

About LARA

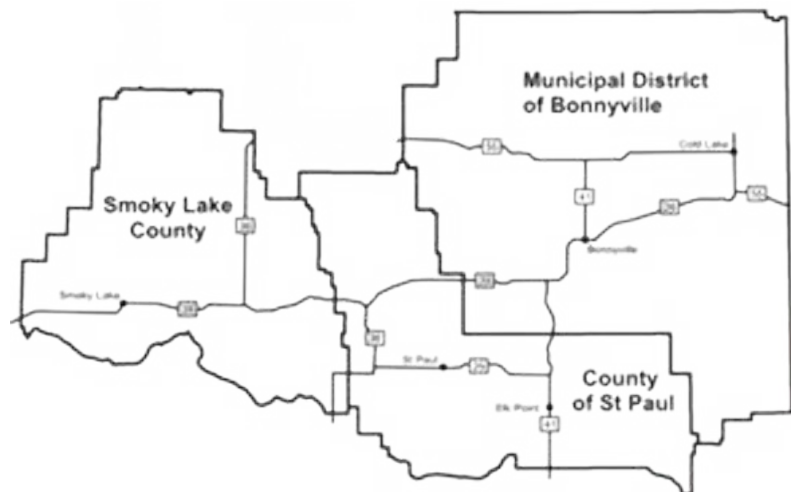
Lakeland Agricultural Research Association (LARA) is a producer-directed organization conducting leading edge applied agricultural research and extension in Northeastern Alberta, serving the Municipal District of Bonnyville, County of St. Paul and Smoky Lake County. Through applied research, demonstration and extension activities, our objective is to 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

Vision Statement:

To be a leader in applied research and extension in Alberta

Mission Statement:

Lakeland Agricultural Research Association conducts innovative, unbiased, applied agricultural research and extension, supporting sustainable agriculture.



(780) 826 7260



5311 - 50 Avenue
Fort Kent, Alberta
T0A 1H0



Box 7068
Bonnyville, Alberta
T9N 2H4



www.laraonline.ca

Table of Contents

2024-2025 Board of Directors.....	4
LARA Staff.....	5
Message from the Chair.....	6
Message from the Executive Director.....	7
Acknowledgements.....	8
2024 Weather Summary.....	9
Average Temperature Summary by site.....	10
Cumulative Precipitation Summary by site.....	11
Explanation of Statistical Analysis in this Report.....	12
Extension Summary.....	13
Cropping Research Program.....	17
Cereal Regional Variety Trials.....	18
Canadian Western Red Spring Wheat.....	20
Canadian Prairie Spring/Special Purpose/Soft White Wheat.....	21
Triticale.....	22
Oat.....	23
Pulse Variety Trials.....	26
Faba Bean.....	27
Yellow and Green Field Pea.....	27
Lupin.....	29
LARA Cropping Trials.....	32
Evaluating row spacing in inter seeding and intercropping systems for weed management.....	33
Impact of allelopathic cover crops and its termination method in cash crops grown subsequent season.....	38
Forage Research Program.....	45
Silage Regional Variety Trials.....	46
Barley.....	48
Oat.....	50
Triticale/Wheat.....	52
Sustainable Canadian Agriculture Partnership Trials.....	53
Evaluation of early seeded multiple-cuts winter cereals for livestock feed as a drought management strategy in Alberta.....	54

Integrated use of organic and inorganic fertilizers for forage barley production in Northeastern Alberta.....	59
Performance evaluation of two-row and six-row forage barley mixtures.....	64
LARA Forage Trials.....	72
Investigating the impact of low-growing clovers (subterranean and white clover) and nitrogen rates on silage crop yield, weed pressure, cereal leaf disease levels, and forage quality.....	73
Environmental Program.....	77
Demonstration Equipment.....	78
Funding Opportunities.....	79
Environmental Farm Plans.....	81
Horticulture Program.....	83
Fruit Orchard.....	84
Greenhouse.....	85
Implementation of no-till vegetable garden.....	86
Lakeland Forage Association.....	87
About Lakeland Forage Association.....	88
Board of Directors.....	89
Northern Range Enhancement Project.....	90
Appendices.....	93
Livestock Nutrition.....	94
Definition of common feed nutrition terms.....	94
Forages and cattle nutrient requirements.....	96
CowBytes Ration Balancing Software.....	98

2024-25 Board of Directors

Lakeland Agricultural Research Association is governed by a volunteer board of directors from across our operational area. This includes one council representative and one alternate as well as two producer representatives from the County of St. Paul, Smoky Lake County and the Municipal District of Bonnyville. The board also includes a representative from the Lakeland Forage Association (LFA) and the LFA board acts as a forage advisory committee to LARA.

Jay Cory
Chair
LFA Rep

Amanda Fischer
Vice-Chair
Smoky Lake County

Murray Scott
Treasurer
MD of Bonnyville

Nick Kunec
Producer Rep
MD of Bonnyville

Phil Amyotte
Producer Rep
County of St. Paul

Dan Gawalko
Council Rep
Smoky Lake County

Patrick Elsen
Producer Rep
County of St. Paul

Louis Dechaine
Council Rep
County of St. Paul

Charlie Leskiw
Producer Rep
Smoky Lake County

Don Slipchuk
Council Rep
MD of Bonnyville



Left to right: Dan Gawalko, Amanda Fischer, Charlie Leskiw, Jay Cory, Patrick Elsen, Louis Dechaine, Phil Amyotte, Murray Scott, Nick Kunec and Don Slipchuk



LARA Staff

Cropping Agrologist

Momna Farzand
cropping@laraonline.ca
(780) 812 1037

Executive Director

Alyssa Krawchuk
director@laraonline.ca
(780) 826 1130

Research Scientist

María Angélica Ouellette
angelica@laraonline.ca
(780) 812 1392

Research Agrologist

Lance André Ouellette
lance@laraonline.ca
(780) 812 1048

Research Technician

Dustin Roth
technician@laraonline.ca
(780) 812 1036

Administration/ Horticulture

Charlene Rachynski
admin@laraonline.ca

Environmental & Communications Coordinator

Kristy Tetreau
kristy@laraonline.ca
(780) 573 6076

Summer Staff

Graham Broda
Koleton Broda
Rhys Hiar
Aletta Deschaine



Message from the Chair

This is my first year as chair of Lakeland Agricultural Research Association (LARA), but I have been part of the organization in some form since my dad started bringing me to LARA events as a child.

It has been a good year! We have a good team of employees including Alyssa, Lance, Angelica, Momna, Dustin, Kristy and Charlene along with a great crew of summer staff. The LARA employees all have different strengths and weaknesses and Alyssa is doing a good job managing them. The board is easy to get along with and highly supportive of LARA's short and long-term goals. Thank you to our current board members for their dedication to the organization. Murray Scott has served three terms on the LARA board and will be stepping back this year. We thank him for his years of service. Murray has always been a calm and level-headed voice on the board and has volunteered on many committees.

Along with conducting innovative and unbiased research trials and hosting over 25 extension events each year, LARA has been filling a void left by the Alberta Government by helping farmers fill out applications for various government funding programs. I know many farmers need their help navigating these programs and I believe this is a very important service LARA has to offer. It brings a lot of resources into the area and has a large impact on the farmers that use them.

Thank you to the County of St. Paul, MD of Bonnyville and Smoky Lake County for their continued support of LARA's programming. This spring, Lac La Biche County made the decision not to continue partnership with LARA and pulled their funding. I know Alyssa and the board spent countless hours of meetings and discussion with the County and we were sad to see them leave after over 30 years of partnership.

The Alberta Government has recognized the importance of unbiased applied research organizations across the province and has committed \$3.2 million to the Alberta Applied Research Associations (ARA) to use for capital investment. We plan on purchasing a new tractor, seeder, sprayer and other small plot equipment to expand our research capabilities.

Local farmer representation on our board of directors is a key component of LARA and we are looking for two new farmer representatives to join our board. If you think you would like to be part of an innovative organization and would like to help guide LARA, we welcome your nomination at our Annual General Meeting. The board of directors we have is a good group and we have great staff. If you are not on the board, but still have questions or concerns, please talk to a board member or staff. We are always looking for new ideas and ways to improve.

Thank you to all of the individuals, organizations and industry that supported LARA this past year.

Message from the Executive Director

This past year has presented many challenges to the agriculture industry in the Lakeland and across Alberta. From low precipitation levels to weeks of extreme heat, the environment had a huge impact on grain, forage and livestock producers alike.

Lakeland Agricultural Research Association continues to be a local source for agriculture innovation, research and education for our local community. We have a passionate team dedicated to improving and advancing the agriculture industry and the profitability and sustainability of our farming community.

We welcomed three (3) new staff members this past year: Lance Ouellette as a Research Agrologist, Dr. Angelica Ouellette as our Research Scientist and Kristy Tetreau as our Environment & Communications Coordinator. Each of them has brought unique skills and knowledge and it has been great to see them grow and develop into their new positions. I look forward to seeing what they will continue to bring to the organization into the future.

I want to say a huge thank you to everyone who participated in our research and extension programming at LARA this past year. A huge thank you to all of the hard-working and dedicated board members and to the many producers who continue to support our programming. It has been a challenging year, but your continued support ensures that regional research and extension continues in the Lakeland.

I am looking forward to another successful year in 2025!

Sincerely,

Alyssa Krawchuk

Acknowledgements

Without the generous support and commitment of our funding partners, we would not be able to conduct the cutting edge, innovative research or provide the extension events and services 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

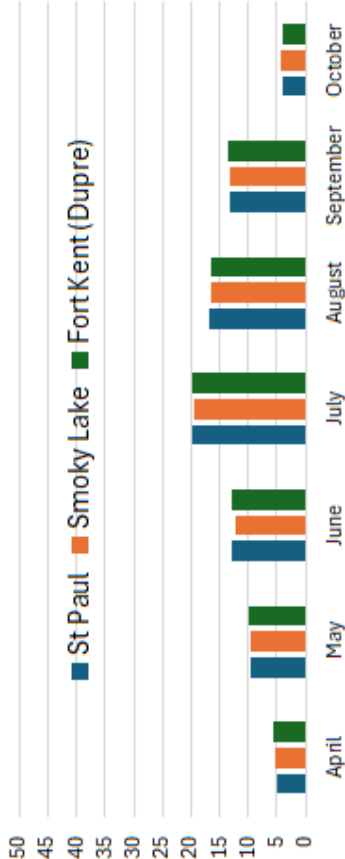


2024 Weather Summary

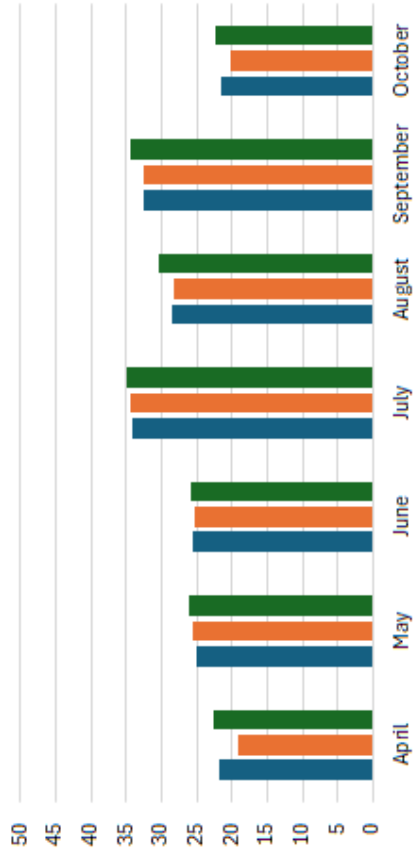
Weather average values in temperature, precipitation and growing degree days. St Paul, Smoky Lake and Fort Kent (Dupre weather station) in the 2024 growing season.													
Site	Month	Temperature					Precipitation					Growing Degree Days Long Term (base 5°C) (GDD)	
		°C					mm						
		2024	2019-2023	Minimum	Maximum	Average	2024	2019-2023	Precipitation (mm)	Cumulative Prep (mm)			
St. Paul	April	-8.6	-14.4	21.8	18.7	5	1.9	12.8	9.8	32	835.6	37.5	38.9
	May	-5.4	-3.0	25.1	26.3	9.5	11.2	55.1	31.8	71.2	874.8	204.3	205.7
	June	1.2	3.8	25.5	28.2	12.9	15.9	46.1	98.1	144.9	948.5	482.1	483.5
	July	6.9	7.1	34.1	29.8	19.7	17.5	32.1	61.4	223.6	1027.2	844.3	845.7
	August	4.5	3.4	28.4	30.0	16.8	16.5	42.9	47.1	276	1079.6	1169.4	1170.8
	September	1.4	-2.3	32.5	26.4	13.3	11.7	68.6	14.3	307.6	1111.2	1336.5	1337.9
	October	-5.7	-12.2	21.4	20.4	4.1	3.1	12.8	13.2	327.8	1131.4	1370.0	1371.4
Smoky Lake	April	-8.0	-13.1	19.2	18.8	5.2	2.4	43.6	14.2	25.3	848.6	37.7	39.0
	May	-3.2	-4.2	25.6	25.9	9.6	10.9	61.9	39.8	66.8	890.1	201.8	203.1
	June	-1.2	2.6	25.2	27.9	12.4	15.0	62.1	101.4	153	976.3	468.3	469.6
	July	5.0	6.1	34.5	30.1	19.5	16.8	50.4	99.3	233.1	1056.4	818.1	819.4
	August	5.8	3.0	28.1	29.6	16.5	15.9	15.8	61.7	282.8	1106.1	1132.3	1133.6
	September	0.9	-1.8	32.4	25.9	13.2	11.4	40.5	12.9	314.5	1137.8	1292.2	1293.5
	October	-4.5	-11.2	20.2	19.7	4.4	3.4	21.8	17.1	335.4	1158.7	1325.9	1327.2
Fort Kent (Dupré)	April	-9.5	-15.92	22.6	19.32	5.5	2.18	11	11.72	31.2	870.08	36.6	37.88
	May	-3.9	-5.1	26	26.96	10	11.02	50.9	24	71.9	910.78	200.2	201.48
	June	0.9	3.18	25.7	29.2	13	15.78	71	103.34	153.6	992.48	478.4	479.68
	July	6.6	5.1	34.9	30.7	19.8	17.32	52.9	44.68	233.6	1072.48	840.4	841.68
	August	3.5	2.84	30.5	31	16.6	16.14	39.2	54.3	287.1	1125.98	1,161.20	1162.48
	September	1.7	-3.88	34.5	26.52	13.4	11.24	45.3	16.94	321.1	1159.98	1,324.10	1325.38
	October	-6.4	-12.44	22.3	20.86	4.1	3	15	13.26	343.3	1182.18	1,357.50	1358.78

Average Temperature Summary by site

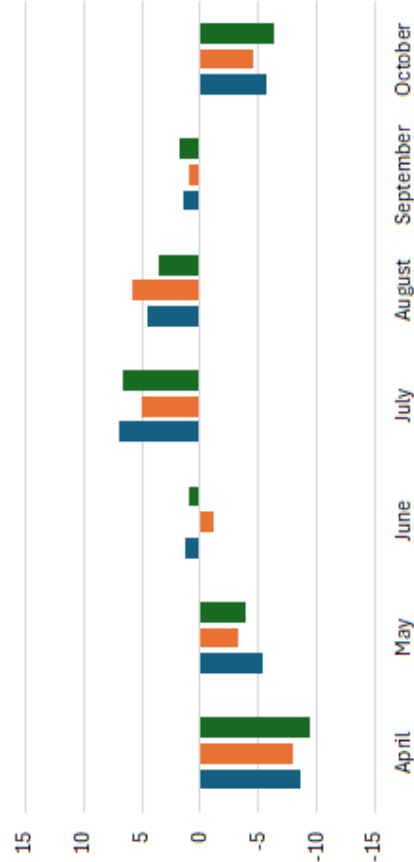
Average Temperatures (°C) in St. Paul, Smoky Lake and Fort Kent (Dupre weather station)



Maximum Temperatures (°C) in St. Paul, Smoky Lake and Fort Kent (Dupre weather station)

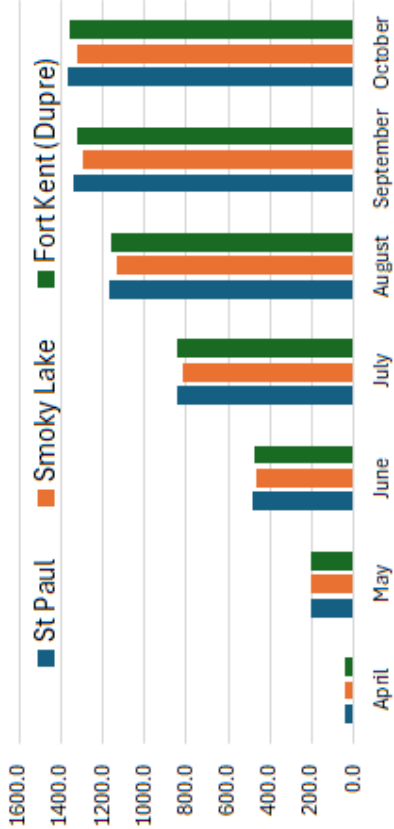


Minimum Temperatures (°C) in St. Paul, Smoky Lake and Fort Kent (Dupre weather station)

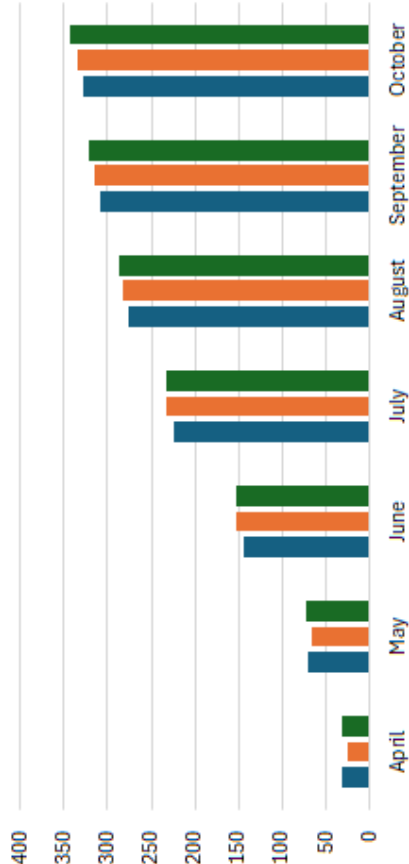


Cumulative Precipitation Summary by site

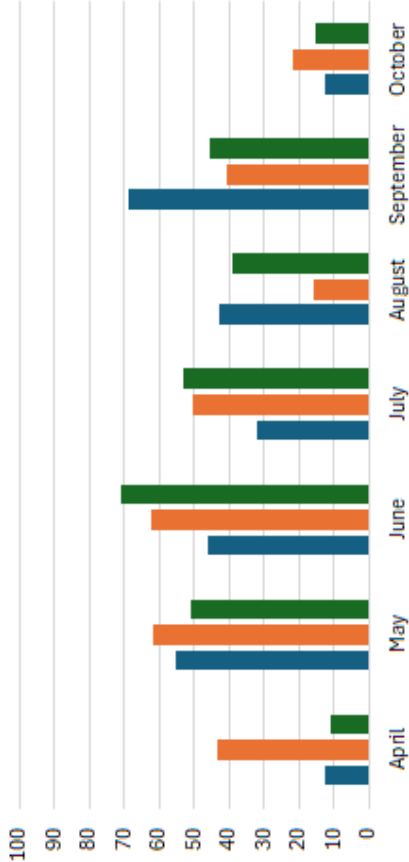
Growing degree days (GDD) in St Paul, Smoky Lake and Fort Kent (Dupre weather station)



Cumulative precipitation (mm) in St Paul, Smoky Lake and Fort Kent (Dupre weather station)



Average monthly precipitation (mm) in St Paul, Smoky Lake and Fort Kent (Dupre weather station)



Explanation of Statistical Analysis in this Report

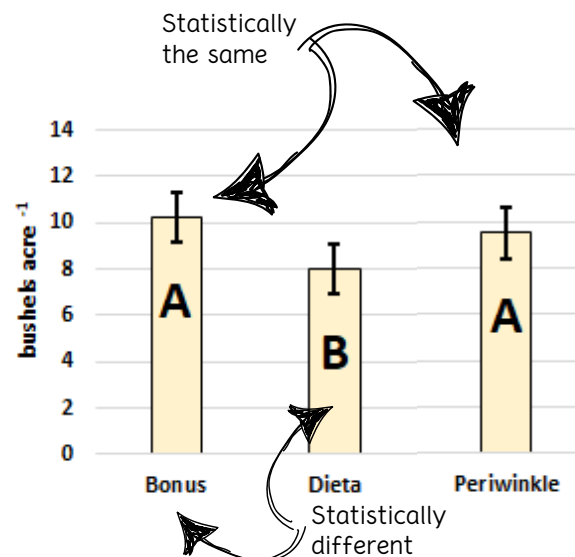
Statistical analyses are used by the Lakeland Agricultural Research Association to determine differences among treatments in variety trials, proprietary trials and research funded trials. Responses such as emergence, height, florescence, maturity, and of course yield are considered dependable variable because they are impacted by variables that were not manipulated during the experiment. Those unmanipulated variables are known as independent. Soil type, agrochemical applications, drought, weather parameters such as temperature, humidity, light exposure are considered independent because they produce measurable effects on the crop plant 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. This is important because they provide a quantitative answer as to why effects varied according to treatment applied.
- They can affirm or deny provable statements that may explain the outcomes observed from assessed dependable variables.

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: lupine 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 lupine 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.



Extension Summary

January 29, 2024 Webinar	Funding Opportunities: Resilient Agriculture Landscapes Program (RALP)	RDAR, LARA Municipal Partners
January 31, 2024 Webinar	Livestock Water Management: A Whole Year Approach. Part 1 - Water & Livestock Health	RDAR, LARA Municipal Partners, WCVM
February 7, 2024 Vilna Cultural Centre	Overcoming Weed Challenges in Regenerative Agriculture	RALL, AAFC, LARA Municipal Partners
February 9, 2025 Glendon RCMP Hall	Farmer Appreciation Night	LARA Municipal Partners
February 13, 2024 Elk Point Seniors Recreation Hall	Sheep and Goat Forum	RDAR, Covers & Co., Lakeland College, LARA Municipal Partners
February 15, 2024 MacArthur Tea Room, Lac La Biche	Securing Success: Programs, Services and Funding Opportunities for Your Farm or Ranch	LARA Municipal Partners
February 21, 2024 Flat Lake Hall	Gardening for Pollinators	LARA Municipal Partners
March 2, 2024 Lac La Biche Agricom	Innovation on the Ranch	LARA Municipal Partners
March 6, 2024 Goodridge Hall	Annual General Meeting and Research Update	LARA Municipal Partners



March 12, 2024
Ashmont Agriplex

Lakeland Agronomy Update

RDAR, LARA
Municipal Partners

March 13, 2024
Ukrainian National
Hall, Smoky Lake

**Securing Success: Programs,
Services and Funding
Opportunities for Your Farm or
Ranch**

RDAR, LARA
Municipal Partners,
WCVN

March 14, 2024
Webinar

**Livestock Water Management: A
Whole Year Approach. Part 2:
Practical Approaches to
Improving Water Quality**

Saskatchewan
Ministry of
Agriculture, LARA
Municipal Partners,
BCRC

March 23, 2024
Craigend Hall

**Environmental Farm Plan (EFP)
Workshop**

LARA Municipal
Partners

March 26, 2024
Bellis Hall

It's Dry: Now What?

LARA Municipal
Partners, CFGA,
Bellis Veterinary Clinic

April 9, 2024
Flat Lake Hall

It's Dry: Now What?

LARA Municipal
Partners, CFGA

April 27, 2024
LARA Research
Farm

**Making No-Till Vegetable
Gardening Successful in the
Canadian Prairies**

LARA Municipal
Partners, Rosedale
Farms

June 2024
Moose Lake
Provincial Park

Walking With Moose

LARA Municipal
Partners

June 2024
School Yards

Soil Detectives

LARA Municipal
Partners

June 27, 2025
LARA Research
Farm

**Soil Builders School with David
Johnson and Hui-Chun Su**

LARA Municipal
Partners, RDAR



July 24, 2024 Tandem T Farms	Agriculture Drone Demonstration	LARA Municipal Partners, Tandem T Farms
July 25, 2024 LARA Research Farm	Fort Kent Summer Field Day	RDAR, LARA Municipal Partners, Canterra Seeds, U of A
July 30, 2024 Smoky Lake Agriplex	Smoky Lake Summer Field Day	LARA Municipal Partners, GoA,
August 1, 2024 Mallaig Legion Hall	Pasture and Water Systems Tour at Silver Spruce Farms	RALL, BCRC, LARA Municipal Partners, Silver Spruce Farms
August 6, 2024 St. Paul Seed Cleaning Plant	St. Paul Summer Field Day	LARA Municipal Partners, Eco-Tea, St. Paul Seed Processors
August 16, 2024 St. Paul Ag Corral	Effective Stockmanship Clinic with Cattle-Up Stockmanship	LARA Municipal Partners
October 16, 2024 Ardmore Community Hall	Grow Your Own Microgreens Workshop with Happy Hollow Microgreens	LARA Municipal Partners, Happy Hollow Microgreens, Mums Seeds
October 29, 2024 Smoky Lake Ukrainian National Hall	CowBytes Ration Balancing Workshop	LARA Municipal Partners, BCRC
November 4, 5, 2024 Vilna Arena	Agriculture Drone School with Landview Drones	LARA Municipal Partners, Vilna Agriculture Society
November 14, 2024 Fort Kent Hall	CowBytes Ration Balancing Workshop	LARA Municipal Partners, BCRC



November 2, 2024
Fort Kent Hall

**Environmental Farm Plan
Workshop**

LARA Municipal
Partners, Alberta
EFP

November 16, 2024
Vilna Seniors Centre

**Environmental Farm Plan
Workshop**

LARA Municipal
Partners, Alberta
EFP

November 30, 2024
Mallaig Legion Hall

**First Annual - Women in
Ranching Workshop**

LARA Municipal
Partners, Bellis
Veterinary Clinic,
CFGa, CNRL

Abbreviations

BCRC - Beef Cattle Research Council
GoA - Government of Alberta
CFGa - Canadian Forage and Grasslands Association
CNRL - Canadian Natural Resources Limited
EFP - Environmental Farm Plan
RALL - Regenerative Alberta Living Lab
U of A - University of Alberta
RDAR - Results Driven Agriculture Research
WCVM - Western College of Veterinary Medicine
AAFC - Agriculture and Agri-Food Canada



Cropping Research Program

Cereal Regional Variety Trials

- Canadian Western Red Spring Wheat
 - Canadian Prairie Spring/ Special Purpose/ Soft White Spring Wheat
 - Oat
 - Triticale
-

Pulse Regional Variety Trials

- Faba bean
 - Yellow/Green pea
 - Lupin
-

LARA Cropping Trials

- Evaluating row spacing in inter seeding and intercropping systems for weed management.
- Impact of allelopathic cover crops and its termination method in cash crops grown subsequent season.



Regional Variety Trials

Objectives:

1. To detail agronomic characteristics of new varieties and proven varieties in a specific geographic area.
2. To provide information about new varieties to local producers.
3. To conduct these tests yearly to produce long term data.

Background:

Regional Variety Trials (RVTs) have been used as a means of testing superior varieties under different environmental conditions. One of the goals of the RVTs is to help researchers and producers identify varieties that are suitable for each particular environment. Multi-location trials often show genotype x environment interaction due to differential response of genotypes to different environmental conditions. Information on the genotype x environment response obtained through RVT's may be helpful in identifying and selecting high-yielding varieties with specific or broad adaptations to their environmental conditions.

Efficiency in the RVT's depends on selecting a large number of locations within a region with varying environmental conditions and assigning to each location the variety most likely to succeed. It is also essential to assess varieties in the trial in terms of their productivity and quality, and to assess stability in yields across years.

The regional variety trials (RVTs) have been grown in the Lakeland since 1991. Each variety is tested for three years against a common check variety that is kept in the trial long-term. Each year, new varieties are added and older ones are removed from the trial. How a variety does relative to the check variety can be used as a comparison between varieties that are not grown in the trial at the same time.

The information gathered from these trials is important for producers; first, to aid in crop variety selection and, second, to improve economic returns. Determining the cereal varieties that are best suited to production in the LARA area will aid producers in making the most economical decisions for their operations.



Cereal Regional Variety Trials Summary

Regional variety trial chronology in three sites across Northeastern Alberta in 2024														
Site	Seeding ^a			Fertilizer ^a			Burndown			Herbicide ^b				Harvest ^c
	Regional Variety Trial									In crop		Desiccant		
	Date	Rate plants foot ⁻²	Date	Rate lb acre ⁻¹	Date	Name	Rate L acre ⁻¹	Date	Name	Rate L acre ⁻¹	Date	Name	Rate L acre ⁻¹	
Fort Kent	May 13	31	May 13	90N 30P 25K 25.2S	May 14	Bromoxynil	40	June 10	Bromoxynil MCPA	3.2	September 16	Reglone ION	0.83	October 9
Winter cereals	September 4 ^d	31	September 4	90N 30P 25K 25.2S	September 4	Glyphosate	1	June 10	Bromoxynil MCPA	3.2	-	-	-	September 6
St. Paul														
Canadian Western Red Spring Wheat	May 11	31	May 11	90N 30P 25K 25.2S	May 13	Glyphosate	1	June 9	Bromoxynil MCPA	1.6	September 17	Reglone ION	0.83	September 25
Canadian Prairie Spring Red Wheat	May 11	31	May 11	90N 30P 25K 25.2S	May 13	Glyphosate	1	June 9	Bromoxynil MCPA	1.6	September 17	Reglone ION	0.83	September 25
Triticale	May 11	31	May 11	90N 30P 25K 25.2S	May 13	Glyphosate	1	June 9	Bromoxynil MCPA	1.6	September 17	Reglone ION	0.83	September 24
Smoky Lake														
Oat	May 14	31	May 14	90N 30P 25K 25.2S	May 14	Bromoxynil	40	June 10	Bromoxynil MCPA	3.2	September 17	Reglone ION	0.83	September 19

^aNo till hoe-drill Fabro seeder with side banding (2008) attached to Ford tractor (1998)

^bR-Tech Thirty-foot sprayer (2024) attached to John Deere tractor (2010)

^cWintersteiger Classic (2020)

^dSeeded in 2023

Canadian Western Red Spring Wheat

Mean values of yield, height, lodging rating, test weight and tkw in 19 varieties of CWRS wheat in St. Paul Alberta in 2024

Variety	Yield (% of AAC Brandon)		Height		Lodging	Test weight	TKW	
	g plot-1		cm		1-9	lb bu-1	g/1000 seeds	
AAC BRANDON	100%	ab*	68	abcd	3.0	57.9	40.8	abc
AAC DARBY VB	86%	bc	72	ab	1.3	61.8	36.6	ef
AAC HOCKLEY	109%	a	60	fg	2.7	62.0	36.5	efg
AAC SPIKE	92%	abc	61	efg	3.3	61.2	36.2	efg
AAC STOUGHTON	83%	bcd	63	defg	3.0	63.3	39.7	cd
AAC VIEWFIELD	96%	abc	63	defg	2.3	62.9	37.9	de
AAC WALKER	86%	bc	62	efg	3.0	62.7	37.1	ef
AAC WESTKING	97%	abc	65	cdef	1.7	63.7	40.9	abc
AAC Craven VB (BW1127)	93%	abc	63	def	4.0	61.6	37.0	ef
AAC Walsh (BW5089)	101%	ab	68	abcd	1.7	63.2	43.1	a
AAC Oakman (BW5104)	84%	bcd	66	cde	3.0	62.0	36.4	efg
CDC ENVY	64%	d	67	bcde	3.7	58.6	35.2	fg
DONALDA	91%	abc	69	abc	2.3	63.1	37.9	de
Garde (LAR18-04850)	94%	abc	59	g	1.0	60.9	34.2	g
Palisade (LAR19-22198)	94%	abc	67	bcde	2.3	62.5	39.9	cd
Baker (LAR19-23455)	101%	ab	63	defg	2.7	63.2	38.0	de
Breadwinner (LAR19-23465)	98%	abc	67	bcde	2.0	63.6	42.5	ab
Flame (LAR20-25463)	98%	abc	68	abcd	1.3	64.1	40.5	bc
ZEALAND	78%	cd	73	a	2.0	62.4	35.2	fg

Results

Average	2025.7	65.3	2.4	62.1	38.2
ANOVA p-value	0.0399	0.0006	0.0742	0.2131	<0.0001
CV%	13.5	5.4	44.2	3.88	3.7

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

The control variety, AAC Brandon was among the CWRS varieties highest yielding, tallest and with heaviest TKW. As such, wheat from most varieties of CWRS were similar in yield to those in the control (AAC Brandon) except those from the CDC Envy and Zealand variety. These wheat varieties reported 14 and 22% less yield respectively, in comparison to the control. There were two groups of CWRS varieties based on height. One with short stands: AAC Hockley, AAC Spike, AAC Walker, and Garde; and the rest of the CWRS varieties, conformed the group of tallest wheat stand varieties. Thousand kernel weight was lighter in wheat from the AAC Darby, AAC Hockley, AAC Spike, AAC Viewfield, AAC Walker, AAC Craven, AAC Oakman, CDC Envy, Donalda, Garde, Baker and Zealand wheat varieties

compared to the control. Drought occurring in the months of July and August may have been a cause for the low weight in tkw in the previously mentioned varieties. In other words, AAC Westking, AAC Walsh, and Breadwinner seem to be the best options for a CWRS wheat variety, since their yield is on par with the control and their tkw values were among the highest.

Canadian Prairie Spring/ Special Purpose/ Soft White Spring Wheat

Mean values of yield, height, lodging rating, test weight and tkw in 13 varieties of CPS/SP/SWS wheat in St. Paul Alberta in 2024

Variety	Yield (% of AAC Brandon)		Height		Lodging		Test weight		TKW	
	g plot-1		cm		1-9		lb bu-1		g/1000 seeds	
AAC AWESOME	79%	fg*	62.6	abc	1.0	b	59.5	g	49.0	ab
AAC BRANDON	100%	bcde	61.0	bcd	2.0	a	63.3	b	40.6	h
AAC CAMROSE	86%	efg	58.2	cd	1.0	b	61.6	cde	42.9	fg
AAC GALORE	115%	ab	62.3	bc	1.0	b	60.5	efg	47.3	bc
AAC GOODWIN	88%	defg	64.8	ab	2.0	a	63.0	bc	41.7	gh
AAC PENHOLD	94%	def	56.6	d	1.0	b	62.2	bcd	43.2	fg
AC ANDREW	77%	g	58.6	cd	1.0	b	59.9	fg	43.7	ef
AC SADASH	120%	a	68.2	a	1.7	a	63.1	b	45.0	de
ALOTTA	120%	a	59.7	bcd	1.0	b	61.5	de	50.8	a
HY2152	101%	bcde	59.3	bcd	2.0	a	61.2	def	46.2	cd
Fierce VB (LAR20-25760)	111%	abc	62.0	bcd	1.7	a	64.7	a	36.9	i
RECOIL	97%	cde	57.9	cd	1.0	b	62.2	bcd	38.3	i
UA FOREFRONT	102%	bcd	57.2	cd	1.0	b	63.1	b	44.7	def

Results

Average	2085.8	60.6	1.33	62.0	43.9
ANOVA p-value	<0.0001	0.0132	0.0009	<0.0001	<0.0001
CV%	9.5	5.6	27.7	1.3	2.5

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

In contrast to CWRS varieties, some wheat varieties from this group over yielded AAC Brandon (control). Indeed, wheat varieties AAC Galore, AC Sadash and Alotta produced more grain above AAC Brandon by 15, 20 and 20% increase respectively. Moreover AC Sadash wheat stands not only outyielded those from AAC Brandon, but its plant individuals from the former variety were also significantly taller. AAC Goodwin, AC Sadash, HY2152 and Fierce VB wheat varieties were as likely as the control to lodge than the rest. Grain taken from harvest of the Fierce VB wheat variety had the heaviest test weight compared to that of other wheat varieties tested. In addition, tkw was heaviest in grain taken from Alotta and AAC Awesome

wheat variety stands compared to the control. Results showed that Alotta is likely the best choice of CPSR/SP/SWS wheat varieties in comparison to the control as it yielded more, less likely to lodge, and with heaviest tkw for seeding, but if the interest is economic return then Fierce VB would be a better option, despite the fact more seed would be required to achieve optimal number of plants per metre squared (its tkw is among the lowest).

Triticale

Mean values of yield, height, lodging rating, test weight and tkw in three varieties of triticale in St. Paul Alberta in 2024

Variety	Yield (% of Brevis)		Height	Lodging rating	Test weight		TKW
	g plot-1		cm	1-9	lb bu-1		g/1000 seeds
AB Sunbeam (T293)	105%	a*	72.3	3.3	57.3	a	44.6
BREVIS	100%	a	71.9	1.0	56.6	a	47.6
PRONGHORN	91%	b	76.8	3.0	54.6	b	48.6

Results							
Average	2029.5		73.7	2.4	63.0		46.9
ANOVA p-value	0.0116		0.2038	0.06	0.0007		0.4933
CV%	3.2		4.0	36.07	0.6		8.3

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

There were only three varieties of triticale in 2024, two of these were compared against the Brevis variety. Thus, the Proghorn triticale variety underyielded Brevis by 9% and grain harvested from this variety was 2.7 pounds per bushel less than Brevis. Conclusively, AB Sunbeam is a better triticale choice as yield and test weight from its stands are on par with Brevis, therefore, compared to Brevis, on par with economic return.

Oat - Fort Kent

Mean values of yield, height, lodging rating, test weight and tkw in 13 varieties of oat in Fort Kent Alberta in 2024

Variety	Yield (% of CS Candem)		Height		Lodging	Test weight		TKW	
	g plot-1		cm		1-9	lb bu-1		g/1000 seeds	
AAC ANTHONY	102%	bcd*	99	bc	3.3	36.7	d	43.8	ab
AAC FEDAK	105%	abcd	96	bcd	1.3	39.8	abc	44.6	a
AAC NEVILLE	105%	abcd	84	fg	2.0	38.2	cd	39.4	efgh
AAC WESLEY	100%	cd	86	fg	2.0	40.0	abc	38.1	gh
AC MORGAN	112%	abc	94	cde	3.0	39.9	abc	42.2	bcd
CDC ANSON	113%	abc	84	g	1.7	38.2	cd	39.4	efgh
CDC ARBORG	116%	a	101	b	3.3	40.7	a	40.9	cdef
CDC BYER	115%	ab	92	de	2.0	40.3	ab	38.6	efgh
CS CAMDEN	100%	cd	90	ef	2.0	39.3	abc	38.7	efgh
KYRON	112%	abc	90	ef	2.7	39.4	abc	37.7	h
OREBOOST	86%	e	100	b	1.3	35.5	e	42.5	abc
OT3121	118%	a	97	bcd	3.3	38.9	bc	41.5	bcde
CDC Westgate (SA152324)	92%	d	115	a	4.3	38.7	bc	40.1	defg

Results

Average	3967.5	94.3	2.5	38.9	40.6
ANOVA p-value	0.0014	<0.0001	0.1505	0.0002	<0.0001
CV%	7.7	3.5	50.21	2.8	3.4

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

There were thirteen varieties of oat that were sown for grain yield. This trial was duplicated in Fort Kent and Smoky Lake. In Fort Kent, OT3121 and CDC Arborg oat varieties outyielded CS Candem (control) by 18 and 16% percent respectively whereas the OREBoost variety yielded 24% less grain than that of CS Candem. CDC Westgate, OT3121, OREBoost, CDC Arborg, AAC Fedak and AAC Anthony oat stands were significantly taller than CS Candem whereas CDC Anson stands were shorter. Test weight was heavier in the AAC Fedak, AAC Wesley, AC Morgan, CDC Arborg, CDC Byer, and Kyron oat varieties, all of the test weights taken from grain of these varieties were on par with CS Candem. CS Candem oat weight per thousand kernels was lighter than that of AAC Anthony, AAC Fedak, AC Morgan, and OREBoost. Overall, the AAC Fedak oat variety seems to be the best as its yield, test weight and tkw is among the highest.

Oat - Smoky Lake

Mean values of yield, height, lodging rating, test weight and tkw in 13 varieties of oat in Smoky Lake Alberta in 2024

Variety	Yield (% of CS Candem)		Height		Lodging	Test weight		TKW	
	g plot-1		cm		1-9	lb bu-1		g/1000 seeds	
AAC ANTHONY	99%	abcd*	76	bcd	2.7	36.0	bc	41.2	ab
AAC FEDAK	95%	bcd	70	defg	1.3	38.0	ab	44.3	a
AAC NEVILLE	103%	abc	69	efg	1.0	37.3	ab	41.9	ab
AAC WESLEY	85%	cde	65	g	1.3	36.2	bc	36.1	cd
AC MORGAN	93%	bcde	76	bc	1.7	39.8	a	41.3	ab
CDC ANSON	96%	abcd	65	g	1.0	36.9	abc	38.4	bcd
CDC ARBORG	105%	ab	89	a	3.0	39.5	ab	41.4	ab
CDC BYER	111%	ab	75	cde	1.0	38.2	ab	39.3	bcd
CS CAMDEN	100%	abcd	68	fg	1.3	37.3	ab	38.9	bcd
KYRON	116%	a	72	cdef	2.0	38.1	ab	39.9	bc
OREBOOST	82%	de	81	b	1.0	27.9	d	35.7	d
OT3121	94%	bcde	74	cdef	2.0	37.1	ab	38.7	bcd
CDC Westgate (SA152324)	74%	e	88	a	1.3	33.4	c	35.5	d

Results

Average	2257.0	74.4	1.6	36.6	39.4
ANOVA p-value	153	<0.0001	0.0973	<0.0001	0.0039
CV%	12.3	5.1	52.5	5.8	6.1

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

Oat yield from the same varieties sown in Fort Kent behaved differently. The CS Candem oat individuals were amongst the highest yielding, on par with Kyron, CDC Byer, CDC Arborg, CDC Anson, AAC Neville, and AAC Anthony. In contrast, oat stands from CC Westgate underyielded CS Candem by 36% percent. Likewise to Fort Kent, CS Candem oat stands were also shorter than those from the CDC Westgate, OT3121, OREBoost, CDC Arborg and CDC Anthony varieties. In contrast, oat stands from AC Morgan and CDC Byer varieties were also taller than CS Candem,, whereas AAC Fedak and CS Candem were statistically the same height. In Smoky Lake test weight in the CS Candem variety was similar to results obtained in Fort Kent and on the same varieties. In addition, test weight from CS Candem oat stands grown in Smoky Lake was also on par with that of AAC Neville, CDC Anson and OT3121 oat varieties. Thousand kernel weight from grain taken from CS Candem oat was lighter than that from AAC Fedak variety, but heavier than that from OREBoost and CDC Westgate oat varieties. Compared to Fort Kent, oat stands from the CDC Westgate variety were likely more sensitive to drought in Smoky Lake and this would explain why tkw from this oat variety is lower than that of the Control (CS Candem). The

AAC Neville oat variety is a safe option for seeding as it is high yielding, short and with heavy test weight and tkw values. Another good option is CDC Arborg, but since oat stands from this were the tallest, these oat stands are more prone to lodging.



Summer tour of the Fort Kent Cereal Regional Variety Trials.

Pulse Variety Trials

Pulse variety trial chronology in St. Paul Alberta in 2024													
St. Paul Site	Seeding ^a			Fertilizer ^a			Burndown			Herbicide ^b			Harvest ^c
	Regional Variety Trial									Desiccant			
St. Paul Site	Date	Rate plants foot-2		Date	Rate lb acre ⁻¹		Date	Name	Rate L acre ⁻¹	Date	Name	Rate L acre ⁻¹	Harvest ^c
Faba bean	May 4	4		-	-		May 13	Glyphosate	1	June 2	Metribuzin	110g	October 2
							June 9,22	Bromoxynil MCPA	0.4L	September 18	Reglone ION	0.83	
Field pea (yellow and green)	May 4	8		-	-		May 13	Glyphosate	1	June 2	Metribuzin	110g	August 26
							June 9,22	Bromoxynil MCPA	0.4L	-	-	-	
Lupin	May 4	Lupin	4	-	-		May 13	Glyphosate	1	June 2	Metribuzin	110g	August 26 ^c September 17 ^c October 2 ^a
							June 9,22	Bromoxynil MCPA	0.4L	September 18 ^a	Reglone ION	0.83	
Blue pea	May 4	Blue	11	-	-		June 9,22	Bromoxynil MCPA	0.4L				
		White	5										

^aNo till hoe-drill Fabro seeder with side banding (2008) attached to Ford tractor (1998)

^bR-Tech Thirty-foot sprayer (2024) attached to John Deere tractor (2010)

^cWintersteiger Classic (2020)

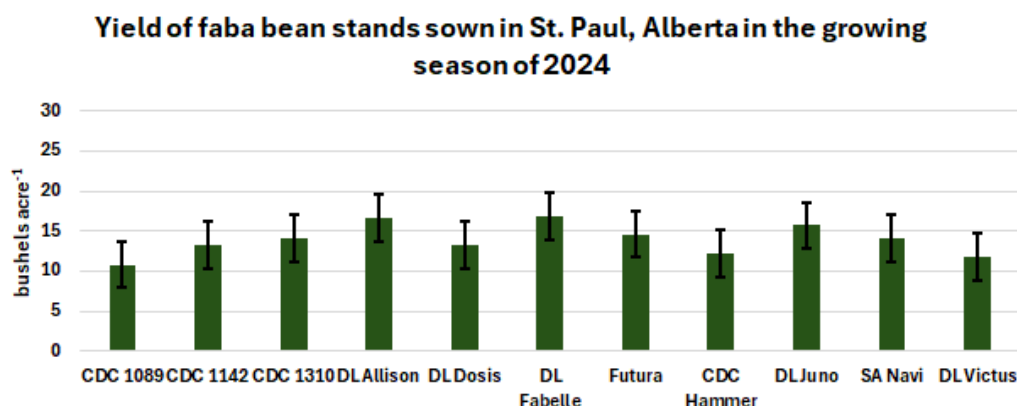
^dFaba bean and white lupin

^eField pea

^fBlue lupin

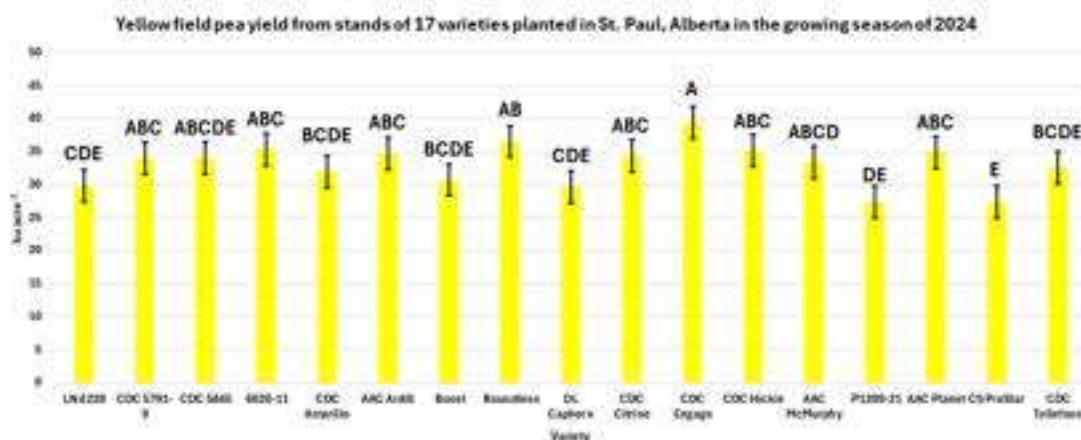
Pulse Variety Trials

Faba Bean



Eleven faba bean varieties were trialed in 2024 as part of the pulse RVT program. Statistical analysis revealed that there were no significant differences for emergence ($P=0.0947$), plant height ($P=0.4200$), yield ($P=0.9095$), test weight ($P=0.5272$) and thousand kernel weight ($P=0.1624$). The lack of differences between varieties was not unexpected as the Lakeland region experienced a severe heat wave in early July, followed by extended drought conditions into August. Faba beans are known to be sensitive to drought conditions. Crop yields were below average for the region. These results are in line with AFSC crop reports that suggest that the snowbird variety yielded an average of 22 bu/ac in 2021 (Risk Area 15, Lakeland Region), which was also a dry year. In comparison with 2018, 2019, and 2020, where average Faba Bean yield was 51, 40, and 47 bu/ac, respectively (Risk Area 15, Lakeland Region). More information is available on: <https://albertapulse.com/growing-pulses/how-we-help/>

Yellow Field Pea



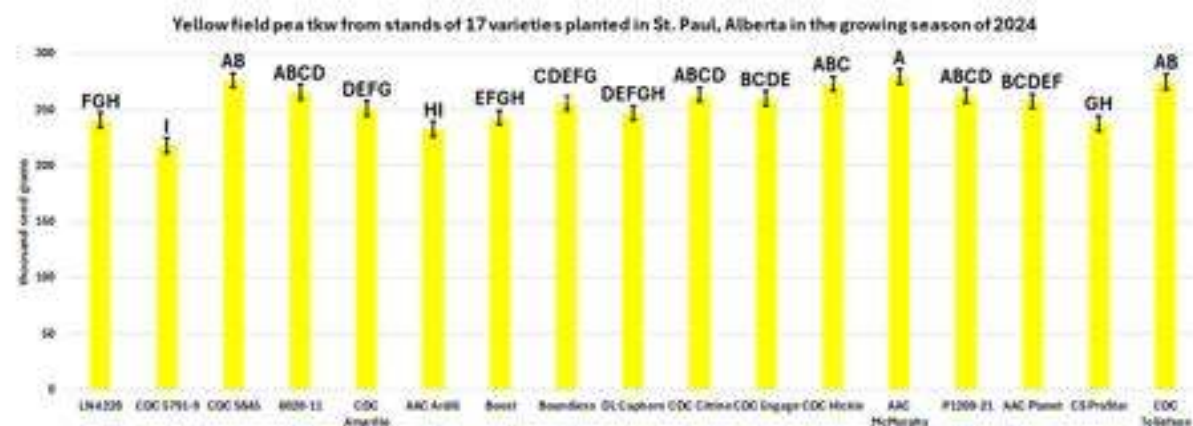
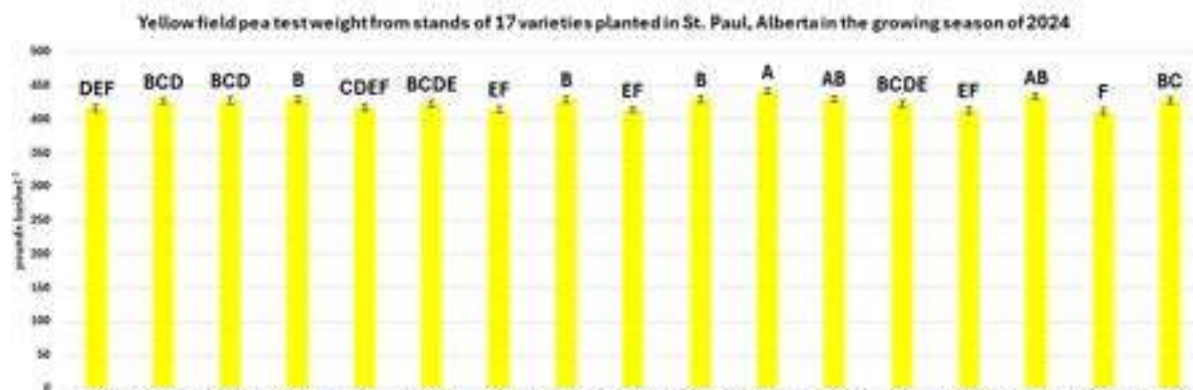
Seventeen yellow pea varieties were trialed in 2024 as part of the pulse Variety Trial program. Statistical analysis revealed that there were significant differences for yield ($P=0.0258$), test weight ($P<0.0001$) and thousand kernel weight ($P<0.0001$), but not for emergence ($P=0.8049$). Field peas are known to perform better in drought conditions compared to other pulse crops. The trial average in 2024 was 33 bu/ac, which was in line with 2021 (another dry year) AFSC report for dryland field peas in the Lakeland region (32 bu/ac).

CDC Engage performed the best in terms of yield in 2024, which was 19% higher than the check variety (CDC Amarillo). P1209-21 and CS Prostar performed the worst in terms of yield. Both varieties were 14% lower than the check variety. All other varieties were not significantly different than the check variety in terms of yield.

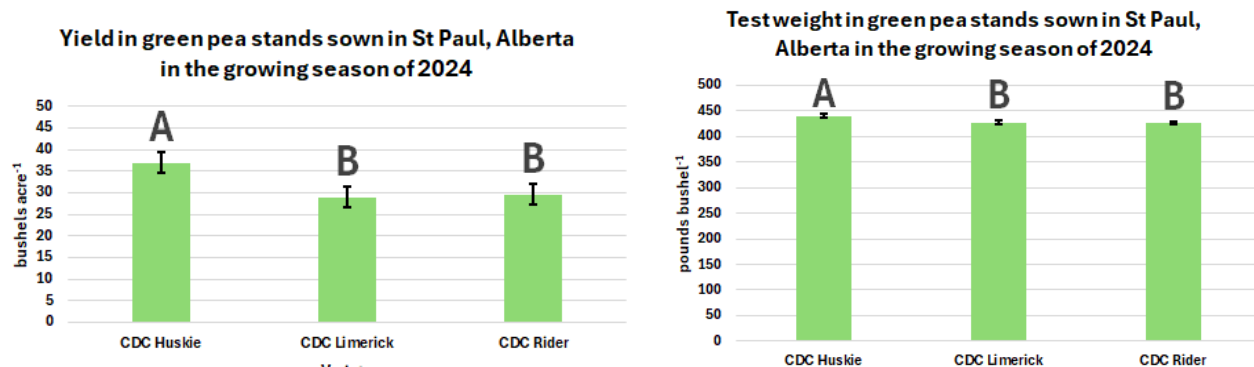
CDC Engage also had the highest test weight, followed by CDC Hickie, and AAC Planet (6,4, and 3% higher than the check). All other varieties were on par with the check variety.

McMurphy and Tollefso had the highest thousand kernel weight values (11 and 9% higher than the check). CDC 5791-9 and AAC Ardill, on the other hand, had the lowest thousand kernel weight values (13 and 7% lower than the check).

More information is available on: <https://albertapulse.com/growing-pulses/how-we-help/>



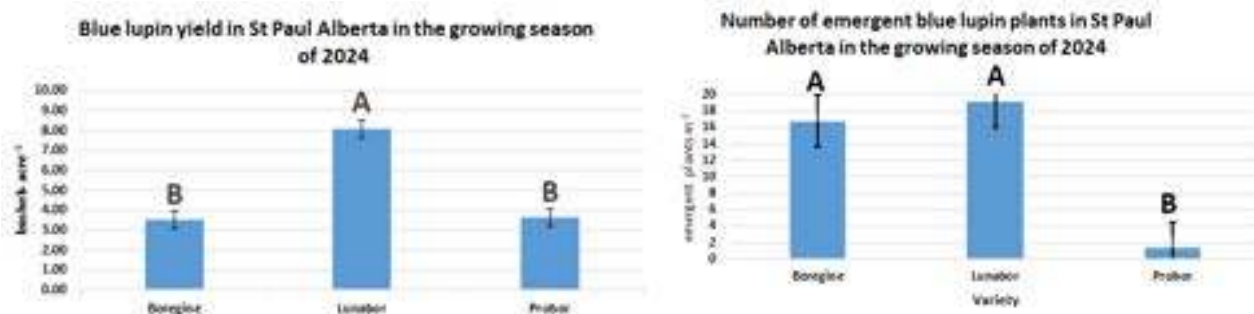
Green Field Pea



Only three green pea varieties were trialed in 2024 as part of the pulse Variety Trial program. Statistical analysis revealed that there was only significant differences for yield ($P=0.0286$) and test weight ($P=0.0464$). Values for emergence ($P=0.7281$), thousand kernel weight ($P=0.0713$) were statistically the same in all three varieties. Field peas are known to perform better in drought conditions compared to other pulse crops. The trial average in 2024 was 33 bu/ac, which was in line with 2021 (another dry year) AFSC report for dryland field peas in the Lakeland region (32 bu/ac). CDC Huskie outperformed both the check variety (CDC Limerick) and CDC rider in terms of yield (28% higher).

More information is available on: <https://albertapulse.com/growing-pulses/how-we-help/>

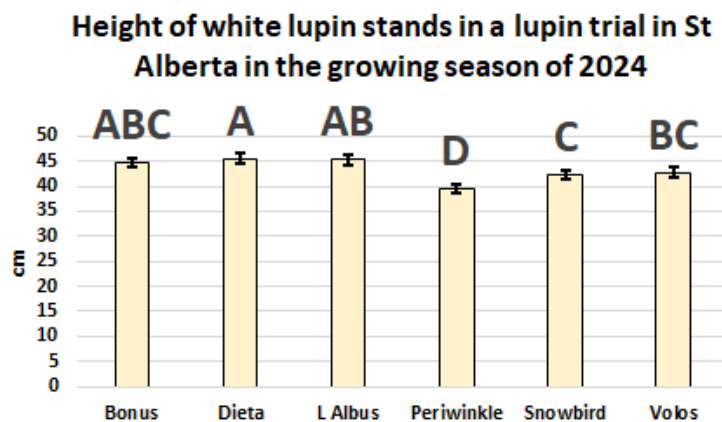
Blue lupin



There were three blue lupine varieties tested in the lupin variety trial. For the growing season of 2024, lupines had difficulty emerging and very few individuals were found at each plot site. The number of blue lupins was so low it was found best to harvest them by hand as combining them would cause grain yield loss. Despite all this, Lunabor yielded more than likewise varieties: Boregine and Probor ($P=0.002$). Similar to yield, Lunabor emergent stands were more numerous than Probor stands, but not those of Boregine ($P=0.0096$). Height was found to be the same ($P=0.1201$, no stand taller than 50cm by the end of August. Similarly, there was no difference among varieties in number of nodes ($P=0.6141$).

It is possible the wet conditions in May and June occurring in St. Paul may have made it difficult for lupine to grow further. As aforementioned, many lupine stands did not emergence. In addition, even though maturity occurred as expected (close to yellow pea), it occurred fast and pods split soon after. Many of the grain from these pods was found to start emerging while on the ground. Further trials for lupine need to be conducted in order to understand the effect of climate and soil factors involved in their development and yield

White lupin

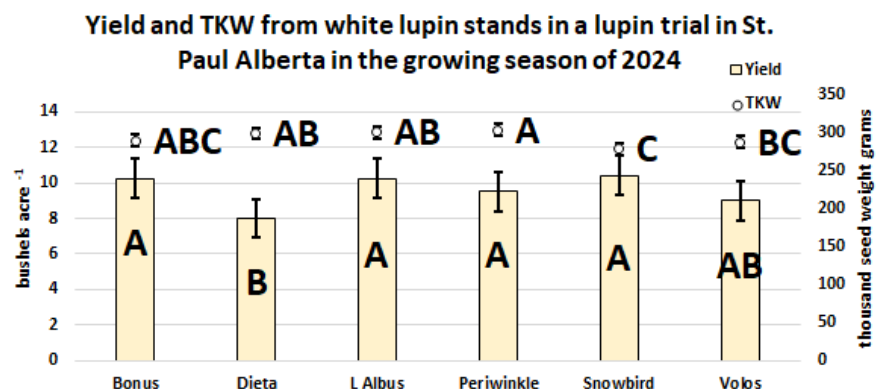


In white lupin varieties grown in the 2024 season in St. Paul Alberta, no differences were found in emergence ($P=0.8088$), number and rating of nodes ($P=0.5310$) or test weight ($P=0.6704$).

The growing season of 2024 was not suitable for white lupine either. Many of the stands were too short (no taller than 50cm) but there were more stands in trial plots compared to number of stands in blue lupine varieties. Height was also significant ($P=0.0111$). Periwinkle was the shortest white lupine variety, followed by Snowbird, Volos and Bonus. Although the tallest stands were from plots sown by the Dieta variety, these individuals were no

taller than those found in plots sown to Bonus and L. albus varieties. Yield was the same for all varieties but Dieta ($P=0.0237$). It is possible that the variety Dieta is more sensitive to environmental factors than other varieties resulting in yields

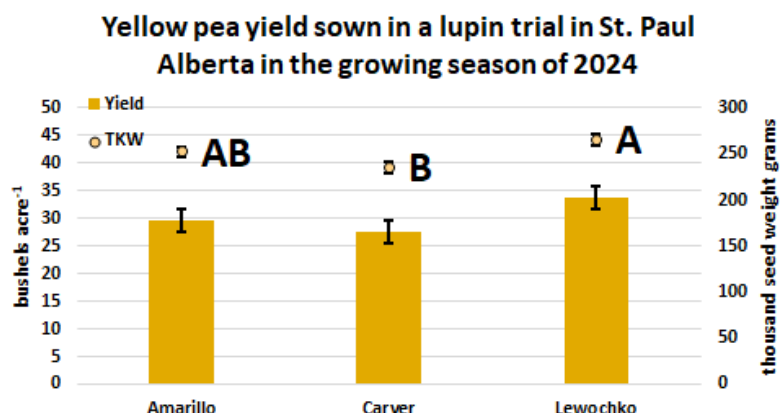
significantly lower. Thousand kernel (seed) weight was lighter in the Snowbird, Volos and Bonus varieties ($P=0.0300$). There was a trend where height in some way predicted tkw (except in the Dieta and Periwinkle white lupine varieties). As such, shortest stands had lightest tkw than those stands able to grow taller. These results indicate that although Snowbird was one of the most yielding, its thousand seed weight is the lowest, meaning that, should this variety be sown the next season, more seed is required to achieve optimal number of stands, which could be costly for growers. This is contrary to the Periwinkle variety, which was one of the most yielding and had one of the heaviest tkws.



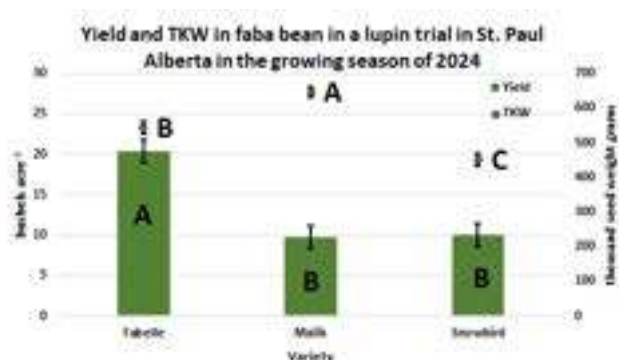
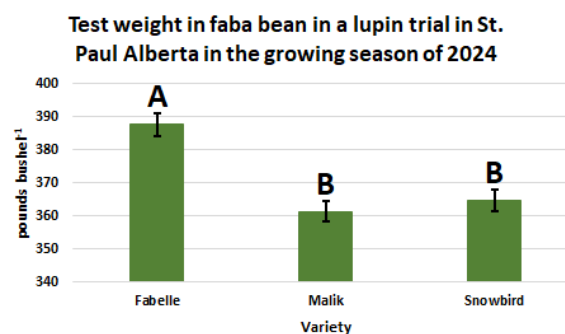
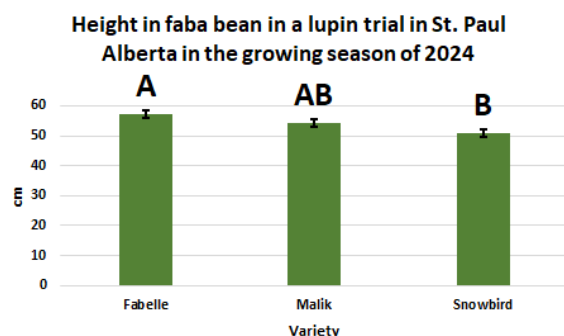
Yellow Field Pea (in lupin trial)

Along with blue lupine and white lupine varieties, the lupine trial also had for comparison three yellow pea and three faba bean varieties. These varieties had the same yield ($P=0.1692$), test weight ($P=0.1446$), height ($P=0.3375$), node number and rating (0.3153) and emergence ($P=0.4076$). Thousand kernel (seed) weight was greater in the

Lewochko variety compared to Carver and both were the same in comparison to the control (Amarillo). In comparison to lupine, yellow pea stands looked healthy and yield was similar to that found in yellow and green pea trials. It is possible that the drought occurring in July and August may have hastened their maturity, but otherwise all varieties were on par with each other.



Faba bean (in lupin trial)



and Snowbird. Overall faba bean varieties were affected by the drought this growing season. This is reflected mostly in its yield, which was below 30 bushels per acre in all varieties in this trial.

Faba bean varieties were quite different among each other in height ($P=0.0282$), test weight ($P=0.0061$), tkw (tsw) ($P=0.0002$) and yield ($P=0.0065$). The fabelle faba bean variety stands were as tall as Malik but had heavier test weight and was higher yielding than Malik and Snowbird varieties. An outstanding caveat found among this varieties is that Malik had a heavier thousand seed weight, followed by Fabelle

LARA Cropping Trials Summary

LARA cropping trials chronology in three sites across Northeastern Alberta in 2024													
Site	Regional Variety Trial	Seeding ^a			Fertilizer ^a		Burndown			Herbicide ^b In crop			Termination ^c
		Date	Rate pounds acre ⁻¹		Date	Rate lb acre ⁻¹		Date	Name	Rate L acre ⁻¹	Date	Name	
Fort Kent	Impact of allelopathic cover crops and its termination method in cash crops grown subsequent season.		sole	mix									
		Annual ryegrass	180	90									
		Hairy vetch	44	22	April 25	30P		May 13	Glyphosate	1			
		Rye	40	20		25K							
		Sunflower	12	12		25.2S							September 18 ^d September 20 ^e
St. Paul	Impact of allelopathic cover crops and its termination method in cash crops grown subsequent season.		sole	mix									
		Annual ryegrass	180	90									
		Hairy vetch	44	22	April 25	30P		May 13	Glyphosate	1			
		Rye	40	20		25K							
		Sunflower	12	12		25.2S							September 27 ^d October 1 ^e
Evaluating row spacing in inter seeding and intercropping systems for weed management			Rate plants foot-2										Harvest
		Field pea	20										
		Wheat	30		April 26	67.5N 22.5P 18.75K 18.9S		May 13	Glyphosate	1	August 30	Reglone ION	0.83
													October 2
Smoky Lake	Evaluating row spacing in inter seeding and intercropping systems for weed management		Field pea	20									
		Wheat	30		April 26	67.5N 22.5P 18.75K 18.9S		May 13	Glyphosate	1	August 30	Reglone ION	0.83
													September 19

^aNo till hoe-drill Fabro seeder with side banding (2008) attached to Ford tractor (1998)

^bP-Tech Thirty-foot sprayer (2024) attached to John Deere tractor (2010)

^cP-Tech Alfaifa Omega self-propelled forage harvester (circa 1980)

^dRoller crimped

^eIncorporated

^fWintersteiger Classic (2020)

Evaluating row spacing in inter seeding and inter cropping systems for weed management.

Polyculture is an agricultural strategy to reunite two crops in the same field area. Although interchangeable, intercropping is the practice where two or more crops are sown in alternate rows and interseeding (also known as mixed intercropping) is sowing two or more crops within the same seeding row. The advantages of intercropping versus monocropping are: (a) weed suppression, (b) yield increase and stability and (c) nutrient cycling if crops are seeded as interjected crops. Such advantages vary according to row distance between seeding rows of different crop species. However,

literature falls short in describing how row distance affects weeds and yield of interseeding systems. This experiment consisted of eight treatments as follows: monocrop treatments of either wheat or field pea, an intercrop (alternate rows of wheat and field pea) and an interseed (wheat and field pea in the same seeding row). Each of these treatments will have seeding rows set either at 4.5 or 9 inches apart. Thus, this experiment aimed to compare intercropping and inter seeding wheat and peas at different seeding row distances and observe how land equivalent ratio (LER) and weed population is affected. This is the first study of its kind in Northeastern Alberta and thus it will provide stepping stone knowledge in the quest towards agricultural sustainability.

List of treatments to evaluate row distance between intercropping and interseeding using wheat and field pea as crops

Row distance (inches)	Agricultural system	Crop seeding rate. (Plants foot-2)	
		Wheat	Field pea
9	Intercropping	30	20
		30	20
	Interseeding	3	0
		0	20
	Monocrop	30	20
		30	20
4.5	Intercropping	30	0
		30	20
	Interseeding	30	0
		0	20
	Monocrop	30	20
		0	20



This project was a randomized complete block design with eight treatments. The trial was set in St Paul (54°5'N, 110°15'W) and Smoky Lake (54°6'N, 112°38'W). This is to increase the robustness of the data and therefore reduce spatial and time statistical noise. Plots for this experiment were 1.15m*7.5m. Soil samples were taken from each site and sent to a specialized laboratory for chemical analysis. Results from this analysis were used to calculate necessary fertilizer requirements for target yield in wheat. Plot maintenance consisted of a pre-seed burndown, followed by fertilizer application. Fertilizer rates in polyculture treatments are cut to half as previous research have established a full fertilizer

rate may hinder the legume ability to fixate nitrogen (Yu et al., 2015; Bailey-Elkin et al., 2022). Fertilizer was side banded at the same time seeds will be sown with a drilled seed cone. Weeds were aimed to be reduced with 2-methyl-4-chlorophenoxyacetic acid (MCPA) before flag leaf in wheat and while field pea stands are 10 to 17.5 cm high. Glyphosate was sprayed before harvest for plant desiccation to facilitate combining.

Yield was collected for each plot. Seeds collected from intercropping and interseeding plots were separated into wheat and field pea grain. The weight of these grains was compared to the weight of those obtained in wheat and field pea monocrops to compute land equivalent ratios (LER).

The Alberta government estimated that average bushels per acre in 2024 in Northeastern Alberta were going to be wheat and field pea were 44.1 and 33.7 respectively (Government of Alberta, 2024). Our results show that wheat and field pea yield on both sites were far below the average threshold (Table 1). This is likely a consequence of the drought conditions and heat waves that occurred in July and August. It is important to comprehend that this experiment is unlikely to have caused such low yields and instead, plants were struggling in the challenging temperature and moisture conditions that occurred in 2024. Indeed, wheat was somewhat tolerant to the effects, but peas matured quickly, and rising temperatures affected their growth and pod development in most plots. However, various responses were obtained despite the low yields. In the first year of this project, we have gathered evidence that cropping practices in polyculture matter, and these can be determinant of yield outcomes. Number of weed individuals was not observed to be affected by distance, seeding practice or the interaction between the two. Due to logistical problems with our scale, weed, field pea and wheat biomass were not properly measured in Smoky Lake and a desiccant was sprayed for harvest in St Paul before above ground biomass was collected. It is expected that in the following growing season crop biomass can be collected and in that way forage and grain land equivalent values can be computed.

Table 1. P values obtained from analysis of variance in yield and Land Equivalent Ratio (LER) values from wheat and field pea crops sown either as a monocrop, intercrop or interseed in rows of either 4.5 or 9 inches in St. Paul and Smoky Lake, Alberta in 2024

	Yield		LER		
	Wheat	Field pea	Wheat	Field pea	Total
Distance between seed rows	0.0016	0.0007	0.9496	0.0137	0.0184
Seeding practice	0.0001	0.0219	<.0001	0.0343	0.0001
Distance between rows X seeding practice	0.2707	0.1362	0.2022	0.1740	0.0629

Distance between rows and seeding practice impacted wheat, field pea yields and field pea and total land equivalent ratio by separate and there is no interaction between these effects (Table 1). In contrast, wheat LER was influenced more by seeding practice rather than row distance (Table 1). This shows that seeding practices and row distance affected each crop differently and more research is required to see how this develops under more suitable growth conditions. Consequently, more data needs to be obtained for future growing seasons.

Less distance between rows can provide greater yields in both crops, but land equivalent ratio (LER) is 32% greater if crops are grown farther apart (Table 5). Row distance increased LER because narrowed rows increase competition and may enhance the competition of one of the crops in the polyculture system over the other. Therefore, reducing row distance may aid to reduce space for cropping but eventually it is not a factor that may contribute to yield.

Seeding practice affected wheat and field peas differently (Table 1). Wheat yield in an interseed (crops seeded within the same rows) system is greater than an intercrop (crops seeded in alternate rows) system. Wheat LER values showed that yield on the other hand did not change despite row distance but did increase 25% more under interseed polyculture systems compared to polycultures sown in alternate rows. Previous research has shown that legumes can transfer N up to 22% to their companion crop in a polyculture system (Reid et al., 2024). This means that a legume like field pea is likely providing more nitrogen to wheat through biological fixation if sown in an interseed system rather than an intercrop system.

	inches	Bushels acre ⁻¹				LER					
		Wheat		Field pea		Wheat		Field pea		Total	
Distance between seed rows (cm)	4.5	31.66	A ^a	4.62	A	0.55	A	0.55	B	1.10	B
	9.0	26.83	B	2.89	B	0.57	A	0.86	A	1.42	A
Seeding practice	Intercrop	21.41	C	3.53	B	0.50	C	0.79	B	1.29	B
	Interseed	27.05	B	3.91	AB	0.75	B	1.03	AB	1.77	A
	Monocrop	39.28	A	7.59	A	1.00	A	1.00	A		B
Error		11.4		2.8		2 X10 ⁻²		0.1		0.2	

^aDifferent letters indicate significance between treatments (P<0.05, N=40)

Yield in field pea in contrast was the same in either polyculture system. However, field pea LER values indicate that yield was 36% greater if field pea was sown in rows 9 inches rather than 4.5 inches apart (Table 2). Moreover, field pea yield taken from plots where rows were intersown diminished by 21% compared to that of field pea monocrops according to field LER values. It is possible that field peas have less yield because wheat stands in this case were not acting as an intercrop companion, helping it suppress other weeds but instead, it becomes another plant competitor which it has to grow along. This, in turn, caused field peas stands to yield less grain compared to those stands sown with no companion crops.

Total LER values indicated that yield of both crops was 48% greater if wheat and field pea are intersown rather than sown in alternate rows. This explains two aspects (a) wheat stands benefit more from field peas grows within their same seeding row lane and (b) wheat stands likely gain more competitive advantage from field peas, particularly if sown within the same lane.

Both our sites were sown following a canola crop. Despite efforts to remove volunteer canola stands in the crop with glyphosate and bromoxynil in Smoky Lake as well as glyphosate and metribuzin in St Paul, volunteer canola was one of the most common weeds found in the trial. Weeds in the trial can be attributed to a reduction of both wheat and field pea stands in the beginning of the season. Hand weeding efforts for weed management were conducted in July but eventually yield was likely compromised by abnormal temperature and scarce moisture.

In spite of success removal of volunteer canola from the site, Table 3 indicated that polyculture systems influenced canola stands. As such, more canola individuals were counted in June but there was no difference in number in July and August ($P < 0.0001$). Moreover, there were less canola individuals in plots sown to an intercrop system compared to those found in plots sown to wheat and field pea monocrops ($P = 0.0427$). Canola stand number was not impacted by row distance or by the interaction between row distance and seeding system. This is something to explore in future growing seasons as this can elucidate further aspects in plant crop and weed dynamics.

Table 3. Canola individuals counted once in June, July and August in plots sown to monocrops of wheat, field pea, wheat + field pea interseed and intercrop systems at either 9 or 4.5 inches apart in St. Paul and Smoky Lake in 2024

Month	Seeding practice	Individuals m ⁻²	Error	
June		125.85	7.7	A*
July		58.25	7.9	B
August		50.02	10.8	B
	Intercrop	55.84	10.3	B
	Interseed	74.48	10.1	AB
	Monocrop			
		Pea	91.73	A
		Wheat	90.11	A

*Different letters indicate significance between treatments ($P < 0.05$, $N = 40$)



Due to the poor yields obtained in 2024 due to drought, relative neighbour effect (RNE), the actual yield loss (AYL), crowding coefficient (K) and competitive ratio are not included because there would be obvious differences between wheat over field pea. As mentioned before, we would like to double the field pea seeding rate in order to obtain a better grasp of competition coefficients in the intercrop systems.

In conclusion:

- Wheat and field pea yields are greater under interseed rather than intercrop systems. By increasing field pea seeding rates, more field pea stands can withstand wheat competitiveness and thus produce more grain and forage quality under these systems. It is not recommended to reduce row distance because this may be counter productive for yield.
- Distance between rows is important in both mono crop and polyculture species. Narrower distances induce greater competition between plant stands of the same crop species and those of the companion crop species. This led to a decrease in land equivalent ratio, because yield is compromised.
- Canola individuals were more prominent in plots sown to an intercrop system compared to plots sown to monocrops of either wheat or field pea.
- Plots sown to an interseed practice showed better yield and more weed suppression. Land Equivalent Ratio values in plots sown to an interseed system were greater than those sown to an intercrop practice and also had less volunteer canola individuals compared to plots sown to monocrop practices.

Thank you for your support on this project:

Michael Carson
Guy Brousseau



Impact of allelopathic cover crops and its termination method in cash crops grown subsequent season

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.

Table 1. Experimental treatments including cover crop species, seeding rates, and termination methods.

Cover crop	Seeding rate Pounds/acre ¹	Cover crop	Seeding rate Pounds/acre ¹	Termination
None	0	None	0	
Rye	180			
Annual ryegrass	45			
Hairy vetch	40			
Sunflower	12			
Rye	90	Annual ryegrass	22	Incorporated
		Hairy vetch	20	
		Sunflower	12	
Annual ryegrass	22	Hairy vetch	20	
Hairy vetch	20	Sunflower	12	
None	0	None	0	
Rye	180			
Annual ryegrass	45			
Hairy vetch	40			
Sunflower	12			
Rye	90	Annual ryegrass	22	Roller-crimped
		Hairy vetch	20	
		Sunflower	12	
Annual ryegrass	22	Hairy vetch	20	
Hairy vetch	20	Sunflower	12	



The experiment was located at two sites at Lakeland Agricultural Research Association. These sites are St Paul (54°5'N, 110°15'W), and Fort Kent (54°18'N, 110°37'W). 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, seeding rate of all other cover crop species was doubled. The experiment was set up as a four replicate, complete random design. Hand weeding, either by stirrup hoe and/or

a wheel stirrup hoe between seed rows around the first week of June. 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 the following growing season, cash crops such as canola, wheat or peas are planned to 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.

For both study years, a quadrat of 25X25 cm will be situated randomly across the plot. In 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. Afterwards, biomass was taken out of this one quadrat and separated as weeds and cover crop species. For the second study year, biomass will be taken before the cash crop harvest and separated as weeds, cash crop and if present, cover crop harvest.

Crop and weed biomass, land equivalent ratio and actual yield loss

Crop and weed biomass, land equivalent ratio (LER) and actual yield loss (AYL) were different among treatments ($P < 0.0001$). Cover crop biomass was expected to be greater in cover crops such as sunflower in contrast to annual ryegrass. As such, plots with sunflower + hairy vetch had more biomass

Table 4. Cover crop and weed biomass values, biomass land equivalent ratio (LER) and actual yield loss (AYL) in control (no cover crop seeded) and cover crop seeded plots with either annual ryegrass, rye, hairy vetch and sunflower in monocrop and intercrop systems in Fort Kent and in St. Paul Alberta on the growing season of 2024

		Cover crop		Weed		LER		AYL	
		g m ⁻²		g m ⁻²					
Control				1156.00	A	0.00			
Annual ryegrass	Hairy vetch	1515	DE	251.00	CD	1.00	B	1.00	A
	Rye	1576.9	DE	285.00	CD	1.24	B	0.27	B
	Sunflower	1866	DE	44.80	G	1.23	B	0.02	B
Hairy vetch	Rye	3037	BC	160.00	DE	1.48	AB	0.20	B
	Sunflower	1387	DE	321.00	BC	1.00	B	1.00	A
Rye	Hairy vetch	2918	DE	207.70	EF	1.28	B	-0.34	C
	Sunflower	3013	A	405.00	B	1.99	A	0.05	B
Sunflower	Hairy vetch	1960	CDE	88.90	FG	1.00	B	1.00	A
	Rye	2168	CD	93.70	FG	1.19	B	-0.02	BC
	Sunflower	4564	AB	748.00	B	1.00	B	1.00	A
		Rye	420.72	132.8		0.7			

*Difference letters indicate significance between values ($P < 0.05$, $N = 80$)

compared to plots where annual ryegrass was seeded as a sole crop. Weed biomass on the other hand was greater in plots where sunflower was sown with annual ryegrass and less biomass was found in plots where annual ryegrass was interseeded with rye. This is important to notice because annual ryegrass+ rye, which is one of the lightest cover crop treatments, was able to suppress more weeds than treatments where sunflower was sown (Table 1).

Values observed in LER demonstrate there is no cover crop intercrop treatment that yields less than their respective monocrops. Also, that there is an increase of 99% and 48% in plots where sunflower was intersown with hairy vetch and annual ryegrass respectively in comparison to the other intercrop treatments. Yield loss (AYL) shows that the rye + hairy vetch system is disadvantageous compared to any cover crop mix with annual ryegrass, as well as the sunflower+ hairy vetch system. Indeed, rye was observed to grow more aggressively than sunflower. Highest LER was found in where sunflower+ hairy vetch was

sown but AYL shows that both species will not thrive in synergy because there will be far more hairy vetch individuals than those of sunflower. Furthermore, LER and AYL values in annual ryegrass + sunflower mixtures show this system as a great option for forage value and ground coverage. Hairy vetch + sunflower can also be an option but hairy vetch, like rye tends to grow more aggressively than sunflower, thus reducing the AYL coefficient. Further outcomes will help to strengthen these results or provide us with even more startling differences.

Differences in weed biomass, number of weed individuals, and number of weed species across treatments

Cover crop biomass as well as weed biomass, number of individuals and species differences among treatments were calculated as follows: Cover crop biomass from annual ryegrass, hairy vetch, rye and sunflower as sole crop was subtracted to (a) allotted cover crop biomass value from all intercrop mixes that had either of the aforementioned cover crops and (b) cover crop biomass found at each intercrop system that contained either of the aforementioned cover crops. Weed biomass, number of individuals, number of species values and found in plots where no cover crop was seeded were subtracted to (a) values found in all monocrops cover crop species treatments (b) values found in all intercrop cover crop species treatments. Likewise, Weed biomass, number of individuals, and number of species values and found in plots where monocrops of annual ryegrass, hairy vetch, rye and sunflower were sown were subtracted to (c) same values found in all cover crop intercrop mixes that had either of the aforementioned cover crops and (d) same values found at each intercrop system that had the either of the cover crops before mentioned in a monocrop system (Table 2). Table 2 classifies the subtraction as effect minus comparison effect.

Effect	Comparison effect	Weed biomass			Weed individuals			Weed species	
		g m ⁻²			Individuals m ⁻²			Weed species	
control	monocrop cover crops	290.82	89.8	*	26.08	11.6	*	0.48	0.2
	cover crop mixes	583.48	96.7	*	36.94	11.2	*	0.56	0.2
annual ryegrass	annual ryegrass	47.80	92.7	*	8.11	12.0		-0.04	0.2
rye	rye	336.53	92.7	*	10.78	12.0		0.30	0.2
sunflower	sunflower	-58.87	92.7	*	-13.44	12.0		-0.08	0.2
hairy vetch	hairy vetch	804.77	92.7	*	40.00	12.0	*	0.13	0.2
annual ryegrass	annual ryegrass mixed with hairy vetch	-74.00	113.6		11.00	14.7		-0.15	0.3
	annual ryegrass mixed with rye	196.40	113.6	*	20.67	14.7		0.28	0.3
	annual ryegrass mixed with sunflower	51.00	113.6		-13.33	14.7		-0.27	0.3
	hairy vetch mixed with annual ryegrass	371.00	113.6	*	50.00	14.7	*	0.08	0.3
hairy vetch	hairy vetch mixed with rye	835.88	113.6	*	30.33	14.7	*	0.28	0.3
	hairy vetch mixed with sunflower	946.30	113.6	*	37.67	14.7	*	0.03	0.3
	rye mixed with annual ryegrass	443.40	113.6	*	18.67	14.7		0.44	0.3
rye	rye mixed with hairy vetch	167.00	113.6		-7.67	14.7		0.21	0.3
	rye mixed with sunflower	399.20	113.6	*	26.33	14.7		0.28	0.3
	sunflower mixed with annual ryegrass	-66.50	113.6	*	-28.00	14.7	*	-0.23	0.3
sunflower	sunflower mixed with rye	-114.00	113.6		-17.00	14.7		-0.17	0.3
	sunflower mixed with hairy vetch	4.90	113.6		3.67	14.7		0.15	0.3

^aEstimate differences were calculated as values from the mean values from the effect column minus the comparison effect column.

Error values are represented in *italics*.

*Value significant at $P < 0.05$, $N = 88$.



Weed biomass was expected to be greater in control plots. Therefore, the greater the value thus, the greater the impact of the comparison effect (Table 2). Thus, weed biomass collected was heavier in plots where a sole cover crop was sown than when a cover crop was interseeded with another. Total mean number of weed individuals was 151 ± 13 per squared metre. This means that 81% and 74% of weed individuals per metre squared are suppressed in cover crop monocrops and intercrop mixes respectively (Table 2). Similarly, weed species mean value in control plots were 3.5 ± 0.2 . Table 2 shows number of weed species in monocrop and intercrop cover crop plots lowered by 84 and 81% respectively. This shows that overall, cover crops suppress more weed biomass but not more weed individuals or weed species when sown in mixture in contrast to cover crops being sown in a monocrop. Possibly, in some plots, such as hairy vetch or rye mixtures, the cover crop biomass was so luscious that it hindered weed seedlings growing underneath. In this way, weed seeds were unable to capture light due to weed smothering and hence there were more weeds seedlings that developed. This in turn produced a decrease in weed biomass but not in weed individuals and weed species in cover crop mixtures.

Differences in weed biomass, number of weed individuals, and number of weed species across treatments

On that note, mixtures of annual ryegrass, rye and hairy vetch have more weed biomass suppression compared to their monocrops of the same species. Difference in number of weed individuals, however, were only significant in hairy vetch. As such weed number was 64% less compared to those found in hairy vetch monocrop plots, given that 112 ± 10 per metre squared individuals were found in them. It is possible that the compound allelopathic effect of both species in an intercrop mixture were more pronounced in mixtures of hairy vetch rather than other mixtures and thus more weed individuals were suppressed.

Weed biomass differences between plots of annual ryegrass as a sole crop and with annual ryegrass+rye showed that annual ryegrass+rye reduces weed biomass by 79% (Table 1 and 2). This however had no effect in number of weed individuals or weed species.



As for hairy vetch, weed biomass in hairy vetch when mixed with either annual ryegrass, rye and sunflower decreased by 56, 55 and 49% respectively (Table 1 and 2) compared from weed biomass taken from hairy vetch monocrop plots. It is likely that hairy vetch +sunflower have a synergistic effect and thus aid to reduce weed biomass better than counter intercrop systems where hairy vetch was sown. Furthermore, given that the number of weed individuals per squared metre was 112 ± 10 , weed individuals decreased by 55, 71 and 66% in hairy vetch intersown with either annual ryegrass, rye or sunflower respectively compared to weed individuals found in hairy vetch monocrops (Table 2). This further explains the synergistic effect of hairy vetch with sunflower. Not the same can be said about the hairy vetch+ rye mixtures because it was found that rye inhibited some of hairy vetch propagation and growth. It is possible that interspecific competition between hairy vetch and rye may have aid to reduce number of weed individuals but not weed biomass, as hairy vetch was unable to smother weeds as extensively as it could have done when mixed with sunflower.

Weed biomass in plots where rye was mixed with either annual ryegrass or sunflower reduced weed biomass by 77% and 80% more compared to that found in plots sown to rye alone (Table 1 and 2). It is important to note that in rye+ sunflower mixture, few sunflower individuals were observed which means that rye not only demonstrated to be highly allelopathic but also propagated aggressively. Thus, it is not recommended to seed rye and sunflower in mixture at the seeding rates proposed as it may hinder sunflower growth.

Sunflower mixtures with annual ryegrass had a 1, 20 and 6% increase in weed biomass, weed individuals and weed species respectively compared to sunflower monocrops. Mean values for weed individuals were 146 ± 13 . This means one or both of the following (a) annual ryegrass and sunflower allelopathy is antagonistic, and it is hindering growth of either cover crop rather than reducing weed growth or (b) annual ryegrass is likely affected by sunflower growth and as such it is impeding for annual ryegrass to propagate and reduce growth of surrounding weeds.

Relative neighbour effect (RNE) was the same across treatments ($P=0.9823$), we hypothesize that as the project continues this will change. It is expected that the cover crop that will be sown in 2025 may influence that of each of the cover crop treatments.

Effect of allelopathic cover crop treatments on individual weed species

Weeds that were more prominent over the course of three months are in decreasing order: Wild buckwheat (*Polygonum convolvulus* L.), Hemp nettle (*Galeopsis tetrahit* L.), Stinkweed (*Thlaspi arvense* L.) and Rough cinquefoil (*Potentilla norvegica* L.) in Fort Kent, whereas Wild buckwheat, Redroot pigweed (*Amaranthus retroflexus* L.), Lambsquarters (*Chenopodium album* L.) and Canada thistle (*Cirsium arvense* L.) were more ubiquitous across the trial in St. Paul. Figure 1 shows the number of weeds individuals that were counted over time in all treatments. Averaging number of weed individuals on both sites it was found that the most prominent weeds were Wild buckwheat, Hemp nettle, Lambs quarters and Redroot pigweed. All weed individuals from these species were the same across treatments (Table 3). Of all these weeds, lamb's quarters individuals were found

to be the same across all months in the growing season (Table 3). Figure 1 shows weed individuals for each of these species changed over the course of three months.

Effect	Wild buckwheat	Hemp nettle	Lamb's quarters	Redroot pigweed
cover crop treatment	0.41	0.86	0.68	0.16
month in the growing season	$<1.00 \times 10^{-4}$	2.00×10^{-4}	0.26	2.0010^{-4}
Cover crop treatment X Month in the growing season	0.34	0.19	0.91	0.03

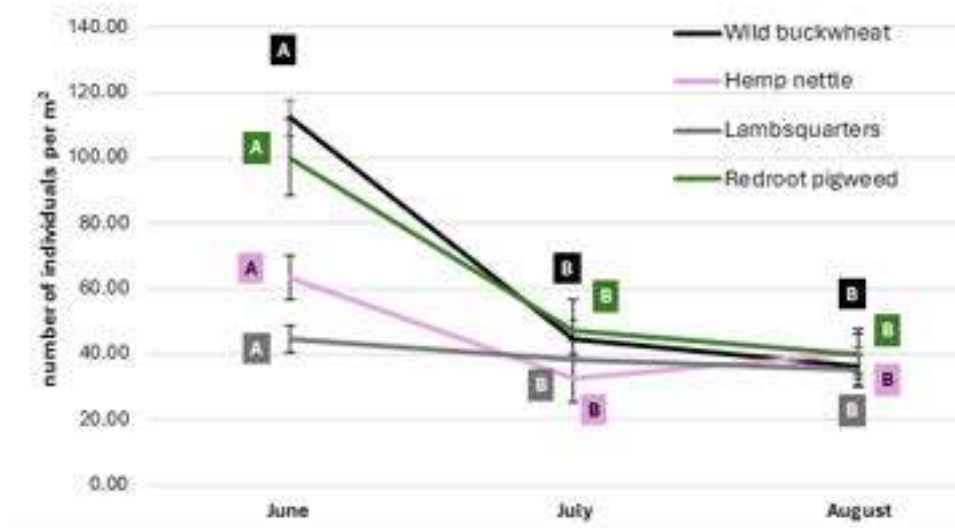
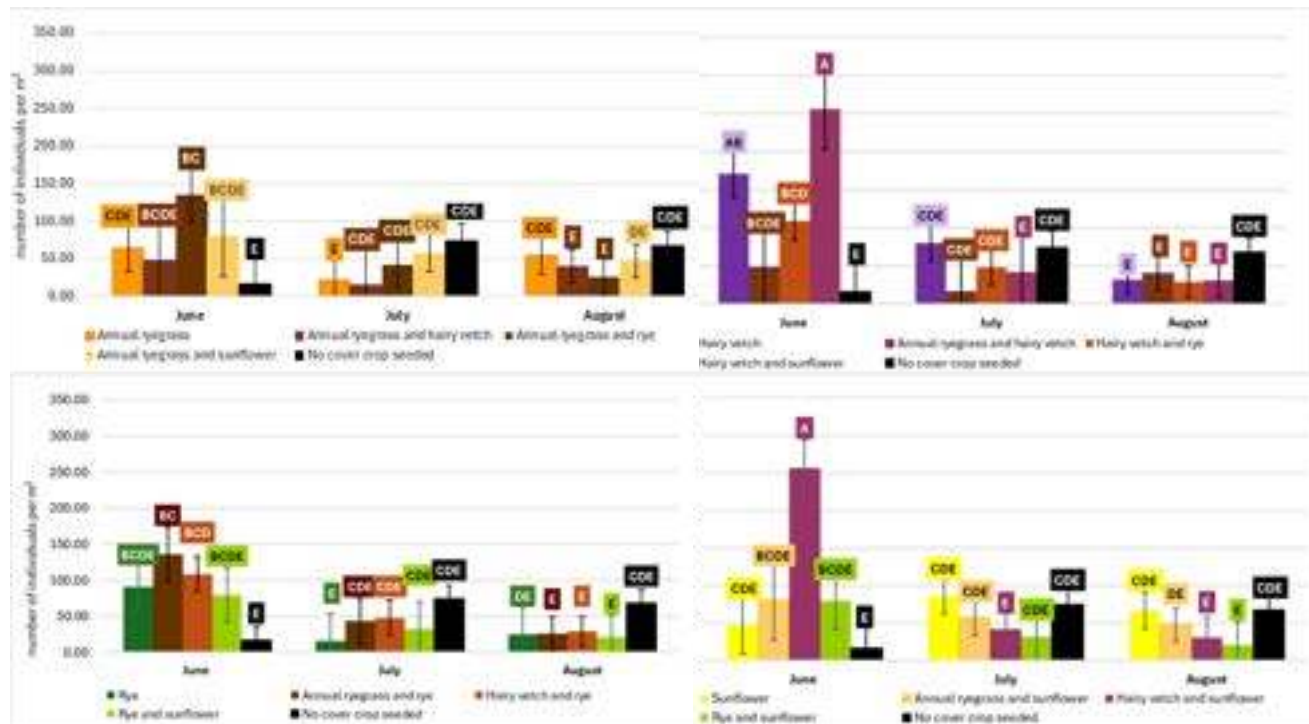


Figure 1. Number of weeds per m² found in allelopathic treatments at three separate times during the growing season. Different letters of the same color show significance across three different measurements over the growing season ($P < 0.05$, $N = 88$)

Effect of allelopathic cover crop treatments on individual weed species

Figure 1 shows that all crops were effectively suppressed by the cover crop treatments by the end of the growing season. This shows that the allelopathic cover crop treatments sown are effective alternatives to suppress these weed species. Thereby, chemical management under these cover crop treatments can be delayed the following season, should a cash crop is considered to be included in the crop rotation.

Red root pigweed did show interaction effects from the allelopathic cover crop treatments over the repeated measures taken in the growing season (Figure 2-5). Redroot pigweed individuals in annual ryegrass + rye intercrop (Figure 2), hairy vetch, hairy vetch + rye and hairy vetch + sunflower were more numerous in June compared to the control treatment. However, Redroot pigweed individuals overall showed no difference across cover crop treatments in July and August in comparison to the control (Figure 2-5).



Presence of Redroot pigweed (*Amaranthus retroflexus* L.) in (2) annual ryegrass (3) hairy vetch (4) rye and (5) sunflower stands sown either in monocrop or intercropped with aforementioned cover crops

In conclusion:

- Land equivalent ratio (LER) was greater in mixtures of sunflower + hairy vetch and sunflower + annual ryegrass. However actual yield loss shows that sunflower + hairy vetch and sunflower + rye have are disadvantageous. As such, sunflower stands are scarcer under these mixtures. If forage value is considered then annual ryegrass + sunflower are recommended as their AYL was the greatest among all cover crop treatments tested.
- Weed suppression is possible if a cover crop or better yet a cover crop intercrop is seeded compared to no cover crop in the ground. This means that chemical weed management can be reduced with inclusion of a cover crop and thus, reduce economical inputs
- So far, it has been shown that rye is the best monocrop and intercrop to suppress weeds are rye and annual ryegrass + rye respectively

Thank you for your support on this project:



Forage Research Program

Silage Regional Variety Trials

- Barley
 - Oat
 - Triticale/Wheat
-

Sustainable Canadian Agriculture Partnership Trials

- Evaluation of early seeded multiple-cuts winter cereals for livestock feed as a drought management strategy in Alberta
 - Integrated use of organic and inorganic fertilizers for forage barley production in Northeastern Alberta.
 - Performance evaluation of two-row and six-row forage barley mixtures.
-

LARA Forage Trials

- Investigating the impact of low-growing clovers (white and subterranean clover) and nitrogen rates on silage crop yield, weed pressure, cereal leaf disease levels, and forage quality.



Silage Regional Variety Trials

Objectives:

1. To detail agronomic characteristics of new varieties and proven varieties in a specific geographic area.
2. To provide information about new varieties to local producers.
3. To conduct these tests yearly to produce long term data.

Background:

Regional Variety Trials (RVTs) have been used as a means of testing superior varieties under different environmental conditions. One of the goals of the RVTs is to help researchers and producers identify varieties that are suitable for each particular environment. Multi-location trials often show genotype x environment interaction due to differential response of genotypes to different environmental conditions. Information on the genotype x environment response obtained through RVT's may be helpful in identifying and selecting high-yielding varieties with specific or broad adaptations to their environmental conditions.

Efficiency in the RVT's depends on selecting a large number of locations within a region with varying environmental conditions and assigning to each location the variety most likely to succeed. It is also essential to assess varieties in the trial in terms of their productivity and quality, and to assess stability in yields across years.

Silage variety trials have been grown in the Lakeland since 2008 and became the Silage Regional Variety Trials (SRVT) in 2023. Each variety is tested for three years against a common check variety that is kept in the trial long-term. Each year, new varieties are added and older ones are removed from the trial. How a variety does relative to the check variety can be used as a comparison between varieties that are not grown in the trial at the same time.

The information gathered from these trials is important for producers first, to aid in crop variety selection and, second, to improve economic returns. Determining the cereal varieties that are best suited to production in the LARA area will aid producers in making the most economical decisions for their operations.

Silage Regional Variety Trials

Regional silage trial chronology in St. Paul Alberta in 2024														
Site	Regional Variety Trial	Seeding ^a		Fertilizer ^a		Burndown		Herbicide ^b			Desiccant		Harvest ^c	
		Date	Rate lb plants foot-2	Date	Rate acre ⁻¹	Date	Name	Rate L acre ⁻¹	Date	Name	Rate L acre ⁻¹	Date		Name
St. Paul	Feed barley	May 11	31	May 11	90N 30P 25K 25.2S	May 13	Glyphosate	1	June 9	Bromoxynil MCPA	1.6	-	-	August 1
	Oat	May 11	31	May 11	90N 30P 25K 25.2S	May 13	Glyphosate	1	June 9	Bromoxynil MCPA	1.6	-	-	August 1
	Triticale/wheat	May 11	31	May 11	90N 30P 25K 25.2S	May 13	Glyphosate	1	June 9	Bromoxynil MCPA	1.6	-	-	August 7

^aNo till hoe-drill Fabro seeder with side banding (2008) attached to Ford tractor (1998)

^bR-Tech Thirty-foot sprayer (2024) attached to John Deere tractor (2010)

^cR-Tech Alfa Omega self-propelled forage harvester (circa 1980)

Barley

Yield and percentage of dry forage matter in ten varieties of Barley seeded in St Paul, Alberta and percentage (dry matter) of crude protein (CP), Acid and Neutral detergent fibre (ADF and NDF respectively), total digestible nutrients (TDN), starch, water soluble carbohydrates (WSC) and digestibility after 30 hours ingestion.

Variety	% Dry matter										
	Yield (% of CDC Austenson)		Detergent fibre				Starch	WSC	True Invitro Digestibility (30 hrs)		
			CP	Acid	Neutral	TDN					
KWS KELLIE	121	a	10.53 abc	-	-	-	-	65.88 a	16.35 b	10.51 bcd	74.53 ab
CDC DURANGO	120	a	-	-	31.99 abc	49.18 abc	64.46 abc	16.21 b	11.01 bc	73.36 abc	
CDC FRASER	120	ab	11.31 a	32.27 ab	48.69 abc	-	-	-	-	9.91 cd	73.25 abc
CDC RENEGADE	118	ab	10.49 abc	32.04 abc	49.09 abc	64.41 abc	-	-	13.14 ab	74.54 ab	
AB MAXIMIZER	115	ab	-	-	32.30 ab	49.89 ab	-	-	17.31 ab	8.72 cd	72.18 bc
AB HAGUE	110	ab	10.67 abc	32.17 ab	51.21 a	64.27 bc	14.86 b	8.67 cd	-	-	
CANTU	109	ab	10.59 abc	-	-	47.33 abc	65.22 ab	15.17 b	13.80 a	76.85 a	
AAC LARIAT	104	ab	10.20 abc	33.15 a	51.21 a	-	-	-	-	-	-
CDC AUSTENSON	100	bc	10.23 abc	32.16 ab	51.11 a	64.27 bc	15.21 b	8.70 cd	-	-	
AB STANDSWELL	81	c	-	-	-	-	65.25 ab	21.52 a	-	-	73.45 abc
Results											
Average	8763.3 2	g/plot	10.34	31.85	48.83	64.61	16.07	9.82	72.99		
ANOVA p- value	0.01	*	0.39 NS	0.11 NS	0.05 NS	0.12 NS	0.16 NS	1.3 x10-3	**	0.14	NS
CV%	10.54		9.04	2.67	4.71	1.41	17.64	16.16	3.45		

Values followed by different letters are statistically different. (*=P<0.05 **P=0.01). Yield adjusted to 65% moisture.

Yield and percentage of dry forage matter in ten varieties of Barley seeded in St Paul, Alberta and percentage (dry matter) of Phosphorus, Potassium and Magnesium elements.

Variety	Yield (% of CDC Austenson)		% Dry matter							
			Ca		P		K		Mg	
KWS KELLIE	121	a	0.64	ab	-	-	-	-	0.25	ab
CDC DURANGO	120	a	0.55	abc	0.25	ab	2.26	abcd	0.24	bc
CDC FRASER	120	ab	0.63	abc	0.26	a	2.34	abcd	-	-
CDC RENEGADE	118	ab	0.59	abc	0.25	ab	-	-	0.25	abc
AB MAXIMIZER	115	ab	-	-	0.26	a	2.44	abc	0.24	bc
AB HAGUE	110	ab	0.59	abc	-	-	2.15	abcd	0.24	bc
CANTU	109	ab	0.55	abc	0.26	ab	2.49	a	-	-
AAC LARIAT	104	ab	0.65	a	-	-	-	-	0.25	abc
CDC AUSTENSON	100	bc	0.56	abc	0.26	a	2.43	abc	0.24	bc
AB STANDSWELL	81	c	-	-	0.27	a	2.52	a	0.25	ab
Results										
Average	8763.32	g/plot	0.58		0.25		2.31		0.24	
ANOVA p-value	0.01	*	0.38	NS	0.15	NS	0.07	NS	0.07	NS
CV%	10.54		12.88		5.57		9.7		4.48	

Values followed by different letters are statistically different. (*=P<0.05). Yield adjusted to 65% moisture.

Barley was affected by the dry months of July and August and hence it was really short and matured faster. It is possible this may explain the values observed in yield, crude protein, detergent fibre (acid and neutral), total digestible nutrients, starch, water soluble carbohydrates and true in vitro digestibility. KWS Kellie and CDC Durango were outstanding varieties that surpassed the yield of CDC Austenson by 21% and 20% respectively. On the other hand, AB Standswell barley was 19% less yielding than barley stands from CDC Austenson. Crude protein, ADF and NDF values were the same across all barley varieties. Total Digestible Nutrients extracted from biomass of the KWS Kellie barley variety however was greater than that extracted from barley biomass of AB Hague and CDC Austenson varieties. Starch values were greater in barley biomass taken from AB Standswell variety compared to that of all other varieties except AB Maximizer, which were the same. Water soluble carbohydrates were more concentrated in biomass taken from Cantu barley compared to that from all other varieties, except from that of CDC Renegade. Finally, true in vitro digestibility was greater in barley biomass from Cantu variety compared to that of AB

Maximizer, whereas WSC from biomass of all other varieties were significantly the same. Values for Calcium, Phosphorus, Potassium and Magnesium were the same across in biomass of all varieties. In can be concluded that (a)AB Standswell grew poorly compared to the control variety but had greater starch content than the majority of the other varieties. Aside from that all varieties had similar outcomes in all responses tested from biomass harvested.

Oat

Yield and percentage of dry forage matter in four varieties of Barley seeded in St Paul, Alberta and percentage (dry matter) of crude protein (CP), Acid and Neutral detergent fibre (ADF and NDF respectively), total digestible nutrients (TDN), starch, water soluble carbohydrates (WSC) and digestibility after 30 hours ingestion.

Variety	Yield (% of CDC Baler)		% Dry matter						
			Detergent fibre			TDN	Starch	WSC	True Invitro Digestibility (30 hrs)
			CP	Acid	Neutral				
CDC BALER	100	a	12.89 a	33.54 abc	52.54 ab	62.81 abc	7.24 b	11.59 a	73.60 a
AAC DOUGLAS	82	bc	10.68 bc	32.19 bc	50.85 ab	64.25 ab	15.87 a	7.30 bc	72.75 a
AAC WESLEY	75	dc	10.19 c	31.87 c	48.48 b	64.59 a	18.72 a	5.72 c	74.52 a
OREBOOST	70	dc	11.98 ab	34.64 a	54.82 a	61.63 c	7.53 b	10.00 ab	70.83 a
Results									
Average	1555.63	g/plot	11.72	33.26	51.87	63.1	10.99	9.58	72.97
ANOVA p-value	2.9X10 ⁻³	**	0.02 *	0.05 NS	0.20 NS	0.05 NS	6.0 X 10 ⁻⁴ ***	0.01 *	0.68 NS
CV%	11.84		7.34 %	3.02 %	5.21 %	1.7 %	22.87 %	20.11 %	3.8 %

Values followed by different letters are statistically different. (*=P<0.05 **P<0.01 ***P<0.001). Yield adjusted to 65% moisture.

Yield and percentage of dry forage matter in four varieties of Barley seeded in St Paul, Alberta and percentage (dry matter) of Phosphorus, Potassium and Magnesium elements.

Variety	Yield (% of CDC Baler)		% Dry matter			
			Ca	P	K	Mg
CDC BALER	100	a	0.73 a	0.25 ab	2.30 ab	0.22 a
AAC DOUGLAS	82	bc	0.59 bc	0.22 b	1.88 b	0.24 a
AAC WESLEY	75	dc	0.56 c	0.26 a	2.12 ab	0.25 a
OREBOOST	70	dc	0.69 ab	0.25 ab	2.23 ab	0.23 a
Results						
Average	1555.63	g/plot	0.66	0.26	2.2	0.24
ANOVA p-value	2.9 X10 ⁻³	**	0.03 *	0.18 NS	0.18 NS	0.68 NS
CV%	11.84	%	9.26 %	3.4 %	10.76 %	12.01 %

Values followed by different letters are statistically different. (*P<0.05). Yield adjusted to 65% moisture.



Oat varieties were not as affected as barley with the drought. However, some of the varieties matured earlier than others by the time of harvest. Biomass harvested from all oat varieties underyielded below the control (CDC Baler) by 18 (AAC Douglas), 25 (AAC Wesley) and 30% (OREBoost) respectively. Acid Detergent fibre was less concentrated in biomass taken from AAC Douglas and AAC Wesley varieties compared to that of OREBoost biomass. However, ADF extracted from biomass of these varieties were statistically the same as that from the biomass of the control. OREBoost biomass had a greater percentage of NDF compared to biomass harvested from the AAC Wesley variety but NDF content extracted from either OREBoost or AAC Wesley biomass were the same as those found in biomass of CDC Baler and AAC Douglas varieties. Starch content was greater in biomass from AAC Douglas and AAC Wesley varieties compared to that extracted from CDC Baler and OREBoost biomass. Water soluble carbohydrates (WSC) from CDC Baler and OREBoost biomass were similar compared to that from the control biomass. But these two varieties had higher WSC content in their biomass than the WSC found in biomass from AAC Wesley. As for true in vitro digestibility values, there was no difference between oat variety biomasses.

Phosphorus and Potassium values were statistically the same in biomass from AAC Wesley and OREBoost oat varieties in comparison to those found in CDC Baler biomass. However, Calcium content was similar in OREBoost and CDC Baler biomass, but Ca content in biomass from AAC Wesley and AAC Douglas biomass Ca content was significantly lower than that from the control biomass. There was no difference in Magnesium content from either oat variety biomass. As a conclusion, (a) all varieties underperformed in yield CDC Baler; (b) OREBoost had similar CP, ADF, NDF, starch, and WSC values but less nutrients (TDN) compared to CDC Baler; (c) in contrast, AAC Douglas and AAC Wesley had less crude protein, and WSC but more starch than CDC Baler and (d) Calcium, Phosphorus and Potassium in CDC Baler and OREBoost were the same, whereas AAC Wesley and AAC Douglas had same P and K content as CDC Baler but less Calcium.



Triticale

Yield and percentage of dry forage matter in two varieties of wheat and one variety of triticale seeded in St Paul, Alberta and percentage (dry matter) of crude protein (CP), Acid and Neutral detergent fibre (ADF and NDF respectively), total digestible nutrients (TDN), starch, water soluble carbohydrates (WSC) and digestibility after 30 hours ingestion.

Variety	Yield (% of AC Sadash)		% Dry matter								True Invitro Digestibility – 30 hrs (%DM)
			CP	Detergent fibre		TDN	Starch	WSC			
				Acid	Neutral						
AC SADASH	100	a	10.37 ab	33.31 a	51.22 a	63.05 a	14.14 a	8.10	cd	69.91 a	
AAC GALORE	93	ab	10.36 ab	32.82 a	50.98 a	63.58 a	13.80 a	10.57	cb	71.81 a	
ALOTTA	91	ab	9.82 b	32.81 a	49.70 a	63.58 a	15.27 a	11.90	b	71.75 a	
Results											
Average	4588.78 g/plot		10.32	33.13	51.43	63.24	13.01	10.64		70.28	
ANOVA p-value	0.04	*	0.04 *	0.99 NS	0.94 NS	0.99 NS	0.05 *	6.0 x 10 ⁻⁴	***	0.3768 NS	
CV%	11.80		7.18	6.80	9.86	3.81	25.91	12.83	%	3.56 %	

Values followed by different letters are statistically different. (*=P<0.05 **P<0.01 ***P<0.001). Yield adjusted to 65% moisture.

Yield and percentage of dry forage matter in two varieties of wheat and one variety of triticale seeded in St Paul, Alberta and percentage (dry matter) of Phosphorus, Potassium and Magnesium elements.

Variety	Yield (% of AC Sadash)		% Dry matter			
			Ca	P	K	Mg
AC SADASH	100	a	0.64 ab	0.24 a	1.95 a	0.25 a
AAC GALORE	93	ab	0.58 b	0.25 a	2.14 a	0.24 a
ALOTTA	91	ab	0.57 b	0.25 a	2.06 a	0.24 a
Results						
Average	4588.78 g/plot		0.62	0.24	1.97	0.24
ANOVA p-value	0.04	*	0.04 *	0.27 NS	0.36 NS	0.86 NS
CV%	11.80		12.13	6.26	13.51	9.36

Values followed by different letters are statistically different. (*=P<0.05). Yield adjusted to 65% moisture.)

Triticale varieties seemed least affected by the drought compared to barley and oat as maturity occurred at a later time compared to the former cereals. Triticale values from biomass were statistically the same across all varieties in yield, crude protein, acid and neutral detergent fibre, total digestible nutrients starch and true in vitro digestibility. In contrast, water soluble carbohydrates were greater in the Alotta

triticale biomass variety compared to the control biomass, AC Sadash. However, AC Sadash and AAC Galore biomass had similar WSC values. Calcium, Phosphorus, Potassium and Magnesium content from biomass of triticale varieties was similar for the 2024 growing season.

Sustainable Canadian Agriculture Partnership Trials

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

Activity	Date
Early Seeding (soil temperature at 2°C)	April 19 th , 2024
Regular Seeding (soil temperatures at 12°C)	May 13 th , 2024
Harvest (Early block – cut 1)	June 20 th , 2024
Harvest (Regular block – cut 1)	July 4 th , 2024
Harvest (Early block – cut 2)	July 4 th , 2024
Harvest (Regular block – cut 2)	August 7 th , 2024
Harvest (Early block – cut 3)	July 22 nd , 2024
Harvest (Regular block – cut 3)	September 17 th , 2024
Harvest (Early block – cut 4)	August 26 th , 2024

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

Seeding date	Seeding rate	Fertility (lb/acre)	Weed control	Harvest date	Accumulated precipitation
28-May-2024	300 plants/ sq ft	84:44:14	Buctril M	08-Aug-2024	134.8

Performance evaluation of two-row and six-row forage barley mixtures.

Seeding date	Seeding rate	Fertility (lb/acre)	Weed control	Harvest date	Accumulated precipitation
25-May-2024	300 plants/ sq ft	84:43:14	Buctril M	02-Aug-2024	147.9

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

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:

- 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.
- 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.
- 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.



Figure 1-1: early seeded trial (left), late seeded trial (right).

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. For weed control, a pre-seed burnoff was carried out with one spray of glyphosate (540g ai/L). The project was seeded in a randomized complete block design (RCBD) with four replications of ten treatments. CDC Austenson was seeded as check.

Treatment list		
Winter wheat	Winter triticale	Fall rye
AAC Coldfront	AB Provider	AC Hazlet
AAC Wildfire	AB Bronco	KWS Serafino
Pintail	Tadeus	SU Performer

Table 2. Project timeline	
Activity	Date
Early Seeding (soil temperature at 2°C)	April 19 th , 2024
Regular Seeding (soil temperatures at 12°C)	May 13 th , 2024
Harvest (Early block – cut 1)	June 20 th , 2024
Harvest (Regular block – cut 1)	July 4 th , 2024
Harvest (Early block – cut 2)	July 4 th , 2024
Harvest (Regular block – cut 2)	August 7 th , 2024
Harvest (Early block – cut 3)	July 22 nd , 2024
Harvest (Regular block – cut 3)	September 17 th , 2024
Harvest (Early block – cut 4)	August 26 th , 2024

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 2 for more details). The appropriate fertilizer was applied based on soil tests taken in the fall of 2023. Fertilizer was side banded at seeding. In crop spraying occurred approximately 3-4 weeks after seeding with 0.4L/ac of Buctril M. Hand weeding occur 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. Total rainfall during the growing season was 241 mm.

Results and Discussion:

The early seeded treatment was harvested a total of four times throughout the grazing season while the regular seeded treatment was harvested three times. For early seeded treatment, the first, second, third and fourth cut occurred after four, six, eight, and twelve weeks of seeding, respectively. On the other hand, the first harvest for regular seeded treatment was after seven weeks of seeding and regrowth was harvested twice after four and nine weeks of first harvest.

Overall, the early seeded treatment yielded higher than the regular seeded treatment. In the early seeded treatment, the third cut was more productive than the first two cuts while in the regular seeded treatment, the second cut produced more biomass than the other two cuts (Figure 2). The presence of unexpectedly developed tillers in the second and third harvests of regular and early seeded treatments probably resulted in higher yield for these cuts compared with the other cuts. In early seeded treatment, the highest yielding variety was AAC Coldfront (2.26 t ac⁻¹) followed by AB Provider (1.77 t ac⁻¹), AB Bronco (1.76 t ac⁻¹), Tadeus (1.73 t ac⁻¹), SU Performer (1.71 t ac⁻¹), Hazlet (1.68 t ac⁻¹), Pintail (1.61 t ac⁻¹), KWS Serafino (1.58 t ac⁻¹) and AAC Wildfire (1.42 t ac⁻¹). While in regular seeded treatment, the highest yielding variety was AB Bronco (1.57 t ac⁻¹) followed by SU Performer (1.30 t ac⁻¹), AAC Wildfire (1.19 t ac⁻¹), AB Provider (1.19 t ac⁻¹), Hazlet (1.14 t ac⁻¹), KWS Serafino (1.03 t ac⁻¹), AAC Coldfront (0.97 t ac⁻¹), Pintail (0.97 t ac⁻¹) and Tadeus (0.36 t ac⁻¹) (Table 3 & 4).

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

Variety	Cut 1		Cut 2		Cut 3		Cut 4	Total
AAC Coldfront	1.52	a	0.74	ab	-	-	-	2.26
AB Provider	0.29	ef	0.54	cd	0.94	a	-	1.77
AB Bronco	0.29	ef	0.19	bc	0.88	ab	-	1.76
Tadeus	0.15	fg	0.9	a	0.68	cd	-	1.73
SU Performer	0.45	de	0.69	abc	0.57	cd	-	1.71
Hazlet	0.52	d	0.64	bc	0.52	d	-	1.68
Pintail	1.13	b	0.32	e	0.16	e	-	1.63
KWS Serafino	0.15	fg	0.37	de	0.57	cd	0.49	1.58
AAC Wildfire	0.85	c	0.38	de	0.21	e	-	1.42
CDC Austremon (Check)	0.06	g	0.22	e	0.73	bc	0.34	1.35
F ₀ (P)	2.99e-12***		2.94e-06***		1.22e-08***		0.134	

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

Table 4. Total dry matter yield (ton/acre) by varieties in regular seeded treatment.

Variety	Cut 1		Cut 2		Cut 3		Total
CDC Austremon (Check)	1.07	a	0.6	cde	-	-	1.67
AB Bronco	0.23	de	1.34	a	-	-	1.57
SU Performer	0.31	cde	0.76	bc	0.23	b	1.30
AAC Wildfire	0.57	b	0.62	cd	-	-	1.19
AB Provider	0.18	e	1.01	b	-	-	1.19
Hazlet	0.40	bcd	0.37	ef	0.39	a	1.14
KWS Serafino	0.34	cde	0.41	def	0.28	ab	1.03
AAC Coldfront	0.47	bc	0.50	def	-	-	0.97
Pintail	0.49	bc	0.30	f	-	-	0.79
Tadeus	0.19	e	-	-	0.17	b	0.36
F ₀ (P)	2.55e-07***		1.75e-07***		0.0716		

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

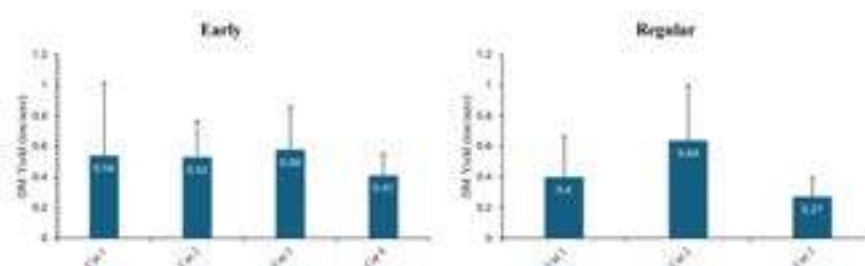


Figure 2. Average forage dry matter yield (ton/acre) by harvest number and seeding date.

When considering crude protein (CP), the early seeded treatment had higher CP content than the regular seeded treatment and the first harvest showed higher CP content than the subsequent harvests in both treatments. Similarly, the highest total digestible nutrients (TDN) were recorded in the early seeded treatment and the first cut contained higher concentrations of TDN than the other three cuts in that treatment. As expected, acid detergent fiber (ADF) and neutral detergent fiber (NDF) concentrations were lower in earlier cuts in both early and regular seeded treatments (Table 5).

Table 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					Regular				
	Brix %	CP %	TDN %	ADF %	NDF %	Brix %	CP %	TDN %	ADF %	NDF %
Cut 1	6.41	b	24.86	a	70.31	a	23.86	c	43.12	c
Cut 2	5.95	b	20.00	b	67.47	b	27.50	b	49.37	b
Cut 3	7.53	a	15.32	c	63.25	c	32.93	a	56.49	a
Cut 4	6.75	ab	14.41	c	64.48	c	31.34	a	56.95	a
Pr(>F)	0.0314*	7.91e-12***	4.59e-11***	4.58-11***	2.68-12***	0.661	<2e-16***	2.45e-07***	3.34e-07***	2.97e-12***

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

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

	Early				Regular			
	Ca %	P %	K %	Mg %	Ca %	P %	K %	Mg %
Cut 1	0.45	a	0.30	b	2.70	a	0.30	a
Cut 2	0.34	b	0.33	a	2.56	a	0.25	b
Cut 3	0.26	c	0.33	a	2.12	b	0.23	b
Cut 4	0.27	bc	0.31	ab	1.80	b	0.23	b
Pr(>F)	2.3e-09***	0.03*	3.74e-06***	2.97e-07***	3.42e-08***	0.000249***	0.00125**	7.68e-05***

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

Table 7. Average sodium (Na), copper (Cu), and molybdenum (Mo) by harvest number and seeding date treatment.

	Early			Regular		
	Na	Cu	Mo	Na	Cu	Mo
Cut 1	0.36	b	5.47	b	0.83	a
Cut 2	0.27	bc	6.43	a	0.92	a
Cut 3	0.02	c	6.56	a	0.89	a
Cut 4	0.10	a	7.19	a	1.04	a
Pr(>F)	2.77e-07***	4.39-05***	0.696	0.00338**	0.382	4.61e-07***

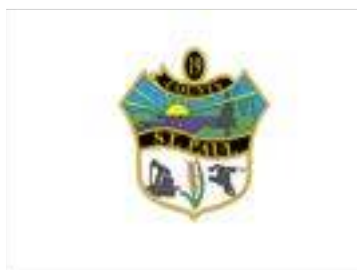
Note: Significance Codes: 0 '***' 0.001 '***' 0.01 '**' 0.05 '.'; - missing value.



Figure 1-2. A representative picture of trial; captured by Alyssa Krawchuk on July 25, 2024.

We may conclude that during the periods of dry conditions, early seeded winter cereals can be a viable alternative grazing resource. By seeding early, more grazing periods can be obtained with higher quality forage over regular seeding dates. This can be used as an alternative feed source during drought years reducing grazing pressure on perennial pastures, the need to buy dry feed or the need to rent alternative pasture. The year after a drought, this could be used as a method to defer grazing on drought-stressed pastures until later in the grazing season and provide more rest for these pastures throughout the summer. Furthermore, by seeding early the winter cereals can take advantage of any early growing season moisture that might occur before regular seeding dates.

Thank you for your support on this project:



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

Barley (*Hordeum vulgare* L.) is one the most common forage crops in Alberta. It has superior forage quality among small grain cereal species examined (Baron et al., 2000). In 2023, approximately 157,000 hectares of silage barley was harvested, with the total estimated production of 2.3 million tonnes in Alberta (Wong, 2024). Although there is a substantial potential to increase barley production, productivity is often limited by soil acidity, nutrient deficiency, and low levels of fertilizers application. In conventional agriculture, synthetic fertilizers are quite extensively used to increase crop yield and improve soil quality; therefore, the input of synthetic or inorganic fertilizers alone constitutes a greater portion of the total variable cost for crop production in Alberta (AAF, 2023). It has been widely realized that injudicious application of synthetic fertilizer, particularly nitrogen, pollutes surface water, ground water and atmosphere through runoff, leaching and volatilization, respectively. Long-term unreasonable synthetic fertilization may also reduce soil organic carbon and total microbial biomass and deteriorate soil quality and crop productivity over time (Tripathi et al., 2020). In contrast to inorganic fertilizers, organic fertilizers improve soil fertility on a sustainable basis through increase in soil organic matter content, water holding capacity and microbial activity (Zhang et al., 2015; Zhou et al., 2022). A long-term study in the cold prairie has shown that manure worked better on improving microbial biomass carbon than chemical fertilizer or no fertilizer treatments (Kiani et al., 2017). Similarly, compost and biochar are both high quality organic fertilizers which have received increasing attention due to their promising effects on plant growth, soil nutrient content, and carbon storage (Ashiq et al., 2020; Hagemann et al., 2018).

However, nutrients derived from organic sources are not immediately available for plant uptake compared to nutrients from synthetic fertilizers. Many research findings have shown that neither inorganic fertilizers nor organic nutrient sources alone bring a sustainable increase in crop yields (Godara et al., 2012; Abid et al., 2020). A balanced and integrated use of organic and mineral fertilizers is a sustainable eco-friendly agricultural approach to maintain soil fertility and improve crop productivity. However, no in-depth study was available to examine the effect of this integrated nutrient management practice on forage barley production in Northeastern Alberta. Therefore, a research trial was carried out to fill this knowledge gap with the following principal objectives:

Objectives:

- 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.
- 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.
- To compare the economic feasibility of organic versus inorganic nutrient sources in Northeastern Alberta.

Materials and Methods:

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. LARA Fabro five row seeder was used for seeding with 9" row spacing. In crop spraying of 0.4L/ac of Buctril M was carried out on June 09, 2024. 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 soft dough stage. Individual plots were harvested with LARA Alfalfa-Omega self-propelled forage harvester. The total precipitation accumulated during the growing season was 134.8 mm. For each treatment plot, ~ 400 g of chopped forage (sub-sample) was frozen immediately 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.

Table 1. Characteristics of applied organic and inorganic fertilizers

Nutrient Source	N (%)	P (%)	K (%)	Ca (%)	Mg (%)	OC (%)	C: N	DM	Ash (%)
Urea	46	0	0	-	-	-	-	-	-
MAP	11	52	0	-	-	-	-	-	-
Potash	0	0	60	-	-	-	-	-	-
Biochar	1.04	-	-	-	-	85.0	-	32.7	7.8
Compost	1.5	-	-	-	-	16.2	7.1	-	-
Manure	0.9	0.2	1.2	1.1	0.4	39.5	15:1	37.6	-

Note: N: Nitrogen; P: Phosphorus; K: Potassium; Ca: Calcium; Mg: Magnesium; OC: organic carbon
C: N: Carbon: Nitrogen; DM: dry matter; MAP: Monoammonium phosphate; - missing value.

Table 2. Treatment description.

Treatment	Application Rate
Control	No fertilizer
Synthetic fertilizer	84:44:14 lbs/acre NPK
Biochar	1 ton/acre
Compost	2.5 ton/acre
Manure	5 ton/acre
Synthetic fertilizer + biochar at 3:1 ratio	63:33:11 lb/acre NPK + 0.25 ton/acre
Synthetic fertilizer + compost at 3:1 ratio	63:33:11 lb/acre NPK + 0.63 ton/acre
Synthetic fertilizer + manure at 3:1 ratio	63:33:11 lb/acre NPK + 1.25 ton/acre
Synthetic fertilizer + biochar at 1:1 ratio	42:22:7 lb/acre NPK + 0.5 ton/acre
Synthetic fertilizer + compost at 1:1 ratio	42:22:7 lb/acre NPK + 1.25 ton/acre
Synthetic fertilizer + manure at 1:1 ratio	42:22:7 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. LARA Fabro five row seeder was used for seeding with 9" row spacing. In crop spraying of 0.4L/ac of Buctril M was carried out on June 09, 2024. 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 soft dough stage. Individual plots were harvested with LARA Alfalfa-Omega self-propelled forage harvester. The total precipitation accumulated during the growing

season was 134.8 mm. For each treatment plot, ~ 400 g of chopped forage (sub-sample) was frozen immediately 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.



Figure 1-1. A representative picture of trial; captured by Alyssa Krawchuk on July 25, 2024.

Results and Discussion:

The results indicated that plots under the treatments with partial substitution of inorganic fertilizers (NPK) by organic fertilizers such as cattle manure and compost gave better results than plots where inorganic or organic fertilizers were applied alone. The highest forage biomass was obtained from application of 75% of the recommended rate of inorganic fertilizers (63:33:11 lb/acre NPK) + 1.25 ton/acre of cattle manure and lowest forage biomass was obtained from the control (no fertilizer treatment). The highest forage DM yield obtained was 3.45 t ac⁻¹, whereas the lowest was 2.24 t ac⁻¹. Application of 50% of the recommended dose of inorganic fertilizers (42:22:7 lbs/acre NPK) integrated with 1.25 ton/acre of compost, gave the second highest forage production at 3.15 t ac⁻¹. On the other hand, application of full recommended dose of inorganic fertilizers (84:44:14 lbs/acre NPK) gave the third highest forage DM yield in this study at 3.01 t ac⁻¹. All the non- NPK treatments even if they received full rates of manure, compost, and biochar, gave the least forage production (Figure 2).

The average crude protein (CP) content ranged from 10.80 to 13.85% for plots that were amended with organic fertilizers in combination with mineral fertilizers. The highest CP content (13.85%) was recorded in treatment where 75% of the recommended rate of inorganic fertilizers (63:33:11 lb/acre NPK) was applied along with 0.25 ton/acre of biochar. Similarly, total digestible nutrients (TDN) were greater ($\geq 65\%$) in all plots under the treatments where integrated applications of organic and inorganic fertilizers were used.

When comparing treatments with each other, the lowest acid detergent fiber (ADF) and neutral detergent fiber (NDF) concentrations were recorded in plots under the treatments where 25% of recommended dose of inorganic fertilizers was replaced by either 1.25 ton/acre of cattle manure or 0.63 ton/acre of compost (Table 4).

So, we may conclude that the integrated use of inorganic and organic fertilizers (Compost and manure) can not only reduce the input of synthetic fertilizers but also help to maintain high silage barley yield and quality and achieve sustainable agriculture. Since this study is conducted in only one type of environment during a single growing season, further research is needed to produce any broad conclusions

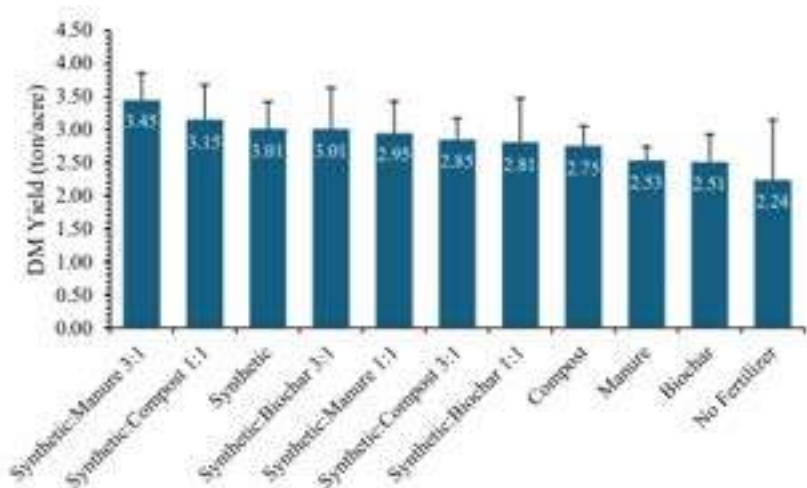


Figure 2. Effects of different fertilizer treatments on forage barley dry matter (DM) yield.

Table 4. 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	11.20	29.70	53.40	65.77
Synthetic Fertilizer	11.68	26.26	46.59	68.44
Biochar	11.75	30.22	52.18	65.40
Compost	12.10	28.55	47.58	66.66
Manure	12.36	30.41	51.44	65.21
Synthetic Fertilizer: Biochar 3:1	11.85	27.69	45.93	67.33
Synthetic Fertilizer: Biochar 1:1	11.10	27.62	47.60	67.38
Synthetic Fertilizer: Compost 3:1	11.10	26.34	45.24	68.39
Synthetic Fertilizer: Compost 1:1	12.30	31.10	55.23	64.70
Synthetic Fertilizer: Manure 3:1	12.81	26.57	45.84	68.20
Synthetic Fertilizer: Manure 1:1	10.80	30.60	55.02	66.48
Pr (>F)	0.204	0.157	0.231	0.161

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

Table 5. 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	0.30	0.23	1.50	0.22	0.23
Synthetic Fertilizer	0.28	0.26	1.51	0.21	0.26
Biochar	0.32	0.24	1.53	0.20	0.18
Compost	0.28	0.25	1.53	0.20	0.19
Manure	0.31	0.26	1.70	0.21	0.12
Synthetic Fertilizer: Biochar 3:1	0.37	0.24	1.50	0.25	0.33
Synthetic Fertilizer: Biochar 1:1	0.28	0.22	1.22	0.22	0.31
Synthetic Fertilizer: Compost 3:1	0.33	0.23	1.34	0.21	0.25
Synthetic Fertilizer: Compost 1:1	0.33	0.21	1.32	0.22	0.34
Synthetic Fertilizer: Manure 3:1	0.29	0.22	1.18	0.20	0.31

Table 6. Forage copper (Cu), zinc (Zn), iron (Fe), and manganese (Mn) content for all fertilizer treatments.

Treatment	Cu (ppm)	Zn (ppm)	Fe (ppm)	Mn (ppm)
No Fertilizer	5.72	19.17	106.31	24.11
Synthetic Fertilizer	4.70	27.85	102.80	28.56
Biochar	5.50	23.75	108.90	24.31
Compost	5.75	25.08	108.51	28.49
Manure	6.28	22.88	107.41	24.50
Synthetic Fertilizer: Biochar 3:1	4.93	28.10	103.74	28.90
Synthetic Fertilizer: Biochar 1:1	4.48	24.19	90.99	24.51
Synthetic Fertilizer: Compost 3:1	4.82	25.57	113.10	29.16
Synthetic Fertilizer: Compost 1:1	4.97	26.21	113.10	27.88
Synthetic Fertilizer: Manure 3:1	4.80	25.29	90.20	24.67
Synthetic Fertilizer: Manure 1:1	4.93	24.70	84.66	25.78
Pr (>F)	0.00872**	0.58	0.488	0.672

Note: Significance Codes : 0 **** 0.001 *** 0.01 ** 0.05 ., ppm: Parts per million.

References:

- Abid, M., Batool, T., Siddique, G., Ali, S., Binyamin, R., Shahid, M. J., & Alyemeni, M. N. (2020). Integrated nutrient management enhances soil quality and crop productivity in maize-based cropping system. *Sustainability*, 12(23), 10214.
- Alberta Agriculture & Forestry. (2023). AAF. 2023 Cropping Alternatives. Retrieved Feb 05, 2024, from: <https://open.alberta.ca/agi-itrb-cropping-alternatives-2023.pdf>.
- Ashiq, W., Nadeem, M., Ali, W., Zaeem, M., Wu, J., Galagedara, L., & Cheema, M. (2020). Biochar amendment mitigates greenhouse gases emission and global warming potential in dairy manure based silage corn in boreal climate. *Environmental Pollution*, 265, 114869.
- Baron, V. S., Okine, E., & Dick, A. C. (2000). Optimizing yield and quality of cereal silage. In *Proc. 2000 Western Canadian Dairy Seminar. Adv Dairy Tech* (Vol. 12, pp. 351-367).
- Godara, A. S., Gupta, U. S., & Singh, R. (2012). Effect of integrated nutrient management on herbage, dry fodder yield and quality of oat (*Avena sativa* L.). *Forage Research*, 38(1), 59-61.
- Hagemann, N., Subdiaga, E., Orsetti, S., de la Rosa, J. M., Knicker, H., Schmidt, H. P., & Behrens, S. (2018). Effect of biochar amendment on compost organic matter composition following aerobic composting of manure. *Science of the Total Environment*, 613, 20-29.
- Kiani, M., Hernandez-Ramirez, G., Quideau, S., Smith, E., Janzen, H., Larney, F. J., & Puurveen, D. (2017). Quantifying sensitive soil quality indicators across contrasting long-term land management systems: Crop rotations and nutrient regimes. *Agriculture, Ecosystems & Environment*, 248, 123-135.
- Tripathi, S., Srivastava, P., Devi, R. S., & Bhadouria, R. (2020). Influence of synthetic fertilizers and pesticides on soil health and soil microbiology. In *Agrochemicals detection, treatment and remediation* (pp. 25-54). Butterworth-Heinemann.
- Wong, B. Alberta 2023 Greenfeed and silage production survey results. (2024). Retrieved November 13, 2024, from: <https://open.alberta.ca/dataset/agi-alberta-greenfeed-silage-production-survey-results-2023.pdf>.
- Zhang, Q., Zhou, W., Liang, G., Wang, X., Sun, J., He, P., & Li, L. (2015). Effects of different organic manures on the biochemical and microbial characteristics of albic paddy soil in a short-term experiment. *Plos one*, 10(4), e0124096.
- Zhou, Z., Zhang, S., Jiang, N., Xiu, W., Zhao, J., & Yang, D. (2022). Effects of organic fertilizer incorporation practices on crops yield, soil quality, and soil fauna feeding activity in the wheat-maize rotation system. *Frontiers in Environmental Science*, 10, 105807.

Thank you for your support on this project:



Performance evaluation of two-row and six-row forage barley mixtures.

The production of high-yielding and high-quality forage has been a big challenge for Alberta livestock producers because of severe drought conditions across multiple regions of the province since 2021. Water stress and associated crop and pasture failures leave many growers producing insufficient quantities of forage for livestock operations. The shortage of available forage indicates that producers may need to adopt new strategies to get the most yield possible when water is limited due to drought conditions. Perennial forages (grasses or legumes) create a good basis for livestock farming systems, but many perennial forages go dormant as a survival mechanism under drier conditions (Taleb et al., 2023). Annual forages are known to use water more efficiently than perennial forages and could be utilized as additional livestock feed during times of limited rainfall and perennial pasture shortage. Barley is one of the most widely grown annual forage crops in western Canada because it is highly adaptable to diverse growing conditions. It is more water use efficient than other small grains, making it a valuable annual forage crop during moisture-stressed periods. In 2023, approximately 157,000 hectares of silage barley was harvested, with the total estimated production of 2.3 million tonnes in Alberta (Wong, 2024). Anecdotal accounts from cattle producers in Northeastern Alberta have indicated that higher forage yields may be obtained when growing two-row and six-row barley mixtures. However, there have been no assessments performed in an applied research settings to endorse this claim in Northeastern Alberta. A field study conducted by Gill et al. (2013) in the Peace region of Alberta revealed that two-row barley are superior to six-row barley in terms of forage yield and nutritional quality. Therefore, we hypothesized that mixing and planting a suitable ratio of phenotypically contrasting barley varieties would increase forage biomass and improve the overall nutritional profile of a blend. To test this hypothesis, four new barley varieties in the Lakeland region of Alberta, each representing a unique combination of spike type, two-row or six-row, were utilized in a field trial with the following principal objectives:

Objectives:

- To determine the performance of two-row and six-row barely pure stands as well as their binary mixtures in three seeding ratios (1:1, 1:3, and 3:1) for forage dry matter (DM) yield.
- To determine the performance of two-row and six-row barely pure stands as well as their binary mixtures in three seeding ratios (1:1, 1:3, and 3:1) for forage nutritional quality.
- To determine if further research is warranted as this project is a one-year proof of concept project.



Materials and Methods:

The trial was carried out from May 15, 2024, to Aug 02, 2024, at the LARA research farm (54° 18'N, 110° 37'W; NE 25-61-5-W4) in Fort Kent, Alberta. Prior to seeding, soil samples were taken to a depth of 0-6 and 6-12 inches to determine the nutrient level at Element Lab, Edmonton. For weed control, a pre-seed burnoff was carried out with one spray of glyphosate (540g ai/L). 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 1 & 2). CDC Austenson was seeded as a check variety. Seeding rate (g/plot) was calculated using the formula: $1000 \text{ kernel weight} \times (\text{desired plants}/\text{m}^2/1000) \times \text{plot area m}^2 \times (100/\text{germination}\%) \times 1.05$. The factor 1.05 was used during calculations to take care of seedling mortality. Desired plant density was set to 300 plants/m² for all plots.

Table 1. Varieties chosen for barley mixture ratios

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 2. Treatment list

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 soil test, the recommend rate of fertilizers (84:43:14 lbs NPK ac-1) was side banded during seeding. In crop spraying of 0.4L/ac of Buctril M was carried out on June 09, 2024. 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 soft dough stage. Individual plots were harvested with LARA Alfalfa-Omega self-propelled forage harvester. The total precipitation accumulated during the growing season was 147.9 mm. For each treatment plot, ~ 400 g of chopped forage (sub-sample) was frozen immediately 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.



Figure 1-1. A representative picture showing different project related activities e.g., seeding (Top left), height measurements (Top right), and harvesting (Bottom).

Results and Discussion:

The present study showed that mixtures ought to be more advantageous to farmers than corresponding pure stands when considering forage DM yield as % of check, CDC Austenson (Figure 2). On average, CDC Austenson produced 3.40 t ac⁻¹ of forage DM yield in this trial. We found significant differences among treatments when considering forage DM yield and different quality parameters including crude protein (CP), calcium (Ca), magnesium (Mg), and zinc (Zn) (Table 4, 5 & 6). The average forage DM yield ranged from 2.44 t ac⁻¹ to 3.70 t ac⁻¹ for the mixtures, with AB Maximizer and AB Standswell sown in 1:3 seeding ratio the lowest yielding mixture and AB Maximizer and AB Tofield grown in 3:1 seeding ratio the highest yielding mixture. Among the varieties seeded in monocultures, the highest forage DM yield was produced by AB Maximizer (3.44 t ac⁻¹) followed by AAC Lariat (3.31 t ac⁻¹) and AB Tofield (2.70 t ac⁻¹). AB Standswell produced the lowest forage DM yield (2.07 t ac⁻¹) in pure stands. A total of two mixtures; AB Maximizer and AB Tofield at seeding ratio of 3:1 and AAC Lariat and AB Tofield at seeding ratio of 3:1 yielded 9 and 7% higher than the check variety, respectively (Figure 3). AB Maximizer was the only variety grown in pure stands, which yielded 1% higher than the check variety. Varieties such as AAC Lariat, AB Tofield and AB Standswell yielded 3, 21, and 39% lower than the check variety, respectively, when seeded as monocrops (Table 4).

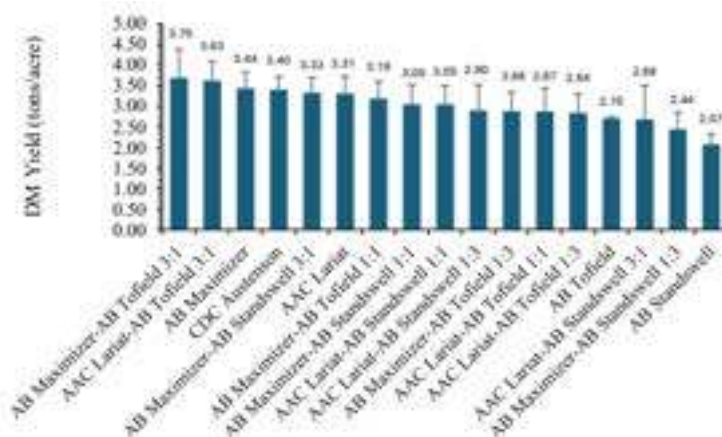


Figure 2. Forage dry matter (DM) yield for variety mixtures and monocultures.



Figure 3. The two top yielding mixture of the present study; AB Maximizer and AB Tofield at seeding ratio of 3:1 (Left) and AAC Lariat and AB Tofield at seeding ratio of 3:1 (Right).

As a general rule of thumb, dietary CP level of 7-9-11% should be maintained to meet the nutrient requirements of beef cows during mid gestation, late gestation and lactation. Of the 12 mixtures tested in this study, 11 had CP content (> 11%) adequate to meet the nutrient requirements for beef cattle after calving. Only CP content (9.67%) of mixture with AAC Lariat and AB Standswell in 3:1 seeding ratio was not sufficient to meet the requirements for beef cattle until post calving. Total digestible nutrients (TDN), which is the easiest method to estimate the amount of energy in the feed follows 55-60-65 rule, where beef cows' mid pregnancy, late pregnancy, and post calving require 55, 60 and 65%, respectively. Our results revealed that all mixtures contain $\geq 65\%$ of TDN and

would meet the energy demands of lactating beef cattle. The maximum TDN (68.71%) was recorded in AB Maximizer and AB Tofield while in 1:3 binary mixture. The lowest TDN (64.97%) came from mixture with AAC Lariat and AB Standswell at seeding ratio of 1:1 (Table 4). Overall, mixtures had adequate Ca (0.27-0.43%), Mg (0.23-0.29%), Na (0.14-0.3%), P (0.20-0.22%), and K (1.04-1.16%) to meet the requirements by beef cows during gestation and nursing calves. However, it is important to note that none of the mixtures had enough Cu (10 ppm) to meet the requirements by different categories of beef cattle (Table 6). Therefore, free choice mineral supplementation, particularly of Cu, would be needed in diets when any of these mixtures are fed to beef cattle.

Table 4. 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)					
AB Maximizer-AB Tofield 3:1	109	a	32.81	abcd	45.68	abcd	27.44	abcd	67.53	abcd
AAC Lariat-AB Tofield 3:1	107	a	31.97	bcd	47.19	abcd	27.79	abcd	67.26	abcd
AB Maximizer	101	ab	33.52	ab	38.81	d	23.97	d	70.23	a
Check	100	abc	33.32	abc	40.17	cd	24.79	cd	69.59	ab
AB Maximizer-AB Standswell 3:1	98	abc	32.47	abcd	43.52	abcd	26.31	abcd	68.40	abcd
AAC Lariat	97	abc	31.25	de	45.99	abcd	25.67	bcd	68.81	abc
AB Maximizer-AB Tofield 1:1	94	abc	31.35	cde	47.78	abc	28.67	abc	66.96	abcd
AAC Lariat-AB Standswell 1:1	90	abcd	31.32	cde	50.38	ab	30.73	a	64.97	d
AB Maximizer-AB Standswell 1:1	90	abcd	31.46	cde	47.08	abcd	28.00	abcd	67.09	abcd
AAC Lariat-AB Standswell 1:3	85	bcd	33.76	ab	41.52	cd	27.08	abcd	67.80	abcd
AB Maximizer-AB Tofield 1:3	85	bcd	32.19	abcd	42.26	bcd	25.92	abcd	68.71	abcd
AAC Lariat-AB Tofield 1:1	84	bcd	31.74	bcd	46.09	abcd	27.05	abcd	67.83	abcd
AAC Lariat-AB Tofield 1:3	84	bcd	31.99	bcd	46.03	abcd	28.74	abc	66.51	bcd
AB Tofield	79	cde	31.73	bcd	48.39	abc	29.84	ab	65.66	cd
AAC Lariat-AB Standswell 3:1	79	cde	9.67	e	52.43	a	30.12	ab	65.44	cd
AB Maximizer-AB Standswell 1:3	72	de	32.96	abcd	43.49	abcd	27.35	abcd	67.38	abcd
AB Standswell	61	e	34.07	a	40.21	cd	26.75	abcd	68.06	abcd
Pr (>F)	0.00128 ***	0.0215*	0.172	0.504	0.343					

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

Table 5. 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)					
AB Maximizer-AB Tofield 3:1	0.33	cd	0.21	ab	1.16	a	0.27	abcd	0.25	abcd
AAC Lariat-AB Tofield 3:1	0.39	abc	0.20	ab	1.05	abc	0.26	abcde	0.21	bcd
AB Maximizer	0.27	ef	0.23	a	1.00	c	0.23	de	0.20	cde
Check	0.27	ef	0.20	ab	1.04	bc	0.24	de	0.26	abcd
AB Maximizer-AB Standswell 3:1	0.27	f	0.20	ab	1.05	abc	0.23	e	0.25	abcd
AAC Lariat	0.33	cd	0.22	ab	1.00	c	0.24	cde	0.18	de
AB Maximizer-AB Tofield 1:1	0.28	ef	0.20	ab	1.06	abc	0.25	abcde	0.25	abcd
AAC Lariat-AB Standswell 1:1	0.43	a	0.20	ab	1.12	ab	0.29	a	0.26	abcd
AB Maximizer-AB Standswell 1:1	0.30	def	0.22	ab	1.05	abc	0.25	bcd	0.21	cde
AAC Lariat-AB Standswell 1:3	0.39	abc	0.21	ab	1.04	bc	0.26	abcde	0.30	ab
AB Maximizer-AB Tofield 1:3	0.28	ef	0.21	ab	1.08	abc	0.24	cde	0.20	cde
AAC Lariat-AB Tofield 1:1	0.39	abc	0.22	ab	1.13	ab	0.28	abcd	0.24	abcde
AAC Lariat-AB Tofield 1:3	0.41	ab	0.22	ab	1.11	abc	0.28	abc	0.23	abcde
AB Tofield	0.41	ab	0.21	ab	1.14	a	0.28	ab	0.25	abcd
AAC Lariat-AB Standswell 3:1	0.39	abc	0.20	ab	1.09	abc	0.26	abcde	0.14	e
AB Maximizer-AB Standswell 1:3	0.34	bcd	0.20	ab	1.10	abc	0.25	abcde	0.27	abc
AB Standswell	0.37	abcd	0.19	b	1.00	bc	0.28	abcd	0.32	a
P<(F)	5.78e-06***	0.777	0.136	0.0607	0.0624					

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

Table 6. Forage copper (Cu), zinc (Zn), iron (Fe), and manganese (Mn) content for all cropping treatments.

Treatment	Cu (ppm)		Zn (ppm)		Fe (ppm)		Mn (ppm)	
AB Maximizer-AB Tofield 3:1	3.64	ab	26.10	efg	106.49	a	29.19	abc
AAC Lariat-AB Tofield 3:1	3.40	ab	28.54	cdef	106.42	a	32.14	abc
AB Maximizer	3.45	ab	24.10	g	89.66	abc	27.56	bc
Check	3.30	ab	25.15	fg	87.20	abc	29.56	abc
AB Maximizer-AB Standswell 3:1	3.41	ab	24.39	g	91.20	abc	26.53	c
AAC Lariat	3.27	ab	26.87	defg	82.29	bc	28.08	abc
AB Maximizer-AB Tofield 1:1	3.34	ab	28.28	cdef	87.50	abc	29.71	abc
AAC Lariat-AB Standswell 1:1	3.48	ab	29.81	bcd	84.10	abc	31.78	abc
AB Maximizer-AB Standswell 1:1	3.74	ab	27.11	defg	90.29	abc	28.41	abc
AAC Lariat-AB Standswell 1:3	3.12	b	31.70	abc	86.29	abc	30.57	abc
AB Maximizer-AB Tofield 1:3	3.84	a	32.40	ab	99.31	ab	29.15	abc
AAC Lariat-AB Tofield 1:1	3.56	ab	29.77	bcde	68.52	c	30.66	abc
AAC Lariat-AB Tofield 1:3	3.41	ab	32.31	ab	96.33	ab	33.17	abc
AB Tofield	3.27	ab	35.27	a	98.33	ab	36.36	a
AAC Lariat-AB Standswell 3:1	3.30	ab	27.62	defg	88.32	abc	35.81	ab
AB Maximizer-AB Standswell 1:3	3.50	ab	28.35	cdef	82.16	bc	30.78	abc
AB Standswell	3.37	ab	32.3	ab	89.51	abc	29.99	abc
Pr (>F)	0.863		5.24e-07***		0.364		0.643	

Note: Significance Codes: 0 '****' 0.001 '***' 0.01 '**' 0.05 '.'; ppm: parts per million.

We also performed a direct comparison of two-row and six-row varieties utilized in this study (Table 7, 8 & 9). Overall, two-row varieties yielded (3.38 t ac⁻¹) higher than six-row varieties (2.83 t ac⁻¹). Similarly, the average TDN content (69.57%) of two-row varieties was also higher than six-row varieties (66.86%). Though not significantly different, the average CP content of six-row varieties (12.90%) was slightly higher than two-row varieties (12.39%). This study corroborates the findings of Gill et al. (2013) who seeded 12 barley varieties (6 two-row and 6 six-row) from 2009 to 2011 in the peace region of Alberta and noticed that most two-row barley varieties are superior to six-row barley varieties in terms of forage DM yield and nutritive value. Thus, we may also conclude that two-row varieties which showed the highest yield and quality potential in present study, might be responsible for compensation observed within the mixtures. The first two top yielding mixtures had two-row and six-row varieties at seeding ratio of 3:1, suggesting that 3:1 mixture of a high yielding two-row variety and a low-yielding six-row variety could increase the overall forage DM yield and nutritional quality and offer a diet that is able to meet the nutritional requirements for different classes of beef cattle.



Table 7. Mean dry matter (DM) yield, crude protein (CP), neutral detergent fiber (NDF), acid detergent fibre (ADF), and total detergent fibre (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	3.40	a	13.32	a	24.80	b	40.17	a	69.59	a
Two-Row	3.38	a	12.39	a	24.82	b	42.40	a	69.57	a
Six-Row	2.83	b	12.90	a	28.30	a	44.30	a	66.86	ab
Pr (>F)	0.000126***		0.66		0.094.		0.61		0.0945.	

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

Table 8. Mean calcium (Ca), phosphorous (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	0.27	b	0.20	a	1.04	ab	0.24	b	0.26	ab
Two-Row	0.30	b	0.22	a	1.00	b	0.24	b	0.19	b
Six-Row	0.39	a	0.20	a	1.09	a	0.28	a	0.29	a
Pr (>F)	0.00269**		0.158		0.121		0.0151*		0.0191*	

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

Table 9. 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 (ppm)		Zn (ppm)		Fe (ppm)		Mn (ppm)	
Check	3.30	a	25.15	b	87.20	a	29.56	ab
Two-Row	3.36	a	25.49	b	85.98	a	27.82	b
Six-Row	3.32	a	33.57	a	93.92	a	32.72	a
Pr (>F)	0.981		3.92e-06***		0.463		0.0755	

Note: Significance Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.'; ppm: parts per million.

As our study is conducted in only one type of environment during a single growing season, the strength to produce any broad conclusions is limited. Further research is needed to explore how variety selection, seeding ratios, and experimentation under diverse environmental conditions will affect the ability of these mixtures to stabilize forage productivity and quality over time.



Momna Farzand and Brian Kennedy speaking about new barley varieties used in this trial at LARA summer field tour in Fort Kent, Alberta, on July 25, 2024.

Thank you for your support on this project:



LARA Forage Trials

LARA cropping forage trial chronology in Fort Kent, Alberta in 2024													
Site	Regional Variety Trial		Seeding ^a		Fertilizer ^a		Burndown			Herbicide ^b			Harvest ^c
					Date	Rate plants foot-2	Date	Rate lb acre ⁻¹	Date	Name	Rate L acre ⁻¹	Date	
Fort Kent			Date	Rate plants foot-2	Date	Rate lb acre ⁻¹	Date	Name	Rate L acre ⁻¹	Date	Name	Rate L acre ⁻¹	
Investigating the impact of low-growing clovers (white and subterranean clover) and nitrogen rates on silage crop yield, weed pressure, cereal leaf disease levels, and forage quality													

^aNo till hoe-drill Fabro seeder with side banding (2008) attached to Ford tractor (1998)

^bR-Tech Thirty-foot sprayer (2024) attached to John Deere tractor (2010)

^cR-Tech Alfalfa Omega self-propelled forage harvester (circa 1980)

Investigating the impact of low-growing clovers (white and subterranean clover) and nitrogen rates on silage crop yield, weed pressure, cereal leaf disease levels, and forage quality.



Figure 1: Oat (*Avena sativa* L.) under-seeded in a mixed row to Subterranean clover (*Trifolium subterraneum* L.). Photo taken at the LARA Research Farm (Ft-Kent, Alberta) July 2nd, 2024.

According to Farm Credit Canada, crops planted and grown in 2023 were the most expensive to ever be put in the ground (Vossler 2024). Producers are thus looking for alternatives to reduce the costs of production, while maintaining and/or increasing crop yield. The solution may lie in under-seeding the cereal crop with an annual low-growing clover. Subterranean clover (*Trifolium subterraneum* L.) is an annual legume with high palatability. A native of the mediterranean region, it can tolerate warm and drought conditions. White clover (*Trifolium repens* L.), on the other hand, may be more familiar to producers in Alberta. It is a cool seasoned legume that is often put in pasture mixes. It has good shade tolerance. It can overwinter in Alberta if conditions are not too extreme (mild winters with ample snow cover). It differs from Subterranean clover in that it can tolerate cool and wet conditions. Some pasture mixes will include both clovers to cover both environmental scenarios. In terms of nutrient content, white clover, for example, has a crude protein content of 25% (over 6 times higher than straw). Total digestible nutrient (energy) is high (~80%).

Calcium content is estimated to be 1.5% (almost ten times that of straw). Phosphorus content is estimated to be 0.4% (almost four times that of straw). White clover can fix from 100 to 150 lbs of N/acre. Some of which would invariably be uptaken by the removal of above-ground biomass (i.e. grazing).

In this scenario, producers would first harvest their silage crop in late July or early August, which would open the canopy for the clover undergrowth to access sunlight and maximize plant growth before freezing up (6-8 weeks). The primary goal of this practice would be to offer producers another grazing window prior to winter feeding, such as swath and bale grazing. The secondary goal of this practice would be to reduce N fertilizer rates, and thereby reducing input costs, as cereal-legume intercrops typically require lower N rates.

The third goal would be to offer a competitive environment where weeds are out competed early in the season.

With these goals in mind, Lakeland Agricultural Research Association (LARA) set forth a research trial in 2024 with objective is to evaluate the effects of either feed barley (*Hordeum vulgare* L.) or oat (*Avena sativa* L.) into a relay crop of either with white clover (*Trifolium repens* L.) or subterranean clover (*Trifolium subterraneum* L.) on: 1) weed pressure, 2) cereal leaf disease levels, 3) silage yield, and 4) forage quality, 5) N set as either 50 and 75% of recommended rate (RR), respectively.

The 2024 growing season did not follow long-term weather trends. It was unseasonably dry in the months of June, July and August. This was reflected in below average yields for oats and barley, respectively (Table 2.) Likewise, we did observe noticeable differences forage quality for the clover+cereal mixes. Yet despite the drought conditions, significant differences were observed with cereal type ($P<0.0001$) as well as the interaction of cereal*clover*nrate ($P<0.0001$). Feed barley outyielded oats. These results were not out of the ordinary as barley tends to tolerate drought conditions better than oats. It was also noticed that we had a better establishment of subterranean clover compared to white clover, which likely influenced the grain yield in those mixes. In the cereal+white clover mixes, thus behaved more as a monocrop instead of an intercrop. These results demonstrate that there was a yield decrease in the cereal+subterranean plots. This decrease was most likely exacerbated by the drought conditions, where the established clover was competing with the cereal for access to soil water and nutrients.



Effect	Clover	Cereal	Nitrogen rate (% of RR)	Estimate (tons/ac)	Standard error	Degrees of freedom	T value
Clover*Cereal*N	Subterranean	Oat	50	2.3 c	0.19	27	12.15
Clover*Cereal*N	Subterranean	Oat	75	2.3 c	0.19	27	12.54
Clover*Cereal*N	None	Oat	100	2.4 c	0.19	27	12.94
Clover*Cereal*N	White	Oat	50	2.7 bc	0.19	27	14.33
Clover*Cereal*N	White	Oat	75	2.7 bc	0.19	27	14.36
Clover*Cereal*N	Subterranean	Barley	50	3.0 ab	0.19	27	15.63
Clover*Cereal*N	Subterranean	Barley	100	3.2 ab	0.19	27	17.13
Clover*Cereal*N	White	Barley	50	3.3 a	0.19	27	17.54
Clover*Cereal*N	None	Barley	100	3.3 a	0.19	27	17.75
Clover*Cereal*N	White	Barley	75	3.4 a	0.19	27	18.2
	P value ^a						
Clover	0.0512						
Cereal	<0.0001						
N Rate	0.713						
Clover*Cereal	0.728						
Clover*N Rate	0.721						
Cereal*N Rate	0.725						
Clover*Cereal*N Rate	<0.0001						

^aLeast squared means were significant at an alpha level of <0.05.

Although we did not observe significant differences in yield between white and subterranean clover, the p-value ($p=0.0512$), was very near the threshold of significance ($p<0.05$), which indicates that we should keep investigating these two clovers, as they can potentially behave differently from one another. LARA intends to apply for funding and investigate the role of clover intercrops/relay crops in improving relative feed value during stubble grazing. LARA also intends on investigating the role that these low-growing clover have on soil available nitrogen in the following spring (i.e. nitrogen supply to the grain cash crop).

Thank you for your support on this project:



Environmental Program

Demonstration Equipment

- Solar Watering Systems
 - RazerGrazer
-

Funding Opportunities

- LARA Watershed Resiliency and Restoration Program
-

Environmental Farm Plans

- EFP Process

Demonstration Equipment

Lakeland Agricultural Research Association (LARA) runs a small “Try Before You Buy” program available to all producers in our operational area. Equipment is free to try with a small damage deposit.

Current equipment includes:

Demonstration Solar Watering Systems

In 2022 LARA purchased a new portable solar watering system through funding from Alberta Environment and Parks. This system can be placed in any surface water source for the use of watering livestock.

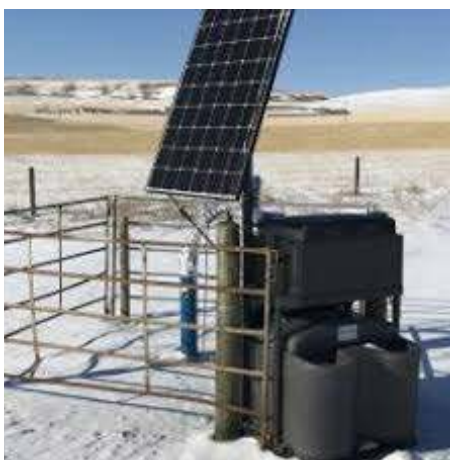
LARA also has a portable solar winter watering system that can be placed in any surface water source for livestock watering.

Demonstration Razer Grazer Electric Fencer

LARA has a demonstration Razer Grazer electric fencer from Range Ward that is available for producers to borrow.

These items are available for a free trial and allows the producer a chance to see if an alternative watering system or electric fencing system will work for their situation. A \$500.00 damage deposit is required and will be returned upon inspection of the returned item.

Call the LARA office to book the system if you are interested.



Off-site watering system (phot from CAP Solar)



Razer Graze (photo from RangeWard)

Funding Opportunities

LARA Watershed Resiliency and Restoration Program (WRRP)

Watersheds are unique, come in many shapes and sizes and can cross many different land uses. The simple definition of a watershed is the area of land that catches precipitation, and drains into a wetland, stream, river or groundwater. The riparian zone is the interface between the upland and a water course. This area is heavily influenced by water, how and where it flows and is reflected in the plants, soil characteristics and wildlife that are found there. Riparian areas have a large role in water quality, quantity and biodiversity. They provide eight key functions to: trap and store sediment; build and maintain banks and shorelines; store water; recharge aquifers; filter and buffer water; reduce and dissipate energy; create primary production; and maintain biodiversity by providing habitat for plants, wildlife and fish. These Ecological Services benefit people, other living organisms, and the overall functioning of interconnected natural systems within watersheds. Conservation and restoration of wetlands and riparian areas in Alberta are needed for sustainably functioning watersheds. Some of the funding available is outlined in the info-graphic to the right.

This program received additional funding and is being continued until December 2025.

If you are interested in the LARAWRRP program, please reach out to the LARA office at (780) 826-7260.



Funding Assistance Resources

The County of St. Paul, Municipal District of Bonnyville, Smoky Lake County and Lakeland Agricultural Research Association (LARA) have compiled information on programs that are currently available to local agriculture producers. See the reverse of this card to learn about five of these programs. LARA can assist with applications or supply additional information.



We are here to help!

We have many resources available to assist local producers, including technicians to assist you with completing an Environmental Farm Plan (EFP).

Visit laraonline.ca for webinars, workshops and other learning opportunities.

(780) 826-7260

On-Farm Climate Action Fund (OFCAF)

- Offered by Results Driven Agriculture Research
- Up to \$75,000 per farm available for projects in three categories 1) improving nitrogen management, 2) increasing adoption of cover cropping and, 3) expanding the adoption of rotational grazing
- Eligibility requirements include at least \$25,000 of farm income and you must work with a professional agrologist (P.Ag.) or certified crop advisor (CCA)

rdar.ca/funding-opportunities/ofcaf

Resilient Agriculture Landscapes Program (RALP)

- Offered by Alberta Agriculture and Irrigation
- Opens on February 1, 2025
- Closes on November 30, 2025
- Up to \$150,000 per farm is available for projects including riparian management, grazing, intercropping, and establishment of eco-buffers
- Eligibility requirements include at least \$25,000 of farm income and a current Environmental Farm Plan.

alberta.ca/resilient-agricultural-landscapes-program

Watershed Resiliency and Restoration Program (WRRP)

- Offered by LARA
- Opened on March 1, 2024
- Closes on September 15, 2025
- Open only to producers in the M.D. of Bonnyville, County of St. Paul, Lac La Biche County and Smoky Lake County
- Current Environmental Farm Plan is required.
- Program provides funding for riparian health assessments, fencing for sensitive areas, stream crossings, off-site watering systems and wetland enhancements.

Call 780-826-7260 or director@laraonline.ca

On-Farm Water Supply

- Offered by Alberta Agriculture and Irrigation
- Now open
- Includes dugouts and wells
- Up to \$15,000 available for projects

alberta.ca/water-program or call (403) 381-5532

Water Pumping Program

- Offered by Alberta Agriculture and Irrigation
- Now open
- Producers can rent pipe and pumping equipment to fill dugouts from nearby water sources
- Rental rates apply
- Water licenses to divert water required

alberta.ca/water-pumping-program

Environmental Farm Plan (EFP)

The environment is becoming a more prominent issue. It is a large factor in marketing agriculture and food products in today's global markets. Consumers are demanding more transparency and are demanding high quality and safe products. Reputation of food safety is critical to retain and gain access to domestic and international markets.

Environmental Farm Plans (EFP) provide a tool for producers to assess their own operation and identify environmental risks, current standards, areas for improvement and also highlight what they are doing well.

Having a completed EFP allows producers to access different funding opportunities, such as the Growing Forward Stewardship Program. It is also useful in product branding that demonstrates specific environmental standards. There is a ten-year mandatory renewal period for all EFPs. If your EFP is older than 10 years old you will have to renew it to be eligible for funding opportunities.

The EFP Process

An EFP can be completed with one-on-one session(s). The EFP first identifies the soil and farm site characteristics. Following this, the producer completes only the relevant chapters that apply to their operation; such as wintering sites, fertilizer, pesticides, crop management etc.

Upon completion the EFP is submitted to a Technical Assistant for review. Once reviewed, the EFP will be returned along with a letter of completion.



The EFP is a living document and should be reviewed and updated periodically. As of April 1, 2018, there is a mandatory 10-year renewal period for an EFP.

If you wish to complete an EFP or have any questions regarding EFP please contact the LARA office at 780-826-7260. Currently, we have 11 EFP in progress.

A valid EFP is required for Agri-Invest as well as many other producer funding opportunities available.

Visit <https://www.albertaefp.com/> for more information.

Horticulture Program

Fruit Orchard

- Rejuvenation Project

Greenhouse

- Vegetable variety evaluations

No-Till Vegetable Garden

- Implementation of no-till vegetable garden



Rejuvenation of the Fruit Orchard

We spent a good many days working in the orchard removing dead wood and free seeded growth, shoots and undergrowth. Past years of drought caused quite an amount of dead wood which was our priority. New plantings will take place this coming year to replace varieties that suffered the worst as well as introducing some new varieties to the orchard.



Greenhouse

Work in the greenhouse in late April – early May.

Varieties in the greenhouse this year included the following:

Cucumber, tomatoes, broccoli, cabbage, peppers, artichokes, Brussels sprouts, celery, cauliflower and a variety of herbs. For pest control we planted marigolds throughout. This proved to be very effective for all but the Brussels sprouts. Year two of planting Brussels sprouts and to date; cabbage moth – 2; harvest – 0.



Harvest in the greenhouse was abundant. Broccoli, cucumber, celery, tomatoes and peppers produced all summer yielding pounds worth of produce. The only failures were melons and Brussels sprouts. As mentioned previously the cabbage moth won again this year and the melons, while producing an abundance of vines and flowers, failed to yield any fruit.



Implementation of a No-Till Vegetable Garden

This year, we started a no-till garden beside our greenhouse. This came about as we hosted a workshop on No-Till Gardening with Rosssdale Farms from Marwayne. As this was our first year we were more focused on developing it rather than actually harvesting a crop off of it. The premise of a no-till garden is that watering and weeding should be minimal once the garden is developed. We did plant some squash, potatoes, cabbage and carrots. Between late frosts and excessive rain in the spring we found we had to transplant the squash crops three times. Summer finally did arrive and with it some fairly hot and dry weather. We were very pleased that the rows did hold the moisture (no watering required) and weeds were very minimal.



As well as the rows we also experimented with a potato tower. We did have some growth; however as we discovered, the no-till site is perhaps the lowest spot in the entire yard and as a result the tower was saturated for most of the season leading to the tubers rotting rather than growing. Lesson learned for next year. Harvest from the no-till was quite good and we found that we had more zucchini than we could use or give away. The cabbage, carrots and potatoes produced very well. Next year we are hoping to utilize the entire area and try more varieties of vegetables.



Lakeland Forage Association

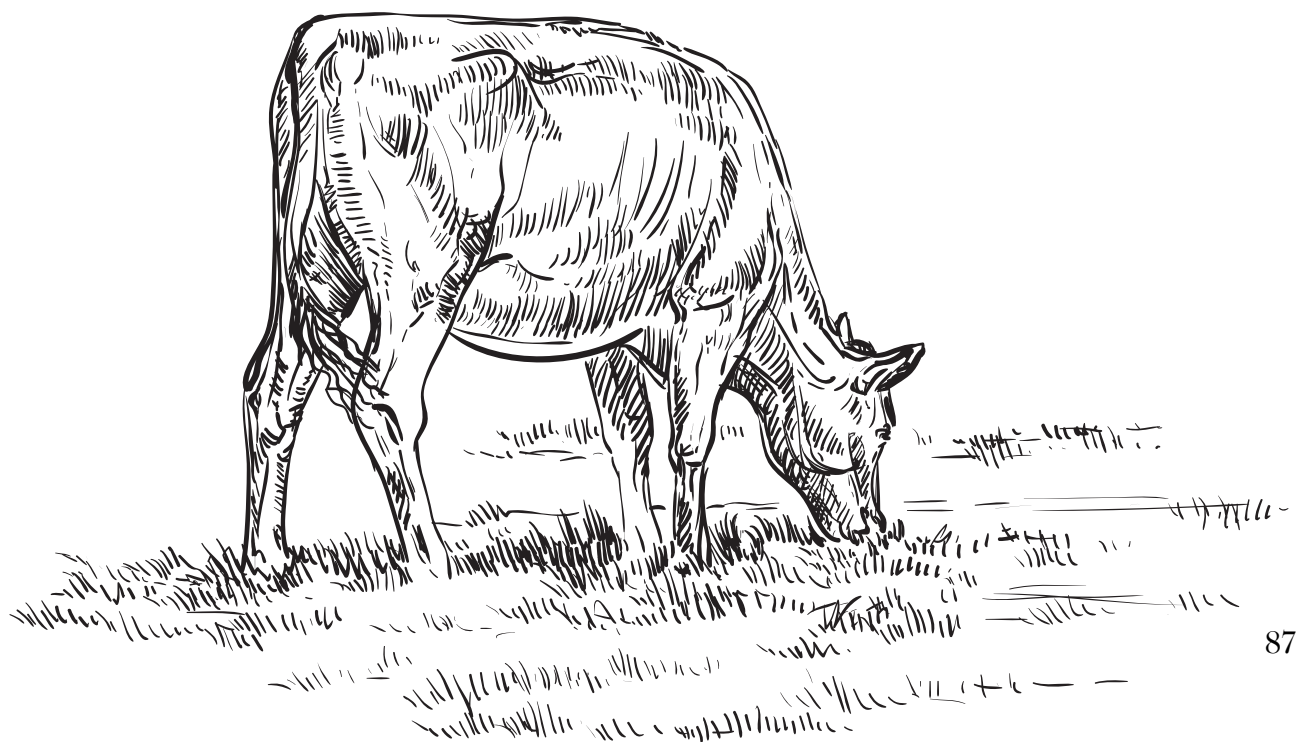
About LFA

Board of Directors

Northern Range Enhancement Project

- Heifer Project
-

LFA
Lakeland Forage Association



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 Gazon, 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!

2024-2025 Board of Directors

Lakeland Forage Association (LFA) is run by a volunteer board of directors comprised of twelve (12) local producers with a keen interest in forage and livestock production.

Jay Cory
Chair

Laurence Kwiatkowski
Vice-Chair

Jason Cherniwchan
Treasurer

Neil Cory
Director

Ernie Melnychuk
Director

Nathan Gamache
Director

Jennifer O-Reilly
Director

Gerald Mathiot
Director

Coral Robinson
Director

Shaun Robinson
Director

Kenneth Sidener
Director

Amanda Hawthorn
Director

lakelandforage@gmail.com



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 2024, there was one project at the Olympic Lake Grazing Lease.

1. Heifer project

Methods:

The heifers were weighed when they entered the pasture on June 5, 2025. The Bulls were pulled on August 7, 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 19, 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 a total of 10 inches of rain over the grazing season.

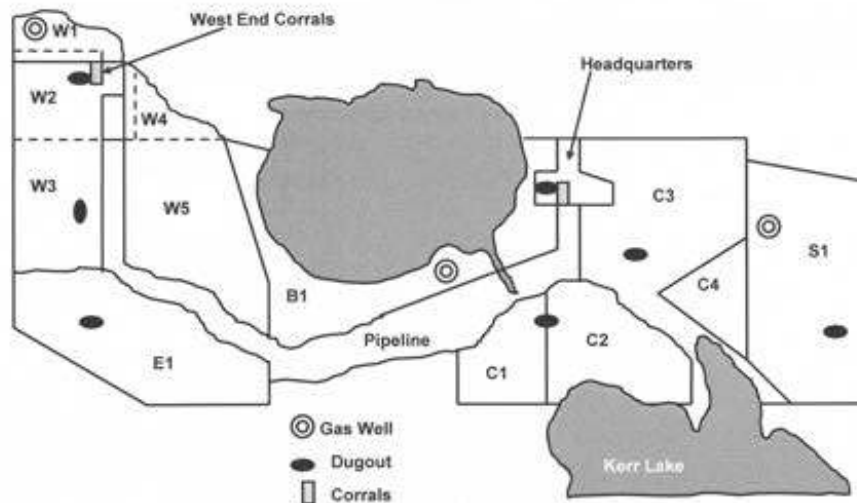


Figure 1. Map of the Northern Range Enhancement Project (NREP) pasture system.

Table 1. Grazing rotation for the 2025 grazing season at Olympic Lake Grazing Lease.

Paddock Name	First Graze					Second/Third Graze				
	Date In	Date Out	# of days	# of head		Date In	Date Out	# of days	# of head	
				heifers	bulls				heifers	bulls
Headquarters	05-Jun-24	08-Jun-24	1	397	13	18-Sep-24	19-Sep-24	1	395	0
Pipeline	06-Jun-24	07-Jun-24	1	397	13	05-Aug-24	07-Aug-24	1	394	12
W4	07-Jun-24	09-Jun-24	2	397	13	21-Jun-24	22-Jun-24	1	397	13
W4						06-Jul-24	07-Jul-24	1	394	12
W4						21-Aug-24	22-Aug-24	1	395	0
W1	09-Jun-24	11-Jun-24	2	397	13	01-Jul-24	03-Jul-24	2	397	13
W1						30-Aug-24	31-Aug-24	1	395	0
W3	11-Jun-24	13-Jun-24	2	397	13	03-Jul-24	06-Jul-24	3	394	11
W3						16-Sep-24	18-Sep-24	2	395	0
W5	13-Jun-24	17-Jun-24	4	397	13	01-Aug-24	06-Aug-24	5	395	12
W5						12-Sep-24	16-Sep-24	3	395	0
W2	17-Jun-24	21-Jun-24	4	397	13	16-Aug-24	20-Aug-24	4	395	0
E1	22-Jun-24	01-Jul-24	10	397	13	22-Aug-24	30-Aug-24	8	395	0
C2	07-Jul-24	14-Jul-24	7	394	11	01-Sep-24	09-Sep-24	8	395	0
C1	14-Jul-24	20-Jul-24	6	394	11	30-Aug-24	01-Sep-24	2	395	0
C3	20-Jul-24	27-Jul-24	7	395	11	09-Sep-24	13-Sep-24	3	395	0
C4	27-Jul-24	01-Aug-24	6	395	11					
S1	07-Aug-24	16-Aug-24	8	394	0					
		Total:	60				Total:	46		

Results and Discussion:

There was a total of 106 days in the grazing season at Olympic Lake Grazing Lease (Table 1). The average daily gain (ADG) over the grazing season was 1.04lbs/day.

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 5, 2025 and August 7, 2025.

The average daily gain (ADG) throughout the season was 1.32 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 a total of 10 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	-

Appendices

Livestock Nutrition

- Definition of common feed nutrition terms
 - Forages and cattle nutrient requirements
 - CowBytes Ration Balancing Software
-



Definition of Common Feed Nutrition terms

ADF Acid Detergent Fibre – the least digestible portion of roughage. ADF content is used to determine digestibility and energies.

AIP Available Insoluble Protein – the portion of the total available protein which is not soluble in the rumen fluid, but is still available to the cow.

AP Available Protein – the portion of the total protein which is available to the animal if the animal could completely digest the feed.

BP Bypass Protein – ingested protein that is not degraded in the rumen.

CP Crude Protein – the total protein contained in feeds as determined by measuring nitrogen content.

DE Digestible Energy – the amount of energy consumed minus the amount of energy lost in feces.

GE Gross Energy – measure of total caloric energy of a feedstuff.

IP Insoluble Protein – the portion of protein which digestive juices or similar solutions cannot dissolve.

ME Metabolizable Energy – equal to DE minus energy lost in urine, feces and in methane for ruminants.

NDF Neutral Detergent Fibre – measures cellulose, hemi-cellulose, lignin, silica, tannin and cutin; used as an indicator of feed intake.

NEG Net Energy for Gain – amount of energy for gain above that which is required for maintenance; used for balancing rations for ruminants.

NEM Net Energy for Maintenance – amount of energy required to maintain an animal with no change in body weight or composition.

RFV Relative Feed Value – an index for assessing quality based on the ADF and NDF levels of a feed. As fibre values increase the RFV of forages decreases.

SP Soluble Protein – the portion of protein which digestive juices of ruminant can dissolve.

TDN Total Digestible Nutrients – a term which is estimated from the ADF content and is used to describe the digestible value of a feed.



Did You Know?

LARA offers two free feed tests each year to all producers in the County of St. Paul, MD of Bonnyville and Smoky Lake County

**Contact the office at
780-826-7260**

P.I.D. number required with sample submission

Hay probes are available to borrow free of charge

Forages and Cattle Nutrient Requirements

Table 1. Composition of Some Common Feedstuffs.

Feedstuff	Percent of DM Basis								
	DM	CP	ADF	NDF	TDN	Ca	P	K	Mg
Alfalfa Hay	90.5	19.9	31.9	39.3	60	1.63	0.21	2.56	0.34
Early									
Alfalfa Hay	90.9	17	38.7	48.8	55	1.19	0.24	1.56	0.27
Late									
Alfalfa Silage	44.1	19.5	37.5	47.5	63	1.32	0.31	2.85	0.26
Barley Grain	88.1	13.2	5.77	18.1	88	0.05	0.35	0.57	0.12
Barley Straw	91.2	4.4	48.8	72.5	40	0.3	0.07	2.36	0.23
Barley Silage	37.2	11.9	33.9	56.8	60	0.52	0.29	2.57	0.19
Corn Silage	34.6	8.65	26.6	46	72	0.25	0.22	1.14	0.18
Mature									
Oat Grain	89.2	13.6	14	29.3	77	0.01	0.41	0.51	0.16
Oat Straw	92.2	4.4	47.9	74.4	50	0.23	0.06	2.53	0.17
Oat Silage	36.4	12.7	38.6	58.1	59	0.58	0.31	2.88	0.21
Oat Hay	90.7	9.5	38.4	63	53	0.32	0.25	1.49	0.29
Smooth Brome	26.1	21.3	31	47.9	74	0.55	0.45	3.16	0.32
Early Pasture									
Smooth Brome	87.6	14.4	36.8	57.7	56	0.29	0.28	1.99	0.1
Hay Mid-bloom									
Rye Grass	22.6	17.9	38	61	84	0.65	0.41	2	0.35
Pasture									
Orchard Grass	89.1	12.8	33.8	59.6	65	0.27	0.34	2.91	0.11
Hay Early Bloom									
Orchard Grass	27.4	10.1	35.6	57.6	57	0.23	0.17	2.09	0.33
Early Pasture									
Timothy Hay	89.1	10.8	35.2	61.4	59	0.51	0.29	2.41	0.13

Source: NRC 1996. Nutrient Requirements of Beef Cattle (7 Ed.) National Academy Press, Washington D.C.

Table 2. Tolerance Information for some Perennial Legumes

Legumes	Acidity Tolerance	Alkalinity Tolerance	Salt Tolerance	Drought Tolerance	Winter Hardiness
Alfalfa	Moderate	High	Moderate	Very High	Moderate-High
Cicer Milkvetch	Low	Moderate	Low-Moderate	Moderate-High	Very High
Alsike Clover	Moderate	Moderate	Low-Moderate	Low-Moderate	High
Red Clover	Low	Moderate	Low	Low-Moderate	Moderate-High
Sainfoin	Low	Low	Low-Moderate	Moderate	Moderate
Birdsfoot Trefoil	High	Moderate	High	Moderate	Low-Moderate
Sweetclover	Low	High	Moderate	Moderate-High	Moderate

Table 3. Tolerance Information for some Perennial Grasses

Grasses	Acidity Tolerance	Alkalinity Tolerance	Salt Tolerance	Drought Tolerance	Winter Hardiness
Meadow Bromegrass	Moderate	Moderate	Low-Moderate	Moderate-High	Moderate
Smooth Bromegrass	Moderate	Moderate	Low-Moderate	Moderate-High	Moderate-High
Reed Canarygrass	High	Moderate	Moderate-High	Moderate-High	Low-Moderate
Creeping Red Fescue	High	Moderate	Moderate-High	Moderate-High	High-Very High
Meadow Fescue			Moderate	Low	Moderate
Tall Fescue	High	Moderate	Moderate-High	Moderate	Moderate
Creeping Foxtail	High	Low	Low	Low-Moderate	High-Very High
Meadow Foxtail	Moderate		Low	Low	High
Orchardgrass	Moderate	Low	Low-Moderate	Moderate	Moderate
Italian Ryegrass	High	Low	Moderate	Low	Low
Perennial Ryegrass	High	Low	Moderate	Low	Low
Timothy	Very High	Low	Low	Low	Moderate
Crested Wheatgrass		Moderate	Moderate	Very High	Very High
Intermediate Wheatgrass	Low	Moderate	Moderate	Moderate	Moderate
Northern Wheatgrass	Moderate	High	Moderate	Very High	Moderate
Slender Wheatgrass		High	Moderate-High	Moderate	High
Tall Wheatgrass		Very High	Very High	High	Moderate
Western Wheatgrass	Moderate	Moderate	Very High	Moderate - High	Moderate
Russian Wildrye	Low	Moderate	High	Very High	High
Altia Wildrye			High	Very High	High
Dahurian Wildrye			High	Moderate-High	Moderate-High

Table 4. Nutrient Requirements for Beef Cattle.

	Daily Gain	Dry Matter Intake	Crud Protein		TDN		Ca	P
	(lbs)	(lbs)	lbs/day	% of DM	lbs/day	% of DM	(%)	(%)
600 lb Calves	1.5	13.08	1.32	9.5	9.4	68.5	0.32	0.21
950 lb Bred Heifers	0.9	19	1.5	8	10.3	54.1	0.27	0.02
1200 lb Cows								
Mid Pregnancy	-	20.8	1.4	6.9	10.1	48.8	0.19	0.19
1200 lb Cows								
Late Pregnancy	0.9	22.3	1.7	7.8	11.8	52.9	0.26	0.21
1000 lb 2 yr. Heifer								
With Calf	0.5	20.8	2.1	10.2	12.9	61.9	0.31	0.23
1200 lb Cow Nursing	-	23	2.1	9.3	12.1	55.5	0.27	0.22
Calf (1st 3-4 months)								

Source: NRC 1996. Nutrient Requirements of Beef Cattle (7 Ed.) National Academy Press, Washington D.C.

CowBytes Ration Balancing Software

CowBytes ration-balancing software allows Canadian beef cattle producers to formulate their own feed rations. Producers can input various combinations of feed and byproducts at different prices to reduce feed costs while meeting animal production targets.

CowBytes was developed for Windows but may work on a Mac with virtual machine software. Caution is advised for Apple users.

The software will be delivered on a USB flash drive via regular mail. The \$60 fee includes GST/HST and shipping.



To learn more about the CowBytes program or to order your copy, visit beefresearch.ca today.

