcies/mixes and termination method.
    - Canola yielded 35% more if sown in plots previously planted to annual ryegrass compared to yield from canola sown in plots previously planted to sunflower
    - Plots that were roller crimped had an overall 18% more yield than plots that were incorporated.
- Plots sown to Annual ryegrass + Rye in the cover crop season had 89.5% less weed biomass compared to that collected in plots sown to Hairy vetch + Sunflower.
- Weed individuals were suppressed as follows
  - In plots sown to Rye, Annual ryegrass + Rye and Rye + Sunflower
  - On plots terminated through incorporation
- In the cash crop season
  - All plots previously sown to annual ryegrass mixtures and incorporated were the least weedy compared to unseeded (control) plots and plots sown to sunflower and incorporated in the cover crop season
- Plots previously planted to hairy vetch + sunflower and roller crimped had 100% more weeds than plots terminated in the same fashion but previously sown to Rye + Sunflower, and Sunflower in the cover crop year

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Demonstration Trials

Cover Cropping - Forage mixes of Covers & Co.

Covers & Co provided the seed for a cover crop demonstration in 2025 in Fort-Kent.

Annual blends included:

1. Cool season cover
2. Dryland cover
3. Overwinter cover
4. Full season cover
5. Pearl millet
6. Sorghum-sudangrass

The cover crop blends were seeded in late June. Apart from the warm season crops, the blends didn't produce well until we received moisture in early august.

Pictures were taken on August 28th in Fort-Kent.

The full season and the dryland cover appeared visually to weather the drought better than the other blends.

Dryland Blend

Full Season Blend

Demonstration Trials

Oilseed and Pulses - Showcasing the impact of various agronomic practices on canola growth, development and yield

Canola is an oilseed crop mostly grown in western Canada. There are several factors that need to be considered in order to obtain optimal yields. These factors include seeding rate, seeding date, seeding speed, seeding depth and herbicide spray timing. This demo aimed to educate growers on how important these agronomic practices are in canola seeding and how they translate into crop development and eventual yield at the end of the season.

Alberta crop statistics has shown a decrease in canola production of 1.2% and a decrease in yield of 3.2% over the past 22 years (Crop statistics | Alberta.ca,2025). Alberta in 2024 showed a decrease in canola yield by 10.6% below the five-year average (Agriculture Alberta and Analytics Branch Data, 2024).

It is possible some of the decrease in canola yield, besides weather, can be attributed to poor BMP (best management practice) adoption. Yet canola remains one of the dominant cash crops for the region and it is one of the cash crops that brings the most economic profit to growers. With this visual education tool, growers may identify some plots seeded and associate them with problems they may have encountered in their own farms. As such, plots in this demonstration will show growers the importance of accounting for all the effects that may influence canola stands and consequently, canola yield.

Producers were invited to summer field tours and allowed to observe the difference of seeding rate, seeding date, seeding speed, seeding depth and herbicide spray timing effects in canola. In this way, there was a visual and clear difference between following the guidelines given for these effects and ignoring them. This demonstration was made to raise questions as to why demonstration plots are so different from each other, and we will use photographic observations to further demonstrate BMPs through other knowledge dissemination methods such as newsletters.

Objectives:

- To create a visual demonstration, where growers can see the impact of the following factors on canola growth, development and eventual yield in an educational setting
  - seeding rate,
  - seeding date,
  - seeding speed,
  - seeding depth, and
  - herbicide spray timing
- To use this demonstration as a practical take home message for growers, so they can see this demo and visually understand the basics for optimal canola planting in their own farming operations.

Materials and Methods

The demonstration was sown at Lakeland Agricultural Research Association headquarters in Fort Kent (54°18'N, 110°37'W). To total of fifteen plots will be set as follows:

Table 6B-1 List of treatments selected to display different factors influencing canola yield in Fort Kent, Alberta in 2025

	Seeding rate Plants foot^{-2}
1	4
2	6
3	8
	Seeding date
4	Second week of June
	Seeding speed Miles hour^{-1}
5	3.2
6	4.1
7	5.5
	Seeding depth
8	1.5cm
9	2.5cm
10	3.5cm
	Herbicide timing
11	1-4 leaf stage
12	Past 4 leaf stage
13	At bolting

As part of this demonstration trial, plots will be set at 6mX8m. To remove weeds before seeding, glyphosate was applied at 1L per acre. Liberty Link canola was planned to be seeded thus glufosinate at 1.6 litres per acre was applied in crop at the 1 to four leaf stage except in plots where herbicide timing was required to be at a different canola growth stage (treatments # 12 and 13).

Canola watch posed a scenario from the Ultimate Canola Challenge (Canola Council of Canada, 2018) where speeds of 3.5 and 5.5 miles/hour are tested if it is assumed growers usually seed at 4.5 miles/hr.

Phone conversations to two growers on March 19, at 2:30pm argued that speeds of 2 miles an hour were likely to be conducted in a shank seeder whereas with a disc seeder greater speed of 4, 4.5 up to 6 miles an hour are more likely. At the Lakeland Agricultural Research Association, we are in possession of a shank seeder that is attached to a tractor. The 3220 John Deere tractor has three gears B2 (3.2 miles/hr), B3 (4.1miles/hr) and B4 (5.5miles/hr). These were therefore the speeds used for this demonstration trial.

Overall Outcome:
This demo was placed at the right place, with the right people, at the wrong time. The week prior to our field tour (July 31, 2025), the Canola Council of Canada restructured, removing their agronomic team. As such, Canola Council agronomist, Keith Gabert, who was scheduled to present on the demonstration, was no longer able to attend either representing the Canola Council or as an independent agronomist. In his place, LARA research agrologist, Lance Ouellette delivered the presentation at the tour. Nevertheless, the tour was well attended, growers were interested in the demo and eventually is ended up being a success as it sparked reminiscence of personal experiences, and friendly repartee among growers.

Growers emphasized their following: (a), a lack of difference in plant density in canola sown at different seeding rates per square foot and (b); the importance of seeding speed, as plots sown at speeds greater than 3 miles per hour were sparser than the canola plot sown at the standard speed of 3.1 miles per hour.

Photos were taken to outline the differences among canola under various conditions. Plot treatments were changed from 14 to 13. One canola plot treatment was set for canola sown in the second week of May. However, as aforementioned, canola was sown in June and thus one plot (namely, "canola sown in the second week of June") was added instead. Overall, this issue was inconsequential since the canola plot sown as 6 plants per squared foot could be regarded as canola planted at the right time for comparison purposes. In conclusion, this demonstration was informative for growers, especially in which canola was (a) sown at greater speeds and (b) sown deeper in the soil. Both speed and depth impacted plant density and eventually would impact yield as number of plants were lower compared their controls (canola sown at 3.1 miles per hour and at 1.5cm depth respectively).

Differences in canola seeding rate were not major as per visual assessments. Most plots showed almost the same plant density.

Plots where canola was sprayed, at 1-4 leaf stage, past the 4 leaf stage and at bolting stage respectively did show differences in plant density. More canola plants were observed when these individuals were sprayed at the 1-4 leaf stage compared to the other two plots in the demonstrations. Moreover, these plots showed that past the 4 leaf stage and bolting, the spraying for weed management is negligible compared to spraying at earlier stages.

Canola sown at speeds such as 4.1 and 5.5 miles per hour was not ideal. Plots where canola was sown at this speed showed more empty spaces between canola individuals compared to the canola plot sown at 3.2 miles per hour. Difference in speed thus illustrate that canola requires sufficient time to be placed in the soil and subsequently buried with a hoe drill and greater speeds impede for this process to be carried out properly.

Through visual ratings, canola depth showed to be influential in plant development. Less canola plants were observed in plots where seed was sown as deep as 3.5cm. Differences between 1.5 and 2.5cm depths did not show outstanding differences.

Demonstration Trials

Oilseed and Pulses - Camelina and Ethiopian variety showcase

The seed for this demonstration trials was provided by Dr. Christina Eynck. She is a research scientist and specialty crop breeder at Agriculture Agri-Food Canada (Saskatoon). The goal of the demonstration was to showcase both camelina (Camelina sativa) and Ethiopian mustard (Brassica carinata) to producers during our field day (July 31st, 2025). Dr. Eynck was present at the field day, and she gave an excellent presentation on the agronomics, cultivar selection, and opportunities as a future crop in the Canadian prairies. Three cultivars of each were on display. Main take home was that camelina may be a better fit for our climate. It has a different oil profile than canola. Exceptionally high in alpha-linolenic acid (Omega-3). Camelina is the richest source of plant-based omega-3s after flax. Be on the lookout for new cultivars that are entering the market!

Camelina

Ethiopian Mustard

Demonstration Trials

Oilseed and Pulses - Narrow and wide lupin showcase

The lupin demonstration trial was sown in Smoky Lake. In this demonstration there were three varieties of narrow leaf lupin (Boregine, Lunabor and Probor) and one variety of wide leaf lupin (Dieta). Seeds for these varieties were kindly provided by Robyne Davidson at Lakeland College. These varieties were kindly donated because they show the most promise for production and commercialization in Canada.

Overall, the narrow leaf lupin varieties can be identified by their flower. It is most likely that white flowers belong to plants from the Boregine variety whereas Lunabor and Probor possess violet and blue flowers respectively. Probor plant stands tend to be the shortest narrow leaf lupin variety in comparison to Boregine and Lunabor. Seeds in the Probor narrow leaf lupin variety are the lightest in comparison to seeds from the Boregine variety, whereas Lunabor seeds are in between Probor and Boregine. Ultimately Lunabor is considered to be the most yielding variety followed by Boregine and Probor. Among these latter varieties, there not much difference in yield.

Protein content in lupin can be found to be between 30 to 55% in the seed. As such, Lupin content in narrow leaf lupin varieties such as Lunabor and Probor is considered the same, however, both of these varieties have greater seed protein content than that found in seeds from the Probor variety.

As for wide leaf lupin, Dieta is a bitter free variety. This is important to mention because grains are thus palatable for livestock and thus used as an alternative to other grains such as field pea and faba bean. Wide leaf lupin senescence does not quite concord with our weather changes here in Canada. Hence, by the time summer ends and fall makes its way, white lupin needs to be desiccated around the same time a grower will plant to desiccate their faba bean plants. Currently, white lupin has been marketed for human consumption in various organic food outlets as a healthy source alternative for protein.

Despite the transcending efforts done by Robyne Robinson and their team at Lakeland College, lupin has had a struggle to settle into the crop rotation in the Canadian Prairies. This is because the weed management options in lupin are very limited as only Sencor ® (Metribuzin) is the only herbicide registered for in crop application. In other parts of the world such as Europe and Oceania, herbicides such as Prowl ® (Pendimenthalin) or Venture ® (Fluazyfop-p-butyl) are alternatives used for broadleaf and grassy weeds respectively. It is envisioned that the Canadian Pesticide Management Regulatory Agency (PMRA) can in the future provide some flexibility and allow more choices of chemical weed management for this crop.

Horticulture Program

The Lakeland Agricultural Research Association's Horticulture Program continues to thrive as a hands-on educational initiative that connects students, producers, and community members to local food systems, soil health, and sustainable growing practices. Through a diverse range of gardens, demonstration plots, and learning opportunities, the program emphasizes practical skills, ecological awareness, and long-term land stewardship.

The program includes a perennial garden, a tilled vegetable garden, a no-till demonstration garden, and an active greenhouse. Together, these spaces provide opportunities to explore both conventional and regenerative growing methods while highlighting the relationship between food production and ecosystem health.

The perennial garden represents a long-term investment in both food security and ecological resilience. It features hardy crops that return year after year, including sour cherries, currants, plums, raspberries, saskatoons, and sea buckthorn. Many of these plantings are integrated into shelterbelts across the research farm, demonstrating how perennial food systems can be incorporated into broader farm landscapes to support biodiversity, wind protection, and soil health.

Tilled Garden

In 2025, the tilled vegetable garden was planted as a Three Sisters garden, a companion-planting method that grows corn, beans, and squash together. This garden demonstrated the synergy between crops that support one another both above and below ground—corn providing structure, beans fixing nitrogen, and squash suppressing weeds and conserving moisture.

The garden was planted by a Grade 6 class from Ardmore School through LARA's Junior Gardeners Program, providing students with hands-on experience in planting, teamwork, and food-system education.

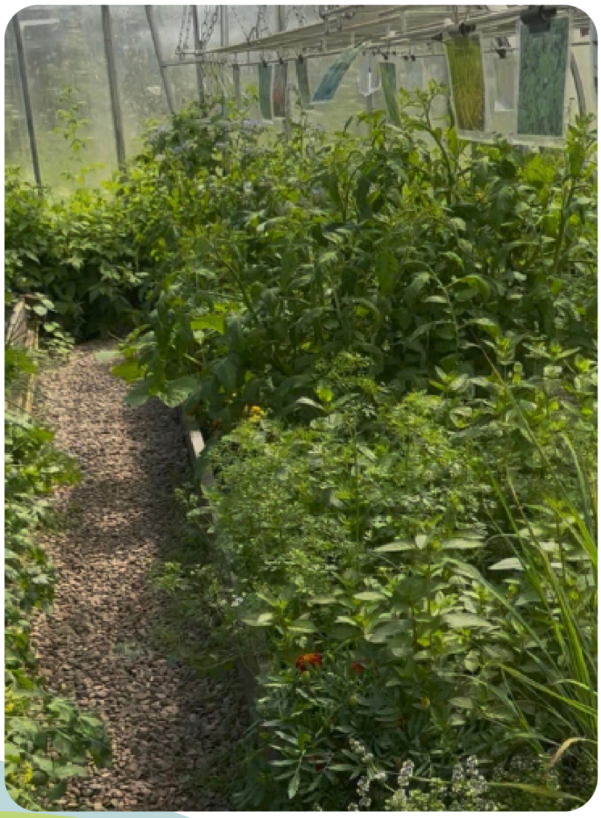
No -Till Garden

The no-till garden, established in 2024 in partnership with Kim Ross of Rossdale Farm, continues to focus on soil health and regenerative practices. Crops grown in 2025 included cabbage, broccoli, zucchini, pumpkins, and winter squash. Early in 2025, minor layout modifications were made to address site-specific challenges. The garden is located in a low-lying area that retains moisture and is prone to early frost. To improve drainage and reduce frost risk, rows were hilled and covered with straw, which helped mitigate excess moisture in wet periods and provided some protection during early frost events. While cabbage moth pressure was an issue, plans are in place to use protective netting for brassica crops in the 2026 growing season.

Greenhouse

The greenhouse was especially productive this year, with plantings that included tomatoes, peppers, onions, melons, broccoli, cabbage, asparagus, herbs, borage, marigolds, and nasturtiums. The inclusion of flowering plants supported pollinators and beneficial insects while helping deter common garden pests. Prior to planting, beds were enriched with compost sourced from E Tree Farms.

Key lessons learned included the need for improved airflow, as high planting density likely contributed to a whitefly infestation later in the season. Drip irrigation was also added and performed well overall; however, additional drip lines will be installed in future years to better manage watering needs during periods of extreme heat.



Community

A key outcome of the Horticulture Program is its contribution to community food security and experiential learning. Produce harvested throughout the growing season was donated to a variety of local recipients, including Ardmore School, Bonnyville Lodge, and the Bonnyville Friendship Centre. In addition, a portion of the harvest was incorporated into meals served at LARA-hosted workshops and events, allowing participants to directly experience locally grown food while reinforcing the connection between sustainable production, education, and community nourishment.

The Horticulture Program is supported by LARA's municipal partners, the MD of Bonnyville, County of St. Paul, and Smoky Lake County as well as West Coast Seeds. Through continued partnerships, adaptive learning, and community engagement, the program remains a valuable platform for education, innovation, and sustainable food production in the Lakeland region.

Lakeland Forage Association

The Lakeland Forage Association (LFA) was formed in 1972 to promote the management and use of forage crops, and to identify and pursue the forage crop research needs of Northeastern Alberta. The LFA provides forage demonstrations, extension activities and coordination of forage research. The governing board of directors currently has 13 members who are elected for staggered three-year terms at the LFA annual general meeting. They are responsible for the management of the Olympic Lake Grazing Lease. The Olympic Lake Lease was obtained by LFA in 1985, has grown to 2000 acres and has been used for two main projects: the Northern Range Enhancement Project (NREP) and the Olympic Lake Heifer Project. Under the NREP, this lease was used as a demonstration for turning boreal forest land into an enhanced, sustainable rangeland. Range improvements have included clearing and breaking the land, windrowing, and spraying and burning. This pasture has been rotationally grazed for 20 years (currently there are 12 paddocks) and so fencing was also involved in the range improvements. Grazing capacity has almost doubled in the past 20 years. Now that the pasture has been developed the focus has changed from development to increasing pasture longevity and rejuvenating older pastures. Projects with this goal have included yearly rotation of fertilizer application, spraying weeds (trials have included Grazon, Remedy, and Restore) and introducing legumes into the pastures. The Heifer Project has been tracing the effect of body weight and body condition on heifer fertility for over ten years. The heifers are weighed at the beginning and the end of the grazing season. These measurements are then compared to the fall pregnancy test results. From 2010 to 2013, the heifers were weighed two additional times, when they are switched from tame pasture to native brush pastures around the end of July and then when they switch from these native pastures back to the tame pastures around mid-September. LFA would like to thank Dale Glover, who managed the pasture for his second year and did a fantastic job!

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Northern Range Enhancement Project

Objectives:

1. To monitor the weight of heifers entering and exiting the pasture.
2. To evaluate methods of pasture rejuvenation.
3. To develop a complimentary grazing system, allowing for maximum utilization of tame and native species.

Background:

The Lakeland Forage Association (LFA) obtained Grazing Lease N. 840055 from the provincial government in 1985. The lease is located in Lac La Biche County near Olympic Lake (NE17-64-14) and was originally 1500 acres. A second lease was obtained by LFA to increase the pasture to 2000 acres. At the time the lease was obtained, the pasture had not been grazed for 15 years and no formal range improvement had taken place.

The LFA has used the Olympic Lake Grazing Lease as a demonstration for turning boreal forest land into an enhanced sustainable rangeland. Four different treatments have been used to increase carrying capacity: 1) clear and break, 2) spray and burn, 3) windrowing and 4) fertilizing. Rotational grazing has been practiced for the past 20 years and management improvements, such as cross-fencing, fertilizing and spraying, have been utilized to increase carrying capacity. The pasture has gone from carrying 998 Animal Unit Months (AUMs) in 1990 to 1607 in 2006. In 2010 1130 AUM's were grazed on the pasture, allowing some recovery from the drought in 2009. The cattle are rotated through the paddocks in a high intensity, low frequency grazing system.

Now that the pasture has been developed the focus has changed to increasing pasture longevity and pasture rejuvenation. Similar to other pastures in Northeastern Alberta, aspen encroachment and old pastures are a problem.

Every year approximately 11 patrons are given allotments for up to 30 heifers and one bull. The grazing season typically runs from mid-June to early-mid October. Patron applications are due by January 31 of each year.

In 2025, there was one project at the Olympic Lake Grazing Lease.

- Heifer project

Methods:

The heifers were weighed when they entered the pasture on June 12, 2025. The Bulls were pulled on August 12, 2025, allowing for a 60-day breeding period. At this time the heifers were weighed for a second time. Due to the dry conditions, heifers were removed from the pasture on September 13, 2025, allowing for adequate grass carryover for the 2026 grazing season. The heifers were weighed for a third and final time during the heifer take-out day in September. Similar to previous years the heifers were not pregnancy checked. The pasture received less than 5 inches of rain over the grazing season.

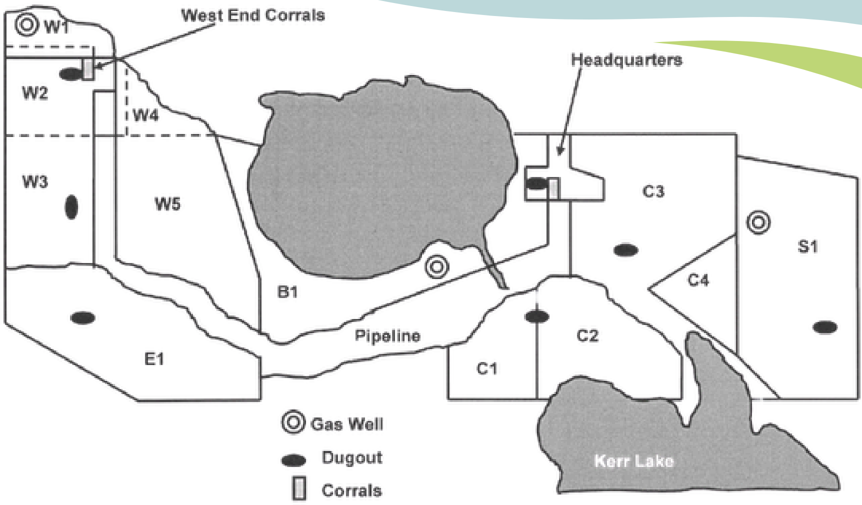


Figure 1. Map of the Northern Range Enhancement Project (NREP) pasture system.

Results and Discussion:

There was a total of 94 days in the grazing season at Olympic Lake Grazing Lease.

There was a total of 13 patrons grazing cattle at Olympic Lake in 2025 with herd size ranging from 30 heifers and 1 bull to 60 heifers and 2 bulls in partnerships. All red or black angus heifer bulls were used for breeding between June 12, 2025 and August 12, 2025. The average daily gain (ADG) throughout the season was 1.02 lbs/day. The stocking rate at the Olympic Lake Lease has slowly declined since 2009, which has allowed for significant recovery and improvement of the pasture.

The pasture received less than 5 inches of rain in 2025, which led to an earlier take-out day from the pasture to ensure adequate grass carry-over and regrowth potential for the 2026 grazing season.

The stocking rate at the Olympic Lake Pasture has slowly declined since 2009, which has allowed for significant recovery and improvement to the pasture. The historical data for the pasture is summarized in table 2.

Table 2. Historical data from Olympic Lake Grazing Lease, 2003-2024.

Year	Grazing Season (days)	# of Head	Weight Gain	ADG	% Open
2003	131	410	116	0.9	10
2004	127	427	163	1.35	10
2005	127	439	156	1.22	13
2006	127	462	-	-	18
2007	126	435	130	1.03	18
2008	128	369	224	1.76	14
2009	111	410	124	1.13	19
2010	120	350	170	1.43	14
2011	121	350	223	1.86	14
2012	126	343	139	1.1	9
2013	120	336	205	1.71	11
2014	133	271	266	2	28
2015	121	280	-	-	-
2016	123	350	141	1.16	-
2017	105	388	158	1.29	-
2018	113	410	123	1.17	-
2019	117	390	152	1.24	-
2020	99	399	181	1.55	-
2021	116	386	142	1.44	-
2022	109	388	138	1.26	N/A
2023	-	-	-	-	-
2024	106	395	140	1.32	-

Statistical Terms

*Adapted from Dr. Stephen Bowley from Bowley S.R. A hitchhikers guide to statistics in Plant Biology. 2008 2nd Ed. Any old subject books. Guelph, Ontario, Canada.

Analysis of variance

- Statistical test to compare the means of various treatments in an experimental design.
- The analysis artitions the variance of the experiment into recognizable sources (generally the effects and the error).
- This analysis assumes that (1) all effects in the model are additive and (2) experimental errors are random, independent and normally distributed when sampling from the population

Coefficient of variance

- The coefficient between the standard deviation and the mean.
- Typically used to evaluate the robustness of the data. However, it is an incorrect assumption because it does not account for other factors that may influence the statistical analysis such as:
  - independence among means, randomness of the data, or normal distribution of the observations drawn from the population.
- Is inaccurate to assume validity of the coefficient of variance if other uncontrolled and uncontrollable factors were not assumed to occur or blatantly ignored despite having a major influence in the outcome of the data.
  - Uncontrolled and uncontrollable factors include precipitation, wind, soil characteristics (moisture, texture, micro and macro nutrients, organic matter, etc.)
  - Factors mentioned may veer away from a "satisfactory" CV. This, however, does not mean data is unusable.

Degree of freedom

- Computed as N-1
- It is the amount of information available to estimate fixed, random effects, their interactions and the residual of error.

Experimental design

- It is a structured plan where experimental units are arranged randomly and independent from treatments and replicates of these treatments.
- In completely random block designs, experimental units are randomized at each block or replicate.
- Factorial designs consist of having levels for each factor and thus each treatment is the combination of those levels.
- A split plot is when one main factor that divided into smaller (split) factors, making interactions between factors are less random and more localized. A split plot factor is when the main factor is split into a secondary factor, and the location of the split factors is random at each replicate.
- A split block factor can be similar to a split plot but instead it has a set order of split factors within the main factor, across replicates.

A	B	C	D
B	C	D	A
C	D	A	B
D	A	B	C

Complete Randomized Design (CRD)

D	C	A	B
C	D	B	A
D	B	C	A
C	B	D	A

Randomized Complete Block Design (RCBD)

A1 B1	A1 B2	A1 B3	A2 B1	A2 B2	A2 B3
A1 B1	A1 B2	A2 B2	A2 B1	A2 B3	A1 B3
A1 B2	A2 B2	A2 B1	A1 B1	A1 B3	A2 B3
A2 B3	A1 B2	A2 B2	A2 B1	A1 B1	A1 B3

Factorial design

Factor A
A1 and A2

Factor B
B1, B2 and B3

B	B	C	B	C	E	E	C
F	A	B	A	E	C	F	D
A	E	D	C	B	D	D	A
E	C	A	E	A	F	C	B
C	F	E	D	D	B	B	F
D	D	F	F	F	A	A	E

Split plot design

Main plot

Split plot: A through F

B	D	C	A	C	B	A	D
B	D	C	A	C	B	A	D
B	D	C	A	C	B	A	D
B	D	C	A	C	B	A	D
B	D	C	A	C	B	A	D
B	D	C	A	C	B	A	D

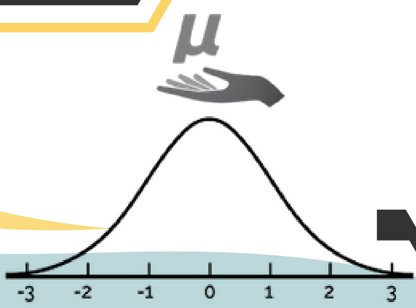
Split block design

Main plot

Split plot: A through D

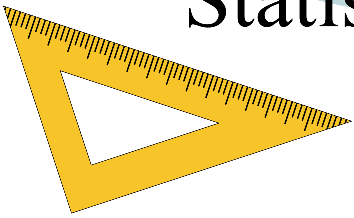
Mean

- The most common measure of central tendency.
- The coefficient between the total of the observations and the number of observations.
- In laymen terms, the sum divided by the count.

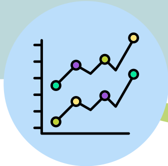


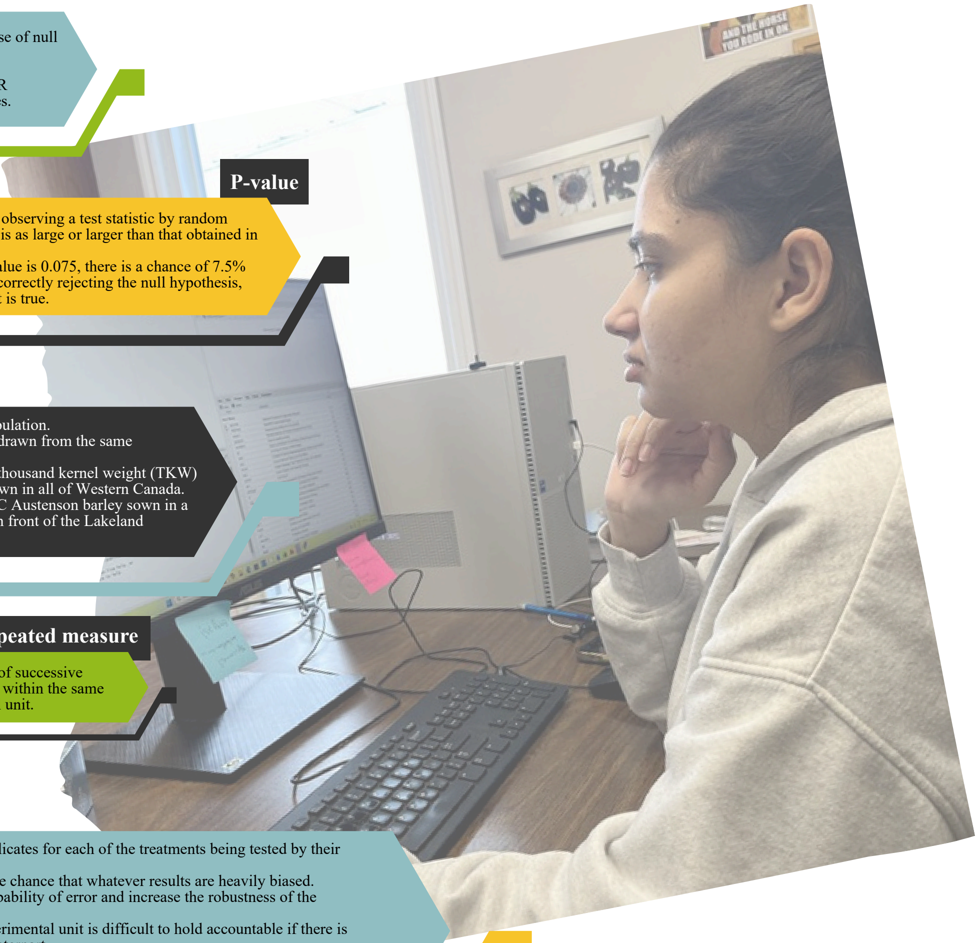
Normal distribution

- Symmetrical bell-shaped distribution.
- The centre of the distribution curve is where the mean is located.
- How tall the curve represents the population variance around the mean.
- Normal probability plot shows if observations follow an expected (normal) distribution.



Statistical Terms





Null hypothesis

- Every experiment is conducted on the premise of null hypothesis.
- Expressed as such:
    - the mean is equal to a specified value OR
    - there is no difference between two values.

P-value

- Likelihood of observing a test statistic by random sampling that is as large or larger than that obtained in the study.
- Example: P value is 0.075, there is a chance of 7.5% that we are incorrectly rejecting the null hypothesis, when in fact it is true.

Parameter vs. statistic

- Parameter is a constant for a particular population.
- Statistic may vary from sample to sample drawn from the same population.
- Example: A parameter could be the mean thousand kernel weight (TKW) value of CDC Austenson barley variety sown in all of Western Canada. A statistic could be the mean TKW of CDC Austenson barley sown in a field trial in the Fort Kent research farm, in front of the Lakeland Agricultural Research Association office.

Repeated measure

A recording of successive observations within the same experimental unit.

Replicates vs. Blocking

- Experimental design must have replicates for each of the treatments being tested by their corresponding experimental units.
    - Failure to replicate increases the chance that whatever results are heavily biased.
- Replicates are set to reduce the probability of error and increase the robustness of the experimental design.
    - A treatment with only one experimental unit is difficult to hold accountable if there is no other experimental unit counterpart.
- Replicates (each set of experimental treatments) are often denominated blocks.
    - The variation among blocks is maximized and the variation within blocks is minimized.
- The variation among blocks does not affect the mean value because each treatment appears the same number of times at each block.

Sample size

The sample size, known as N is the total number of samples taken for a specific response.

Standard deviation vs. Standard error

- When you subtract the mean by each of the observations that composed it, square (x^2) each difference, and sum them all up, you have variance.
- The square root (√) of the variance is the standard deviation.
- In a trial, standard deviation is a sample standard deviation, drawn from a population.
- Sample standard deviation tends to vary from sample to sample from the same population.
- While standard deviation denotes dispersion of the population of observation, standard error denotes dispersion of the distribution of the actual mean value.