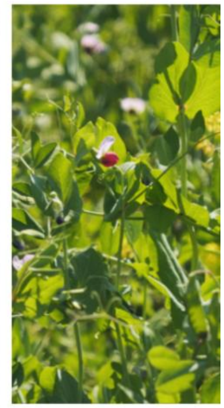






Gateway Research Organization

2023 Annual Report

Contents

Chairperson's Report

Mike Hittinger

Gateway Research Organization

Manager's Report

Sandeep Nain

I am pleased to present to you our annual report for the year 2022. This report highlights our achievements and progress in advancing agricultural research and promoting innovative, sustainable and economical practices suited best for farmers in our area. I would also like to extend my heartfelt thanks to the GRO staff R**ick Tarasiuk, Jay Byer, Kabal singh and Amber Kenyon** for their diligent work in making this year successful.

At Gateway, we're all about getting our hands dirty (literally!) to conduct research that benefits farmers. We believe that producers know best when it comes to developing innovative solutions for their challenges, and that's why we work closely with them to conduct research trials. Special shoutouts to *Jubilee Feedlot*, *Pibroch Colony, Randy Pidsadowski, Justin Nanninga, Ken Anderson, Colby Hanson, Tom Macmillan, and Dean Wigand,* for helping us out with our trials in Westlock and County of Barrhead.

Gateway research organization is committed to conducting research that has a practical impact on the agriculture industry. Therefore, we are constantly seeking fresh ideas for research trials and demonstrations that align with the needs of our members. This year, we worked on several projects that focused on developing innovative solutions to address key challenges faced by farmers. We also focused on fostering partnerships and collaborations with industry stakeholders, including seed producers, technology providers, post secondary institutes, municipal and government agencies.

Our outreach and engagement efforts were fairly successful this year, with our team organizing over 20 in-person events and field days throughout the year. We also utilized digital platforms to reach a wider audience and create relevant content at our YouTube and Podcast (35,000 downloads). We believe that the success of our research work relies on our ability to extend its benefits to the farming community. .

I would like to take a moment to express my sincere appreciation to **Kenleigh Pasay** for exceptional commitment and service to GRO board over the years.

As we look ahead to the coming year, we will face new challenges and opportunities, but I am confident that with your support, we will continue to make great strides forward. We will continue to keep our members up to date on GRO's activities and create more value as a local farmer-led applied research associations.

Let us remember our past accomplishments with pride and look forward to the future with optimism and determination.

Agricultural Research and Extension Council of Alberta (ARECA) Executive Director Report

Alan Hall

ARECA continues to highly value our relationship with GRO. With your strong **Board of Directors** and **Sandeep** and **his people**, you have been very successful in supporting farmers and businesses in the area you serve. Our compliments on your valuable efforts and top notch performance over the past year.

GRO, several other forage and applied research associations and ARECA are taking a hard look at what we individually and collectively will focus on over the next few years. We anticipate that by mid year we will have things worked out and agreed to. This will enable us all to attract new and additional funding support for all, some of which will hopefully be on a longer term deal. Over the past few years, financial support to GRO and the rest of us has been characterized by short term and uncertainty. We have been working closely with Results Driven Agricultural Research (RDAR) and the Province in this undertaking and things are looking most positive in getting stable, longer term support in place later this year.

We are all very pleased and most appreciative of the current financing support from RDAR and the Province through this time of transition. Minister Horner's recent announcement of an additional $1.5 million funding support for Associations like GRO is most welcome news. **A huge thank you to Minister Horner, RDAR and Alberta Agriculture & Irrigation for doubling the level of their base funding for Associations from a year ago.**

This work will also lead to some new programs, projects and services in the years ahead that ranchers and farmers have said they need. Coupled with this will be some changes with ARECA in providing stronger support services to GRO and other associations that they are needing. ARECA, with the help of GRO, other Associations, Agricultural Service Boards and Commissions are continuing to deliver the Environmental Farm Plan (EFP) service to individual producers. Over 3,200 farmers and ranchers have their up to date EFP now in place. We anticipate that doubling or tripling over the next 3-5 years.

EFP is proving to be a very useful tool for producers to use within their supply chains for sustainable sourcing of on farm commodities, for their use with government producer grant and business risk management programs that are trending to requiring an applicant to have an EFP, and in assisting several provincial and national farm organizations who are supporting their producer members in securing an EFP.

This is proving helpful in messaging to the consumers, supply chains, and international buyers, regarding sustainable environment production practices Alberta ranchers and farmers use. In some supply chains this message is enabling maintaining and growing markets. ARECA is helping with the On Farm Climate Action Fund (OFCAF) individual producer grants for ranchers and farmers to assist them with putting specific production practices in place in their businesses around rotational grazing, cover crops and nitrogen fertilizers.

We are also working closely with Associations, Agricultural Service Boards and others in getting a peer to peer grazing mentorship program in place. There are now 13 mentors on board helping individual farmers and ranchers with their grazing systems. ARECA is under contract with Canadian Forage and Grassland Association for this OFCAF and grazing mentorship effort. We are working closely with RDAR, and we are working with and helping finance extension activities that GRO and other Associations are undertaking. This includes things like workshops, tours, field days, grazing clubs, on farm demonstrations, use of specialists etc.

ARECA, with strong support from the Province, Commissions, and the medical community, have teamed up with University of Alberta in the development and provision of mental health services support to individual producers and their families throughout rural Alberta. ARECA is “greasing the skids” in assisting health professionals and producers to hook up in a meaningful way when needed. Research is showing that intergenerational farm/ranch transfers, depopulation of livestock on farms due to diseases like avian flu and chronic wasting disease, and farm financial pressures due to weather/markets/rising input costs are taking their toll on producers and their families who are trying to cope. GRO and Associations are a most valued partner in this effort. Further the medical community have come to us for training in how to work with farmers and ranchers. Often there are services available but the medical professionals struggle to develop a solid working relationship with producers as they do not fully understand producers or the farming/ranching culture. ARECA is developing these programs and will be working with many organizations like Associations, Commissions, community based groups and the medical community through a program called **AgKnow**. Click onto **www.agknow.ca** to see what all is happening on this front.

It has been a busy past year and an exciting upcoming year with these new developments. Here at ARECA, we look forward to continuing a strong working relationship with GRO in helping you to continue a strong track record of excellent service to the farmers and businesses in your area.

Gateway Research Organization

2022-Board of Directors & Committee

Mike Hittinger Chair

Kelly Olson: - Vice- Chair

Graham Letts- Treasurer

Kenleigh Pasay - Secretary

Etianne Pauline - ARECA Representative

Crop committee	Forage and Livestock Committee
Ken Anderson	Kelly Olson
Randy Pidsadowski	Kenleigh Pasay
Byron Long	Etianne Pauline
	Kurtis Properzi
	Lori Jesperson
	Graham Letts

Acknowledgement to Sponsor

The Board of Directors and staff extends their sincere appreciation for the active support for our research programs

Program Funding

Project and Extension Sponsorship

In-Kind Contributors (Including a combination of goods, land, equipment, product, services, percentage markdowns, etc)

Special gratitude to Randy Pidsadowski, Pibroch colony, Tom Mcmillan, Dean Wigand, Raymond Marquette, Justin Nanninga, Colby Hanson, Ken Anderson, Guido Van loon, Steve Kenyon and Jubilee feedlot.

WESTLOCK SEED CLEANING CO-OP LTD

- Agriculture and Agri-Food Canada
- **Greener Pastures Ranching**
- **Anderson Seed Growers**

Gateway Research Organization

Our History

Gateway Research Organization was formed from consolidation with the Pembina Forage Association in 1994. The Pembina Forage Association was started in 1975 by local producers interested in pasture management and forage & livestock research. While maintaining its interest in forage & livestock issues, the new organization became more involved in applied research and demonstrations in crops and environmental sustainability.

Our Vision

Gateway Research Organization will be a renowned and respected agriculture research and extension organization that is the preferred source of unbiased farm production information.

Our Mission

Gateway Research Organization provides cost-effective applied agricultural research, demonstration, and extension for producers in order to facilitate greater returns to farms by providing economically and scientifically sound information that enables our clients to make informed decisions.

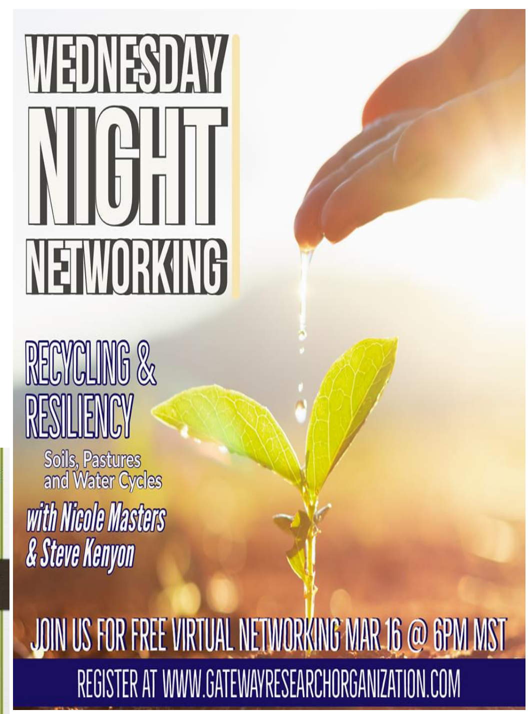
The Goals of our Organization

1. To increase the profitability of our members.
2. To encourage active participation by local producers.
3. To provide a valuable resource for information transfer and extension to producers.
4. To produce high quality, unbiased, and scientifically sound research.
5. To produce research based on local growing conditions and soil properties.
6. To collaborate with specialists from the agricultural industry, government, and educational institutions.

2022 Extension Activities

Co- Hosted Two big Conference in 2022:

Another Successful year with WNN



To stay connected with producers we are active on social media. Please visit us

- Our website is: www.gatewayresearchorganization.com
- Download podcast **Sustainable Agriculture** | a podcast by gatewayresearchorganization (podbean.com)
- Subscribe to **YouTube** Channel **@gatewayresearchorganization**
- On **Twitter** at: **@GatewayResearch**
- Find us on **Facebook** at: **Gateway Research Organization**

Regional Cereal Variety Trials

Co-operators: Randy Pidsadowski- NW-8-61-26-W4

Objectives: To provide yield and agronomic information of current cereal varieties as well as newer varieties to producers in central Alberta.

Introduction:

Variety selection plays an important role in production management due to the impact that yield, maturity, and other agronomic characteristics can have on producer profitability. Variety testing continues to be important in providing producers with information on the performance of newly registered and established varieties.

Table: 1 The yield and characteristics of cereals grown in our region are presented below.

	RVT - Project Description
Seeding Date	Wheat/Triticale/Oat on **May 05,** Barley **on May 12**
Seeding Specifics	Fabro zero-till drill Seeding depth: 1$^{1/4}$ inch for all **Seeding Rates:** 25 plants/ft^2 – Barley 28 plants/ft^2- Malt Barley 31 plants/ft^2 - CWRS & CPSR Wheat 29 plants/ft^2 - Triticale 28 plants/ft^2 - Oats Seed treatment: Cruiser Maxx Vibrance Quattro
	RVT - Project Description
Fertilizer/ac	**Fertilizer: Fall Applied:** 46-0-0(coated with Neon Air) 163.04 lbs/ac 75 lbs/ac actual N **Spring Applied:** Side banded **For Wheat/Triticale: 17.57-0-26.21-6.95-0.82 305.18 lbs/ac** 53.6 lbs/ac Actual N 80 lbs/ac Actual K 21 lbs/ac Actual S 2.5 lbs/ac Actual Cu

	For Barley/Oat: 11.41-0-31.89-8.45-0.99 **250.83 lbs/ac** 28.6 lbs/ac Actual N 80 lbs/ac Actual K 21 lbs/ac Actual S 2.5 lbs/ac Actual Cu **For Malting Barley: 6.7-0-40.85-7.66** **195.83 lbs/ac** 13.12 lbs/ac Actual N 80 lbs/ac Actual K 15 lbs/ac Actual S **Seed Placed:** 11-52-0 58 lbs/ac 6.38 lbs/ac Actual N 30.16 lbs/ac Actual P
Herbicide	Curtail M 750ml/acre June 07 Axial (Wheat & Barley) 500ml/acre June 19
Rainfall	Recorded from May 1 to August 30, 2022: **174.1 mm**
Harvest Date	August 26 (Feed & Malt Barley) August 31 (CWRS and CPSR Wheat) August 31 (Triticale) September 01 (Oat)

2-Row Barley – The majority of malt-grade barley produced is two-row. Two-row barley is characterized by having only one fertile spikelet at each node. Six-row barley has three fertile spikelets at each node. This lack of crowding in two row barley allows for straight, symmetrical kernels with low dormancy, a key characteristic essential for malting. The malting process begins by soaking the grain and causing it to germinate. The low dormancy and high seed viability in two-row barley are important for this process.

6-Row Barley- This is the world's most important crop for feeding livestock. As feed, it is nearly equal in nutritive value to corn, which is very high in energy. This leads it to be valuable in feedlots and as hog feed. Six-row barley allows for desirable portions of firm fat and lean meat.

Table 2: Barley: 2022

Name		Height		Lodging		Protein		Yield					Bushel Weight		Test Weight		TKW	
		Cm		(1-9)		%		kg/ha		% 0f CDC COPELAND	bu/ac		lbs/bu		kg/HL		g	
CDC COPELAND (Check)	TWO Row	101	a-d	5.7	c-f	10.6	a-e	7484	bc	**100%**	139	b	59.0	c-f	73.0	a-d	46.6	c-g
CDC RENEGADE	TWO Row	106	ab	6.0	b-e	11.0	a-d	8105	abc	**109%**	151	ab	60.0	a-e	74.0	a-d	51.0	a-e
AAC PRAIRIE	TWO Row	103	abc	4.7	efg	10.8	a-e	7449	c	**99%**	138	b	60.3	a-e	74.3	a-d	47.0	b-g
RGT PLANET	TWO Row	82	e	1.0	i	9.7	ef	8771	abc	**117%**	163	ab	58.3	def	71.7	bcd	51.2	a-d
ESMA	TWO Row	81	e	1.3	i	10.0	def	8584	abc	**114%**	159	ab	60.0	a-e	74.0	a-d	51.6	abc
KWS KELLIE	TWO Row	77	e	1.3	i	9.8	ef	9250	a	**124%**	172	a	58.0	def	71.7	bcd	49.5	a-e
AB PRIME	TWO Row	95	cd	4.3	fg	10.6	a-e	8482	abc	**113%**	157	ab	60.7	a-d	75.0	ab	49.0	a-f
AB BREWNET	TWO Row	98	a-d	5.7	c-f	11.6	a	8363	abc	**112%**	155	ab	59.7	a-e	73.3	a-d	47.7	b-g
CANTU	TWO Row	101	a-d	2.4	h	10.4	b-f	8986	ab	**120%**	167	a	62.5	a	76.9	a	53.5	a
BIGHORN	TWO Row	102	a-d	5.3	def	10.8	a-e	8376	abc	**112%**	155	ab	62.0	ab	76.7	a	50.7	a-e
IBEX	TWO Row	102	a-d	3.3	gh	11.3	ab	8477	abc	**113%**	157	ab	61.3	abc	75.7	a	52.2	ab
TORBELLINO	TWO Row	80	e	1.3	i	9.5	f	7998	abc	**107%**	149	ab	57.7	ef	71.0	cd	48.4	b-g
CDC AUSTENSON	TWO Row	101	a-d	4.7	efg	10.5	b-f	7494	bc	**100%**	139	b	62.3	a	77.0	a	47.6	b-g
AAC SYNERGY	TWO Row	99	a-d	7.5	abc	10.6	a-e	8227	abc	**109%**	152	ab	61.2	abc	76.2	a	48.5	b-g
AB HAGUE	TWO Row	98	a-d	8.0	a	11.1	abc	8116	abc	**109%**	151	ab	59.7	a-e	73.7	a-d	43.6	g
TR 19268	TWO Row	98	a-d	7.7	ab	11.0	a-d	9064	a	**121%**	168	a	60.3	a-e	74.7	abc	48.0	b-g
RGT ASTEROID	TWO Row	76	e	1.3	i	9.9	ef	9484	a	**127%**	176	a	57.7	ef	71.3	bcd	50.3	a-e
TR 20761	TWO Row	93	cd	4.7	efg	9.7	ef	8134	abc	**109%**	151	ab	60.0	a-e	74.7	abc	46.0	d-g
SR 18524	SIX Row	92	d	6.7	a-d	9.9	ef	8204	abc	**109%**	152	ab	57.0	f	70.7	d	37.1	h
FB 20601	TWO Row	94	cd	6.7	a-d	10.8	a-e	8018	abc	**107%**	149	ab	60.0	a-e	74.3	a-d	44.2	fg
TR 19655	TWO Row	107	a	7.7	ab	10.5	b-f	8215	abc	**110%**	153	ab	59.3	b-f	73.3	a-d	47.1	b-g
TR 19175	TWO Row	98	a-d	7.3	abc	10.4	b-f	7984	abc	**106%**	148	ab	62.3	a	76.3	a	50.2	a-e
TR 19758	TWO Row	96	bcd	2.6	h	10.2	c-f	8401	abc	**112%**	156	ab	61.7	abc	76.3	a	45.7	efg
LSD P=.05		5.85		0.59 - 1.24		0.60		801.08			14.88		1.61		2.13		2.89	
Standard Deviation		3.55		0.13t		0.36		486.17			9.03		0.97		1.29		1.76	
CV		3.75		6.1t		3.48		5.84			5.84		1.62		1.74		3.65	

Means followed by the same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls). **Lodging: 1 = erect; 9 = flat; TKW: Thousand Kernels Weight

Table 3: Malt Barley: 2022

Name		Height		Lodging		Protein		Yield					Bushel Weight		Test Weight		TKW	
		Cm		(1-9)		%		kg/ha		% 0f CDC COPELAND	bu/ac		lbs/bu		kg/HL		g	
CDC COPELAND (Check)	TWO Row	99	-	5.3	d	10.1	-	6989	-	**100%**	130	-	60.0	-	74.0	b	46.0	ab
AC METCALFE	TWO Row	101	-	7.3	bc	10.7	-	7278	-	**104%**	135	-	62.0	-	76.7	ab	46.3	ab
AAC SYNERGY	TWO Row	96	-	6.7	cd	10.3	-	7850	-	**112%**	146	-	62.0	-	76.7	ab	49.7	a
AAC CONNECT	TWO Row	100	-	8.0	abc	10.8	-	7417	-	**106%**	138	-	62.0	-	76.3	ab	50.0	a
CDC BOW	TWO Row	95	-	7.7	abc	10.2	-	7667	-	**109%**	142	-	62.7	-	77.7	a	50.0	a
CDC FRASER	TWO Row	95	-	8.3	ab	9.8	-	7644	-	**109%**	142	-	60.7	-	75.0	ab	47.0	ab
CDC COPPER	TWO Row	93	-	3.7	e	10.0	-	8068	-	**115%**	150	-	60.3	-	74.0	b	45.7	ab
CDC CHURCHILL	TWO Row	93	-	6.7	cd	10.0	-	8315	-	**118%**	154	-	60.7	-	75.3	ab	45.7	ab
AB BREWNET	TWO Row	91	-	9.0	a	10.5	-	7636	-	**109%**	142	-	60.0	-	74.0	b	44.7	b
AAC PRAIRIE	TWO Row	96	-	5.7	d	10.0	-	7484	-	**107%**	139	-	62.3	-	77.0	ab	47.7	ab
LSD P=.05		7.69		1.01		0.61		777.01			14.27		1.83		2.10		2.97	
Standard Deviation		4.48		0.59		0.36		452.96			8.32		1.07		1.23		1.73	
CV		4.68		8.63		3.47		5.93			5.87		1.74		1.62		3.66	

Means followed by the same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls).

**Lodging: 1 = erect; 9 = flat; TKW: Thousand Kernels Weight

Canadian Western Red Spring Wheat– The Canadian Grain Commission currently classes 56 varieties under the Canadian Western Red Spring (CWRS) class. CWRS is known for its hard texture, high protein, and high gluten content. These attributes contribute to making superior bread-making flour. The top two grades, No. 1 and No. 2, are segregated by protein level, with guaranteed minimum protein contents.

Utility Wheat – The Western Canadian wheat classes consist of eight individual descriptions. This trial consisted of two classes: Canadian Prairie Spring Red (CPSR) and Canadian Wheat Soft White Spring (CWSWS).

CANADA PRAIRIE SPRING RED (**CPSR**) has medium to hard kernels and medium to hard dough strength. It has two milling grades and is used for the hearth, flat, and steamed bread, and noodles.

CANADA WESTERN SOFT WHITE SPRING (CWSWS) is soft white wheat with low protein. It has three milling grades used for cookies, cakes, and pastry. CWSWS is also highly sought after by the industrial ethanol industry on account of its low protein content (i.e. high starch content).

Canada Western Special Purpose (CWSP): special-purpose wheat class is for varieties for ethanol or livestock feed markets.

Canada Northern Hard Red (CNHR) is the red spring wheat with medium to hard kernels, very good milling quality and medium gluten strength (lower than both the CWRS and CPSR classes). Introduced on August 1, 2016, the target quality of this class is for it to have sound kernels. There are three milling grades available. Depending on protein content, CNHR will be suitable for the production of pan bread, hearth bread, flatbread and noodle.

Table 4: CWRS Wheat: 2022

Name	Height		Days To Maturity		Protein		Yield					Bushel Weight		Test Weight		TKW	
	cm		#		%		kg/ha		% of AAC BRANDON	bu/ac		lb/bu		kg/HL		g	
AAC BRANDON (Check)	89	fg	104	ab	13.6	-	6634	abc	**100%**	99	abc	69.0	abc	85.3	abc	42.5	a
AAC VIEWFIELD	84	h	102	abc	13.5	-	6477	abc	**97%**	96	abc	68.7	abc	84.7	abc	33.0	efg
AAC WHITEHEAD VB	89	fg	100	abc	11.2	-	7044	a	**106%**	105	a	67.3	bc	83.3	abc	38.1	bc
AAC TOMKINS	93	ef	102	abc	12.2	-	6639	abc	**100%**	99	abc	68.7	abc	84.7	abc	38.9	b
AAC HOCKLEY	87	g	106	a	12.6	-	6758	abc	**101%**	100	abc	69.7	ab	86.3	ab	36.6	bcd
SY DONALD	95	cde	98	bc	13.0	-	6285	bc	**94%**	93	bc	69.7	ab	86.0	ab	34.1	def
SY MANNESS	90	efg	100	abc	11.8	-	6223	bc	**93%**	92	bc	68.3	abc	84.0	abc	30.7	g
AAC HODGE VB	98	bcd	103	abc	12.0	-	7040	a	**106%**	105	a	69.7	ab	86.3	ab	38.0	bc
CDC SILAS	94	def	103	ab	13.1	-	6026	c	**90%**	89	c	66.7	c	82.3	c	34.9	cde
CDC SKRUSH	100	b	100	abc	12.0	-	6492	abc	**97%**	96	abc	68.3	abc	84.3	abc	31.7	fg
REDNET	105	a	104	ab	13.8	-	6472	abc	**97%**	96	abc	70.3	a	86.7	a	37.9	bc
AAC REDSTAR	91	efg	97	c	12.8	-	6025	c	**91%**	90	c	67.7	abc	83.0	bc	34.2	def
BW1094	95	cde	100	abc	12.7	-	6654	abc	**100%**	99	abc	68.7	abc	85.0	abc	36.5	bcd
PT496	99	bc	100	abc	12.1	-	6407	abc	**96%**	95	abc	68.0	abc	83.7	abc	37.4	bc
PT5003	93	def	100	abc	11.7	-	6900	ab	**104%**	103	ab	67.3	bc	83.3	abc	39.4	b
LSD P=.05	3.48		3.65		1.45		427.36			6.32		1.63		1.96		2.09	
Standard Deviation	2.08		2.18		0.87		255.52			3.78		0.97		1.17		1.25	
CV	2.23		2.16		6.89		3.91			3.89		1.42		1.38		3.44	

Means followed the by the same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls).

Table 5: CPSR & CWSP Wheat: 2022

Name	Height	Days To Maturity	Protein	Yield			Bushel Weight	Test Weight	TKW
	cm	#	%	kg/ha	% of AAC BRANDON	bu/ac	lb/bu	kg/HL	g
AAC BRANDON (Check)	88 bc	101 -	13.5 a	6547 b	**100%**	97 b	69.0 a	85.3 a	40.9 a
AAC PENHOLD	81 d	101 -	12.0 abc	6897 b	**105%**	102 b	68.7 a	84.7 ab	40.0 a
AC ANDREW	91 ab	100 -	10.0 d	7836 a	**121%**	117 a	67.0 ab	82.3 ab	37.0 ab
AAC RIMBEY	92 ab	101 -	11.2 c	6882 b	**105%**	102 b	68.3 a	84.3 ab	40.8 a
FOREFRONT	84 cd	105 -	12.5 abc	6333 b	**97%**	94 b	68.0 ab	83.7 ab	37.9 ab
AAC PERFORM	95 a	103 -	11.6 bc	6798 b	**104%**	101 b	68.7 a	84.7 ab	36.3 ab
CDC REIGN	87 c	100 -	13.1 ab	6311 b	**97%**	94 b	67.7 ab	83.3 ab	34.9 b
ACCELERATE	85 cd	103 -	12.5 abc	5993 b	**92%**	89 b	65.7 b	81.7 b	30.7 c
AAC WESTLOCK	92 ab	103 -	11.5 bc	6853 b	**105%**	102 b	67.7 ab	83.7 ab	40.8 a
LSD P=.05	3.42	4.87	1.12	594.62		8.79	1.67	1.98	3.21
Standard Deviation	1.98	2.81	0.65	343.53		5.08	0.96	1.15	1.85
CV	2.24	2.76	5.40	5.11		5.09	1.42	1.37	4.92

Means followed by the same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls).

Oats – Oats are a valuable part of crop rotation. They provide disease and insect breaks for wheat, barley, and canola. Their rapid establishment and growth provide excellent weed suppression. Oats also work well as a “catch crop” for taking up and storing excess nitrogen, and the straw provides a nutrient source for the following year’s crop. The straw also protects against soil erosion and contributes to an increase in the soil’s organic matter content.

Table 6: Oats: 2022

Name	Height		Lodging		Yield					Bushel Weight		Test Weight		TKW		Protein	
	cm		(1-9)		kg/ha		% of CS CAMDEN	bu/ac		lb/bu		kg/HL		g		%	
CS CAMDEN (Check)	103	a-d	3.0	de	6803	ab	**100%**	178	ab	47.3	bcd	58.3	bcd	40.9	bc	11.3	a
AC MORGAN	106	abc	4.3	c	6963	ab	**103%**	183	ab	49.0	ab	60.0	ab	42.2	ab	10.7	ab
CDC ARBORG	108	a	7.3	a	7127	ab	**105%**	187	ab	48.0	abc	59.0	abc	40.3	bc	10.8	ab
KYRON	100	cde	3.3	d	7420	a	**110%**	195	a	47.3	bcd	58.3	bcd	38.4	bc	10.3	b
KALIO	101	bcd	6.7	ab	6428	b	**95%**	169	b	48.0	abc	59.0	abc	39.6	bc	10.4	ab
ORE LEVEL 48	104	abc	7.3	a	6699	ab	**99%**	176	ab	46.3	cde	57.0	cd	40.8	bc	10.9	ab
AAC WESLEY	98	de	6.0	b	6857	ab	**101%**	180	ab	45.7	de	56.7	cd	37.7	c	10.4	ab
OT7104	107	ab	7.3	a	7331	ab	**108%**	192	ab	45.0	e	55.7	d	44.2	a	10.1	b
OT2134	101	bcd	2.3	de	7557	a	**111%**	198	a	49.7	a	61.3	a	42.1	ab	10.3	ab
OT3112	95	e	2.0	e	7536	a	**111%**	197	a	46.3	cde	57.3	bcd	40.1	bc	10.9	ab
LSD P=.05	3.90		0.83		584.96			15.30		1.31		1.77		2.34		0.62	
Standard Deviation	2.28		0.48		341.01			8.92		0.76		1.03		1.36		0.36	
CV	2.22		9.73		4.82			4.81		1.62		1.77		3.36		3.41	

Means followed by the same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls)

Triticale: is the first man-made crop species, is initially produced by crossing wheat (genus Triticum) with rye (Secale). When crossing wheat and rye, wheat is used as the female parent and rye as the male parent (pollen donor). The development of triticale as a cereal crop in Canada first began in 1954 at the University of Manitoba, Winnipeg. Triticale is still a minor crop in Canada. Triticale is grown mostly for forage or fodder, although some triticale-based foods can be purchased at health food stores and can be found in some breakfast cereals.

Table 7: Triticale: 2022

Name	Height		Lodging		Yield				Bushel Weight		Test Weight		TKW	
	Cm		(1-9)		kg/ha		bu/ac		lb/bu		kg/HL		g	
AB STAMPEDER	103	-	2	-	6937	b	103	b	61.7	b	76.3	-	40.8	b
BREVIS	104	-	1	-	7941	a	118	a	66.3	a	81.7	-	42.1	a
LSD P=.05	1.43				429.41		5.17		3.79		6.25		0.81	
Standard Deviation	0.41				122.23		1.47		1.08		1.78		0.23	
CV	0.39				1.64		1.33		1.69		2.25		0.56	

Means followed by the same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls).
**TKW: Thousand Kernels Weight

GRO would like to acknowledge the support from RDAR (Results Driven Agriculture Research) and ARVAC (Alberta Regional Variety Advisory Committee) for these Regional Variety Trials.

RDAR
Results Driven Agriculture Research

Regional Pulse Variety Trial

Co-operators: Justin Nanninga- SW22-61-2-W5

Objectives:

- To provide yield and agronomic information of green pea, yellow pea, and fababean commercial varieties and experimental lines for adaptability and yield potential to producers in west-central Alberta.
- To promote crop diversification and increase pulse production acres in the area.

Introduction:

Variety selection plays an important role in production management due to the impact that yield, maturity, and other agronomic characteristics, such as standability or harvestability for pulse crops, that can affect a producer's profitability. Variety testing continues to be important in providing producers with information on the performance of newly registered and established varieties.

Table 8: Agronomic Information:

Trial	Date Seeded Soil Temp	Seed Depth (in)	Fertilizer Seed Placed	Fertilizer Side Banded	Herbicides	Rate	Date
RVT Yellow Peas	May 09 5^0 C	2	11-52-0 58 lbs/ac	6.7-0-40.85-7.66 195.83 lbs/ac	Viper ADV UAN	404ml/acre 810ml/acre	June 09 June 09
RVT Green Peas	May 09 5^0 C	2	11-52-0 58 lbs/ac	6.7-0-40.85-7.66 195.83 lbs/ac	Viper ADV UAN	404ml/acre 810ml/acre	June 09 June 09
RVT Fababeans	May 09 5^0 C	2	11-52-0 58 lbs/ac	6.7-0-40.85-7.66 195.83 lbs/ac	Viper ADV UAN	404ml/acre 810ml/acre	June 09 June 09

Harvested:

Yellow Peas: August 29, 2022

Fababeans: September 13, 2022

Green Peas: The area where the green peas were seeded had some wild oat issues, so after an inspection, this trial was mowed down. There is no harvest data is available for green peas.

Table 9: Soil Test at site

Nitrogen (lbs/ac)	Phosphorus (lbs/ac)	Potassium (lbs/ac)	Sulphur (lbs/ac)	pH (0-14)	CEC (meq/100g)	Organic Matter (%)
34	30	210	18	5.4	16.3	3.7

Table 10: Yellow Peas – 2022

RVT Yellow Peas 2022				
Treatment #	**Treatment Name**	**Maturity Rating**	**Standability**	**Yield (bu/ac)**
1	CDC AMARILLO (Check)	Medium	2	62
2	AAC ABERDEEN	Medium	3	68
3	AAC ARDILL	Medium	2	63
4	AAC BARRHEAD	Early	1	48
5	AAC BEYOND	Medium	1	61
6	AAC CARVER	Early	2	50
7	AAC JULIUS	Medium	1	61
8	AAC PROFIT	Medium	3	59
9	BOOST	Early/Medium	1	54
10	CDC CITRINE	Early/Medium	1	48
11	CDC CANARY	Early	5	63
12	CDC HICKIE	Medium	1	49
13	CDC LEWOCHKO	Medium	1	52
14	CDC PLANET	Early/Medium	2	52
15	CDC SPECTRUM	Medium	1	52
16	CDC TOLLEFSON	Medium	1	51
17	DL 1814	Early/Medium	2	51
18	LN 4228	Medium	1	41
19	PROSTAR	Early/Medium	2	49

Standability rating: 1 Erect; 9 Flat ; Highlighted rows are the top-performing verities for the year 2022

Table 11: Fababeans – 2022

RVT FABABEANS 2022				
Treatment #	**Treatment Name**	**Maturity Rating**	**Standability**	**Yield (bu/ac)**
1	FABELLE (Check)	Medium	1	72
2	219-16	Early	1	53
3	SNOWBIRD	Early	1	54
4	VICTUS	Medium	1	68

Standability rating: 1 Erect; 9 Flat

Highlighted rows are the top-performing varieties for 2022.

GRO would like to acknowledge the support from the **Alberta Pulse Growers** for these Regional Variety Trials.

ALBERTA PULSE GROWERS

Canola Performance Trial 2022

Co-operator: Neerlandia Co-Op – SW34-61-3-W5

Objectives:

- To evaluate currently available commercial canola seed varieties available to farmers. Yield differences should be due to genetic differences only, not due to high weed, disease, or insect pressure.
- To compare the agronomic characteristics of new varieties and proven varieties in our localized growing condition.
- To provide information on newer varieties to local producers

Introduction: Canola Performance Trials (CPT) are independent trials for Western Canadian canola growers to evaluate (current) commercially available varieties. The funding for these trials comes from Alberta Canola, MCGA, and SaskCanola.

The current version of the CPT program dates back to 2011. However, 2018 was the first year for GRO to host the site for the trial once again. In 2022, the trial includes a total of 10 standard varieties and 20 straight cuts from three herbicide-tolerant systems (Liberty Link, Roundup Ready, and TruFlex).

Table 12: CPT Project Description

Seeding Date	**May 26, 2022**
Seeding Depth	¾ inch
Fertilizers	**Fall Applied: 82-0-0 @ 110 lbs/ac** • 90 lbs/ac Actual N **Deep Banded: 20.67-0-15.50-12.92 @ 193 lbs/ac** • 40 lbs/ac Actual N • 30 lbs/ac Actual K • 25 lbs/ac Actual S **Seed Placed: 11-52-0 @ 58 lbs/ac** • 6.38 lbs/ac Actual N 30 lbs/ac Actual P
Herbicides	• Roundup (RR &TF entries) 270 gai/ac June 16, 2022 • Liberty (LL entries) 1.6 l/ac June 16, 2022
Harvested On	September 23, 2022

CPT - Standard Trial					
Herbicide Group Tolerance	**Treatment #**	**Variety Name**	**Days to Maturity #**	**Height cm**	**Yield bu/ac**
Liberty Link	1	L340PC	95	131	74.35
	2	B3011	97	125	62.20
	3	P501L	102	121	65.83
	4	CP21L3C	97	121	70.23
Roundup Ready	5	1028 RR	97	117	52.66
	6	45CM39	101	124	67.84
	7	45H42	98	118	71.67
TruFlex	8	DKTF 98 CR	96	121	73.58
	9	BY 6207TF	103	129	54.99
	10	CS 2600-CR-T	97	120	71.68

Table 13: Results of CPT Standard Trial

Highlighted rows are the top-performing varieties. The yield was adjusted @ 10% moisture.

Table 14: Results of CPT Straight Cut Trial

CPT - Straight Cut Trial					
Herbicide Group	**Treatment #**	**Variety Name**	**Days to Maturity #**	**Height cm**	**Yield bu/ac**
Liberty Link	1	InVigor L340PC	95	126	72.31
	2	InVigor L345PC	96	108	77.53
	3	InVigor L356PC	94	126	69.66
	4	InVigor L343PC	95	121	76.39
	5	DKLL 82 SC	96	119	58.14
	6	DKTFLL 21 SC	95	113	60.22
	7	CS4000 LL	96	116	62.41
	8	B3010M	99	115	59.14
	9	P506ML	95	111	62.43
	10	P505MSL	95	136	62.59
Roundup Ready	11	D3158CM	98	114	58.03
	12	45CM39	101	111	65.74
TruFlex	13	DKTF 99 SC	94	120	54.22
	14	DKTF 97 CRSC	96	122	71.39
	15	BY 6211TF	98	116	58.75
	16	CS2600 CR-T	96	126	64.86
	17	CS3100 TF	102	115	60.04
	18	CS3000 TF	97	118	64.56

	19	PV 761 TM	95	127	54.57
	20	CP21T3P	95	111	45.97

Highlighted rows are the top-performing varieties. The yield was adjusted @ 10% moisture.

Summary:

Both trials performed very well in the year 2022. In the standard trial, the yield difference was about 22 bushels between the poor-performing variety and top performing variety. While the yield gap was wider in the straight-cut trial.

Unfortunately, the “Canola Performance Committee” decided to discontinue these trials in the year 2023. Canola varieties trials are informative for the local producers. GRO is looking for financial help from “Alberta Canola Commission” so producers can see the side-by-side comparison of canola varieties.

Wheat and Barley Fertility Replicated Demonstration Trials

Increased emphasis is being put on ensuring fertility applications do not give off unnecessary greenhouse gases. Techniques such as precision placement of nitrogen(N), adequate packing after nutrient application, and proper timing of that application are all routinely considered. But what about the fertilizer source? Coated urea products such as ESN and SuperU are designed to mitigate N losses through controlled release mechanisms which may create a larger overlap of plant N needs and release timing. But are there yield and quality penalties to be paid for this more efficient type of nitrogen application? In 2022, through the funding of the Alberta Wheat and Alberta Barley extension program, replicated trials were conducted at GRO, Westlock to see if this was a concern. Four popular Barley varieties and four Canada Western Spring Wheat varieties were tested in a small plot and replicated trials to determine if there is any advantages or disadvantage to using delayed-release nitrogen fertilizers. The wheat plots were seeded on May 12, 2022, while the barley plots were seeded on May 19, 2022. The fertility for both trials is listed below.

- **Barley Trial:** The barley trial was seeded on pea stubble. We applied 23.64N-0P-21.76K-5.44S @ 459.49 lbs/ac (Side banded) and 11-52-0-@ 58 lbs/ac (seed placed) at seeding time.
- **Wheat Trial:** This trial was conducted on canola stubble. The farmer applied 75 lbs/ac of actual nitrogen in the fall of 2021. He used neon air-coated urea. We applied the blend of 24.52N-0P-22.42K-4.11S @267.57 lbs/ac (Side banded) and 11-52-0-@ 58 lbs/ac (seed placed) at seeding time.

Table 15: Results of Barley trial

Rating Type Rating Unit			Height cm	Yield kg/ha	Yield bu/ac	Protein %
Treatment No.	Treatment					
	Variety Name	Nitrogen				
1	AAC Copeland	100% Urea	103 -	6764 -	126 -	10.1 -
2	AAC Copeland	60% Urea + 40% ESN	101 -	6938 -	129 -	10.4 -
3	AAC Copeland	100% SuperU	107 -	6997 -	130 -	10.4 -
4	CDC Austenson	100% Urea	98 -	7153 -	133 -	10.6 -
5	CDC Austenson	60% Urea + 40% ESN	114 -	6945 -	129 -	11.2 -
6	CDC Austenson	100% SuperU	104 -	6933 -	129 -	10.9 -
7	CDC Coalition	100% Urea	102 -	7637 -	142 -	10.1 -
8	CDC Coalition	60% Urea + 40% ESN	103 -	7624 -	142 -	9.6 -
9	CDC Coalition	100% SuperU	103 -	7085 -	131 -	10.0 -
10	AB Advantage	100% Urea	107 -	6927	128	10.1 -
11	AB Advantage	60% Urea + 40% ESN	107 -	7154 -	133 -	10.4 -
12	AB Advantage	100% SuperU	104 -	7237 -	134 -	10.6 -
LSD P=.05			12.75	798.73	14.8	
Standard Deviation			7.53	468.96	8.69	
CV			7.21	6.57	6.55	

Means followed by the same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls).

Note: These trial were one year one site data so should be compared with other peer scientific publication before making final decision.

Table 16: Results of wheat trial

Rating Type Rating Unit			Lodging 1- 9	Yield kg/ha	Yield bu/ac	Protein %	Gluten %
Treatment No.	**Treatment Name**						
1	CDC Redberry	100% Urea	2.6 a	6201 bc	92 bc	14.2 ab	35.9 ab
2	CDC Redberry	60% Urea + 40% SuperU	2.3 a	6450 abc	96 abc	13.8 abc	35.0 abc
3	CDC Redberry	70% Urea + 30% UAN	1.6 ab	6671 ab	99 ab	14.4 a	36.4 a
4	AAC Wheatland	100% Urea	1 b	6544 abc	97 abc	13.5 bc	34.3 bc
5	AAC Wheatland	60% Urea + 40% SuperU	1 b	6864 a	102 a	13.3 c	33.8 c
6	AAC Wheatland	70% Urea + 30% UAN	1 b	6657 ab	99 ab	13.9 abc	35.6 ab
7	AAC Brandon	100% Urea	2 a	6577 abc	98 abc	14.4 a	36.3 a
8	AAC Brandon	60% Urea + 40% SuperU	2 a	6903 a	103 a	14.1 ab	35.6 ab
9	AAC Brandon	70% Urea + 30% UAN	1.6 ab	6840 a	102 a	14.4 a	36.5 a
10	AAC Redstar	100% Urea	1 b	6350 abc	94 abc	13.5 c	34.5 bc
11	AAC Redstar	60% Urea + 40% SuperU	1 b	6049 c	90 c	13.4 C	34.5 bc
12	AAC Redstar	70% Urea + 30% UAN	1 b	6190 bc	92 bc	13.5 bc	34.7 bc
LSD P=.05			0.64	361.91	5.37	0.438	1.08
Standard Deviation			0.06	213.73	3.17	0.259	0.638
CV			14.1	3.28	3.27	1.86	1.81

Means followed by the same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls

***The severe leaf disease was noticed in the AAC Redstar wheat variety

GRO Would like to acknowledge the support of Alberta Wheat and Barley Commission for these trials.

Alberta Barley

Alberta Wheat COMMISSION

Conclusion: In the barley trial, no significant differences were determined, although trends seem to exist in the results among the varieties. Further trials will need to be conducted to see if fertilizer types that are formulated to reduce nitrous oxide greenhouse gas have any impact on yield, standability, or protein in barley. Similarly, more work will have to be done on wheat to see if there is an impact on lodging, yield, protein, and gluten strength. Some significant differences were discovered in the wheat portion of the trial, but these were not entirely consistent with the fertilizer regime. So, at this point in time within one site year of data, there does not as year appear to be great penalties to be paid for using delayed-release fertilizers. Whether there is an economic penalty is highly dependent on the costs of those fertilizers and the applications used to delay the release of N. Those costs have fluctuated wildly over the past few months and years, so any economic analysis would only be reflective of a point in time, rather than a general recommendation.

Reference:

Research project (Dr. Brian Beres @ AAFC Lethbridge) “Integrating N fertilizer technologies with superior genetics to optimize protein in CWRS wheat without comprising yield, 4R principles, and environmental health.”

https://www.albertawheatbarley.com/alberta-wheat/research/projects/integrating-n-fertilizer-technologies-with-superior-genetics-to-optimize-protein-in-cwrs-wheat-without-comprising-yield-4r-principles-and-environmental-health

2022 POGA Milling Oats Trial

Co-operators: Randy Pidsadowski- NW-8-61-26-W4

Increase the Oat Acres in Alberta by Finding a High Yielding Oat Variety that Maximizes Producer Income and Meets the Demands of the Millers.

Summary

This study is a continuous effort to collect data on 11 milling variety oats in Central and Northern Alberta. The goal was to determine how variety and growing location will influence the **yield** and functional property attributes linked to **beta-glucan** levels of the oats. Similar to what's been recorded, there were noticeable varietal differences between the two locations for the yields, as well as beta-glucan content. 2022 was a good year for all crops. Overall, crop yields were satisfactory for grain producers.

Background

Oat production in Alberta has been on a relatively steady decline since 2011. Oats have earned the status of major Canadian export crop from domestic crop status. According to Prairie Oat Grower's Association (POGA), an estimated 3.1 million acres of oats were seeded in the year 2015-16. However, many major millers will not accept oats from Alberta or look to Alberta only after Manitoba and Saskatchewan's supply is gone, because the main oat variety grown in Alberta is Morgan which contain low amounts of Beta Glucan (β-glucan). **A minimum of 4% β-glucan is required for companies to be able to label their products with the Heart Healthy Claim**. Morgan is consistently at or below that amount. Therefore, oat producers in Alberta need an oat variety that can consistently beat the yields of Morgan but has the higher β-glucan amounts that the oat miller desire. To emphasize this fact, since 2015 Grain Millers have helped to fund this variety trial, hoping to identify oat varieties that will help Alberta producers access the milling market more consistently.

Oats are a valuable part of crop rotation and are therefore beneficial to producers. They provide disease and insect breaks for wheat, barley, and canola. Their rapid establishment and growth provide excellent weed suppression. Oats also work well as a "catch crop" for taking up and storing excess nitrogen, and the straw provides a nutrient source for the following year's crop. The straw also protects against soil erosion and contributes to an increase in the soil's organic matter content (Campbell et al., 1991).

Well-planned management and appropriate selection of varieties make oats a profitable crop due to their low input requirements and favorable effects on succeeding crops in a rotation.

Test weight is the most commonly used indicator of grain quality. High test-weight varieties should be chosen by growers who intend to market oat grain. However, functional attributes such as β-glucan solubility and viscosity are the main criteria for the processing industry. Many studies have shown that oat β-glucan can lower blood cholesterol levels, glucose, and insulin response and therefore decrease the risk of cardiovascular diseases and prevention of diabetes (Wang and Ellis, 2014).

Oats are regularly affected by crown rust in other parts of Western Canada, and this disease is moving west, towards Alberta. Morgan does not have crown rust resistance but selecting new disease-resistant varieties can overcome the problem. The information for a producer to choose the newer and higher-yielding varieties specific to their region is, therefore, a very important step to staying profitable in oat production. The β-glucan content in oat may vary with changes in growing conditions (Perez Herrera et al., 2016). The current trial will provide valuable agronomic information for the producers in Alberta to grow oat varieties with higher yields and increased functional properties (β-glucan) attribute.

Objective

To investigate the impact of genotype and growing condition on the yield and β-glucan content of milling oat varieties in Alberta.

<u>Methodology</u>

Eleven milling oat varieties and four forage oat varieties were tested in 2022. Based on the soil fertility recommendations, fertilizers were added to maintain the optimal levels of growing conditions. Seeding rates were calculated based on the 1000 kernel weight of each variety with a seed counter, desired plant density, and germination percentage. A 9-inch spaced 6 rows Fabro small plot seeder was used for the seeding. Each plot of a variety occupied 9.59 sq. m. (1.37 m width and 7 m long) and there were four replications. The trial site was maintained weed-free with the use of herbicides (Table 1). The trial was harvested with a Zurn

150 plot combine (5-foot header) and grain yield from each plot was measured using electronic scales. A clean composite sample (500g) was collected and sent for β-glucan estimation. The growing season of 2019 and 2020 provided very high moisture throughout the year while the 2022 growing season was a somewhat normal year for crop production.

Table 1: Soil Information - 2022

	Nitrogen (lbs/ac)	Phosphorus (lbs/ac)	Potassium (lbs/ac)	Sulphur (lbs/ac)	pH (0-14)	CEC (meq/100g)	Organic Matter (%)
Westlock	124	36	228	31	5.5	26.2	7.5
Peace Region	14	46	658	28	6.4	21.9	5.8

Table 2: Agronomic details for the POGA Trail 2022

Location:	Westlock	Peace Region
Seeding Date:	May 12th, 2022	May 25th, 2022
Harvest Date:	September 02nd, 2022	Sept 16th, 2022
Soil Temp:	14^0 Celsius	22^0 Celsius
Soil Moisture:	Adequate	Adequate
Seeding Depth:	$1^{1/4}$ inch	¾ inch
Fertility total Nutrients (Actual lb/acre)	**35 N-30.16 P-80 K-21.19 S-2.48 Cu**	**127 N-35 P-35 K-10 S**
Herbicides applied to the trial	Pre-emergence Roundup @ 0.78 l/ac (May 6)	Pre-burn Roundup Weathermax and Conquer II @ 670 ml/acre & 242 ml/acre (May 26)
Herbicides applied to trial	In crop Broadleaf: Curtail M @750 ml/ ac (7 June)	In crop Stellar XL @405 ml/ac (June 15)
Fungicides applied to the trial	None	Prosaro @ 325 ml/acre (July 08)
Rainfall (mm)	174.1 mm	210 mm

The decision for applying fertilizer at a higher level was made to allow all varieties to express their best performance potential based on the soil test at both locations.

Table 3: Yield - 2022 Comparison

	Westlock			Peace Region	
Variety	% of AC Morgan	Yield bu/ac		% of AC Morgan	Yield bu/ac
AC MORGAN	100%	192	abc	100%	235 -
CS CAMDEN	98%	189	bc	113%	265 -
KALIO	94%	180	c	106%	248 -
OT3112	102%	195	abc	114%	268 -
CDC RUFFIAN	108%	208	a	110%	259 -
OT 6024	101%	193	abc	106%	250 -
CDC ARBORG	103%	198	ab	114%	269 -
CDC ENDURE	102%	195	abc	102%	240 -
ORE LEVEL 50	95%	182	bc	93%	219 -
AAC WESLEY	104%	199	ab	113%	266 -
AAC DOUGLAS	101%	193	abc	108%	254 -

Means followed by the same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls).

A common oat variety in Alberta, CDC Ruffian, was the highest-yielding variety for 2022 in Westlock, followed by AAC Wesley and AC Arborg. While, in the Peace region, CDC Arborg=OT 3112>AAC Wesley=CS Camden>CDC Ruffian were the top-performing varieties.

Table 4: Other results from the POGA trial 2022 Westlock Site

		Height cm		Lodging (1-9)		Maturity Days		Test Weight kg/HL		TKW g	
1	**AC MORGAN**	104	ab	4.5	c	92	-	59.4	-	35.6	-
2	**CS CAMDEN**	104	ab	4.5	c	94	-	56.3	-	31.8	-
3	**KALIO**	99	ab	7.3	a	91	-	57.3	-	32.9	-
4	**OT3112**	92	b	4.5	c	94	-	56.4	-	35.6	-
5	**CDC RUFFIAN**	103	ab	7.5	a	97	-	57.8	-	34.1	-
6	**OT 6024**	104	ab	5.3	bc	98	-	57.1	-	35.8	-
7	**CDC ARBORG**	110	a	7.5	a	93	-	59.6	-	37.6	-
8	**CDC ENDURE**	109	a	7.8	a	92	-	57.2	-	39	-
9	**ORE LEVEL 50**	99	ab	5.8	bc	92	-	55.3	-	38.8	-
10	**AAC WESLEY**	96	ab	6.5	ab	94	-	56	-	33.6	-
11	**AAC DOUGLAS**	100	ab	5.8	bc	92	-	59.9	-	35.6	-
LSD P=.05		6.91		0.96				3.50		4.30	
Standard Deviation		4.79		0.67				2.10		3.00	
CV		4.69		10.98				3.60		7.50	

Means followed by the same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls).

Table 5: Other results from the POGA trial 2022 Peace site.

		Height cm		Lodging (1-9)		Test Weight kg/HL		TKW g	
1	AC MORGAN	40	a	1	-	58.7	a	38.6	bc
2	CS CAMDEN	39	ab	1	-	57.4	bcd	38.5	bc
3	KALIO	40	a	1	-	57.2	cd	36.9	cd
4	OT3112	34	c	1	-	57	d	36.5	cd
5	CDC RUFFIAN	37	b	1	-	56.8	d	36.9	cd
6	OT 6024	39	ab	1	-	56.6	d	35.2	d
7	CDC ARBORG	41	a	1	-	58.2	abc	38.9	bc
8	CDC ENDURE	41	a	1	-	56.7	d	37.6	c
9	ORE LEVEL 50	39	a	1	-	55.4	e	41.3	a
10	AAC WESLEY	36	b	1	-	55.5	e	37.3	cd
11	AAC DOUGLAS	41	a	1	-	58.4	abc	40	ab
LSD P=.05		1.95		.		0.88		1.55	
Standard Deviation		1.35		0.00		0.61		1.07	
CV		3.50		0.00		1.06		2.83	

Means followed by the same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls).

Test weight is an important indicator of grain milling quality. ACC Douglas had the highest test weight at Westlock and AC Morgan had the highest test weight at Peace region.

Table 6: The Beta-Glucan Results from the POGA trial of 2022

		Westlock (GRO) – 2022		Peace Region (SARDA) – 2022	
	Variety	**Hull percentage (%)**	**Flour BG (%, db)**	**Hull percentage (%)**	**Flour BG (%, db)**
1	AC MORGAN	23.77	3.33	28.69	3.66
2	CS CAMDEN	21.64	3.82	17.22	4.22
3	KALIO	21.88	4.56	21.27	4.08
4	OT3112	17.72	4.85	20.38	5.41
5	CDC RUFFIAN	20.33	3.62	17.98	5.10
6	OT 6024	18.77	4.34	28.55	5.93
7	CDC ARBORG	19.68	4.23	22.76	5.49
8	CDC ENDURE	14.64	4.88	22.42	6.02
9	ORE LEVEL 50	16.11	4.72	22.30	5.23
10	AAC WESLEY	20.23	4.04	19.77	5.30
11	AAC DOUGLAS	22.89	4.78	16.47	5.21

Beta Glucan results: The beta-glucan content of the 11 different milling varieties ranged between 3.33% and 6.01%, with the lowest reported for AC Morgan at Westlock and also in the Peace region. **CDC Endure, OT3112, and AAC Douglas were the highest beta-glucan varieties** at the Westlock location, while **CDC Endure, OT 6024, and CDC Arborg were the highest varieties for beta-glucan** in the Peace region.

Crop Year	Top 3 Varieties for Beta Glucan at Westlock		
2022	CDC Endure	OT3112	AAC Douglas
2021	OT3112	CDC Endure	CDC Skye
2020	OT3112	CDC Endure	CDC Skye
2019	CDC Endure	CDC Arborg	AC Morgan
2018	CDC Endure	CDC Arborg	Triactor
2017	CS Camden	Akina	CDC Ruffian
2016	CDC Seabiscuit	CDC Ruffian	CDC Orin
	Top 3 Varieties for Beta Glucan at Peace Region		
2022	CDC Endure	OT 6024	CDC Arborg
2021	OT3112	CDC Endure	CDC Skye
2020	CDC Skye	OT3112	CDC Endure
2019	CDC Seabiscuit	CDC Arborg	CS Camden
2018	Triactor	AC Morgan	CDC Endure
2017	CDC Ruffian	CS Camden	CDC Orin
2016	CDC Ruffian	AC Morgan	CDC Seabiscuit

Conclusion:

There is a significant effect of location and variety for yield, as well as beta-glucan levels in the years 2016 to 2022. Environmental conditions affect the yield capacity of a variety_to a higher degree than the effect on beta-glucan levels.

Table 7: Overall Summary of the trial - Yields from 2016 to 2022 at Westlock, Alberta

	Yield	Overall Average	2022	2021	2020	2019	2018	2017	2016
Milling Oats	% of AC Morgan	Yield (Bu/Ac)	Yield (Bushel/Acre)						
AC Morgan	100	202	192	161	203	243	226	212	178
CS Camden	98	199	189	150	211	241	206	226	167
CDC Ruffian	101	204	208	147	206	219	207	245	193
CDC Arborg	101	204	198	150	208	244	221	-	-
CDC Endure	100	201	195	143	194	249	226	-	-
OT3112	90	183	195	140	213	-	-	-	-
Kalio	79	161	180	141	-	-	-	-	-
AAC Douglas	84	171	193	148	-	-	-	-	-
ORE Level 50	90	182	182	-	-	-	-	-	-
OT 6024	95	193	193	-	-	-	-	-	-
AAC Wesley	98	199	199	-	-	-	-	-	-
AC Summit	93	189	-	121	178	245	203	217	167
CDC Skye	93	188	-	115	211	237	-	-	-
ORE3541M	57	115	-	115	-	-	-	-	-
CDC Seabiscuit	104	211	-	-	205	239	212	208	189
ORE3542M	99	199	-	-	183	214	201	-	-
CDC Norseman	103	208	-	-	190	222	213	-	-
Triactor	105	212	-	-	-	238	229	208	172
Akina	102	206	-	-	-	-	221	222	176
CDC Orrin	100	202	-	-	-	-	218	221	168
Souris	86	175	-	-	-	-	-	194	155
Kara	98	199	-	-	-	-	-	222	175
CDC Minstrel	93	188	-	-	-	-	-	202	174

Table 7: Beta-glucan (%) contents in milling oats from 2016 to 2022

Milling Oats	Average	2022		2021		2020		2019		2018		2017		2016	
		Westlock	Peace	Westlock	Peace	Westlock	Peace	Westlock	Peace	Westlock	Peace	Westlock	Peace	Westlock	Peace
AC Morgan	3.8	3.3	3.7	3.5	3.5	3.9	3.8	3.9	3.7	3.9	3.4	3.8	4.2	3.9	4.1
CS Camden	4.2	3.8	4.2	4.0	4.0	4.7	4.3	4.4	5.2	4.4	3.8	4.4	4.6	3.7	3.9
CDC Ruffian	3.6	3.6	5.1	3.3	3.9	4.3	3.5	3.6	3.7	3.6	2.7	3.8	3.9	2.7	3.3
CDC Arborg	4.3	4.2	5.5	3.8	4.2	4.6	3.6	4.2	4.3	4.4	3.8	-	-	-	-
CDC Endure	4.7	4.9	6.0	4.1	4.5	5.2	4.6	4.5	4.7	4.7	4.2	-	-	-	-
OT3112	5.2	4.9	5.4	4.9	5.1	6.1	4.8	-	-	-	-	-	-	-	-
Kalio	4.0	4.6	4.1	3.6	3.8	-	-	-	-	-	-	-	-	-	-
AC Douglas	4.5	4.8	5.2	3.7	4.1	-	-	-	-	-	-	-	-	-	-
ORE Level 50	5.0	4.7	5.2	-	-	-	-	-	-	-	-	-	-	-	-
OT 6024	5.1	4.3	5.9	-	-	-	-	-	-	-	-	-	-	-	-
AAC Wesley	4.7	4.0	5.3	-	-	-	-	-	-	-	-	-	-	-	-
AC Summit	4.1	-	-	3.4	3.4	4.8	4.5	4.3	4.6	4.3	3.7	4.3	4.4	3.6	3.7
CDC Skye	4.6	-	-	4.0	4.2	4.9	5.0	4.5	5.0	-	-	-	-	-	-
ORE 3541M	3.7	-	-	3.6	3.8	-	-	-	-	-	-	-	-	-	-
CDC Seabiscuit	4.2	-	-	-	-	4.6	4.0	4.5	4.2	4.4	3.7	4.6	4.6	3.7	3.7
ORE3542M	4.0	-	-	-	-	4.4	3.8	3.8	4.2	4.0	3.5	-	-	-	-
CDC Norseman	4.5	-	-	-	-	4.8	4.6	4.7	4.4	4.5	3.8	-	-	-	-
Triactor	4.1	-	-	-	-	-	-	4.1	4.3	4.4	4.0	4.4	4.5	3.5	3.7
Akina	4.4	-	-	-	-	-	-	-	-	4.8	4.0	5.0	4.9	3.8	3.7
CDC Orrin	3.8	-	-	-	-	-	-	-	-	4.1	3.4	4.4	4.0	3.2	3.7
Souris	4.3	-	-	-	-	-	-	-	-	-	-	4.9	4.4	3.6	4.4
Kara	4.2	-	-	-	-	-	-	-	-	-	-	4.3	5.0	3.6	3.7
CDC Minstrel	3.7	-	-	-	-	-	-	-	-	-	-	3.9	4.3	2.9	3.5

Results and Discussion

2022 was a little dry but the crop production did not affect too much crop's water requirement was fulfilled by the rain. The average site yield at Westlock was 193 bu/ac compared to 252 bu/ac in the Peace region. Westlock site had some lodging issues while at the Peace site, no lodging was noticed. Also, the plant height was surprisingly short in the Peace region compared to the Westlock site. There was no noticeable difference in the test weight at both locations. The quality of grain was a little bit lower at the Peace region site with a higher average hull percentage (21.16%) compared to the Westlock site (19.78%). The average thousand kernel weight was lower at the Westlock site (35.49 g) compared to the Peace region site (37.97 g).

Acknowledgments: We would like to thank **Prairie Oat Growers Association (POGA) and Grain Millers Canada** for their full financial assistance. Special thanks to Dr. Thava Vasanthan for their contribution to lab analysis for this trial.

We would like to thank Canterra Seeds, Canada Seed Depot, SeCan, Alliance Seed, and FP Genetics for their generous seed donations for the trial. This information is presented with the understanding that no product discrimination is intended and neither endorsement of any variety/product mentioned, nor criticism of the named variety/products is implied.

Local wheat/triticale varieties comparison trial

Co-operators: Randy Pidsadowski – NW-8-61-26-W4

Problem: The Gateway Research Organization has been involved in the regional variety trials (RVTs) organized by the government of Alberta and contributed to datasheets for the Alberta Seed Guide since 1988. However, not all locally grown varieties of wheat are included in the RVTs. The producers in our region want to see a close comparison of the newer varieties grown in the RVT program with the most popular varieties grown in our region.

Justification: Prior to planting each year, wheat producers have to make the important and difficult decision of selecting wheat seed varieties from a long list of choices. Since public and private wheat breeders continue to develop higher-yielding wheat varieties over time, wheat producers are confronted with a difficult question about whether to purchase new certified seeds or go with older proven choices. As a producer-run applied research organization, it is mandated for GRO to provide an unbiased source of information regarding the decision-making process. If producers can choose from the information suited close to their individual set of growing conditions including average rainfall, soil type, and agronomic practices, they would most likely maximize performance for selected wheat variety and their profitability.

Objective: Side-by-side comparison of all the locally popular wheat varieties in our area (Surrounding Westlock County) to analyze yield and other agronomic characteristics.

Table 26: List of Varieties for trial

CWRS WHEAT	CNHR & CPSR WHEAT
AAC Redstar	AC Foremost
AAC Starbuck VB	AAC Penhold
AAC Wheatland VB	Forefront
CDC SkRush	**SPRING TRITICALE**
Noor	AAC Delight
Parata	
AAC LeRoy	

Agronomic Information of Local Varieties Trial (Wheat/Triticale)

Seeded May 20, 2022

Seed depth: $1^{1/2}$ inch

Rainfall: From May 1 to August 30, 2022: 174.1 mm or 6.85 inches

Fertilizer:

Fall Applied: 46-0-0 (coated with Neon Air) 163.04 lbs/ac

75 lbs/ac Actual N

Side banded: 17.57-0-26.21-6.95-0.82 216.87 lbs/ac

38.10 lbs/ac Actual N 56.85 lbs/ac Actual K
15.07 lbs/ac Actual S 1.78 lbs/ac Actual Cu

Seed placed: 11-52-0 58 lbs/ac

6.38 lbs/ac Actual N 30 lbs/ac Actual P

Herbicide:

Axial	500 ml/ac	June 19, 2022

Harvested:

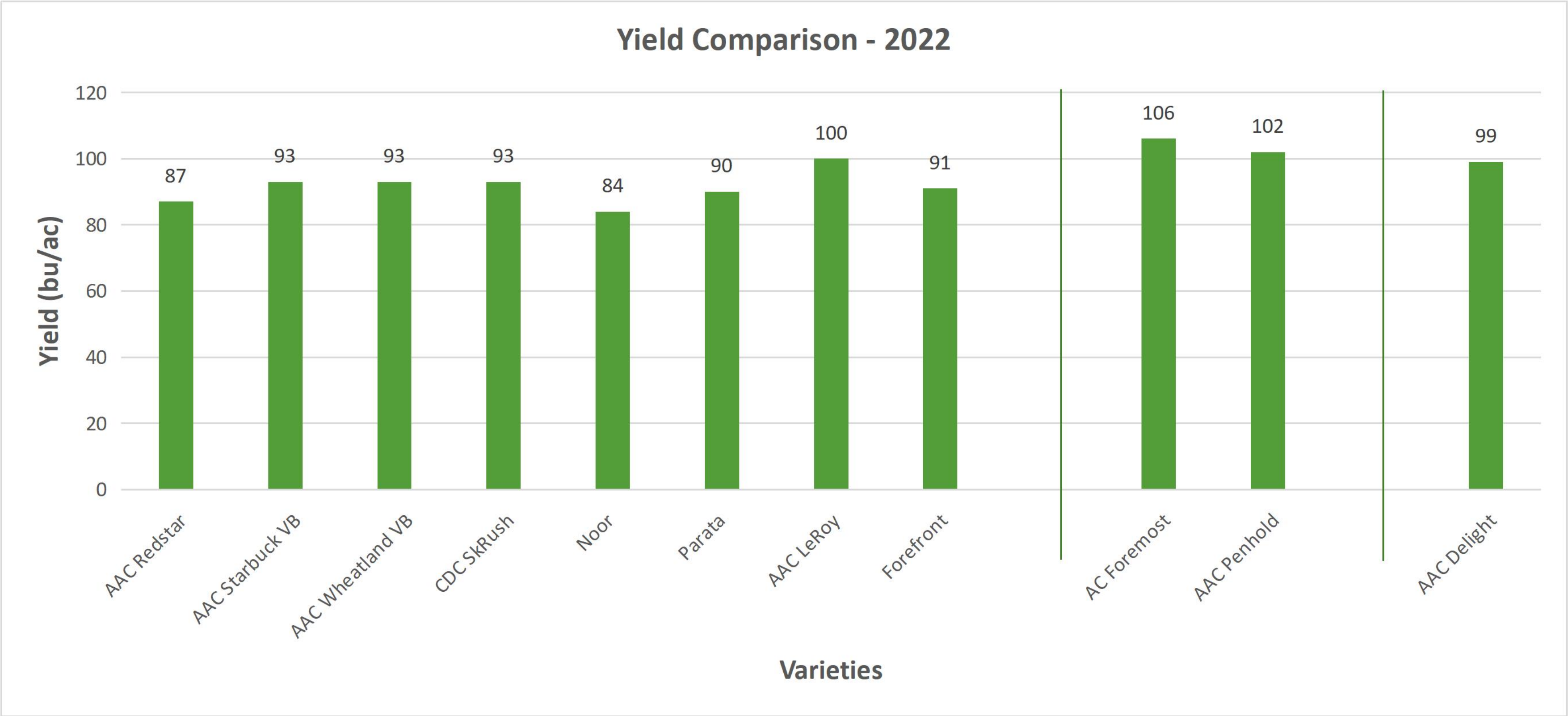
Wheat: **August 31, 2022**; Triticale: **September 08, 2022**

Table 27: Results Local Varieties 2022

Variety Name	Height cm		Protein %		Gluten %		Yield kg/ha		Yield bu/ac		Bushel Weight lb/bu		Test Weight kg/HL		TKW G	
CWRS																
AAC Redstar	93	bc	13.3	a	33.8	ab	5835	d	87	d	69.0	ab	85.0	a	35.7	de
AAC Starbuck VB	87	d	13.2	ab	32.7	bc	6254	bcd	93	bcd	67.5	ab	83.5	ab	36.8	bcd
AAC Wheatland VB	86	d	12.5	c	31.8	cd	6245	bcd	93	bcd	69.0	ab	85.0	a	36.5	cd
CDC SkRush	97	ab	13.2	ab	33.1	bc	6248	bcd	93	bcd	68.0	ab	84.0	a	33.8	e
Noor	99	a	13.7	a	34.4	ab	5668	d	84	d	68.0	ab	84.0	a	33.5	e
Parata	98	ab	13.9	a	35.1	a	6026	d	90	d	70.0	a	86.0	a	35.5	de
AAC LeRoy	92	c	12.6	bc	31.9	cd	6718	abc	100	abc	69.5	a	85.5	a	38.6	abc
Forefront	82	e	12.3	c	30.6	de	6134	cd	91	cd	65.5	b	80.5	b	39.2	ab
CNHR &CPSR																
AC Foremost	81	e	11.5	d	28.7	f	7143	a	106	a	68.0	ab	83.5	ab	38.8	abc
AAC Penhold	78	e	12.0	c	29.9	ef	6885	ab	102	ab	67.5	ab	83.5	ab	40.3	a
Spring Triticale																
AAC Delight	-	-	-	-	-	-	6638	b	99	b	-	-	-	-	-	-
LSD P=.05	3.88		0.50		1.33		453.95		6.75		2.11		2.19		1.83	
Standard Deviation	2.26		0.29		0.77		264.63		3.93		0.93		0.97		1.07	
CV	2.54		2.26		2.40		4.19		4.19		1.37		1.15		2.89	

Means followed by the same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls).

Graph: Varietal Yield Comparison



Regional Silage Trial

Co-operators: Ken Anderson - NW-32-59-2-W5

Objectives

- To compare silage yield and nutritional value of new and commonly used barley, oat, and triticale silage varieties.
- To provide yield and agronomic data for use in the Alberta Agriculture publication "Silage Varieties for Alberta."

Materials and Methods

A randomized complete block with 3 replicates of each treatment was used. The plot size was 1.37 meters wide (6 rows with 9-inch spacing) by 7 meters long. Silage was harvested, and samples were weighed and sent for wet chemistry analysis to obtain moisture and feed quality. Seeding rates were based on 1000 kernel weight and germination in order to achieve 300 seeds/m^2, 300 seeds/m^2, and 370 seeds which translates to about 28, 28, and 34 plants per square foot for barley, oat, and triticale respectively. It is very important to calculate seeding rates using this method (using germination % and 1000 kernel weight) to prevent under or overseeding. Crops with larger seed sizes have fewer seeds per pound/bushel. They need to have more pounds/bushel seeded per acre to keep viable seed counts the same as crops with small seed sizes.

Table 28: Soil information - 2022

LOCATION	NITROGEN (LBS/AC)	PHOSPHORUS (LBS/AC)	POTASSIUM (LBS/AC)	SULPHUR (LBS/AC)	PH (0-14)	CEC (MEQ/100G)	ORGANIC MATTER (%)
NW-32-59-2-W5	70	76	262	25	4.7	15.1	3.5

Barley, Oats, Triticale/Wheat

Seeded June 1, 2022

Seed depth: 1$^{1/2}$ inch

Rainfall: From May 1 to August 15, 2022: 214 mm or 8.43 inches

Fertilizer:

Fall Applied: 82-0-0 100 lbs/ac

82 lbs/ac Actual N

Side banded: 11.41-0-31.89-8.45-0.99 250.83 lbs/ac

28.62 lbs/ac Actual N 80 lbs/ac Actual K
21.2 lbs/ac Actual S 2.5 lbs/ac Actual Cu

Seed placed: 11-52-0 58 lbs/ac

6.38 lbs/ac Actual N 30 lbs/ac Actual P

Curtail M 600 ml/ac June 18, 2022

Harvested:

Barley: **August 10, 2022**; Oats: **August 17, 2022**

Triticale/Wheat: **August 23, 2022**

Barley Varieties Used in the Trial

- **CDC Austenson**: A two-row, rough-awned hulled feed barley with very high grain yield and short, strong straw.
- **AB Advantage**: A six-row smooth-awned feed and forage barley with high grain yield and good agronomic performance.
- **AB Cattlelac**: A six-row semi-smooth awned barley, coupled with good lodging resistance, good grain yield, and excellent disease resistance.
- **AB Wrangler:** A two-row feed, grain and silage variety with high grain and forage yield potential, early to medium maturing, moderate resistance to smut, stem rust, and fusarium head blight, and low DON (deoxynivalenol) accumulation.
- **Altorado**: A two-row, spring-feed barley with good resistance to lodging and a fair to good resistance to drought conditions.
- **Amisk:** Rough awned, six-row, semi-dwarf general-purpose barley with increased feed efficiency, and strong straw for decreased lodging.
- **Canmore:** A two-row, medium-height, and general-purpose barley. This variety fits in the feed market with the added food-grade opportunities in the pearling and Shochu markets. (Shochu is an alcoholic beverage that is replacing Sake in Japan).
- **CDC Fraser:** Two-row malting barley with improved yield potential and excellent lodging resistance.

- **CDC Cowboy:** A two-row-hulled forage type barley with very high forage and grain yield. Susceptible to scald, spot blotch, barley yellow dwarf virus, and loose smut.
- **CDC Maverick:** A two-row forage barley with smooth awns, good for swath grazing as well as baling.
- **Claymore:** A two-row, feed barley, semi-erect growth habit at tillering, good resistance to lodging and shattering, good tolerance to straw breakage, fair to good tolerance to drought.
- **AB Prime:** A two-row feed barley, a newly released variety previously called TR18645.
- **Sundre** – A high-yielding six-row barley variety with good disease resistance.
- **AB Hague**: A two-row feed and forage barley, with superior drought tolerance and disease resistance.
- **AB Tofield**: A six-row, smooth awned barley with stable yield.
- **CDC Churchill**: A very high yielding strong strawed two-row malting barley.
- **Stockford**: The first two rows, hooded (the awns are reduced to a hood), forage type barley to be registered in Canada.
- **Esma**: A very short strong strawed, two-row barley with excellent grain yield potential.
- **Oreana**: A short and heavy-stature two-row barley that is well suited for high-input operations and manured soils.
- **KWS Kellie:** Spring two-row barley with good yield levels and malt quality.
- **CDC Renegade:** Two-row, spring forage barley with semi-erect growth habit.

Table 29: Results of Barley Silage 2022

		Variety Name	Height cm	Yield Tonnes/Ac	% of Check	CP %	ADF %	TDN %	Calcium %	Phosphorus %	Potassium %	Magnesium %	RFV %
1	Two Row	CDC AUSTENSON	82	10.9	100%	10.7	27.7	63.1	0.46	0.16	1.65	0.15	119
2	Six Row	AB ADVANTAGE	104	10.5	96%	8.9	29.3	58.0	0.48	0.20	1.70	0.17	121
3	Six Row	AB CATTLELAC	96	9.5	87%	10.9	27.0	61.7	0.55	0.19	1.68	0.17	130
4	Two Row	AB WRANGLER	84	9.7	89%	11.7	23.1	64.2	0.39	0.23	1.37	0.16	152
5	Two Row	ALTORADO	97	13.2	121%	9.8	27.5	63.7	0.54	0.17	1.36	0.19	124
6	Six Row	AMISK	95	10.7	98%	8.3	33.3	57.0	0.62	0.19	1.46	0.19	100
7	Two Row	CANMORE	92	9.5	87%	9.6	28.0	60.4	0.62	0.18	1.51	0.20	121
8	Two Row	CDC FRASER	81	10.6	97%	9.3	28.3	60.5	0.53	0.20	1.43	0.17	119
9	Two Row	CDC COWBOY	103	12.0	110%	9.2	26.0	61.7	0.48	0.19	1.23	0.19	129
10	Two Row	CDC MAVERICK	107	10.4	95%	9.8	27.8	61.6	0.59	0.20	1.46	0.20	125
11	Two Row	CLAYMORE	98	11.0	101%	9.9	27.9	61.4	0.60	0.19	1.44	0.17	121
12	Two Row	AB PRIME	98	11.5	106%	7.9	36.6	55.0	0.52	0.13	1.75	0.15	90
13	Six Row	SUNDRE	90	11.3	104%	10.7	23.1	64.5	0.43	0.23	1.21	0.15	153
14	Two Row	AB HAGUE	95	11.2	103%	10.0	26.0	62.2	0.43	0.16	1.15	0.17	134
15	Six Row	AB TOFIELD	82	11.1	102%	9.9	27.5	60.6	0.57	0.17	1.51	0.18	129
16	Two Row	CDC CHURCHILL	83	11.3	104%	10.6	24.8	62.2	0.51	0.16	1.50	0.16	136
17	Two Row	STOCKFORD	84	11.3	104%	8.5	30.9	62.7	0.74	0.18	1.44	0.19	110

18	Two Row	ESMA	82	12.1	111%	9.9	26.9	62.0	0.54	0.21	1.54	0.20	122
19	Two Row	OREANA	70	9.3	85%	10.9	29.2	63.9	0.49	0.21	1.87	0.19	113
20	Two Row	KWS KELLIE	87	11.7	107%	9.3	24.7	60.6	0.47	0.22	1.53	0.14	139
21	Two Row	CDC RENEGADE	97	12.5	115%	9.1	30.2	60.7	0.48	0.20	1.51	0.17	114

Harvested @ Soft Dough Stage	Check: CDC Austenson	Yield: Adjusted @ 65% Moisture
TDN: Total Digestible Nutrients	RFV: Relative Feed Value	Highlighted Row: Top performing variety by yield
ADF: Acid-Detergent Fiber	CP: Crude Protein	Highlighted Row: Top performing variety by RFV Value

Triticale Varieties Used in the Trial

- **Taza –** Awnletted (reduced awn expression) standard height spring triticale line intended for use as a feed grain conserved forage, swath grazing crop and potentially for industrial use. Adapted to the Canadian Prairie Provinces. This line has good lodging resistance, good test weight, and high kernel weight
- **AAC Delight –**A spring triticale, moderately resistant to ergot, hexaploid, awns are at tip only.
- **Bunker –** An early maturing, reduced awn forage variety with great digestibility, high-fat content and high silage yields.
- **Sunray –** An early-maturing variety, adapted to the Canadian prairies and represents an improvement in ergot resistance for Canadian triticale with short-stature for increased resistance to lodging. It is resistant to the prevalent races of leaf rust, stem rust, common bunt, root rot and is moderately resistant to grain sprouting.
- **AB Stampeder –** A spring triticale, forage-type line, is more digestible because it has reduced awns, is shorter, and has lower lignin content. It is also favorable for swath grazing.

- **Table 30: Results of Triticale/Wheat Silage 2022**

		Variety	Height	Yield	% of	CP	ADF	TDN	Calcium	Phosphorus	Potassium	Magnesium	RFV
		Name	cm	Tonnes/Ac	Check	%	%	%	%	%	%	%	%
1	Triticale	TAZA	110	13.0	100%	10.9	32.1	60.3	0.22	0.20	1.01	0.11	124
2	Triticale	AAC DELIGHT	111	12.0	92%	8.8	36.2	57.0	0.23	0.13	1.02	0.09	105
3	Triticale	BUNKER	123	9.6	74%	7.8	29.7	60.0	0.31	0.20	1.01	0.15	113
4	Triticale	SUNRAY	110	14.5	112%	9.1	33.1	58.9	0.28	0.12	1.62	0.10	122
5	Triticale	AB STAMPEDER	91	14.2	110%	9.6	22.8	63.2	0.23	0.16	1.01	0.14	146
6	Wheat	AAC AWESOME	89	13.1	101%	8.7	29.1	61.8	0.26	0.15	1.21	0.13	116
7	Wheat	AAC PARAMOUNT	88	14.3	110%	7.6	30.1	55.8	0.23	0.13	1.23	0.12	112
8	Wheat	AC ANDREW	91	15.3	118%	10.8	29.6	62.1	0.21	0.18	1.49	0.13	148
9	Wheat	AC SADASH	86	13.2	102%	12.0	23.7	64.4	0.33	0.22	1.15	0.16	152
10	Wheat	KWS ALDERON	81	11.1	85%	11.7	33.5	61.3	0.23	0.20	1.42	0.17	120

Harvested @ Late Milk Stage	Check: Taza	Yield: Adjusted @ 65% Moisture
TDN: Total Digestible Nutrients	RFV: Relative Feed Value	Highlighted Row: Top performing variety by yield
ADF: Acid-Detergent Fiber	CP: Crude Protein	Highlighted Row: Top performing variety by RFV Value

Oat Varieties Used in the Trial

- **CDC Baler –** A forage oat with very long wide leaves, slightly taller than the standard forage variety, excellent lodging resistance, and exceptional forage yield. It generally has higher energy and protein values than other forage oats.
- **AC Morgan –** A high yielding, later maturing milling oat with good lodging resistance and is commonly used for silage or green feed. Susceptible to crown and stem rust, moderately susceptible to smuts, adapted to black and grey wooded soil zones of Alberta.
- **AC Juniper –** An early maturing oat, well adapted to rust free area of Western Canada.
- **CDC Arborg –** A high yielding, early maturing, high beta – glucan, strong strawed variety with excellent standability.
- **CDC Haymaker –** A high yielding forage variety known for its high grain characteristics and improved yield over CDC Baler. It has plump grain with high seed weight, grain yield better than CDC Baler, crown rust resistance similar to CDC Dancer, susceptible to smut.
- **CDC Nasser –** A low lignin hulled variety with high fat content and good grain quality.
- **CS Camden –** A high yielding, shorter stature variety, with better lodging resistance, high leaf biomass & high beta-glucan.
- **AC Murphy –** A widely adapted forage oat, with high yields, improved lodging resistance and is well suited for silage, swath grazing, and green feed.
- **ORE3542M –** A high yielding, high quality, white-hulled milling oat with medium maturity and strong straw and crown rust resistance.
- **CDC SO -1** –A forage and feed oat variety with a high oil groat and a low lignin hull.
- **CDC Endure**- A high yielding variety with better standability and having high beta glucan level.
- **AAC Douglas** - AAC Douglas is a high beta-glucan white hulled oat with high grain yield potential and excellent groat percentage.

Table 31: Results of Oats Silage 2022

	Variety	Height	Yield	% of	CP	ADF	TDN	Calcium	Phosphorus	Potassium	Magnesium	RFV
	Name	cm	Tonnes/Ac	Check	%	%	%	%	%	%	%	%
1	CDC BALER	78	9.7	100%	14.6	29.8	63.3	0.47	0.23	1.60	0.20	126
2	AC MORGAN	86	10.5	108%	11.7	33.5	63.1	0.37	0.27	1.85	0.15	115
3	AC JUNIPER	104	10.0	103%	12.6	33.0	62.2	0.31	0.22	2.06	0.14	114

4	CDC ARBORG	97	9.4	97%	12.2	34.0	63.5	0.35	0.34	2.26	0.18	117
5	CDC HAYMAKER	103	11.1	114%	15.0	30.3	63.1	0.48	0.27	2.38	0.20	122
6	CDC NASSER	104	10.9	112%	11.6	34.2	63.0	0.37	0.22	1.71	0.20	112
7	CS CAMDEN	93	9.3	96%	13.4	31.7	62.8	0.37	0.25	2.17	0.15	116
8	MURPHY	91	9.9	102%	11.5	36.4	60.2	0.46	0.23	2.27	0.20	100
9	ORE3542M	90	11.6	120%	12.2	31.8	64.2	0.25	0.22	1.71	0.14	121
10	CDC-SO-1	97	10.0	103%	10.4	34.0	63.4	0.37	0.22	1.73	0.19	114
11	CDC ENDURE	90	10.6	109%	13.3	32.7	62.5	0.32	0.23	1.86	0.16	114
12	AAC DOUGLAS	97	11.0	113%	10.3	34.7	62.7	0.31	0.22	1.39	0.16	113

Harvested @ Milk Stage	Check: CDC Baler	Yield: Adjusted @ 65% Moisture
TDN: Total Digestible Nutrients	RFV: Relative Feed Value	Highlighted Row: Top performing variety by yield
ADF: Acid-Detergent Fiber	CP: Crude Protein	Highlighted Row: Top performing variety by RFV Value

NOTE: Silage trial results are sent to the Alberta Seed Guide every year. We rely on Municipal funding to continue these trials so if producers feel the data is relevant and important, please talk to your Municipal Councillor to support GRO.

Alternative Silage Options - 2022

1. **Chicory**

Seeding Rate: 3 -4 pounds/acre

3-4 weeks for sprouting and it requires 80-100 days to become ready for grazing.

Chicory production is optimized under rotational grazing management. Depending on time of year, a rest period of 25 to 30 days between grazing is best for chicory persistence and performance. A stubble height of 1.5 to 2 inches should remain after grazing.

2. **Plantain**

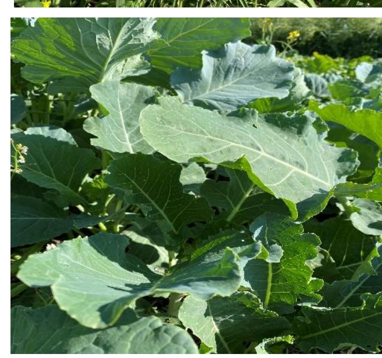
Seeding rate 3.5 – 7 lbs/ac

Plantain should be first grazed no earlier than the six-leaf stage, i.e. the plants have six fully grown leaves, and this is normally 7-8 weeks after sowing. This ensures plants have well-developed root systems to improve survival.

3. **Millet**

Seeding rate: 20 to 25 pounds per acre

It is good for stockpiled or swath grazing and ready to cut for hay 60-70 days after emergence. Proso millet cut for hay should be harvested when the crop is in the boot to milk stage. It rarely provides sufficient regrowth to economically justify another hay harvest, and the regrowth should be utilized by grazing.



Kale

Seeding Rate: 4.5 lbs/ac

It is ready for grazing in 55 to 75 days after seeding. Kale has good salinity tolerance. Plants are high protein, high relative feed value, and low fiber. Strip grazing will utilize the crop most efficiently. Due to its slow early establishment, flea beetles can be a potential pest of kale. Clubroot can be an issue in brassica rotations. Caledonian kale is a clubroot resistant variety.

4. **Forage Radish**

Seeding rate: 4 to 6 pounds of seed per acre

A forage radish cover crop is sown late in the growing season; the seed needs 60 days to become ready for forage. The radish captures and stores while alive, and then release nutrients back into the soil during decomposition.

5. **Forage Brassica**

Seeding Rate: 4.5 lbs/ac

Forage brassica are a biennial leafy bush brassica plant with a small tuber. There are numerous forage brassica hybrids in the market, usually crossed turnips with kale or forage rape. Maximum production levels occur in 80 to 90 days.

6. **Sorghum Sudan Grass**

Seeding Rate: 13.5 lbs/ac

The first cut will be ready for harvest about 60 days from planting. For a faster recovery of aftermath growth, leave at least 10 to 18 cm (4-7 inches) of stubble when harvesting. Optimum growth of these plants occurs under hot, moist conditions. A second cut should be ready 30-35 days later.

7. **Phacelia**

Seeding Rate: 8-15 lbs. per acre

Phacelia attracts pollinators. It starts flowering 45-60 days after emergence. It has slow regrowth, so it is not very good for grazing It is, however, good for hay and dries down nicely.

8. **Double Max Radish**

Seeding Rate: 8-15 lbs. per acre

This line of radish is white and yellow beet cyst nematode resistant. It is fast growing, is a bio fumigant, loosens compacted soil, quickly releases nutrients when decomposing. This radish is good for grazing purposes.

9. Turnip

Seeding Rate: 2-5 lbs/acre

Turnip requires 30 to 60 days to first grazing

Some varieties are better than others for grazing purposes.

Agronomic information of trial

Seeded June 1, 2022

Seed depth: 3/4th inch

Rainfall: From May 1 to August 15, 2022: 214 mm or 8.43 inches

Fertilizer:

Fall Applied: 82-0-0 100 lbs/ac

82 lbs/ac Actual N

Deep banded: 11.41-0-31.89-8.45-0.99 250.83 lbs/ac

28.62 lbs/ac Actual N 80 lbs/ac Actual K
21.2 lbs/ac Actual S 2.5 lbs/ac Actual Cu

Seed placed: 11-52-0 58 lbs/ac

6.38 lbs/ac Actual N 30 lbs/ac Actual P

***Three times rogued during the season

Harvested: **August 22, 2022**

Table 32: Results of Alternatives Crop Silage 2022

Variety		Height	Yield	CP	ADF	TDN	Calcium	Phosphorus	Potassium	Magnesium
Name		cm	Tonnes/Ac	%	%	%	%	%	%	%
1	CHICORY	37	4.4	14.6	30.9	52.9	1.28	0.17	1.66	0.39
2	PLANTAIN	34	1.8	15.8	31.0	57.6	1.57	0.17	1.59	0.17
3	MILLET	111	11.6	8.3	27.3	59.8	0.26	0.11	1.26	0.23
4	FORAGE KALE	74	4.9	11.7	37.1	53.6	0.65	0.17	1.60	0.21
5	FORAGE RADISH	94	7.0	11.8	43.2	47.8	1.44	0.15	1.89	0.22
6	FORAGE BRASSICA	39	7.5	24.2	13.8	63.9	1.34	0.23	2.55	0.21
7	SORGHUM SUDAN GRASS	122	6.9	11.3	20.6	46.4	0.41	0.15	1.35	0.18
8	PHACELIA	71	6.7	11.0	38.7	52.1	2.20	0.11	1.75	0.32
9	MAX RADISH	106	8.6	23.0	18.9	66.7	2.20	0.20	2.92	0.29
10	FORAGE TURNIP	55	5.2	12.7	43.4	49.1	0.86	0.16	1.77	0.18

TDN: Total Digestible Nutrients	RFV: Relative Feed Value	Yield: Adjusted @ 65% Moisture
ADF: Acid-Detergent Fiber	CP: Crude Protein	Highlighted Row: Top performing variety by yield
*** Above-ground yield only		

Winter/Spring Cereal Silage - 2022

Seeded June 1, 2022

Seed depth: $1^{1/2}$ inch

Rainfall: From May 1 to August 15, 2022: 214 mm or 8.43 inches

Fertilizer:

Fall Applied: 82-0-0 100 lbs/ac

82 lbs/ac Actual N

Side banded: 11.41-0-31.89-8.45-0.99 250.83 lbs/ac

28.62 lbs/ac Actual N 80 lbs/ac Actual K
21.2 lbs/ac Actual S 2.5 lbs/ac Actual Cu

Seed placed: 11-52-0 58 lbs/ac

6.38 lbs/ac Actual N 30 lbs/ac Actual P

Curtail M 600 ml/ac June 18, 2022

Harvested:

Barley plots: **August 15, 2022**; Oat plots: **August 17, 2022**

Triticale/Wheat plots: **August 22, 2022**

Table 33: Results of Winter/Spring Cereal Mix Silage 2022

Variety			Height		Yield	CP	ADF	TD N	Calciu m	Phosph orus	Potassi um	Magne sium	RFV
Name			cm	cm	Tonnes /Ac	%	%	%	%	%	%	%	%
1	**PRIMA** /CDC AUSTENSON	**Fall Rye**/Spring Barley	61	93	12.7	9.8	12.7	61.9	0.38	0.18	1.91	0.16	110
2	**PRIMA**/CDC BALER	**Fall Rye**/Spring Oats	63	120	11.0	9.7	11.0	55.1	0.30	0.17	1.60	0.15	95
3	**PRIMA**/TAZA	**Fall Rye**/Spring Triticale	64	117	13.1	8.9	13.1	60.0	0.16	0.19	1.13	0.09	130
4	**AAC WILDFIRE** /CDC AUSTENSON	**Winter Wheat**/ Spring Barley	48	96	12.4	10.6	12.4	62.7	0.37	0.17	1.35	0.14	119
5	**AAC WILDFIRE**/CDC BALER	**Winter Wheat**/ Spring Oats	50	118	10.8	10.0	10.8	55.8	0.34	0.17	1.42	0.17	100
6	**AAC WILDFIRE**/TAZA	**Winter Wheat**/ Spring Triticale	52	116	12.8	9.7	12.8	61.1	0.20	0.18	1.13	0.10	135
7	**BOBCAT** /CDC AUSTENSON	**Fall Triticale**/ Spring Barley	53	94	12.1	9.1	12.1	62.2	0.34	0.15	1.23	0.13	138
8	**BOBCAT**/CDC BALER	**Fall Triticale**/ Spring Oats	56	112	10.5	10.7	10.5	56.3	0.30	0.17	1.45	0.15	100
9	**BOBCAT**/TAZA	**Fall Triticale**/ Spring Triticale	52	110	13.1	8.5	13.1	59.5	0.25	0.18	1.17	0.11	114
10	**LOUMA** /CDC AUSTENSON	**Fall Triticale**/ Spring Barley	60	95	11.4	11.6	11.4	63.9	0.40	0.16	1.76	0.15	131
11	**LOUMA**/CDC BALER	**Fall Triticale**/ Spring Oats	59	117	10.1	9.1	10.1	56.2	0.32	0.19	1.66	0.16	94
12	**LOUMA**/TAZA	**Fall Triticale**/ Spring Triticale	56	113	12.8	11.7	12.8	62.5	0.26	0.21	1.76	0.11	130
13	CDC AUSTENSON	Spring Barley		95	9.9	8.7	9.9	57.0	0.34	0.15	1.44	0.18	108
14	CDC BALER	Spring Oats		108	12.5	10.4	12.5	64.1	0.28	0.17	1.12	0.13	148
15	TAZA	Spring Triticale		117	14.0	9.2	14.0	56.5	0.21	0.18	1.10	0.09	113

Harvested: Barley @ Soft Dough Stage, Oats @ Milk Stage; Triticale @ Late Milk Stage	Check: CDC Baler	Yield: Adjusted @ 65% Moisture
TDN: Total Digestible Nutrients	RFV: Relative Feed Value	Highlighted Row: Top performing variety by yield
ADF: Acid-Detergent Fiber	CP: Crude Protein	Highlighted Row: Top performing variety by RFV Value

Cereal-Legume Silage – 2022

Seeded June 1, 2022

Seed depth: $1^{1/2}$ inch

Rainfall: From May 1 to August 15, 2022: 214 mm or 8.43 inches

Fertilizer:

Fall Applied: 82-0-0 100 lbs/ac

82 lbs/ac Actual N

Side banded: 6.7-0-40.85-7.66 195.83 lbs/ac

13.12 lbs/ac Actual N 80 lbs/ac Actual K

15 lbs/ac Actual S

Seed placed: 11-52-0 58 lbs/ac

6.38 lbs/ac Actual N 30 lbs/ac Actual P

Curtail M 600 ml/ac June 18, 2022

The trial was mowed down in July because accidentally, it was sprayed with the Curtail M. So, there is no further information available for the year 2022.

General Appendix on Forage, Silage and Livestock Feed Measurements

Crude Protein (CP, % of dry matter)

Crude protein is the proportion of the feed estimated to be protein (amino acids). There is no lab method for directly measuring the amount of protein in a sample, but an approximation can be calculated using the nitrogen content of the feed. Crude protein may be an overestimation of the actual protein levels, since there may be some non-protein nitrogen in the feed (such as urea), however this is usually a very small proportion of the feed. Generally, higher protein indicates a higher quality feed.

Total Digestible Nutrients (TDN, % of dry matter)

The total digestible nutrient is the proportion (%) of dry matter that is digestible to the animal. The TDN can be calculated by using the Acid Detergent Fibre (ADF) measurement, or with another calculation that sums the measurements of various digestible components (fat, digestible carbohydrates, digestible protein, digestible fibre).

Relative Feed Values (RFV)

The relative feed value is an index that represents forage quality, and is used to compare the potential energy intake (in other words, how much energy an animal will consume) of forages of the same type. The RFV is a unitless value, and its equation uses the ADF as a measure of digestibility and the NDF as a measure of intake. An RFV value greater than 100 represents a feed of higher quality than alfalfa hay at full bloom.

Perennial Forage Trials – 3rd Year

Objective:

1. Provide unbiased, current, and comprehensive regional data regarding the establishment, persistence, dry matter yield, nutritional quality, and economics of a number of perennial grass and legume combinations when compared to a pure stand of selected species and varieties intended for hayland or grazing.
2. Deliver comprehensive information related to regional establishment, persistence, dry matter yield, quality, and economics of a number of perennial grass and legume mixes.

Background:

The recent survey on the economic, productive, and financial performance of Alberta cow/calf operations indicates that two-thirds of the total cost of maintaining Alberta's cow herd is comprised of pasture (both native and seeded), stored feed, and bedding (Oginskyy and Boyda, 2018). The majority of the annual feed requirement comes from mixed stands of perennial grasses and legumes, therefore managing these forage resources is very important. Across Alberta, most questions ARAs have received from producers wishing to improve their pasture or hayland are related to combinations of grass and legume species. Very few requests are for information on pure stands. Most perennial seed sold by farm supply companies is sold as either a custom or stock blend. Unfortunately, the majority of perennial forage research to date has focused on pure stands rather than mixes. The recent concerted program of research/demonstration on high legume pastures by AFF, ARAs, and Ag Canada, which was devoted to improving producers' understanding of the roles played by legumes in forage production systems, has helped initiate producers' interest in optimizing the use of legumes in forage-livestock systems. Producers are now aware that grass-legume mixes are a key to increased yield and profit/acre. Of great importance is the availability of newer non-bloating legume varieties, in particular sainfoin and cicer milkvetch.

The importance of legumes in grass mixtures cannot be overemphasized. In addition to nitrogen benefits, potential yield, and quality improvements, legume/grass combinations may also provide benefits to soil structure and carbon storage. A mixture of species more closely mimics natural forages than pure stands. There can be symbiotic benefits from differences in root structures, water, and mineral use efficiencies, regrowth, and snow trap potential.

Establishing and maintaining a successful hayland or grazing stand requires significant investment and good management. Selecting varieties that are easy to establish and are resilient while providing high yield and quality can improve net returns for agricultural producers. Results from this project will help tailor appropriate blends of perennial forage species to a particular region and improve a cattlemen's ability to make good management decisions. Generation of information at points across the province from this project will complement the Perennial Forage Variety Evaluation and Demonstration at Multiple Sites in Alberta (ABP/ALMA File No. FRG 19.15) project completed in 2018. It will also contribute directly to three goals of the Alberta Beef Forage and Grazing Center (ABFGC), including reducing winter feeding costs, reducing backgrounding costs and improving late summer/fall pasture. Regional knowledge generated in the project will be shared with local cattlemen through a variety of means, ensuring management decisions contribute to a strong future for individual operations and the agricultural industry in general.

Perennial Forage Trail

Grasses, Legumes, & Grasses-Legume Mix

Seeded: July 28, 2020

Seed depth: ½" inch

Fertilizer:

Broadcast: **11.28-14.44-19.26-9.63** **310 lbs/ac (Grasses)**

35 lbs/ac Actual N 45lbs/ac Actual P

60 lbs/ac Actual K 30lbs/ac Actual S

Broadcast: **11.28-14.44-19.26-9.63** **208 lbs/ac (Legumes+Mixes)**

23.5 lbs/ac Actual N 30 lbs/ac Actual P

40 lbs/ac Actual K 20 lbs/ac Actual S

Herbicide Application:

Glyphosate (Pre-burn) @1000 g/ae/ac + Heat @20g/ac June 19, 2020

Basagran @800ml/ac (Grasses, Legumes & Mixes) September 3, 2020

Assure @150ml/ac September 3, 2020

Harvested:

- 1st Year - Grasses: June 28, 2021; Legume and Mixes: June 29, 2021
- 2nd Year – Grasses, Legumes and Mixes – July 20-21, 2022

Table 34: Seeding information of grasses:

Species	Variety	Seeding Rate (lb/A)	Seeding Area m2	grams/plot
Meadow Brome	Fleet	14	9.59	15.0
	AC Admiral	14	9.59	15.0
Hybrid Brome	AC Success	12	9.59	12.9
	AC Knowles	12	9.59	12.9
Wheatgrasses				
Pubescent	Greenleaf	12	9.59	12.9

Crested Green Wheatgrass	Kirk	7	9.59	7.5
	AC Saltlander	11	9.59	11.8
Orchardgrass	Killarney	10	9.59	10.7
	Blizzard	10	9.59	10.7
Italian Ryegrass	Nabucco or Rendita	10	9.59	10.7
Tall Fescue	Courtney	8	9.59	8.6
Timothy	Grindstad	5	9.59	5.4

Table 35: Seeding information of legumes:

Species	Variety	Seeding Rate (lb/A)	Seeding Area m2	grams/plot
Alfalfa	AC Grazeland	8	9.59	8.6
	Dalton	8	9.59	8.6
	Halo	8	9.59	8.6
	Rambler	8	9.59	8.6
	Rangelander	8	9.59	8.6
	Rugged	8	9.59	8.6
	Spreder 4	8	9.59	8.6
	Spredor 5	8	9.59	8.6
	AC Yellowhead	8	9.59	8.6
	PV Ultima	8	9.59	8.6
	Spyder	8	9.59	8.6
	Assalt	8	9.59	8.6
	44-40	8	9.59	8.6
	Phabalous	8	9.59	8.6
	20-10,	8	9.59	8.6
Sainfoin	AC Mountainview	35	9.59	37.6
	AAC Glenview	35	9.59	37.6
Cicer Milkvetch	Veldt	14	9.59	15.0
	Oxley 2	14	9.59	15.0

Table 36: Seeding information of grasses and legumes mixes:

Species Mixes	Variety	Seeding Rate (lb/A)	Seeding Area m2	grams/plot
Mix 1	Fleet Meadow Brome	7	9.59	7.5
	AC Yellowhead	4	9.59	4.3

Mix 2	AC Success Hybrid Brome	6	9.59	6.4
	AC Yellowhead	4	9.59	4.3
Mix 3	AC Knowles Hybrid Br	6	9.59	6.4
	AC Yellowhead	4	9.59	4.3
Mix 4	Fleet Meadow Brome	7	9.59	7.5
	Spredor 5	4	9.59	4.3
Mix 5	AC Success Hybrid Brome	6	9.59	6.4
	Spredor 5	4	9.59	4.3
Mix 6	AC Knowles Hybrid Brome	6	9.59	6.4
	Spredor 5	4	9.59	4.3
Mix 7	Fleet Meadow Brome	5	9.59	5.4
	AC Yellowhead Alfalfa	3	9.59	3.2
	AC Mountainview Sainfoin	10	9.59	10.7
Mix 8	AC Success Hybrid Brome	4	9.59	4.3
	AC Yellowhead Alfalfa	3	9.59	3.2
	AC Mountainview Sainfoin	10	9.59	10.7
Mix 9	Fleet Meadow Brome	5	9.59	5.4
	AC Yellowhead Alfalfa	2	9.59	2.1
	AC Mountainview Sainfoin	8	9.59	8.6
	Veldt Cicer Milk Vetch	4	9.59	4.3
Mix 10	AC Success Hybrid Brome	5	9.59	5.4
	AC Yellowhead Alfalfa	2	9.59	2.1
	AC Mountainview Sainfoin	8	9.59	8.6
	Veldt Cicer Milk Vetch	4	9.59	4.3
Mix 11	Fleet Meadow	5	9.59	5.4
	Greenleaf Pubescent WG	4	9.59	4.3
	AC Yellowhead Alfalfa	3	9.59	3.2
Mix 12	AC Success Hybrid Brome	4	9.59	4.3
	Greenleaf Pubescent WG	4	9.59	4.3
	AC Yellowhead Alfalfa	3	9.59	3.2
Mix 13	Salinemaster	11	9.59	11.8
Mix 14	Legumeaster	24	9.59	25.8

Table 37: Results of forage (grasses) trial - 2022

	Variety	Height (cm)	Yield (tonne/acre)	CP	ADF	TDN	Calcium	Phosphorus	Potassium	Magnesium	RFV
Meadow Brome	Fleet	108	4.7	8.2	36.1	59.1	0.32	0.16	1.24	0.10	92
	AC Admiral	101	4.8	7.9	37.4	57.3	0.29	0.18	1.22	0.09	87
Hybrid Brome	AC Success	126	6.6	7.6	37.9	56.6	0.22	0.15	1.09	0.05	84
	AC Knowles	129	6.2	8.2	35.8	58.9	0.22	0.13	1.00	0.06	92
Wheatgrasses											
Pubescent	Greenleaf	124	4.4	10.2	36.6	55.8	0.29	0.18	1.33	0.07	90
Crested	Kirk/Carman	92	4.3	8.4	37.7	55.6	0.18	0.15	1.08	0.06	86
Green Wheatgrass	AC Saltlander	107	3.9	8.4	36.8	56.2	0.27	0.16	0.96	0.07	88
Italian Rye grass	Randita	-	-	-	-	-	-	-	-	-	-
Orchard Grass	Blizzard	94	3.3	8.4	36.5	59.3	0.29	0.22	1.75	0.13	91
	Killarney	98	2.7	9.8	38.0	56.6	0.30	0.28	1.60	0.13	88
Tall Fescue	Courtney	108	3.2	8.4	37.8	57.9	0.28	0.20	1.41	0.13	90
Timothy	Grindstad	95	4.1	8.2	38.0	56.5	0.23	0.20	1.24	0.07	86

Table 38: Results of forage (legumes) trial - 2022

	Variety	Height (cm)	Yield (tonne/ac)	CP	ADF	TDN	Calcium	Phosphorus	Potassium	Magnesium	RFV
Alfalfa	AC Grazeland	97	10.6	13.7	39.4	57.7	1.02	0.20	1.41	0.17	104
	20-10,	77	7.5	14.6	36.1	59.5	1.23	0.23	1.81	0.21	120
	Halo	89	7.5	15.1	35.4	60.2	1.22	0.24	1.67	0.20	125
	Rangelander	87	8.5	14.5	38.1	58.4	1.23	0.21	1.76	0.21	112
	Rugged	85	7.5	14.9	36.6	57.1	1.29	0.20	1.53	0.19	119
	Spreder 4	82	7.1	14.8	36.0	56.9	1.08	0.23	1.93	0.20	119
	Spredor 5	95	7.8	14.5	37.0	56.4	1.40	0.19	1.60	0.22	115

	AC Yellowhead	89	8.8	13.8	38.5	56.8	1.29	0.23	1.86	0.28	108
	44-40	73	7.4	13.8	37.8	58.2	1.40	0.22	1.68	0.23	110
	PV Ultima	88	10.7								
	Rambler	90	7.7	14.8	36.3	57.8	1.39	0.23	2.00	0.22	118
	Spyder	90	8.8	14.5	37.7	58.1	1.31	0.19	1.53	0.19	111
	Assalt	91	7.8	14.4	36.9	58.4	1.39	0.24	1.95	0.23	114
	Dalton	87	9.0	15.1	36.1	59.9	1.27	0.22	1.76	0.22	120
	Phabalous	89	8.4	14.1	37.2	54.8	1.52	0.22	1.68	0.23	109
Sainfoin	AC Mountainview	95	6.3	10.4	39.8	54.0	1.16	0.22	1.61	0.27	95
	AAC Glenview	91	6.6	10.7	38.0	53.1	1.22	0.23	1.52	0.30	97
Cicer Milk Vetch	Veldt	86	9.0	10.9	40.2	54.5	1.24	0.23	2.29	0.30	94
	Oxley 2	75	9.2	10.9	40.0	53.6	1.09	0.27	2.20	0.26	98

Unfortunately, we sent the composite sample of varieties 44-40 and PV Ultima for lab analysis. So, the lab analysis in the above-mentioned table is from the composite sample of these two varieties.

Table 39: Results of forage (grasses and legumes mixes) trial - 2022

	Variety	Height (cm)	Yield (tonne/ac)	CP	ADF	TDN	Calcium	Phosphorus	Potassium	Magnesium	RFV
Mix 1	Fleet Meadow Brome	116	7.02	10.4	37.2	55.2	0.88	0.15	1.38	0.17	93
	AC Yellowhead	91									
Mix 2	AC Success Hybrid Brome	132	14.6	9.9	37.7	54.6	0.35	0.08	0.73	0.07	92
	AC Yellowhead	88									
Mix 3	AC Knowles Hybrid Brome	124	10.6	8.9	37.4	56.7	0.40	0.15	1.26	0.11	89
	AC Yellowhead	88									
Mix 4	Fleet Meadow Brome	127	10	8.9	38.4	55.6	0.40	0.16	1.38	0.11	85
	Spredor 5	93									
Mix 5	AC Success Hybrid Brome	146	12	9.4	38.6	54.1	0.52	0.14	1.24	0.10	86
	Spredor 5	93									

Mix 6	AC Knowles Hybrid Brome Spredor 5	129 85	11.8	8.6	37.1	57.2	0.52	0.13	1.32	0.11	89
Mix 7	Fleet Meadow Brome AC Yellowhead Alfalfa AC Mountainview Sainfoin	123 85 92	10.3	8.5	40.1	54.1	0.50	0.15	1.30	0.12	84
Mix 8	AC Success Hybrid Brome AC Yellowhead Alfalfa AC Mountainview Sainfoin	132 87 95	12.1	8.8	38.3	55.1	0.48	0.15	1.20	0.11	86
Mix 9	Fleet Meadow Brome AC Yellowhead Alfalfa AC Mountainview Sainfoin Veldt Cicer Milk Vetch	126 85 98 -	8.5	10.9	37.7	55.0	0.93	0.17	1.51	0.17	94
Mix 10	AC Success Hybrid Brome AC Yellowhead Alfalfa AC Mountainview Sainfoin Veldt Cicer Milk Vetch	141 97 102 -	11.9	10.2	37.9	55.0	0.91	0.16	1.44	0.18	94
Mix 11	Fleet Meadow Greenleaf Pubescent WG AC Yellowhead Alfalfa	128 - 94	9.6	9.4	39.1	55.2	0.49	0.15	1.46	0.11	86
Mix 12	AC Success Hybrid Brome Greenleaf Pubescent WG AC Yellowhead Alfalfa	143 - 89	11.05	10.6	36.6	55.6	0.53	0.14	1.30	0.11	94
Mix 13	Salinemaster	130,72	9.3	9.6	36.7	56.0	0.46	0.14	1.38	0.09	89
Mix 14	Legumeaster	102,97,85	9	12.9	38.7	55.3	1.13	0.19	1.56	0.18	104

Acronym used in tables CP – Crude Protein ADF – Acid Detergent Fiber TDN – Total Digestible Nutrients RFV – Relative Feed Value

Testing of early barley/triticale lines in pre-variety trials for adaptation and stability in different Agro-ecological zones of Alberta

Co-operator – Ken Anderson - NW-32-59-2-W5

Executive Summary: Barley and triticale are important crops suitable for the diverse production conditions of Alberta owing to their tolerance to biotic and abiotic stresses. Higher grain and fodder yield is one of the prime objectives of the cereal improvement program at the Field Crop Development Centre (FCDC). Currently, FCDC's main testing sites are in central Alberta. There is a desire to test the materials more widely across Alberta. The goal of this research project was to test early breeding lines (developed by FCDC) that will aid in the development of more adapted, stable, and higher-yielding varieties that are specific to microclimatic needs while also being end-user friendly.

Yield-contributing traits in plants are influenced by a combination of genetic and environmental factors, as well as their interactions (Kumar et al., 2019). Understanding GxE can help FCDC breeders/scientists to select and develop new varieties that perform well in specific environments, which can be important for commercialization and the adoption of new varieties by growers. This project's high-performing lines are more robust and better adapted to the needs of producers in specific regions, leading to registered varieties for specific parts of the prairies. Furthermore, farmers in Alberta's north-central and Peace regions got to see early breeding material that could become a potential variety down the road, as well as the ability to directly relate to thown farming conditions.

Background:

Producers on the Canadian Prairies grow barley (Hordeum vulgare L.) and triticale (X Triticosecale Wittmack) as the forage crop options for ruminants. Due to its higher forage quality and higher crude protein content, there is increasing use of barley as the forage crop of choice for swath grazing, bale grazing, and silage in western Canada (Hassall et al., 2016). However, drought tolerance is one advantage that triticale holds over other cereals for forage crops (Mwadzingeni et al, 2016).

The purpose of this project is to strengthen the overall selection process of barley and triticale lines with superior forage value for livestock feeding or malt production and have broader adaptability in different agro-climatic regions of Alberta.

Barley is an important cereal crop for Canada with an estimated 10.4 million tonnes in the 2019-2020 crop year. Alberta is the largest barley producer in Canada and accounts for almost half of Canadian production. Barley is the primary grain feedstock for cattle in Alberta accounting for 20% (1.53 million ha) of the cropped area (Perrott et al., 2018). About 75 to 80 percent of total annual barley production in Alberta is used in the feed market for livestock, including cattle, swine, poultry, and sheep. Barley supports the multibillion-dollar Alberta beef industry.

Objectives: The objectives of this study are to:

(1) Evaluate the performance of a selection of early breeding lines of barley and triticale varieties under different growing conditions.

(2) Determine whether there is a relationship between the agronomic performance and environmental interaction of early breeding lines grown in various research experimental plots.

(3) Assisting to breeders in the development of varieties with specific adaptations to maximize yield for silage and/or annual grazing for both the beef and dairy industries.

Research design and methodology: Two research sites were established, one at Westlock with Gateway research organization and the other with Mackenzie applied research association at Fort Vermillion. The experiment was laid out in alpha lattice design with two replications as finalized by the breeder at Olds college.

1. **Malt barley (60 lines)**
2. **Two-row feed/forage barley (48 lines)**
3. **Six-row feed/forage barley (36 lines)**
4. **Triticale (21 lines)**

Total = 165 advanced lines by 2 replicate = 330 plots

- Soil sampling was done to measure soil fertilizer recommendations at each location.
- Data Collection: Plant stand, height, and maturity data were collected before harvesting.

- Yield data along with Thousand seed weight and bushel weight obtained from each treatment. Samples were saved and sent to Olds college, for further quality grading.

Agronomic Information - Westlock

Seeded: May 31, 2022

Seed depth: 1 inch

Rainfall recorded: May 1 to September 15, 2022: 214 mm or 8.43 inches

Fertilizer:

Producer Applied (Fall 2021) 82-0-0	100 lbs/ac	
	82 lbs/ac Actual N	
Side banded: 17.57-0-26.21-6.95-0.82	271 lbs/ac	
	48 lbs/ac Actual N	71 lbs/ac Actual K
	19 lbs/ac Actual S	2.2 lbs/ac Actual Cu
Seed Placed: 11-52-0	58 lbs/ac	
	6.38 lbs/ac Actual N	30.16 lbs/ac Actual P

Pre-burn: Roundup	271 ml/ac	May 20, 2022
In-Crop: Curtail M	600 ml/ac	June 18, 2022
Axial	500 ml/ac	June 18, 2022

Harvested: Barley on September 08 & 09, 2022 (extra time to separate lodged plots)

Triticale on September 28, 2022

Table: Results of Malt barley (60 lines)

			Westlock						
Name	Pedigree	Trial Yield (Kg/Ha)	Yield (Kg/ha)	% of AAC Synergy	Height (cm)	Test Weight (kg/hl)	1000 KWT (g)	Lodging (1-9)	Protein (%)
		(Mean of ten locations)							
AAC SYNERGY	TR02267/NEWDALE	7717.91	5750.54	**100**	89.75	69.74	41.31	8.00	14.19
CDC AUSTENSON	TR358/94AB12271	8184.51	4547.89	**79**	68.91	67.80	38.73	8.00	13.44
CDC COPELAND	CA3X2-11/CB10XP2	7485.45	4664.66	**81**	84.07	70.15	41.02	7.50	14.14
KLARINETTE	ZEPPELIN/GRACE	8111.04	6553.38	**114**	73.71	71.09	43.42	1.00	14.95
F14143014	I10393/I10455	8065.15	5622.76	**98**	87.03	65.51	38.39	9.00	15.27
F15127010	C11116/TR12225	7751.43	6518.35	**113**	91.05	70.39	53.16	7.00	12.52
F15129010	C11127/TR12225	7354.78	4731.73	**82**	92.62	69.30	45.02	9.00	15.36
F15137012	GRACE/TR14928	8007.45	5058.06	**88**	85.00	68.70	39.10	7.50	14.30
F15137016	GRACE/TR14928	7845.31	5784.06	**101**	88.15	69.64	39.90	1.50	14.61
F15137020	GRACE/TR14928	7781.28	5975.06	**104**	86.78	71.96	40.84	7.00	13.82
F15137032	GRACE/TR14928	7881.18	6081.62	**106**	81.88	70.89	44.43	2.00	13.82
F15152021	TR12135/GRACE	7468.43	5503.99	**96**	86.06	73.60	46.22	8.00	15.34
F15158029	TR14927/ANDREIA	8299.12	5330.15	**93**	78.50	68.65	38.16	7.00	14.71
F16142010	C08152017/M08184008	7121.03	5481.57	**95**	84.47	66.66	37.25	9.00	14.84
F16142014	C08152017/M08184008	6964.06	3826.49	**67**	75.64	61.53	31.93	9.00	15.46
F16148011	M08184008/I13186	6859.95	5317.07	**92**	84.85	73.34	40.39	1.50	14.93
F16173015	TR14150/TR15245	7742.47	4786.33	**83**	84.85	63.07	34.54	9.00	17.04
F16220020	TR14146/TR14150	7754.29	5352.51	**93**	83.70	69.58	39.94	1.50	15.99
F16239006	TRAVELER/ALICIANA	7658.04	5879.14	**102**	82.76	68.85	42.79	7.00	15.50
F17130013	M08184008/MARIS OTTER	6843.01	4929.54	**86**	74.57	70.32	38.75	8.50	15.31
F17134017	GRACE/MARIS OTTER	7383.39	4994.88	**87**	78.51	73.59	45.52	7.50	16.17
F17143017	TR14150/M08197006	7630.79	5586.25	**97**	84.43	68.23	42.46	9.00	15.67
F17153016	TR14150/KLAGES	7552.91	4919.32	**86**	75.31	69.53	41.65	7.50	14.83

F17162020	TR14150/C11170	7195.42	6063.56	**105**	87.08	69.20	39.47	7.00	14.79
F17191018	RADEGAST/C11170	7489.36	5427.35	**94**	74.39	67.58	38.19	8.00	12.88
I19401	10031 U	7973.62	5365.54	**93**	80.96	66.27	42.16	9.00	15.02
I20206	SC 134-9F	8341.95	6576.28	**114**	81.74	65.12	45.33	1.00	13.03
I20208	SC 140-11K	8034.19	5785.59	**101**	80.85	64.06	41.22	8.50	12.67
I20209	SC 2791 V1	7748.48	6063.06	**105**	87.79	68.98	42.51	8.00	14.69
I20211	SC 75-3B	7712.63	4681.37	**81**	87.80	65.16	44.15	7.50	14.33
J13030041	MERIT 57/AAC SYNERGY	7639.44	5285.98	**92**	90.97	70.33	40.88	7.50	14.38
J13031100	BENTLEY/MERIT 57	7202.28	5155.01	**90**	90.50	70.51	43.26	8.00	15.45
J15043102	J02033006/TR12135	7527.21	5165.85	**90**	88.80	72.19	43.98	1.50	15.23
J15043114	J02033006/TR12135	7551.19	5564.99	**97**	74.59	65.96	40.04	8.50	13.77
J15045041	J02033006/TR13144	7127.41	5153.07	**90**	81.58	68.97	42.48	8.50	15.11
J15045086	J02033006/TR13144	6859.78	5598.04	**97**	88.09	68.09	40.60	8.50	13.83
J15046019	J02033006/TR13232	7654.66	5183.00	**90**	86.43	68.01	39.47	7.00	15.77
J15047093	J02033006/TR14146	7879.38	5701.07	**99**	80.38	68.91	39.15	7.50	14.48
J15049073	J02033006/CANMORE	7333.16	5370.35	**93**	85.56	72.26	43.70	8.50	15.06
J15059149	J03028003/TR12225	7335.52	4561.83	**79**	82.33	72.54	43.56	7.50	15.15
J15063101	J03028003/TR14150	7395.14	5320.80	**93**	89.46	69.28	38.49	9.00	15.21
J15063105	J03028003/TR14150	7787.88	5726.27	**100**	79.10	71.46	41.13	7.50	15.32
J15063119	J03028003/TR14150	7870.82	5457.21	**95**	79.02	70.37	42.22	1.50	15.47
J15070046	J04073004/TR14146	7498.66	4562.60	**79**	86.83	68.93	38.68	4.00	14.27
J15072162	J04077004/TR12135	7736.71	6018.63	**105**	86.77	71.11	46.44	9.00	13.69
J15072191	J04077004/TR12135	7643.83	5167.74	**90**	86.23	66.40	43.73	7.50	13.62
J16012034	J02033006/TR14150	7872.06	4320.24	**75**	82.74	69.03	41.00	8.00	15.95
J16012045	J02033006/TR14150	7397.38	5459.37	**95**	81.85	66.75	42.12	7.00	14.16
J16016002	J04073004/TR14240	7508.89	5698.09	**99**	84.64	66.01	39.35	7.50	14.55
J16025005	J15018/TR13606	7474.09	4256.31	**74**	81.74	68.03	39.28	7.00	14.69
J16033003	J15027/TR13609	7309.39	5135.68	**89**	88.09	71.08	42.71	4.00	14.92
J16042027	J15045/TR13609	7173.08	4900.87	**85**	95.74	70.65	45.53	8.00	14.95
J16042079	J15045/TR13609	7147.10	4896.47	**85**	82.89	72.96	41.39	1.50	15.17
J16056054	J15063/TR13609	7001.73	4869.86	**85**	87.32	63.22	36.34	8.00	14.08

J16056071	J15063/TR13609	7492.35	4544.41	**79**	79.63	69.46	41.06	1.50	16.08
J16057003	J15063/AAC SYNERGY	7689.27	5864.60	**102**	84.80	68.47	44.96	8.50	14.06
J16064080	TR14150/TR13609	7388.66	5552.70	**97**	86.06	68.04	41.10	9.00	14.15
J16065036	TR14150/AAC SYNERGY	8212.19	5024.28	**87**	86.62	67.93	38.20	8.00	15.67
J16069022	TR15245/AAC SYNERGY	7507.54	5887.18	**102**	77.85	68.80	43.58	9.00	14.12
J16069087	TR15245/AAC SYNERGY	7444.15	5516.39	**96**	87.20	67.80	42.87	9.00	13.84
Grand Mean		7576.99	5334.62		83.78	68.87	41.42	6.81	14.7
LSD		429.29	302.80		5.40	4.90	4.77	1.43	1.74
C.V.		7.06	2.80		3.18	3.51	5.69	10.52	5.85

Table: Results of Two-row feed/forage barley (48 lines)

			Westlock							
#	**Name**	**Trial Yield (Kg/Ha)**	**Yield (Kg/ha)**	**% of CDC Austenson**	**Heading (days from seeding)**	**Height (cm)**	**Lodging (1-9 scale)**	**Maturity (days from seeding)**	**1000 KWT (g)**	**Test weight (kg/hl)**
		(Mean of ten locations)								
1	AB WRANGLER	6256.6	5480.8	**107**	46.95	80.95	3.1	83.05	45.43	70.38
2	CDC AUSTENSON	6818.7	5129.9	**100**	54.14	90.73	8.1	82.45	42.07	72.06
3	CDC COWBOY	5751.1	3961.4	**77**	46.54	84.95	7.27	81.85	49.68	74.07
4	J15015013	6669.6	5981.7	**117**	53.05	89.24	7.22	82.75	41.45	72.77
5	J15017004	6350.1	4681.2	**91**	48.71	82.38	7.66	82.25	40.75	72.36
6	J15017006	6255.2	5465.7	**107**	48.3	89.91	7.02	82.25	39.94	71.62
7	J15017008	6714.6	6230.1	**121**	50.05	81.8	8.73	82.8	48.38	71.79
8	J15018001	6383.7	5777.0	**113**	48.5	105.25	3.93	82.5	42.24	71.75
9	J15019008	6643.0	4987.2	**97**	53.2	90.11	1.38	82.2	43.77	73.77
10	J15019014	6377.3	5839.3	**114**	50.21	85.46	7.64	82.9	44.64	70.57
11	J15019018	6366.1	5678.7	**111**	52.66	96.01	1.22	82.7	44.47	74.97

12	J15020013	6812.4	5450.4	**106**	52.79	98.3	8.49	82.3	42.75	68.68
13	J15020015	6835.0	5185.5	**101**	48.49	86.48	1.65	82.55	39.01	71.66
14	J15026004	6733.3	5333.3	**104**	54	83.91	8.52	82.2	43.91	70.99
15	J15026005	6757.6	5586.1	**109**	51.83	79.33	8.54	82.2	40.93	72.46
16	J15028006	6377.9	5184.3	**101**	50.29	90.57	7.95	82.6	42.44	70.65
17	J15028008	6531.1	5020.4	**98**	52.83	79.87	6.93	82.55	39.72	72.84
18	J15028009	6947.4	6662.8	**130**	49.71	88.98	7.65	82.6	40.72	68.85
19	J17043005	7315.3	5310.4	**104**	48.38	90.05	8.07	82.65	39.62	66.86
20	J17043009	7189.7	5817.7	**113**	49.24	95.76	6.42	82.4	42.94	70.12
21	J17044002	7052.4	5245.6	**102**	54.48	81.21	1.99	82.3	41.77	70.68
22	J17046014	6870.5	5038.9	**98**	53.5	91.93	8.53	82.4	37.56	68.27
23	J17047013	6478.2	5107.7	**100**	51.03	91.13	8.88	82.9	39.45	70.03
24	J17048001	7166.4	5268.7	**103**	54	80.04	0.87	82.7	42	70.72
25	J17048007	6520.2	4575.1	**89**	52.04	85.42	8.33	82.25	40.26	70.73
26	J17050009	6931.4	6261.5	**122**	51.16	91.94	8.54	82.6	48.58	72.55
27	J17051004	7033.4	5436.0	**106**	52.84	84.62	8	82.4	44.59	70.16
28	J17051006	6910.5	4513.0	**88**	53.05	78.28	4.72	82.45	43.57	72.01
29	J17051010	7030.2	5698.8	**111**	51.74	91.88	8.6	82.85	38.47	67.83
30	J17051016	6931.6	4958.6	**97**	53.3	69.86	4.4	82.55	42.81	73.35
31	J17052005	6762.5	5445.5	**106**	53.88	75.57	7.58	82.7	41.18	70.14
32	J17054004	6733.2	5491.4	**107**	53.47	93.5	0.95	82.4	44.69	73.9
33	J17054005	6579.8	4837.4	**94**	52.51	81.1	8.08	82.5	41.93	71.49
34	J17056001	6687.2	5056.1	**99**	55.2	88.56	7.77	82.8	39.81	71.82
35	J17056006	6556.8	7328.3	**143**	54.09	94.86	6.9	83.1	45.38	70.03
36	J17056008	6778.5	5111.6	**100**	52.54	91.96	8.58	83.05	38.48	64.05
37	J17057001	7142.5	5142.4	**100**	49.35	88.96	4.65	82.35	41.91	72.4
38	J17057002	6398.9	5402.2	**105**	54.01	74.64	1.07	83	31.89	61.96
39	J17057007	6967.5	6557.2	**128**	48.46	88.93	9.22	82.65	44.6	69.91
40	J17057012	6265.7	5458.1	**106**	54.46	72.5	1.83	82.8	36.68	66.94
41	J17058001	6618.2	5908.5	**115**	56.54	73.44	1.57	82.85	41.29	71.77
42	J17058011	6351.6	5553.9	**108**	54.32	64.6	1.15	82.35	37.48	70.25

43	T17113016	6451.4	4325.4	**84**	50.79	94.25	1.3	82.2	46.84	75.85
44	T17114006	6942.3	4833.3	**94**	50.76	92.06	6.8	82.7	40.59	71.38
45	F15148015	6639.1	4816.1	**94**	52.83	92.19	8.29	82.8	44.21	72.89
46	F16118007	7061.1	5576.1	**109**	51.45	86.73	8.55	83	42.09	69.35
47	F16125021	6401.1	4761.2	**93**	53.25	90.65	9.05	82.2	36.38	70.29
48	F16156019	6666.9	5453.2	**106**	50.6	85.63	1.35	82.45	37.23	73
	Grand Mean	6687.81	5373.45		51.78	86.39	5.94	82.56	41.80	70.90
	C.V.	5.91	3.64		1.82	4.29	14.70	0.45	5.92	3.09
	LSD	274.88	397.55		1.92	7.55	1.78	0.75	5.04	4.45

Table: Results of Six-row feed/forage barley (36 lines)

			Westlock							
#	**Name**	**Trial Yield (Kg/Ha)**	**Yield (Kg/ha)**	**% of AB Cattlelac**	**Heading (days from seeding)**	**Height (cm)**	**Lodging (1-9)**	**Maturity (days from seeding)**	**1000 KWT (g)**	**Test weight (kg/hl)**
		(Mean of ten locations)								
1	AB CATTLELAC	6699.54	3996.19	**100**	49.59	82.86	7.09	82.25	35.55	66.76
2	AMISK	6865.73	4843.19	**121**	49.38	93.77	7.56	82.55	40.56	66.39
3	F15160015	6825.32	4779.71	**120**	49.12	88.9	8.96	82.75	35.64	67.74
4	F15160022	6742.22	5254.35	**131**	51.35	93.55	8.6	82.65	38.58	65.74
5	F15161004	6541.41	4821.58	**121**	49.56	91.14	8.98	82.6	35.78	67.22
6	F15163013	6355.53	4538.06	**114**	49.28	92.55	8.09	82.45	36.13	69.61
7	F15167001	7019.21	5240.05	**131**	48.62	88.94	8.91	82.4	37.13	65.65
8	F15167014	6549.83	5699.37	**143**	49.41	91.19	9	82.1	35.22	60.08
9	F15170019	7035.55	5942.5	**149**	49.85	92.23	7.69	82.25	36.65	64.9
10	F17213007	6883.65	5003.11	**125**	51.19	83.76	8.87	81.9	35.27	64.56
11	F17213021	6691.85	5933.52	**148**	51.1	88.54	8.69	82.2	41.15	66.55

12	G17086002	6073.33	4640.54	**116**	50.62	90.64	8.49	81.95	34.5	66.34
13	G17086014	6589.69	4621.11	**116**	50.47	86.17	8.44	82.3	39.68	69.33
14	G17086016	6949.39	4960.06	**124**	50.85	93.17	7.59	82.3	35.44	60.91
15	H14005021	7170.55	5031.83	**126**	50.62	92.09	8.89	82.25	34.89	64.87
16	H14010031	6717.24	4833.75	**121**	50.38	85.12	8.58	82.2	39.84	63.16
17	H14017028	7310.77	6219.14	**156**	52.65	84.01	4.83	82.4	35.73	66.07
18	H15001004	6612.11	4767.62	**119**	52.59	85.56	3.02	82.3	43.71	65.89
19	H15004016	6718.9	5199.96	**130**	49.62	88.75	4.48	82.45	40.86	66.52
20	H15009012	6426.5	4604.06	**115**	49.06	84.28	8.46	82.5	38.47	67.45
21	H15181004	6791.86	5725.00	**143**	52.15	85.82	8.9	82.25	32.8	63.44
22	H15181013	6705.7	4926.14	**123**	52.38	85.6	8.06	82.5	37.09	64.03
23	H15182001	6847.69	5058.91	**127**	50.65	90.2	4.91	82.5	31.15	65.27
24	H15183011	6021.26	5222.37	**131**	52.19	81.1	5.06	82.7	30.7	59.35
25	H15185001	6257.11	4097.45	**103**	49.88	97.12	8.46	82.3	37.86	68.92
26	H15186006	6424.5	5192.68	**130**	49.85	91.36	5.02	82.45	39.4	69.04
27	H15186007	6488.5	5530.98	**138**	49.15	90.19	7.95	82.5	37.48	65.63
28	H15186008	6262.22	4190.34	**105**	51.03	90.25	4.59	81.95	40.11	71.96
29	H15186013	6689.91	5164.73	**129**	51.44	86.62	8.47	82.65	38.97	67.54
30	H15189005	6764.46	5190.63	**130**	50.59	92.25	5.1	82.5	39.23	67.58
31	H15190012	6800.42	5325.58	**133**	49.44	87.43	8.39	82.4	38.81	66.84
32	H15192002	6400.47	4622.51	**116**	50.44	92.23	4.46	82.3	42.86	64.71
33	H15192020	6477.7	3159.43	**79**	49.59	87.7	0.9	81.75	43.31	70.65
34	H15192021	6556.44	4978.46	**125**	48.12	92.78	1.47	82.1	41.15	72.07
35	H15193006	6675.4	5044.12	**126**	48.65	93.83	7.94	82.15	38.26	66.36
36	H16008005	7393.43	5413.49	**135**	49.62	92.3	8.56	82.1	39.14	62.87
	Grand Mean	6675.98	4993.68		50.29	89.28	7.04	82.33	37.75	66.17
	C.V.	7.05	3.10		1.77	2.73	29.2	0.37	4.28	3.29
	LSD	308.49	318.34		1.84	5.02	4.23	0.61	3.33	4.48

Table: Results of Triticale (21 lines)

#	Name	Pedigree	Yield (Kg/ha) (Mean of 10 sites)	Westlock Yield (Kg/ha)	% of Brevis	Heading (days from seeding)	Height (cm)
1	12L029002	11L106/T200	5581.3	3960.0	**77.0**	57.3	93.3
2	12L064002	11L154/11L159	5959.4	4030.5	**78.4**	55.8	98.2
3	12L064003	11L154/11L159	5824.0	4412.5	**85.8**	56.8	93.5
4	12L099002	11L199/11L159	5660.7	4551.0	**88.5**	51.5	98.7
5	12L118001	04L025003/09P150	5560.5	4670.5	**90.8**	55.4	117.3
6	12L120007	04L025003/BREVIS	5474.9	3291.0	**64.0**	51.6	106.5
7	12L120008	04L025003/BREVIS	5396.0	4428.5	**86.1**	51.9	109.3
8	12L135006	09P030/07T088	5757.7	4798.5	**93.3**	54.8	109.0
9	12L156007	BREVIS/09P150	5451.6	4912.0	**95.5**	55.5	108.3
10	12L156012	BREVIS/09P150	5732.1	4746.5	**92.3**	53.6	99.6
11	13LI48004	12LI14/10P135	5522.5	3964.0	**77.1**	53.5	106.5
12	13LI48005	12LI14/10P135	5487.0	4247.5	**82.6**	53.3	96.0
13	13LI48016	12LI14/10P135	5082.8	4515.5	**87.8**	53.7	105.9
14	14L053005	09P161/12P375	5770.7	5175.0	**100.7**	56.9	97.2
15	14L053009	09P161/12P375	5898.0	4466.5	**86.9**	57.1	97.4
16	14L053011	09P161/12P375	5850.4	5515.0	**107.3**	57.5	89.0
17	14L053018	09P161/12P375	5879.8	5253.5	**102.2**	55.7	92.3
18	17L057013	12P520/09P144	5535.4	4386.0	**85.3**	54.5	94.9
19	BREVIS	Check	5339.8	5141.5	**100.0**	55.5	94.8
20	AC ULTIMA	Check	5483.2	4746.0	**92.3**	54.0	108.1
21	PRONGHORN	Check	5635.8	5020.5	**97.6**	54.6	111.2
	Grand Mean		5613.50	4582.48		54.79	101.29
	C.V.		7.41	4969.33		0.81	3.60
	LSD		1232.90	376.68		1.03	8.40

Results and Discussion:

Early barley and triticale breeding lines performed differently under different growing conditions, with some lines yielding more than at Westlock and others more at Fort Vermilion. There wasn't a single barley or triticale line that performed best in both locations.

- We noticed the difference in the top-yielding lines in two different growing conditions at Westlock and Fort Vermilion. Among malt barley lines, KLARINETTE and I20206 yielded 14% more than the check (AC Synergy). These two were the only lines with good lodging scores too at Westlock.
- For two-row feed barley; J17056006 and J15028009 were top-yielding lines with about 43% and 30% higher than (CDC Austenson) respectively at the Westlock site.
- For six-row feed barley; The lines H14017028 and F15170019 were 56% and 48% higher yields than (AB CATTLELAC) respectively at Westlock.
- For Triticale breeding lines, the advanced line 14L053011 was a 7% higher yield than Brevis. Also, 14L053018 yields 2% more than the Brevis at Westlock.

The lines that show the highest performance under one set of environmental conditions do not necessarily show the best performance under another set of conditions. That suggests that there was a significant interaction between the performance of the early breeding lines and the environmental conditions, indicating that the lines respond differently to different environmental factors. The lines with the best overall performance will be selected for further breeding and development by the breeders' team from FCDC.

The quality parameters data obtained from the samples sent to the FCDC might have provided valuable information to breeders in the development of barley and triticale varieties with specific adaptations for two-row, and six-row feed barley varieties. However, it is important to note that the forage quality was not directly analyzed in the pilot project, which means that the third objective of the study was not fully achieved. The forage yield and sub-samples were not collected which would have helped in getting information on parameters such as dry matter, crude protein, acid detergent fiber, neutral detergent fiber, and total digestible nutrients, which are important indicators of forage quality.

Despite the incomplete achievement of objective 3, the pilot project provided valuable information to breeders in the development of improved barley and triticale varieties for the beef and dairy industries.

Over the years, FCDC by extensive testing of advanced breeding techniques has led to the development of new barley and triticale varieties with improved agronomic traits that are better suited to Alberta's needs. These improved varieties have the potential to bring significant economic benefits to Alberta barley and triticale producers by increasing yields, decreasing risk, improving crop quality, and reducing input costs (Nitrogen efficient). The results from this project will further enhance FCDC breeding efforts by using agronomic performance data evaluated under different soil and moisture regimes and different microclimatic situations of Westlock and Fort Vermillion.

Overall, the development of new barley and triticale varieties with improved agronomic traits suited to microclimate has the potential to bring significant economic benefits to Alberta barley and triticale producers. Continued investment in research and development of advanced breeding techniques is crucial for the continued success of the Alberta agricultural sector.

Acknowledgment: GRO would like to acknowledge the support from RDAR (Results Driven Agriculture Research) and the FCDC researchers (Olds College) for this trial.

OLDS COLLEGE OF AGRICULTURE & TECHNOLOGY

RDAR Results Driven Agriculture Research

Utilizing Winter Cereals for Forage and Grain purpose

Objectives & Deliverables

1. Evaluation of the establishment of fall-seeded crops under different stubble heights, seeding rates, and seeding dates.
2. Evaluation of spring and fall-seeded annual crops for forage and grain yield.
3. Evaluation of specific soil parameters under various fall and spring crop treatments.
4. Evaluation of the impact on subsequent (spring) crops from fall-seeded cocktail mixes of annual crops.

Grain Trials: Seed crops into 2 stubble heights (Canola and Peas)

Fall Seeded:

Winter Wheat (Wildfire, Pintail)
Fall Rye (Prima, Hazlet)
Triticale (Louma, Metzger)
CCC Mix (oats, millets, brassica, peas, hairy vetch, winter cereals)

Spring Seeded:

Spring Wheat (AAC Brandon)
Spring Barley (CDC Austenson)
Spring Triticale (Bunker)

Canola Stubble Field – Soil Test Information

Nitrogen (lbs/ac)	Phosphorus (lbs/ac)	Potassium (lbs/ac)	Sulphur (lbs/ac)	pH (0-14)	CEC (meq/100g)	Organic Matter (%)
14	34	264	22	5.5	17.7	4.3

Pea Stubble Field – Soil Test Information

Nitrogen (lbs/ac)	Phosphorus (lbs/ac)	Potassium (lbs/ac)	Sulphur (lbs/ac)	pH (0-14)	CEC (meq/100g)	Organic Matter (%)
36	56	168	25	4.7	19.2	4.6

Agronomic Information

Canola Stubble

Fall Seeding: September 21, 2021

Seed depth: 1 inch

Soil Temp. 9.2°C

Spring Seeding: May 20, 2022

Seed depth: $1^{1/4}$ inch

Soil Temp. 8°C

Rainfall recorded: May 1 to Aug. 30, 2022: 174.1mm or 6.85 inches

Fertilizer

Side banded: 29.1-0-13.7-3.4 292 lbs/ac

85 lbs/ac Actual N 40 lbs/ac Actual K 10 lbs/ac Actual S

Seed Placed: 11-52-0 58 lbs/ac

6.38 lbs/ac Actual N 30.16 lbs/ac Actual P

Desiccated Reglone + Glyphosate August 18, 2022

Harvested: September 01, 2022

Peas Stubble

Fall Seeding: September 20, 2021 Spring Seeding: May 20, 2022

Seed depth: 1 inch Seed depth: $1^{1/4}$ inch

Soil Temp. 10.2°C Soil Temp. 8°C

Rainfall recorded: May 1 to Aug. 30, 2022: 175 mm or 6.89 inches

Fertilizer:

Side banded: 29.1-0-13.7-3.4 292 lbs/ac

85 lbs/ac Actual N 40 lbs/ac Actual K 10 lbs/ac Actual S

Seed Placed: 11-52-0 58 lbs/ac

6.38 lbs/ac Actual N 30.16 lbs/ac Actual P

Desiccated Reglone + Glyphosate August 24, 2022

Harvested: September 12, 2022

Table: Grain Yield – Drought Trial

Treatment	**Treatment**	**Seeding**	**Pea Stubble**	**Canola Stubble**
#	**Name**	**Time**	**Yield (bu/ac)**	**Yield (bu/ac)**
1	CCC + Spring Barley	Fall 2021 + Spring 2022	96	77
2	CCC + Spring Triticale	Fall 2021 + Spring 2022	47	36
3	CCC + Spring Wheat	Fall 2021 + Spring 2022	34	35
4	Spring Barley	Spring 2022	128	125
5	Spring Triticale	Spring 2022	70	61
6	Spring Wheat	Spring 2022	77	77

7	Metzger	Fall 2021	90	53
8	Louma	Fall 2021	88	61
9	Prima	Fall 2021	96	68
10	Hazlet	Fall 2021	109	69
11	Wildfire	Fall 2021	82	69
12	Pintail	Fall 2021	55	66

Silage Trials: This trial was seeded on the pea stubbles. So, the soil test information and agronomic information are the same as the pea stubble grain trial. Fall seeded portion was harvested on July 27, 2022, and the spring-seeded part of the trial was harvested on August 24, 2022.

Fall Seeded	Spring Seeded
Winter Wheat (Wildfire, Pintail)	Winter Wheat (Wildfire, Pintail)
Fall Rye (Prima, Hazlet)	Fall Rye (Prima, Hazlet)
Triticale (Louma, Metzger)	Triticale (Louma, Metzger)
CCC Mix (oats, millets, brassica, peas, hairy vetch, winter cereals)	CCC Mix (oats, millets, brassica, peas, hairy vetch, winter cereals)

Acknowledgment: GRO would like to acknowledge the support from **RDAR** and **CARA** (Chinook Applied Research Association) for these trials.

Table: Silage Trial Results – 2021-2022

#	Treatment Name	Seeded	Plants/ m2	Height (cm)	Yield (tonnes/ac)	ADF	TDN	Crude Protein	Calcium	Phosphorus	Potassium	Magnesium	RFV
1	CCC + Hazlet	Fall 2021 + Spring 2022	0	67	7.9	31.0	63.0	15.0	0.47	0.31	2.57	0.17	103
2	CCC + Prima	Fall 2021 + Spring 2023	0	58	8.2	28.3	65.2	15.0	0.50	0.28	2.53	0.19	118
3	CCC + Matzger	Fall 2021 + Spring 2024	0	44	5.6	28.2	64.3	12.0	0.52	0.35	2.41	0.13	124
4	CCC + Pintail	Fall 2021 + Spring 2025	0	46	8.8	31.1	57.4	8.6	0.30	0.21	1.32	0.11	106
5	CCC + Wildfire	Fall 2021 + Spring 2026	0	53	8.7	26.3	61.4	9.8	0.32	0.26	1.74	0.13	130
6	CCC + Louma	Fall 2021 + Spring 2027	0	51	10.1	28.4	56.2	8.7	0.27	0.19	1.17	0.09	115
7	CCC + CCC	Fall 2021 + Spring 2028	0	40,65, 125	18.6	31.2	55.2	7.9	0.35	0.18	1.07	0.12	106
8	Metzger	Fall 2021	87	130	18.5	25.2	44.0	6.9	0.28	0.19	1.35	0.10	107
9	Wildfire	Fall 2021	62	86	14.3	22.8	49.4	7.1	0.20	0.20	1.03	0.10	123
10	Louma	Fall 2021	89	154	18.7	25.5	51.6	7.1	0.19	0.14	1.16	0.07	120
11	Hazlet	Fall 2021	81	111	19.1	25.4	47.6	5.6	0.29	0.17	0.93	0.10	111
12	Pintail	Fall 2021	67	85	16.0	27.0	42.0	6.5	0.24	0.20	1.47	0.14	90
13	Prima	Fall 2021	68	132	16.1	25.7	52.6	6.2	0.27	0.20	1.06	0.12	122
14	Metzger	Spring 2022	60	42	6.1	27.9	62.9	10.8	0.44	0.26	1.83	0.13	124
15	Hazlet	Spring 2022	55	67	9.4	29.6	67.4	12.8	0.39	0.26	2.16	0.14	112
16	Prima	Spring 2022	61	62	8.7	31.1	67.9	13.8	0.55	0.38	3.11	0.15	118
17	Pintail	Spring 2022	59	47	7.4	31.4	65.9	12.9	0.47	0.36	2.69	0.16	112
18	Wildfire	Spring 2022	60	50	7.6	31.9	66.0	10.1	0.62	0.29	2.87	0.20	94
19	Louma	Spring 2022	58	57	7.9	32.5	65.9	12.3	0.54	0.27	2.41	0.20	97

Investigating Practical Solutions to Improve Soil Temperature, Water Holding, and Drainage Capacity in Finer Textured Soils

Executive Summary: In recent years, producers in Alberta have experienced extreme weather events (excess rainfall and/or drought conditions) and are now recognizing that climate variability will continue to be a challenge to their farming operations. Producers have thus expressed a need to build more resilient soils. Cover crops have been suggested as a solution to improve soil water holding and drainage capacity. Most studies have shown that the extent to which cover crops improve soil properties depends on their ability to produce high below-ground biomass. Spring-seeded cover crops offer the advantage of a full growing season, and species selection is imperative for optimizing below-ground biomass production. Deep-rooted cover crops can also improve soil permeability and infiltration. The objectives of this study are to determine the impact of two 2-year crop rotations (4 years total) of deep-rooted cover crops mixtures (first and third year, respectively) and field crops (second and fourth years, respectively) on 1) soil temperatures prior to seeding of the main crop, 2) soil water holding and drainage capacity. The impact of deep-rooted cover crops mixtures composed solely of brassicas versus mixtures composed of brassicas along with cool-season and warm-season crops on such properties will also be measured. Cover crop mixes have been selected based on rooting depth, and ability to produce high below-ground biomass under climatic conditions in Alberta.

Background:

In the past few years, producers in Alberta have experienced extreme weather events (excess rainfall and/or drought conditions) and are now recognizing that climate variability is going to be a big challenge for them in the years to come. In the Peace region soils developed primarily from lacustrine or glaciolacustrine deposits and are characterized by finer textures (clay and silt loams). Under excess rainfall, these soils are particularly susceptible to ponding. Cover crops (CC) have been suggested to improve both soil water holding and drainage capacity (Basche et al. 2016) and may offer a solution for producers that have finer texture soils.

Blanco-Canqui et al. (2020) conducted a review of the literature on the impacts of CCs on soil physical properties and concluded that CCs increased wet aggregate stability by an average of 16% across 27 studies, macro-porosity by an average of 1.5% across 8 studies, and water infiltration by 62% across 17 studies. The scale of the benefits from CCs is often related to the total amount of below-ground biomass produced (Bowman et al. 2000). However, measuring below-ground biomass is difficult in the field, and most authors have relied on aboveground biomass for determining the impact on soil water movement. For example, Martinez-Feria et al. (2016) found that rye CCs had 21 mm of transpiration per 1000 kg/ha of biomass production.

In Alberta, as with most of the Canadian Prairies, the climate is characterized by a short growing season, which often leads to insufficient biomass production for fall-seeded cover crops (<1000 kg/ha) (NPARA 2019). Thus, there is a need to establish strong research on the benefits of spring-seeded cover crops, which regularly yield >2000 kg/ha (NPARA 2019), on soil properties. Cover crop mixtures of cool (C3) and warm (C4) season crops have been suggested to maximize biomass production under both cool and warm conditions (Chu et al. 2017; Snapp et al. 2005). Mixes containing fibrous root systems from grasses and legumes also have a higher surface area than tap roots and further promote soil aggregation and water infiltration (Blanco-Canqui et al. 2020).

Species selection is of critical importance in Alberta. The North Peace Applied Research Association (North Star, AB) has been growing a variety of cool and warm season CCs since 2012 and has listed corn, proso millet, German millet, and Japanese millet as excellent warm season choices for grasses in mixtures (NPARA 2019). Deep-rooted CCs, such as oilseed radish, chicory, sunflower, and sweet clover have also done well in the Peace region (NPARA 2019) and have been suggested to improve soil water infiltration in finer textured soils (Bowman et al. 2000; Chen and Weil 2009; Chen and Weil 2011). Most of the research on deep-rooted CCs has been conducted on brassicas, where seeding rates vary considerably across studies (1 to 5 kg/ha) (Chen and Weil 2009; Chen and Weil 2011; Halde and Entz 2016; Marshall et al. 2016; Murrell et al. 2017). Thus, there is also a need to assess which brassica seeding rates are best suited for mixtures.

Objectives:

1) To determine the impact of two 2-year crop rotations (4 years total) of deep-rooted cover crop mixtures (first and third year, respectively) and field crops (second and fourth years, respectively) on soil water infiltration.

2) To determine the impact of two 2-year crop rotations (4 years total) of deep-rooted cover crop mixtures (first and third year, respectively) and field crops (second and fourth years, respectively) on soil temperatures prior to spring seeding of the main field crop.

3) To determine the impact of two 2-year crop rotations (4 years total) of deep-rooted cover crop mixtures (first and third year, respectively) and field crops (second and fourth years, respectively) on soil organic matter.

4) To examine the impact of deep-rooted cover crops mixtures composed solely of brassicas, as well as mixtures of brassicas with cool and warm season crops on soil properties. Brassica seeding rates will be evaluated in all cover crop mixes.

5) To investigate the forage value of deep-rooted cover crops mixtures composed solely of brassicas, as well as mixtures of brassicas with cool and warm season crops on main crop yield (years 2 and 4, respectively).

6) To establish the cost-benefit analysis of introducing rotations with deep-rooted cover crops mixtures composed solely of brassicas, as well as mixtures of brassicas with cool and warm season crops on main crop yield (years 2 and 4, respectively).

Strategy:

- Create a cropping system composed of two years
  - Year 1 (2022): Deep-rooted cover crops
    - Brassicas
    - Cool seasoned
    - Warm seasoned
  - Year 2 (2023)- Field crops, sown perpendicular to the direction of the cover crops planted the year prior
    - Wheat
    - Canola
    - Pea
- Take soil samples and have them tested for
  - Soil water holding capacity
    - Permanent wilting point
    - Field capacity
  - Bulk density
  - Soil organic matter

Plots

- The first part of the experiment was set up in 2022 as a four-replicate split-plot analysis.
  - Main plot: 3.2X7 m
    - Cover crop treatments
    - Fallow
- The second part of the experiment will be set up in 2023
  - Split plot: 1.6X41.6 m
    - Field crop
    - Fallow

Treatments: Year -1 (2022)

		Seeding rate lbs/ac											
1	**Deep-rooted cover crop species**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Follow	Daikon	1.6	3.2	4.8	1.6	3.2	4.8	1.6	3.2	4.8	1.6	3.2	4.8
	Forage	1.6	3.2	4.8	1.6	3.2	4.8	1.6	3.2	4.8	1.6	3.2	4.8
	Forage Turnip	1.6	3.2	4.8	1.6	3.2	4.8	1.6	3.2	4.8	1.6	3.2	4.8
	Oat				22.4	22.4	22.4						
	Japanese millet				2.7	2.7	2.7						
	Sweet clover				3.4	3.4	3.4						
	Chicory				1.3	1.3	1.3						
	Field pea				11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2	11.2
	Sunflower				1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
	Spring triticale							22.4	22.4	22.4			
	Red Proso millet							2.7	2.7	2.7			
	Berseem clover							3.4	3.4	3.4			
	Brown midrib corn										22.4	22.4	22.4
	Annual ryegrass										2.7	2.7	2.7
	Hairy vetch										3.4	3.4	3.4

Cover crops were harvested and sent as a composite sample per treatment for feed analysis.

Year -2 (2023)

- Perpendicular seeding to the direction in which deep-rooted cover crop mixes were sown
    - Canola
    - Wheat
    - Pea
    - Fallow (no crop)

Agronomic Information

Seeded June 20, 2022

Seed Depth: 1 inch

Rainfall recorded: From May 1 to August 15, 2022: 214 mm or 8.43 inches.

Fertilizer:

Producer Applied: 82-0-0	100 lbs/ac
	82 lbs/ac Actual N
Seed Placed: 11-52-0	58 lbs/ac
	6.4 lbs/ac Actual N
	30 lbs/ac Actual K
Side Banded: 17.57-0-26.21-6.95-0.82	200 lbs/ac
35 lbs/ac Actual N	52 lbs/ac Actual K
14 lbs/ac Actual S	1.6 lbs/ac Actual Cu

Pre-Seed Herbicide: Glyphosate	540 g ae/ac	June 13, 2022

Harvested on: September 29, 2022

Results and Discussion:

Treatment #	Yield tonnes/ac	Crude Protein %	ADF %	TDN %	Calcium %	Phosphorus %	Potassium %	Magnesium %	RFV
1	0.00	0.0	0.0	0.0	0.00	0.00	0.00	0.00	0
2	6.47	10.0	37.3	52.4	1.53	0.15	2.04	0.30	105
3	6.32	10.8	36.2	56.7	1.66	0.17	2.18	0.30	106
4	6.02	9.8	34.9	55.6	1.60	0.16	2.24	0.40	111
5	8.59	9.4	29.5	54.2	1.10	0.17	1.78	0.30	122
6	8.61	8.3	33.8	53.5	0.91	0.15	1.41	0.25	108
7	8.24	9.9	33.5	55.0	1.20	0.15	1.53	0.31	112
8	9.94	9.1	27.7	59.7	0.88	0.16	1.31	0.26	129
9	7.45	10.2	31.8	54.3	1.40	0.13	1.55	0.29	123
10	8.26	9.8	32.0	55.8	1.22	0.15	1.38	0.31	115
11	9.69	8.9	31.1	52.3	1.24	0.14	1.38	0.34	109
12	10.52	7.5	31.1	51.1	1.00	0.12	1.29	0.31	100
13	9.68	10.2	32.1	53.3	1.43	0.15	1.61	0.37	114
TDN: Total Digestible Nutrients			RFV: Relative Feed Value		Highlighted Row: Top-performing variety by yield				
ADF: Acid-Detergent Fiber			Yield: Adjusted @ 65% Moisture		Highlighted Row: Top performing variety by RFV Value				

The 2022 was the first year of the project. So, there is not much to say at this point in time. We collected the per-plot soil sample before the seeding for the base point. Also, we took the infiltration reading before the seeding. After harvesting, we sent the composite forage sample to the lab for forage analysis.

Acknowledgment: The current project is funded by **RDAR** (Results Driven Agriculture Research)**.** This project will collect data in 2022 and 2025.

Determining specific compost blends for regenerative Agriculture in central Alberta

Abstract:

Currently, there is no recommended rate of application of compost for grain production in AB and it is not clear if inorganic fertilizers will need to be used to offset nutritional requirements not met by the slow-release fertility of compost. And a carbon (C) credit protocol for producers using compost needs to be created to offset the extra expenses and incentivize producers. This short-term project fits into the multi-phase work we are doing on Soil Health in central Alberta and will be used as a starting point to determine what kinds of compost blends to use in larger soil health trials.

Background: Decreased soil health costs Canadian farmers >$3 billion/year. The main causes of soil health degradation in Alberta include: 1) overgrazing; 2) salinization through extended periods of drought; 3) soil compaction via poor tillage practices; 4) soil erosion, via wind (especially during drought) or intense rainfall/runoff resulting from improper tillage practices; 5) climate change and extreme weather events; 6) ineffective winter crop cover practices; and maybe most importantly, 7) loss of organic matter.

Regenerative agriculture, which uses practices such as no-till, compost fertilizer, inter-cropping, and cover cropping, is gaining traction in Alberta as a way to improve soil health while also improving grain productivity, and cattle food quality and productivity. It may also have positive economic implications by being more cost-effective and using less non-renewable energy for production. By using compost additions as fertilizer and inter-cropping grain for silage, we expect to see a reduction in greenhouse gas emissions, a more diverse microbial community, and improved carbon sequestration and soil health, all while producing better food for livestock.

Objectives and Deliverables:

Recently, the city of Edmonton has moved to source separated organics (SSO) in their waste management system to divert clean organic waste out of landfills, into composting facilities, and eventually into the soil for agriculture. The problem is that there is a lack of research on crop nutrient availability, carbon (C) storage, or reductions in greenhouse gas emissions created by compost additions to agricultural soils in central Alberta. With reductions in C emissions a significant regional and federal goal, using SSO compost blended with other soil conditioners may represent a very good strategy and one that merits further research.

We proposed to test different compost blends under different crops and soil types. Specific blends were the factorial combinations of compost, biochar, fly ash, beet residues, and inorganic fertilizer replicated at three different experimental locations.

Specific objectives include:

1. Identify soil types with different TOC, pH, EC, and texture
2. Design different compost blends with biochar, fly ash, and beet residues
3. Establish replicated field trials at the plot scale
4. Collect environmental data including seasonal soil temperature, and moisture
5. Collect soil samples after treatment set-up, both before and after the growing season
6. Measure soil variables including pH, EC, GHG, Soil Fertility profile (NPKS+), TOC, TN, C stability, Microbial function, and diversity
7. Begin to develop a Compost C credit system

Specific deliverables include:

1. Scientific articles and presentations, produced during graduate student training at the University of Alberta
2. Final report to RDAR outlining the applicability of the findings to regional producers
3. Integration of the findings into larger projects on Regenerative Agriculture in the region (specifically the BCRC proposed project)
4. Beginning of a Compost C protocol for producers to get sell C offsets

Project Design and Methodology

Treatments were made up of factorial combinations of synthetic fertilizer, compost, biochar, ash, and gypsum as these are locally available waste residues that may be ideal for soil application under regenerative management. The synthetic fertilizer additions were our comparison to conventional practices and were used in conjunction with compost blends to see if our waste amendments need a kick-start.

The treatments for this project included; 1. control (no fertilizer) ; 2. synthetic fertilizer; 3. compost ; 4. compost + synthetic; 5. compost + biochar; 6. compost + biochar + synthetic; 7. compost + ash; 8. compost + ash + synthetic; 9. compost + ash + biochar; 10. compost + ash + biochar + synthetic; 11. compost + ash + gypsum ; 12. compost + ash + gypsum + biochar ; 13. compost + ash + gypsum + biochar + synthetic.

So, there were 13 treatments, replicated 3 times, for a total of 39 plots (10x4m) per location. We were looking at testing 3 different farms with 3 different soil types, so 117 plots total. Application rates of each blend were 10 Mg/ha but scaled down to a plot size of 40m2 x 3 = 120m2 per treatment = 0.012 ha.

Result and Discussion:

Canola yields varied by soil type and treatment with similar results for compost and synthetic fertilizers.

Table: Average Yield of 3 Sites - 2022

Entry	Entry	Camrose	Wetaskiwin	Westlock	Average of 3 Sites
No.	Name	Yield (bu/ac)	Yield (bu/ac)	Yield (bu/ac)	Yield (bu/ac)
1	CONTROL	46	53	36	**45**
2	SYNTHETIC FERTILIZER	55	73	58	**62**
3	COMPOST	46	75	36	**52**
4	COMPOST+SYNTHETIC	58	72	63	**64**
5	COMPOST+BIOCHAR	55	64	39	**53**
6	COMPOST+BIOCHAR+SYNTHETIC	49	67	61	**59**
7	COMPOST+ASH	45	50	34	**43**
8	COMPOST+ASH+SYNTHETIC	52	66	60	**59**
9	COMPOST+ASH+BIOCHAR	46	63	36	**48**
10	COMPOST+ASH+BIOCHAR+SYNTHETIC	48	52	58	**53**
11	COMPOST+ASH+GYPSUM	49	56	31	**45**
12	COMPOST+ASH+GYPSUN+BIOCHAR	41	62	31	**45**
13	COMPOST+ASH+GYPSUM+BIOCHAR+ SYNTHETIC	45	76	58	**60**

Preliminary results suggest that compost blends may produce similar yields when used with synthetic fertilizer, and affect nutrient profiles, yield, and microbial activity. Results from C stability, microbial diversity, and function analysis will be examined next to determine how compost blends affect overall soil function across these different soil types and ultimately, we will determine which blend functions best for specific soil types. We hope to continue this work next summer to determine if synthetic rates can be reduced while maintaining optimal productivity.

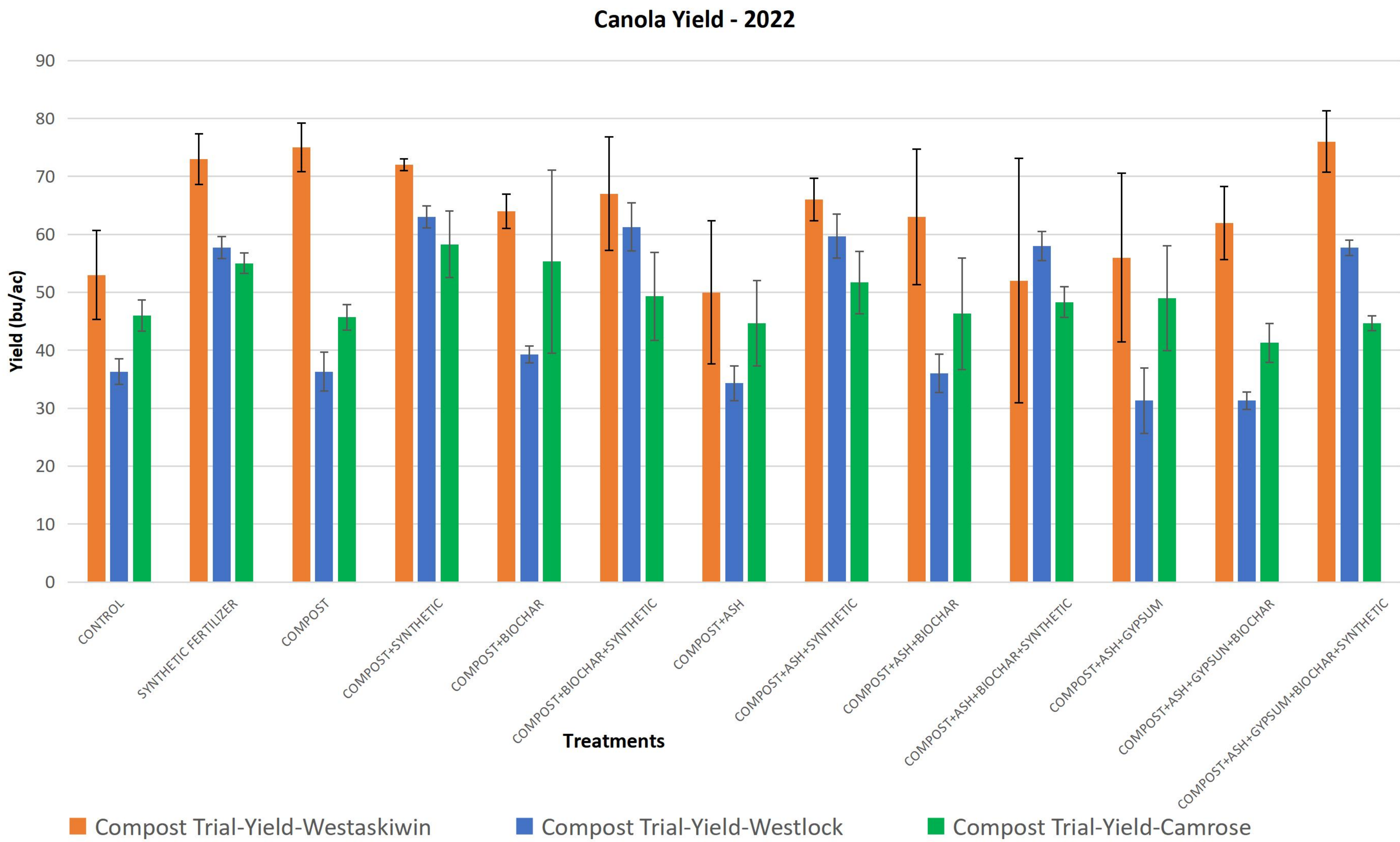


Table: Trial Results at Westlock Site - 2022

Rating Type Rating Unit	Height cm	Yield Kg/ha	Yield bu/ac	Bushel Weight lbs/bu	Test Weight Kg/HL	TKW g	Oil %

1	CONTROL	102	c	2027	bc	**36**	**bc**	55.9	-	69.0	-	4.20	-	47.4	a-d
2	SYNTHETIC FERTILIZER	123	ab	3242	a	**58**	**a**	55.9	-	68.9	-	4.05	-	47.6	a-d
3	COMPOST	114	abc	2043	bc	**36**	**bc**	55.9	-	69.0	-	3.92	-	48.7	ab
4	COMPOST+SYNTHETIC	130	a	3541	a	**63**	**a**	55.8	-	68.9	-	4.45	-	45.9	d
5	COMPOST+BIOCHAR	123	ab	2225	b	**39**	**b**	55.9	-	69.0	-	4.20	-	47.3	a-d
6	COMPOST+BIOCHAR+SYNTHETIC	127	ab	3451	a	**61**	**a**	56.4	-	69.7	-	4.18	-	46.1	cd
7	COMPOST+ASH	103	c	1918	bc	**34**	**bc**	56.2	-	69.3	-	3.92	-	48.6	ab
8	COMPOST+ASH+SYNTHETIC	123	ab	3347	a	**60**	**a**	56.1	-	69.2	-	4.33	-	46.8	a-d
9	COMPOST+ASH+BIOCHAR	112	abc	2031	bc	**36**	**bc**	56.3	-	69.5	-	4.06	-	48.3	abc
10	COMPOST+ASH+BIOCHAR+SYNTHETIC	124	ab	3258	a	**58**	**a**	56.3	-	69.5	-	4.32	-	46.4	bcd
11	COMPOST+ASH+GYPSUM	112	abc	1751	c	**31**	**c**	56.0	-	69.2	-	4.06	-	49.0	a
12	COMPOST+ASH+GYPSUN+BIOCHAR	108	bc	1763	c	**31**	**c**	55.9	-	69.0	-	4.07	-	48.2	a-d
13	COMPOST+ASH+GYPSUM+BIOCHAR+SYNTHETIC	125	ab	3232	a	**58**	**a**	55.5	-	68.5	-	4.60	-	46.4	bcd
	LSD P=.05	11.16		255.06		4.57		0.871		1.049		0.404		1.41	
	Standard Deviation	6.62		151.36		2.71		0.517		0.622		0.24		0.837	
	CV	5.64		5.82		5.85		0.92		0.9		5.73		1.76	

'Means followed by the same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls).

Acknowledgment: This project was funded by **RDAR.** Also, GRO would like to acknowledge the support from the University of Alberta (Dr. Derek Mackenzie) and Alt Root (Compost Facility, Westlock) to complete this project.

Determining specific compost blends for regenerative agriculture in central Alberta

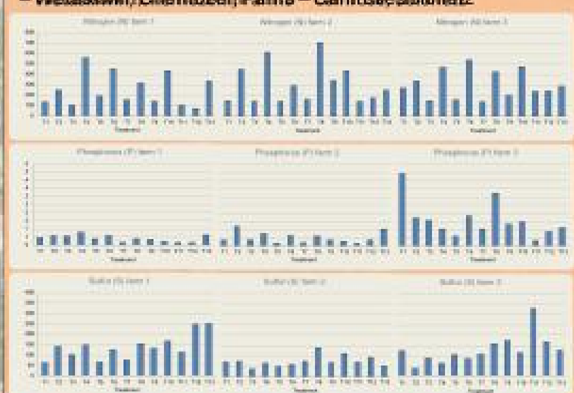
M.D. Mackenzie, B. Lanoil, M. Khodaei, C. Cardoso, Z. Fries, S. Cui, J. Kowalski
Department of Renewable Resources, Faculty of Agriculture, Life, and Environmental
University of Alberta, Edmonton AB

Introduction Currently there is no recommend rate of application of compost for grain production in AB and it is not clear if inorganic fertilizers will need to be used to off-set nutritional requirements not met by the slow release fertility of compost. And a carbon (C) credit protocol for producers using compost needs to be created to offset the extra expenses and incentivize producers. This short-term project fits into the multi-phase work we are doing on Soil Health in central Alberta and will be used as a starting point to determine what kinds of compost blends to use in larger soil health trials.

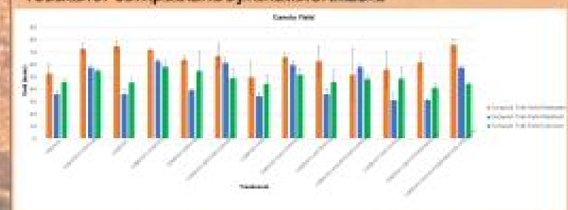
Regenerative agriculture, which uses practices such as no-till, compost fertilizer, inter-cropping, and cover cropping, is gaining traction in Alberta as a way to improve soil health while maintain grain productivity. It may also have positive economic implications by being more cost effective and using less non-renewable energy for production. By using compost additions as fertilizer we expect to see a reduction in greenhouse gas emissions, more diverse microbial community, and improved carbon sequestration and soil health, all while producing better food for livestock. We propose to test different compost blends under different crops and soil types. Specific blends will be factorial combinations of compost, biochar, fly ash, beet residues, and inorganic fertilizer, replicated at two different experimental locations.

Methods We propose to test different compost blends on different soil types, under canola production. Specific blends will be factorial combinations of compost, biochar, gypsum, and wood ash, replicated three times at each site.
Soils were sampled pre- and post-growing season and analyzed for soil fertility with PRS probes (Western Ag innovations), and microbial activity was assessed with respiration. Crop yields are also presented. All data is preliminary and has not been reviewed.

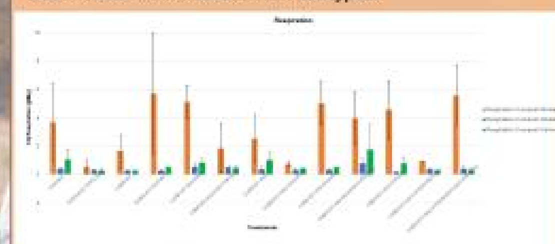
Results: PRS probe data for pre-growing season samples, units are ug/cm² of resin membrane; Farm 1 – Westlock Luvisol; Farm 2 – Wetaskiwin Chernozem; Farm 3 – Camrose Solonetz



Canola yields varied by soil type and treatment with similar results for compost and synthetic fertilizers.



Respiration indicated that microbial activity was affected by treatment and differed between soil types.



Conclusion and Future Work Preliminary results suggest that compost blends may produce similar yields when used with synthetic fertilizer, affect nutrient profiles, yield and microbial activity. Results from C stability, microbial diversity and function analysis will be examined next to determine how compost blends affect overall soil function across these different soil types and ultimately, we will determine which blend functions best for specific soil types. We hope to continue this work next summer to determine if synthetic rates can be reduced while maintaining optimal productivity.

Acknowledgements:

UNIVERSITY OF ALBERTA · RDAR Results Driven Agriculture Research · AltRoot · S-PRL · CIRCLE CONSULTING · GRO

GRO Inter-cropping Trials – 2022

Justin Nanninga - NW5-62-2-W5

Executive Summary:

The purpose of this trial is to provide current and comprehensive yield and quality data on annual mono-crop species compared to the same crop grown in intercropping system. This project will look into the economics of cash crops grown with other crops to improve on-total farmland use production and efficiency. The focus of the project will be on annual cash crops for high yield and using the companion crop or 'high nutritive value' annual crops. This approach could benefit Alberta producers by mitigating the risk of crop failure and increasing the overall productivity of the farm. The project will distribute information to producers across Alberta via written reports, newsletters, websites, and presentations at seminars, field days, and tours.

Objective:

The GRO intercropping project had several purposes:

- Provide proof of concept for intercropping as a locally viable option.
- Examine the potential for overyielding while intercropping.
- Observe some potential benefits and detractions from intercropping.
- Introduce and observe potential new crops for the area.
- Provide further direction for intercropping and innovative cropping.

Research elsewhere has determined intercropping, or planting two crops in the same field together at roughly 60% of the normal seeding rate for each species, has yielded up to 120% of a combined crop. When one adds nitrogen-fixing, properly inoculated pulses into the blend, this yield figure has been shown to meet that target with less than the normally required nutrients, particularly nitrogen, due to fixation and leakage, and excess release of mineral nutrients such as phosphorous. Other stated benefits include improved standability of often flattened pulse crops, reduced disease and pest pressure due to the intermingling of the species, and advanced maturity of later season crops.

Potential downsides of intercropping include the possibility of a pest bridge, where diseases and insect issues can continue to build if there is no year-long break in between similar crops, overpowering competition of one crop over the other, and unexpected variations in normal maturity among intercropping species.

In addition to testing these benefits and downsides, this trial also included some monoculture crops, partly for comparison in yields of new crops, and partially to determine the stand-alone yields of a new crop for north-central Alberta, known as lupins.

Agronomics

The eight-treatment trial was seeded on May 18th, 1.24 inches deep with 58 lbs of 11-52-0 seed placed and 196 lbs of 6.7-0-40-7.66 side banded. All seeds were appropriately treated and inoculated as required. 7.3 inches of moisture were received during the growing season. No pesticides were used.

Plots were harvested on October 12th, but some of the straight stands of blue lupins were harvested earlier as they had begun to shell.

Results and Interpretation:

This is the second year we have attempted to run this trial. In 2021 the conditions were very dry and the soil quality of the plot was not conducive to intensive cropping. 2022 had a different location and a totally revised plot plan. Despite somewhat dry conditions, there was substantial growth of most of the species and combinations. There were a few issues from start to finish which made the results inappropriate to statistically analyzed, so general discussion and conjecture will have to suffice. Comments about individual species are as follows:

Chickpeas: This crop was combined with flax for enhanced standability and nutrient sharing. While treated and seeded at an appropriate rate, emergence was not up to the expected population of 26 plants per square meter (60% of the recommended 44 ppm2). Consequently, yield of this crop by itself was low, of poor seed quality and uneconomic, and did not contribute significantly to the overall plot return. Root nodulation was acceptable, though, so if there were significant nitrogen leakage, there might have been adequate contribution of nutrients to the flax from the chickpeas. There appeared to be no maturity advancement in the polyculture and we used the earliest maturing chickpea type. Despite this, chickpeas in general do not currently appear to be appropriate crops for central Alberta, either in monoculture or polyculture.

Flax: This crop, on the other hand, certainly appears to have potential in the area in the face of hotter, dryer conditions, whether in polyculture or monoculture. It stood well, matured in a sufficiently timely fashion, although it appeared to be one of the later maturing of the crops in the trial. Harvest was not an issue for flax, but the aftermath may be harder to manage than other crops. Yields proved to be acceptable, and if current prices are a benchmark for the future, this crop could work well in an intercropping situation, possibly with lentils.

Lentils: Three different varieties of lentils were trialed for intercropping. Unfortunately, though they were tested with oilseeds which, despite preplanting research recommendations, did not appear to be a good fit. Those crops did not appear to support the lentil stand to be more upright and easier to harvest, and they appeared to compete with the pulse crop for space. However, using current pricing, these combinations seemed to provide a more than adequate return, particularly in plots that were able to be picked up and harvested well. In general, a combination crop that would help lentils be more upright but also support the non-pulse crop with nitrogen sharing may be a potentially viable intercrop.

Yellow mustard: Very little yellow mustard has been grown north of Highway 1 for decades. This likely stems back to issues with volunteers and wild mustard contamination, prior to the onset of modern crop protection products and earlier maturities. In our plots this year, the treated mustard seeds germinated and matured well, no maturity issues existed, the crop stood well, and harvest was not a problem. Due to crop failures in other parts of the world, current prices for yellow mustard are exceptional, and if environmental conditions are such that hot dry growing seasons persist, this crop bears serious consideration either in a monoculture or intercropping situation. No harvest issues existed for this crop alone, but the combination with lentils did not seem to support the pulse crop's standability and subsequent harvestability. The potential for combining this crop with blue lupins exists.

Brown mustard: This crop is the most similar to wild mustard in growth habit and seed size, so having a field very clean of its weedy cousin is a strong necessity to have a saleable crop from this species. That being said, if it were to be grown in an intercropping situation, there may be some potential for this brassica, despite the poor emergence that was experienced by us this year. We had some difficulty obtaining appropriate seed, and a poor seed treatment on our behalf may have resulted in the marginal emergence. Once it was out of the ground, however, the crop grew well enough and harvested adequately, despite the need to set the combine for it and the much larger seeded lentils. How much it benefited from intercropping is still up for debate, and our deliberately low intercropping seeding rate likely contributed to a low plant stand. There appears to be some local potential for this crop, either in a monocrop or an intercropping situation.

Camelina: This is one crop that appears to be suffering from low prices at the moment, so the economics of using it in intercropping situations are not as positive as the mustards. Its yield at the 60% recommended intercropping seeding rate was only around 20 bushels per acre, and if its price is currently below canola, it is a non-starter for economic intercropping. This, combined with its poor standability in its plots leaves a future in the intercropping trial to be questionable.

Quinoa: This crop has proven to be quite an enigma in our intercropping trial. The seed is a hot ticket as far as marketing goes, and it originated in high-altitude, dry, short-season locations, so one might think it should be a good fit in our dry, climatically restricted areas. But in 2021, the extreme hot and dry conditions, combined with a difficult soil location, caused this crop not to yield. In 2022, an exceptional stand of both varieties of this crop led us to be hopeful that an adequate return would be a possibility. It grew so lush and thick that its companion crop of blue or white lupins appeared to have been choked out, to some extent. We are unsure how much additional nitrogen the lupin pulse companion crop contributed to the already well fed on fababean stubble quinoa plants, but something caused them not to produce mature seed well into October. The decision was made to harvest the crop at that time, but there was still no useable seed when harvest occurred. Apparently, this unusual situation was not totally unique for our site of this crop, but at time of writing this report, a conclusion has not been drawn as to why this occurred and how to prevent a repeat, so it is unlikely we will be including quinoa in future intercropping trials.

Lupins: While it was spatially impossible to pair every pulse crop with every non-pulse species in the intercropping trial, apparently pairing lupins with quinoa was not a good choice in that the competition from the other crop prevented both species of lupins from producing to their respective capacity. As this was first year for lupins in the intercropping trial, they were also included as a single crop. This indicated that without the heavy competition from the quinoa, both species of lupins produced very well. The outstanding stand of both types of lupins produced adequate yields into the combine, but the yield would have been even better had we been able to harvest them in a more timely fashion, as it is estimated we lost at least 7 bushels an acre due to pod shatter of at least one of the varieties. It is most likely lupins will be included in future intercropping trials, as they generated a great detail of excitement from their appearance.

Conclusions:

The intercropping trial appears to have some merit, but further refinement needs to occur to ensure an understanding of the best practices for this means of crop production. In the future, however, perhaps larger, more controlled and examined plots, including soil samples before and after cropping, need to occur. Another issue identified was that harvest was not as uniform as originally estimated, and there is a need for either blocking of the various species or allowing for more space in between the plots to allow for a more timely harvest of the plots.

This project had a great deal of support from a number of locations:

- Lupin Platform and Mark Olson provided the lupin seed and inoculant, and supplied a great deal of advice, discussions, and presentations throughout the year.
- Trent Whiting of SeCan sent lentil and flax seed for the trial and was a great supplier of advice.
- Battle River Research Group and Khalil Ahmed supplied some seeds.
- Byron Long supplied the yellow mustard for the trial and was available to contrast and compare his intercropping field scale trial with our small plots.
- Northern Quinoa (NorQuin) and its agronomist, Liam O' Halloran for his help, observations and advice throughout two seasons of our attempting to intercrop quinoa.

All this help, produce and advice is gratefully acknowledged and greatly appreciated.

Further Processing of Innovative Intercropping Products

2022 saw a successful intercropping trial, with an acceptable yield of a number of crops not normally produced in north central Alberta. It was decided that, in the off season, products of these innovative crops would be tested for consumer acceptability. While none of these attempts were controlled trials, all of them were compared against past experience for different food and feedstuffs and these observations make interesting considerations. Some of the products put out for consumer acceptance included:

Flax and Camelina for horse feeding supplements:

Flax and camelina are two grain products that are extensively used for horse supplements. They have been seen to improve the quality of the hair coat, calm the temperament and possibly even improve mobility. Flax and camelina from the intercropping trial were forwarded to a nearby horse owner to feed and compare the impact of these locally produced supplements. At the time of printing the results have not yet been received, but may be reported in a future

Camelina Crop

Flax Crop

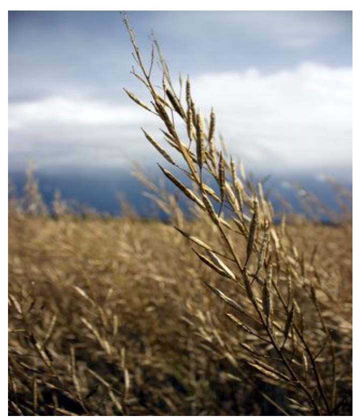
Yellow and brown mustards for condiment production:

Yellow and brown mustard seeds are species that are not commonly grown in this part of the province. Prior to the advent of herbicide tolerant canolas, wild mustard (similar to brown) particularly was an unwanted addition to canola seed, and cause for downgrading. Yellow mustard, being in an entirely different genus and a longer season crop, was not considered appropriate for here. With the variation in the weather of late, however, it was decided to revisit these potential crops to see how they fared locally.

As it turned out, not only was the year a very appropriate one for growing mustard, the prices were quite astronomical due to crop failures elsewhere and a very favorable net return would have resulted from a field of mustard. Both species of seed were of exceptional quality. Without having them tested for sinigrin (the glucosinolate which gives mustard seeds their pungent tastes) content, they seemed to be very potent, more so than grainy or Dijon mustards commercially available, even after blending and producing a product with acetic stabilizers that maintain the potency at some level following recognized recipes.

Northern vigor from crops produced in north central Alberta, with its long days and other attributes, might make the sinigrin content higher with production at this latitude, like what has been noted in local ginseng production. Time will tell with repeated trialing of these crops whether or not such apparent concentrations of sinigrin are maintained in subsequent years with different growing conditions, as it is thought that this year, with adequate spring moisture followed by a hot dry summer, may have been ideal for production of this active ingredient. Regardless, both the grainy (a mix of yellow and brown mustard seed) and Dijon (pure yellow mustard seed) formulations of condiment mustard products met with very favorable consumer acceptance. Further study of this crop is considered a strong possibility.





Yellow mustard pods Grainy Condiment Mustard Brown Mustard pods

Red and green lentils as human foodstuffs:

Both small red and green lentil production was locally grown and put forward for human acceptability to experienced users of these nitrogen fixing crops. Included in familiar recipes, both types of lentils produced were found to be of more than an acceptable quality. Local production, harvest and cleaning of the crop was also acceptably possible with readily available equipment, and the nitrogen fixing capability of the crop makes it appropriate for consideration in the future, both as a polyculture or a monoculture crop.

Red Lentils

Large Green Lentils

Chickpeas for human consumption:

This year's production did not meet with favorable consumer acceptance. The seeds themselves were dark, there was possibly more earth tag than in production elsewhere and they were of marginal maturity when harvest was necessitated. Further study of the production of this crop is required before local growth of this nitrogen fixing crop is recommended.

Chick pea plant and harvested crop

Lupins and Quinoa for further processing and consumption:

Lupin crops produced very well in 2022, and appeared to have high quality seed, both with the early blue and later white lupin species, at least in monoculture. Their polyculture companion crops did not produce the expected yield, given the growing conditions and intercrop partner used. More study will be required for these crops, including their use for specialty foods and protein fractionation.

Blue Lupin Flowers Blue and White Lupin Seed Red and Golden Quinoa Seed Heads

Quinoa, on the other hand, did not produce seed in 2022, for reasons still being researched. The growth of the crop was nothing short of amazing, but no seed matured by the time harvest was necessitated.

Further study of quinoa for local production may be required before local recommendations can be confidently supplied.

Potential Economic Returns in 2022 from these crops was also investigated. As some of these species produce a product that is recently becoming recognized for its value, some of the economics are someone imprecise, while others with a more established market are more definite, but as this economic analysis is just a snapshot in time, the returns may be misleading due to market forces. Regardless, here would be the gross returns for some of these products, had GRO harvested market quantities of these crops:

Pulse Crop	Companion	**Pulse Yield (Bu/acre)**	**Pulse Revenue ($/acre)**	**Broadleaf Yield (Bu/acre)**	**Broadleaf Revenue ($/acre)**	**Total Revenue ($/acre)**
Desi Chickpeas	Flax	**6.4**	115	**29.9**	645	$760
Green Lentils	Brown Mustard	**6.7**	211	**12.0**	600	$811
Very Small Red Lentils	Yellow Mustard	**4.7**	94	**38.0**	2088	$2,182
Small Red Lentils	Camelina	**8.3**	192	**26.3**	290	$482

Lupin	**Intercrop**	**Yield**	**Yield (Bu/acre)**	**Revenue ($/acre)**
White	Lupin Intercropped		**4**	**58**
White	Lupin Mono		**57.5**	**823**
Blue	Lupin Intercropped		**3.5**	**50**
Blue	Lupin Mono		**33.2**	**475**

As previously mentioned, some of the intercropping gross returns are rather high but others, while still attractive, are rather low due to expectedly low market pricing as at December 1, 2022. It should also be noted that the intercropped lupin combined return would have been much higher if their quinoa companions would have actually made seed, an anomaly that is yet to be understood. It also should be noted that these revenue figures are based on gross crop sales. Not only would prices for these commodities vary, but also the cost of production needs to be taken into consideration and deducted to comprehend a more balanced net cropping year figure.

In conclusion, all these crops grown for local consumption hold some promise for value added production, some in their current form and others with additional consideration and development. These products were also all grown as companion crops with two crops interseeded on the same day, with the expectation they would also be physiologically mature at the same time. Further research for these crops, alone and in companion situations, is being considered.

Acknowledgment: This project was funded by Canadian Agricultural Partnership Program under the Adaptive Innovation Stream.

Effect of Liming Application on Crop Rotation and Clubroot

Background:

The number of fields infested with clubroot disease in Alberta are still growing. Clubroot has been diagnosed in fields as far north as the Northern Sunrise County and as far south as Newell County. It continues to spread throughout the prairie provinces.

Clubroot-resistant varieties have been developed and launched and some have failed within a few years of becoming available on the market. The resistance has been overcome in close to 200 fields in Alberta (Nicole Fox M.Sc.). The biggest reason is linked to the close rotation of the canola crop.

Canola is Canada's most important agricultural source of revenue, generating about 25% of all farm cash receipts. The first infestation of clubroot on canola was discovered in 2003 in central Alberta. Clubroot can be considered the largest economic threat to canola. Research done by Nicole Fox for an M.Sc thesis (The Evaluation of Lime Products as a Clubroot (*Plasmodiophora brassicae*) Management Tool) indicates that a soil pH greater than 7.2 may be a viable tool for disease management. "Different lime products, and hydrated lime in particular, may represent an effective tool to manage *P. brassicae* in highly infested patches in a field, at field entrances, and in acidic soils, by reducing clubroot severity on susceptible and resistant hosts. As such, the application of lime may help to supplement the use of genetic resistance, by reducing disease pressure and the potential for pathotype shifts."

Trials, where hydrated lime was used on a clubroot-infected field (2018 - Edberg location, Keith Gabert), are showing some promising initial results. This project seeks to test different liming products, their effectiveness on clubroot disease management, and the impact of a soil pH greater than 7.2 on the yield of HRS wheat, yellow peas, and canola over a 3-year time period.

Increasing the soil pH to more than 7.2 is not common practice. Most of the research that has been done in Alberta or northern British Columbia on soil pH amelioration was done from 1970 to early 1990. Since then, many new varieties of wheat and peas have been developed and canola has replaced the production of rapeseed.

Most, if not all, of the research done at the time was focused on increasing soil pH by 1 pH unit to about 6 -6.5. No information is available on crop yield when soil pH is increased to more than 7.2. It is unclear what the impact is, if any, of raising the soil pH over 7.2 on the productivity of other crops. For most crops, it seems that the higher pH is just outside their optimum.

Farming practices and disease management tools have changed and greatly impacted the overall productivity of crops over the last 30 years. The application of chemical fertilizers and sprays continues to have an acidifying effect on topsoil. In 2019 about 50% of Alberta soils have a pH of 6.0 and lower, with 15-20% being less than 5.5. In 1970 this was estimated to be 21% of Alberta soils, or 2.1 million acres, with 4% having a pH lower than 5.5. (source: Doug Penney, Lacombe June 26, 2019)

Application of lime has been suggested to also improve soil health (Plant-Soil Interactions at Low pH: Principles and Management pp 703-710) as yield improvements have been recorded even as soil pH has returned to initial pre-treatment levels.

Objectives:

1. Determine the annual impact on the yield on plots treated with lime to a soil pH above 7.2 vs Control (not limed) plots for a typical Alberta crop rotation of canola, HR wheat, and yellow peas over three years.
2. Evaluate the effectiveness of different liming products alone or in combination.
3. Evaluate the effectiveness of increased soil pH to at least 7.2 on clubroot disease spores and disease occurrence on the roots (clubroot trial).
4. Assessment of soil health at the start of the trial (year 1) and the end of the trial (year 3).

Project Plan:

The project started in the fall of 2019 with soil sampling done so lime requirement curves could be developed.

1. Yield Trial:

The three crops (canola, hard red wheat, and yellow peas) are grown in soil with a pH adjusted to 7.2 compared to an unadjusted control, using the following treatments:

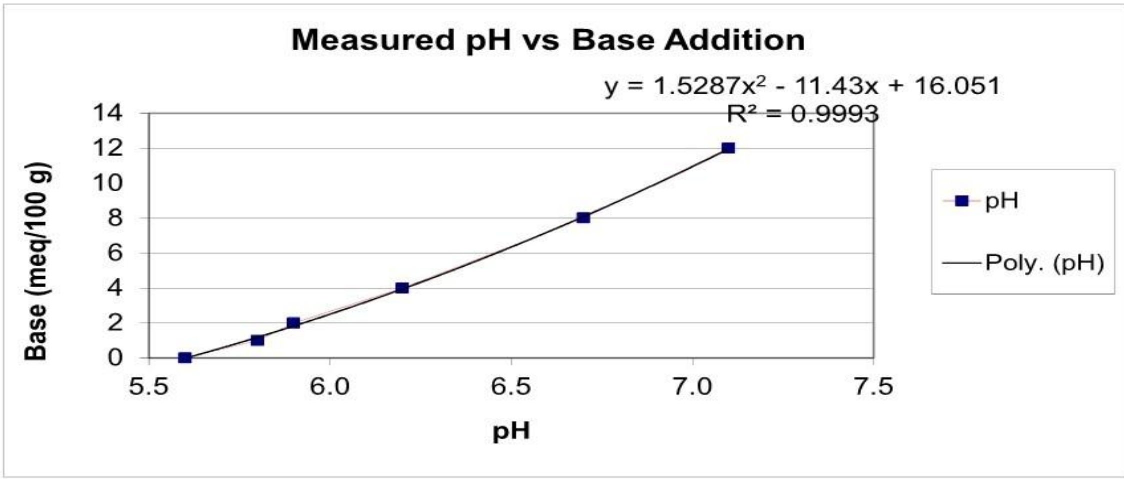
- 100% hydrated lime
- 75% hydrated lime & 25% crushed limestone
- 50% hydrated lime & 50% crushed limestone
- 25% hydrated lime & 75% crushed limestone
- 100% crushed limestone

Trial Design:

Rotation:	Block 1	Block 2	Block 3
2020	Canola	Hard Red Wheat	Yellow Field Peas
2021	Yellow Field Peas	Canola	Hard Red Wheat
2022	Hard Red Wheat	Yellow Field Peas	Canola

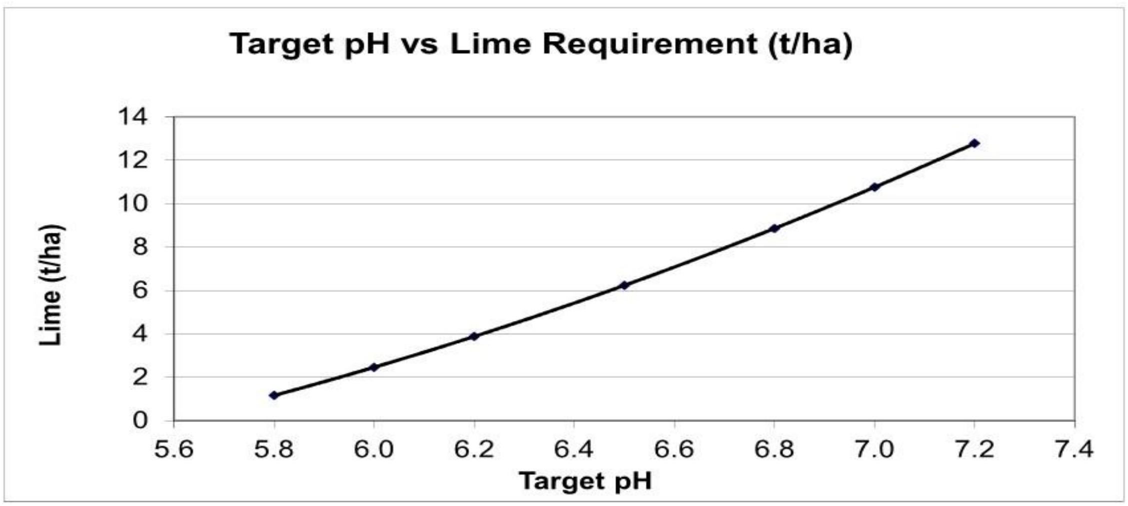
Soil pH Curve of Topsoil (0-3”) - 2020

Base Addition	meq/100 g	0	1	2	4	8	12
Resulting pH	pH	5.6	5.8	5.9	6.2	6.7	7.1



Theoretical Lime Requirement

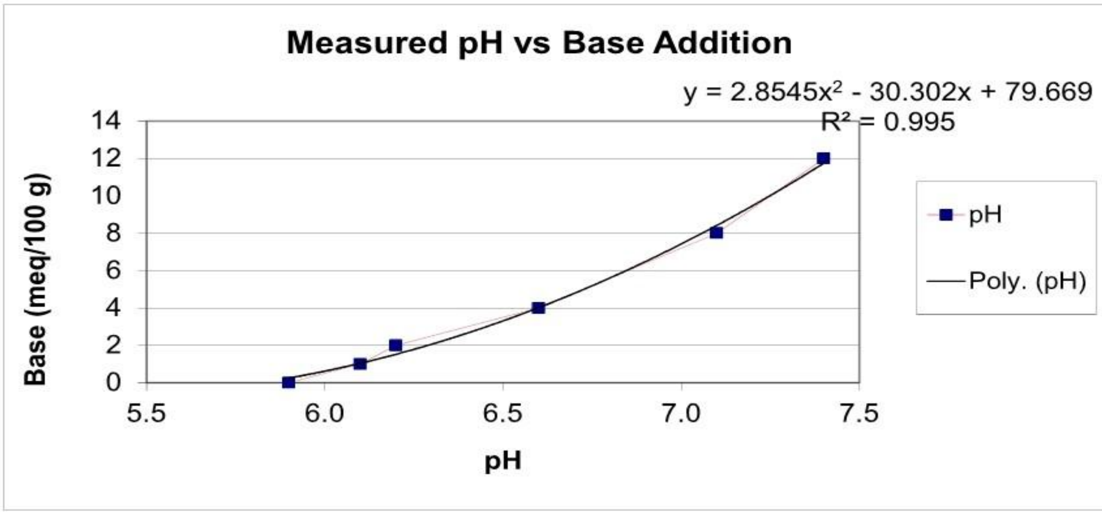
Target pH	5.8	6.0	6.2	6.5	6.8	7.0	7.2
Base Required (me/100g)	1.2	2.5	3.9	6.3	9.0	10.9	13.0
CaCO3 (mg/kg)	596	1262	1990	3197	4543	5517	6553
Lime Required (t/ha)	**1.2**	**2.5**	**3.9**	**6.2**	**8.9**	**10.8**	**12.8**



Note: Only valid within pH range measured

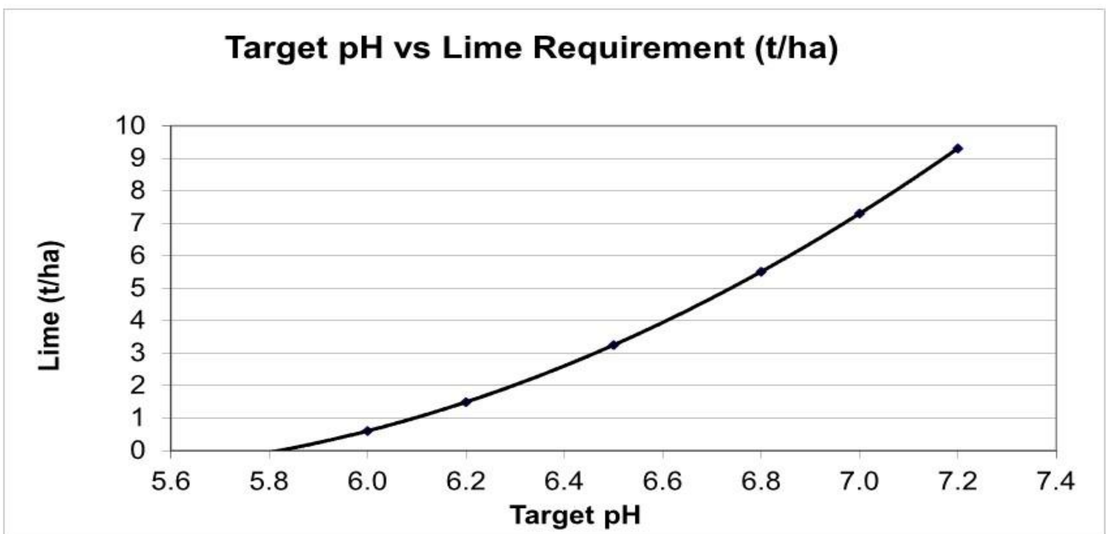
Picture: Soil pH Curve of Lower Soil (3-6”) - 2020

Base Addition	meq/100 g	0	1	2	4	8	12
Resulting pH	pH	5.9	6.1	6.2	6.6	7.1	7.4



Theoretical Lime Requirement

Target pH	**5.8**	**6.0**	**6.2**	**6.5**	**6.8**	**7.0**	**7.2**
Base Required (me/100g)	-0.1	0.6	1.5	3.3	5.6	7.4	9.5
CaCO3 (mg/kg)	-29	312	768	1668	2826	3742	4774
Lime Required (t/ha)	**-0.1**	**0.6**	**1.5**	**3.3**	**5.5**	**7.3**	**9.3**



Note: Only valid within pH range measured

Based on the above soil pH curve and the lime equivalency factor. The following lime calculations were made for each treatment.

	Treatment	Crushed lime (ton/acre)	Hydrated lime (ton/acre)
1	Control	0.00	0.00
2	100% Hydrated lime	0.00	1.49
3	75% Hydrated lime +25% Crushed lime	0.39	1.17

4	50% Hydrated lime +50% Crushed lime	0.82	0.82
5	25% Hydrated lime +75% Crushed lime	1.26	0.43
6	100% Crushed lime	1.79	0.00

Lime Application: Lime was applied in each plot using Scott's lime applicator. It was tedious work, and a strong wind was a big hurdle in controlling the application. Our target was 5% more than the calculated numbers above taking minimal loss into account. Each strip was rototilled to a four-inch depth after the lime application.

Based on the collected soil sample from each plot starting in the spring of 2021, the following lime calculation was made to top up each treatment.

	Treatment	Crushed lime (ton/acre)	Hydrated lime (ton/acre)
1	Control	0.00	0.00
2	100% Hydrated lime	0.00	0.65
3	75% Hydrated lime +25% Crushed lime	0.28	0.49
4	50% Hydrated lime +50% Crushed lime	0.55	0.32
5	25% Hydrated lime +75% Crushed lime	0.82	0.16
6	100% Crushed lime	1.10	0.00

There were positive results from the lime application in the year 2021. No additional lime was added in spring 2022.

	Agronomiic Information - 2022
Seeding specifics	May 04 (Wheat & Peas); May 24 (Canola) $1^{1/4}$ inch Wheat; $2^{1/4}$ inch Peas; $^{3/4}$ inch Canola
Fertilizer/acre	• Wheat – Side banded: 27.38-0-14.46-7.23 @ 414.93 lbs/ac Seed placed: 11-52-0 @ 58 lbs/ac • Peas – Side banded: 6.7-0-40.85-7.66 @ 195.83 lbs/ac Seed placed: 11-52-0 58 lbs/ac • Canola – Deep banded: 27.38-0-14.46-7.23 @ 414.93 lbs/ac Side banded: 11-52-0 @ 58 lbs/ac
Herbicide	Curtial M 800 ml/ac June 07, 2022 (Wheat) Axial 500 ml/ac June 07, 2022 (Wheat) Viper 404 ml/ac June 09, 2022 (Peas) UAN 809 ml/ac June 09, 2022 (Peas) Glyphosate 270 g/ae/ac June 16, 2022 (Canola)
Rainfall	Recorded from May 1 to Sept 30, 2022: 219.05 **mm**
Harvest Date	August 30, 2022 (Wheat) August 30, 2022 (Peas) September 21, 2022 (Canola)

Treatment No.	Treatment Name	Height cm		Yield kg/ha		Yield bu/ac		Protein %		Gluten %	
1	No Liming	77	ab	5398	a	**80**	**a**	13.9	-	34.0	-
2	100% Hydrated Lime	77	ab	4844	c	**72**	**c**	13.9	-	33.5	
3	75% Hydrated lime 25% Crushed Lime	81	a	5194	ab	**77**	**ab**	14.0	-	33.7	-
4	50% Hydrated lime 50% Crushed Lime	81	a	4975	bc	**74**	**bc**	13.7	-	32.8	-
5	25% Hydrated Lime 75% Crushed Lime	76	b	4553	d	**68**	**d**	13.9	-	34.2	-
6	100% Crushed lime	79	ab	5164	ab	**77**	**ab**	14.0	-	33.3	-
	LSD P=.05	3.51		212.32		**3.40**		0.55		1.4	
	Standard Deviation	2.33		140.87		**2.25**		0.30		0.92	
	CV	2.97		2.81		**3.02**		2.16		2.74	

Wheat Trial Results From 2022

Means followed by the same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls).

Peas Trial Results From 2022

Treatment No.	Treatment Name	Height cm		Yield kg/ha		Yield bu/ac		TKW g	
1	No Liming	95	c	3041	c	**45**	**c**	227	b
2	100% Hydrated Lime	105	a	3737	a	**56**	**a**	237	a
3	75% Hydrated lime 25% Crushed Lime	105	a	3792	a	**56**	**a**	235	a
4	50% Hydrated lime 50% Crushed Lime	99	b	3565	b	**53**	**b**	231	b
5	25% Hydrated Lime	97	bc	3521	b	**52**	**b**	230	b

75% Crushed Lime				
6 100% Crushed lime	104 a	3709 ab	**55 a**	239 a
LSD P=.05	2.70	163.89	**2.34**	4.08
Standard Deviation	1.79	106.38	**1.52**	2.71
CV	1.78	3.02	**2.79**	1.16

Means followed by the same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls).

Canola Trial Results From 2022

Treatment No.	Treatment Name	Height cm		Yield kg/ha		Yield bu/ac		Bushel Weight lb/bu		Test Weight kg/HL		TKW g		Oil %	
1	No Liming	119	-	2693	c	**48**	**c**	57	-	70	-	3.50	-	40.3	-
2	100% Hydrated Lime	114	-	3791	a	**68**	**a**	55	-	68	-	3.88	-	42.5	-
3	75% Hydrated lime 25% Crushed Lime	110	-	3768	a	**67**	**a**	55	-	68	-	3.63	-	42.1	-
4	50% Hydrated lime 50% Crushed Lime	119	-	3019	bc	**54**	**bc**	56	-	69	-	3.70	-	41.8	-
5	25% Hydrated Lime 75% Crushed Lime	116	-	3258	b	**58**	**b**	57	-	70	-	3.50	-	40.6	-
6	100% Crushed lime	114	-	3409	ab	**61**	**ab**	55	-	68	-	3.60	-	42.2	-
	LSD P=.05	7.38		371.70		**6.79**		2.25		2.63		0.27		2.83	
	Standard Deviation	4.90		246.62		**4.51**		1.49		1.74		0.18		1.88	
	CV	4.25		7.42		**7.60**		2.67		2.54		4.95		4.52	

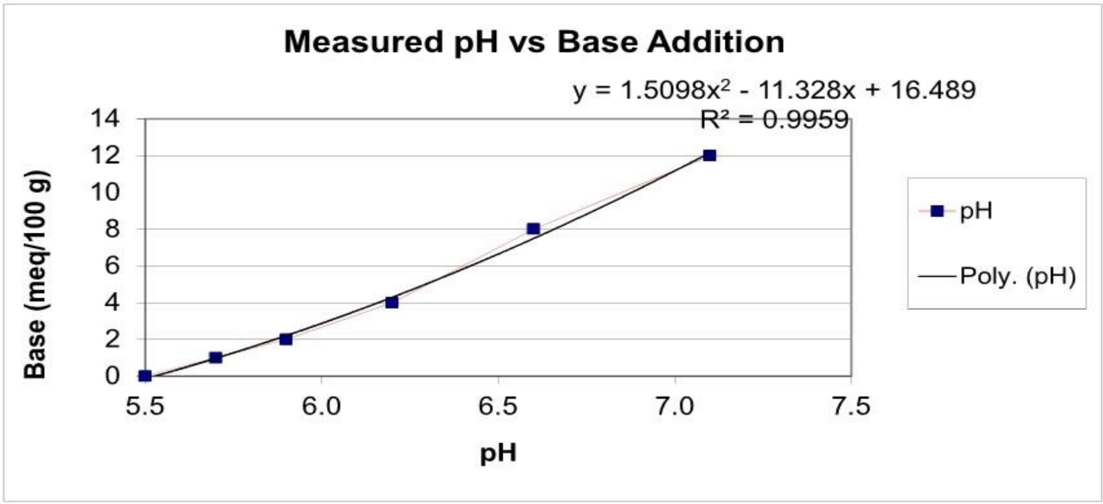
Means followed by the same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls).

.

2. Liming effect on Clubroot

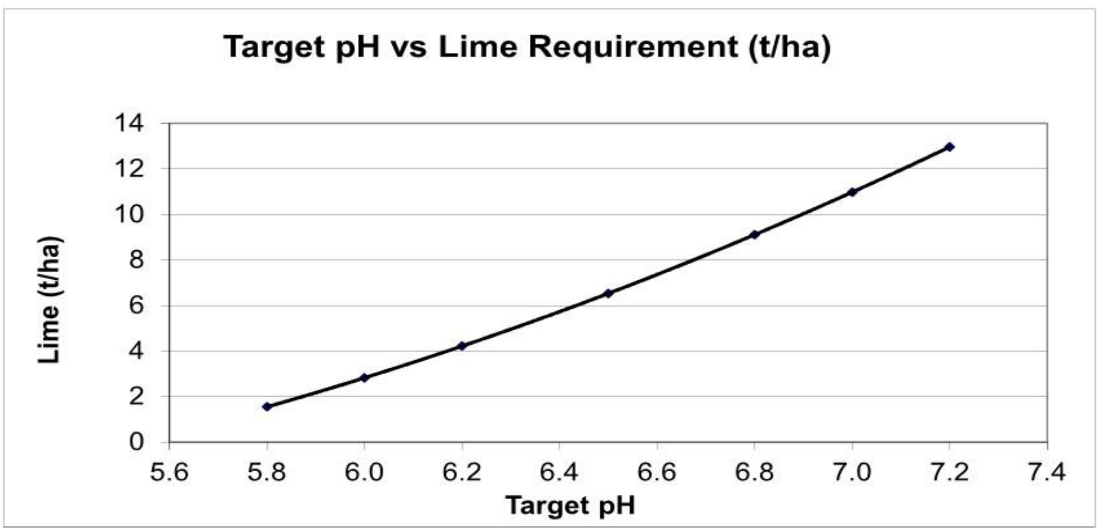
Soil pH Curve of topsoil (0-3”) - 2020

Base Addition	meq/100 g	0	1	2	4	8	12
Resulting pH	pH	5.5	5.7	5.9	6.2	6.6	7.1



Theoretical Lime Requirement

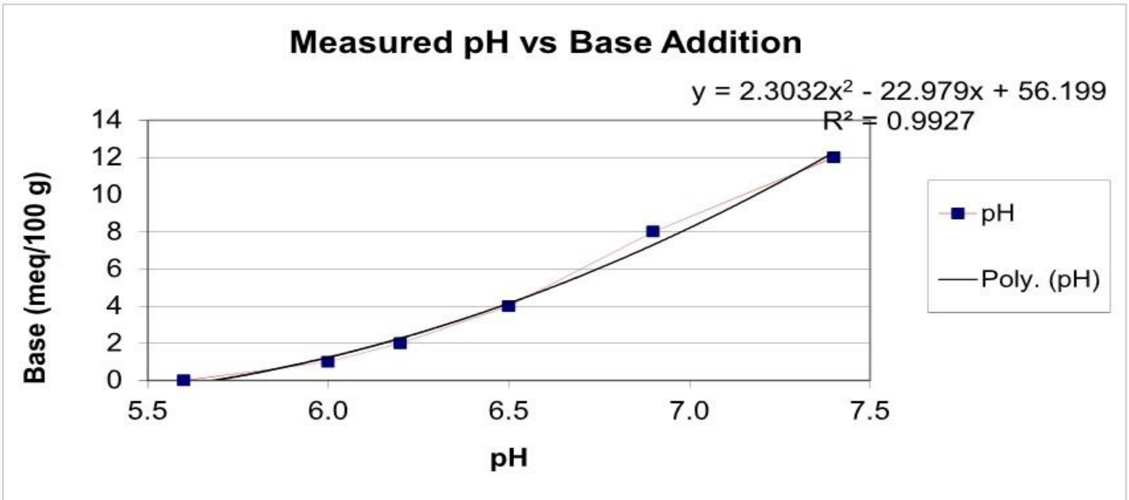
Target pH	**5.8**	**6.0**	**6.2**	**6.5**	**6.8**	**7.0**	**7.2**
Base Required (me/100g)	1.6	2.9	4.3	6.6	9.3	11.2	13.2
CaCO3 (mg/kg)	794	1448	2163	3350	4673	5631	6650
Lime Required (t/ha)	**1.5**	**2.8**	**4.2**	**6.5**	**9.1**	**11.0**	**13.0**



Note: Only valid within pH range measured

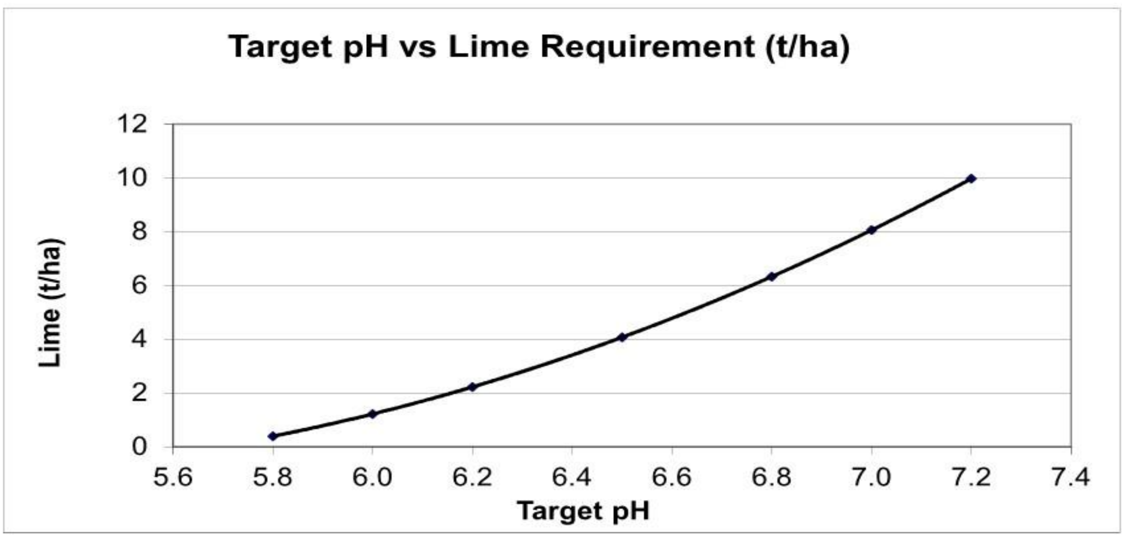
Picture: Soil pH Curve of lower soil (3-6”) - 2020

Base Addition	meq/100 g	0	1	2	4	8	12
Resulting pH	pH	5.6	6.0	6.2	6.5	6.9	7.4



Theoretical Lime Requirement

Target pH	**5.8**	**6.0**	**6.2**	**6.5**	**6.8**	**7.0**	**7.2**
Base Required (me/100g)	0.4	1.2	2.3	4.1	6.4	8.2	10.1
$CaCO_3$ (mg/kg)	202	625	1141	2089	3247	4134	5115
Lime Required (t/ha)	**0.4**	**1.2**	**2.2**	**4.1**	**6.3**	**8.1**	**10.0**



Note: Only valid within pH range measured

Based on the above soil pH curve and the lime equivalency factor. The following lime calculations were made for each treatment.

	Treatment	Crushed lime (ton/acre)	Hydrated lime (ton/acre)
1	Control	0.00	0.00
2	100% Hydrated lime	0.00	1.50
3	75% Hydrated lime +25% Crushed lime	0.40	1.19

4	50% Hydrated lime +50% Crushed lime	0.84	0.84
5	25% Hydrated lime +75% Crushed lime	1.33	0.44
6	100% Crushed lime	1.87	0.00

Lime Application: Same as yield trial, lime was applied in each plot using Scott's lime applicator. Each strip was rototilled to a four-inch depth after the lime application.

Based on the collected soil samples from each plot starting in the spring of 2021, the following lime calculations were made to top up each treatment.

	Treatment	Crushed lime (ton/acre)	Hydrated lime (ton/acre)
1	Control	0.00	0.00
2	100% Hydrated lime	0.00	0.65
3	75% Hydrated lime +25% Crushed lime	0.26	0.49
4	50% Hydrated lime +50% Crushed lime	0.55	0.32
5	25% Hydrated lime +75% Crushed lime	0.82	0.16
6	100% Crushed lime	1.10	0.00

There was no addition of lime in spring 2022.

	Agronomic Information - 2022
Seeding specifics	May 25, 2022
	Depth – ¾ inch
	Project Description
Fertilizer/acre	Deep banded: 27.38-0-14.46-7.23 @ 414.93 lbs/ac Side Banded: 11-52-0 @ 58 lbs/ac
Herbicide	Liberty 1.6 l/ac June 16, 2022
Rainfall	Recorded from May 1 to Sept 30, 2022: 219.5 **mm**
Harvest Date	September 27, 2022

Clubroot Canola Trial Results From 2022

		Height		Yield		Yield		Bushel Weight		Test Weight		TKW		Oil	
Treatment #	Treatment Name	cm		kg/ha		bu/ac		lbs/bu		Kg/HL		g		%	
1	No Liming	94	b	4185	b	**75**	**b**	53.8	-	66.3	-	3.3	-	41.5	-
2	100% Hydrated Lime	102	a	4638	a	**83**	**a**	54.0	-	66.8	-	3.3	-	41.6	
3	75% Hydrated lime	99	ab	4329	ab	**77**	**ab**	54.3	-	66.5	-	3.3	-	41.6	-
	25% Crushed Lime														
4	50% Hydrated lime	98	ab	4361	ab	**78**	**ab**	53.8	-	66.8	-	3.4	-	41.5	-
	50% Crushed Lime														
5	25% Hydrated Lime	96	ab	4296	ab	**77**	**ab**	53.8	-	66.5	-	3.4	-	41.9	-
	75% Crushed Lime														
6	100% Crushed lime	95	ab	4094	b	**73**	**b**	53.3	-	65.5	-	3.4	-	40.9	-
LSD P=.05		5.18		308.53		**5.30**		1.27		1.30		0.21		1.29	
Standard Deviation		3.44		204.71		**3.51**		0.84		0.86		0.14		0.84	
CV		3.53		4.74		**4.57**		1.56		1.30		4.13		2.02	
'Means followed by same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls).															

Combined Results from 2020-2022

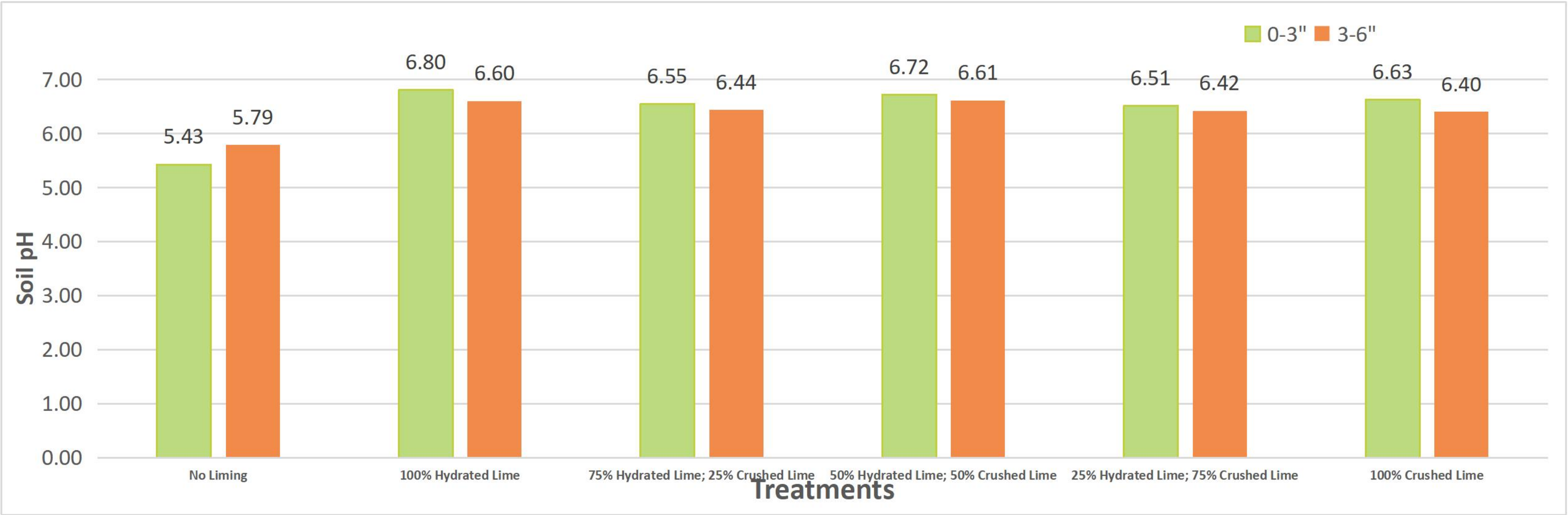
Wheat Trial		Yield % as compared to Control			
Treatment #	**Treatment Name**	**Year 2020**	**Year 2021**	**Year 2022**	**Average of trial**
1	**No liming**	100	100	100	**100**
2	**100% Hydrated Lime**	110	120	119	**116**
3	**75% Hydrated lime + 25% Crushed Lime**	121	107	115	**114**
4	**50% Hydrated lime + 50% Crushed Lime**	96	157	109	**121**
5	**25% Hydrated Lime + 75% Crushed Lime**	122	120	107	**116**
6	**100% Crushed lime**	108	111	114	**111**

Yellow Peas		Yield % as compared to Control			
Treatment #	**Treatment Name**	**Year 2020**	**Year 2021**	**Year 2022**	**Average of trial**
1	**No liming**	100	-	100	**100**
2	**100% Hydrated Lime**	109	-	123	**116**
3	**75% Hydrated lime + 25% Crushed Lime**	105	-	124	**115**
4	**50% Hydrated lime + 50% Crushed Lime**	123	-	117	**120**
5	**25% Hydrated Lime + 75% Crushed Lime**	106	-	115	**111**
6	**100% Crushed lime**	93	-	122	**108**

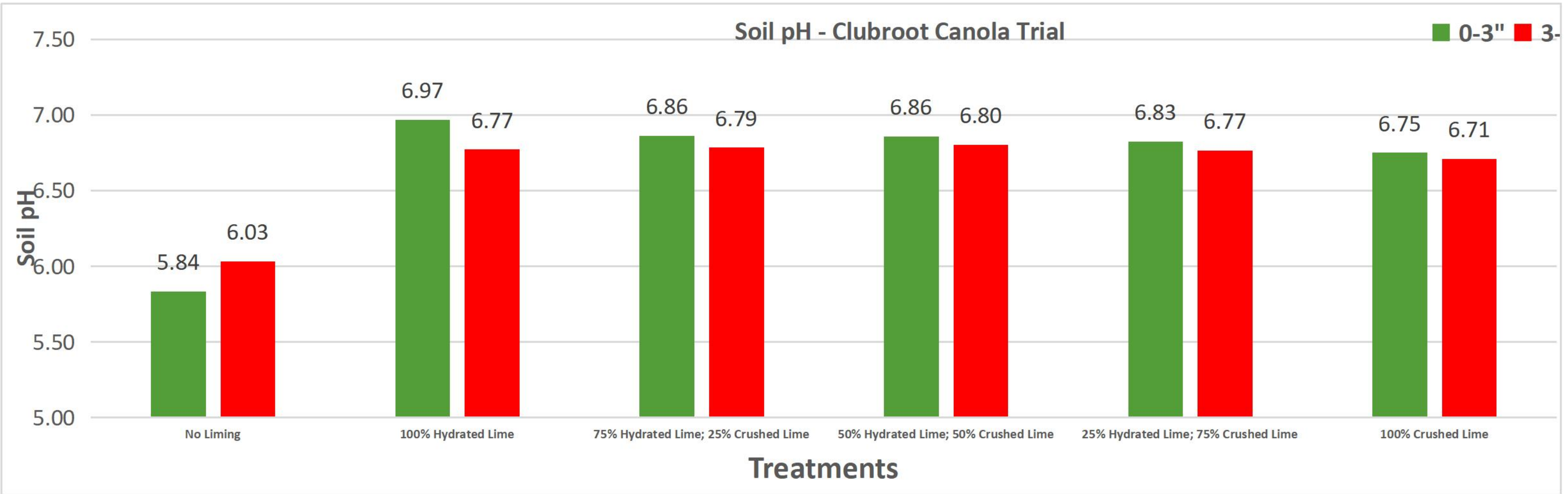
Canola		Yield % as compared to Control			
Treatment #	Treatment Name	Year 2020	Year 2021	Year 2022	Average of trial
1	No liming	100	100	100	**100**
2	100% Hydrated Lime	247	187	141	**192**
3	75% Hydrated lime + 25% Crushed Lime	158	175	140	**158**
4	50% Hydrated lime + 50% Crushed Lime	158	159	113	**143**
5	25% Hydrated Lime + 75% Crushed Lime	147	165	121	**144**
6	100% Crushed lime	132	164	127	**141**

Canola – Clubroot trial		Disease Severity Index			
Treatment #	Treatment Name	Year 2020	Year 2021	Year 2022	Average of trial
1	No liming	0.99	0.53	0.31	**0.61**
2	100% Hydrated Lime	0.77	0.17	0.12	**0.35**
3	75% Hydrated lime + 25% Crushed Lime	0.94	0.18	0.14	**0.42**
4	50% Hydrated lime + 50% Crushed Lime	0.95	0.24	0.14	**0.44**
5	25% Hydrated Lime + 75% Crushed Lime	0.98	0.20	0.19	**0.46**
6	100% Crushed lime	0.94	0.25	0.18	**0.46**

Graph: Average Soil pH Comparison over 3 years in crop rotation trials



Graph: Soil pH Comparison over 3 years in clubroot canola trial



Result and Discussion:

The lime application had a variable effect on the yield parameter in all three crops.

The overall average from 3 years of data at Westlock showed a 20% increase in yield with liming for wheat and peas achieved with 50% of each mix of Hydrated lime and crushed lime.

The most positive increase in crop yield was observed in Canola with liming treatment. There was up to a 92% increase in yield with 100% hydrated lime and a 43% increase with a 50% mix of hydrated and crushed lime.

In addition, the 100% lime treatment was significantly effective in reducing the clubroot disease severity compared to the control. The clubroot infection severity was delayed in lime-applied treatments as compared to the check. There was a significant reduction of 40% in disease severity index in 100% hydrated lime compared to control.

The soil pH increased slightly less in the yield trials, but in the clubroot site, it bumped from 5.84 to 6.97 in three years. In addition, results also showed that increasing pH has no negative impact on soil health parameters from year 1 of application compared to year 3. Although more soil health work especially the effect on the viability of the clubroot spores is still needed to be explored in future trials.

Acknowledgment: This project was funded by **Graymont, RDAR,** and Canadian Agricultural Partnership Program under the Adaptive Innovation Stream.

Impact of soil amendments on root-borne diseases, N uptake, soil health, and field crops productivity in four soil zones of Alberta

Background: The long-term application of inorganic fertilizers has resulted in serious adverse effects on the physicochemical properties of soil, such as the degradation of soil organic carbon (SOC) and soil acidification (Liu et al., 2020). Soil Acidification may affect adversely soil health, nutrient availability, and the composition of the root exudates, which attract soilborne pathogens and nutrient availability (Fukui et al. 1994). Over 90 percent of the acid soils in western Canada occur in Alberta (Agri-facts, 2002). It has been estimated that soil pH may be costing producers $100/ac due to lost production and fertilizer inefficiencies and that this problem may be affecting up to 20 million acres in western Canada (Elston Solberg, Advance, June 24, 2015). The main objective of this proposal is to assess and compare the impacts of soil amendments applications on root-borne disease, N availability, and productivity of peas and wheat with its economic impact on profitability. This project will generate soil zone-specific information critical to farmers about the use of biochar, Ag lime, sugar beet lime, and wood ash. Producers will be able to make informed decisions about the use/disuse of liming in their farming situation.

Soil amendments such as agricultural lime, biochar, and wood ash correct soil acidity and pH levels by neutralizing the acids in the soil so that microorganisms can break down the organic material that replenishes the soil. Biochar is a novel organic amendment that is a C-rich material formed by pyrolysis (heating) of biomass in an oxygen-limited environment (Chan et al. 2007). Sugar beet sludge lime and Wood ash may be two cost-effective choices for our prairie producers. It may be a suitable replacement for hydrated lime. Lupavie et al. (2009) estimated a $300 per acre benefit from applying wood ash on acidic soil during seven years of growing different crops.

Objective: To evaluate the effects of biochar, Aglime, sugar beet sludge lime and wood ash, root-borne diseases, N uptake, soil health, and field crops productivity in four soil zones of Alberta. This trial was conducted at BRRG (Galahad), CARA(OYEN), GRO(Westlock), and MARA (Vermillion). In the year 2021; Yellow peas (CDC Meadow) were seeded. The rate of each soil amendment product was 5.5 tons/acre. The same plots were seeded with AAC Wheatland VB (CWRS wheat variety) in 2022.

Agronomic Information

Seeded June 3, 2022

Seed Depth: $1^{1/4}$ inch

Rainfall recorded: May 15 to September 30, 2022: 219.5 mm or 8.64 inch

Fertilizer:

Seed Placed: 11-52-0 58 lbs/ac

6.4 lbs/ac Actual N

30 lbs/ac Actual K

Side Banded: 27.38-0-14.46-7.23 414.93 lbs/ac

113.62 lbs/ac Actual N

60 lbs/ac Actual K

30 lbs/ac Actual S

Curtail M 700 ml/ac June 18, 2022

Axial 500 ml/ac June 18, 2022

Harvested on: September 19, 2022

Treatment Name	Height cm	Yield		Protein %	Bushel Weight lbs/bu	Test Weight Kg/HL	TKW g
		Kg/ha	bu/ac				
Control	87	5319	79	13.5	69.0	85.2	35.9
Ag lime	86	5480	81	13.5	69.3	85.5	36.1
Biochar	86	5635	84	13.6	68.6	84.6	35.1
Wood ash	84	5779	86	13.5	68.9	85.0	36.6
Beetroot sludge lime	86	5639	84	13.5	68.5	84.5	35.7

Results from 2022:

Yield, protein%, bushel weight, test weight, and TKW are adjusted @ 13.5% moisture.

Acknowledgment: This project was funded by **RDAR** (Results Driven Agriculture Research). The project collected data in 2021, 2022 and 2023.

The detailed report will be shared with members once Battle River Research Group will have a complied report for all sites.

Applying humalite for enhancing wheat and canola production and soil health

Background: Humalite is a naturally occurring substance containing organic matter, high concentrations of humic acid, and low heavy metals due to its unique freshwater depositional environment. Large deposits of this product are in the holdings of Prairie Mines and Royalty ULC (PMRU) southeast of Hanna, Alberta. One of the main challenges of current agricultural practices is low nutrient use efficiency by crops (e.g., nitrogen) due to the loss of nutrients by leaching, denitrification, and volatilization. Previous research has shown that inorganic fertilizer treated with humic acid can significantly improve soil nutrient availability and fertilizer use efficiency, nutrient uptake, root growth, shoot growth, nutritional quality, and yield.

Objectives:

- Evaluate the effect of different humalite application rates on wheat and canola yield/quality.
- Determine ideal application rates of humalite in wheat and canola production systems.
- Evaluate the effects of different humalite application rates on nitrogen use efficiency in different soil zones and plant nutrient uptake.
- Assess the effects of humalite on soil health parameters. The goal is to identify the ideal application rate for humalite, and fertilizer quantifies how these rates affect yield in wheat and canola and the short-term effects on soil health.

The experiment was conducted at four different locations in Alberta. Here we are just presenting the Gateway Research Organization (GRO) site results. 45CM39 canola was seeded as a second-year test crop. Five humiliate application rates: 0, 100, 200, 400 & 800 pounds per acre, and three nitrogen fertilizer (urea) application rates: zero, and ½ the recommended rates and recommended rates were applied on canola. The humalite to be used have a particle size of 0.04 to 0.25 inches. Each treatment combination was replicated four times. Baseline composite soil samples, representative of each site, were collected for soil chemistry and selected biological and physical parameters. Crop height and leaf chlorophyll were measured at flowering.

Agronomic Information

Seeded May 25, 2022

Seed Depth: ¾ inch

Rainfall recorded: May 15 to September 30, 2022: 219.5 mm or 8.64 inches

Fertilizer:

Seed Placed: 11-52-0 58 lbs/ac

6.4 lbs/ac Actual N 30 lbs/ac Actual K

Deep Banded:

Full Rate of Urea: 32.76-0-10.28-5.14 194.56 lbs/ac

63.5 lbs/ac Actual N

20 lbs/ac Actual K

10 lbs/ac Actual S

Half Rate of Urea: 27.05-0-14.72-7.36 135.87 lbs/ac

36.75 lbs/ac Actual N

20 lbs/ac Actual K

10 lbs/ac Actual S

Zero Urea: No Deep Banded Fertilizer, Only Seed Placed

Glyphosate 270 g/ae/ac June 16, 2022

Harvested on: October 04, 2022

Recommended Urea Rate	Humalite Rate lbs/ac	Height cm	Spad Rating (Chlorophyll Reading)	Yield Kg/ha	Yield Bu/ac	Oil %	Bushel Weight lbs/bu	Test Weight Kg/HL	TKW g
Zero	0	86	45.8	3656	65	44.8	50.6	62.5	4.41
Zero	100	92	47.1	3710	66	45.2	51.5	63.6	4.32
Zero	200	102	46.3	3887	69	44.8	50.9	62.8	4.41
Zero	400	85	45.8	3693	66	44.6	51.7	63.9	4.46
Zero	800	89	46.0	3743	67	44.4	50.9	62.9	4.31
Half Rate	0	105	49.7	3918	70	44.6	51.2	63.1	4.21
Half Rate	100	97	47.7	4017	72	44.6	51.0	63.0	4.26
Half Rate	200	102	48.3	4039	72	44.5	50.6	62.5	4.31
Half Rate	400	102	47.4	4250	76	44.5	51.1	63.1	4.26
Half Rate	800	108	50.4	4043	72	44.7	50.7	62.6	4.36
Full Rate	0	111	50.4	4045	72	44.3	50.5	62.3	4.35
Full Rate	100	106	48.7	4074	73	44.3	50.8	62.7	4.36
Full Rate	200	108	50.8	4198	75	44.8	51.3	63.3	4.10
Full Rate	400	101	49.5	3957	71	44.5	50.8	62.7	4.20
Full Rate	800	116	54.4	4151	74	44.3	50.7	62.6	4.18

Table: Results of Humalite Trial – GRO, Westlock - 2022

Yield, oil%, bushel weight, test weight, and tkw are adjusted @ 10% moisture.

This project was funded by **RDAR** (Results Driven Agriculture Research). The project collected data in 2021 and 2022. The project will collect data in 2023 and 2024.

UNIVERSITY OF ALBERTA

RDAR Results Driven Agriculture Research

Producer Run Intercropping Trial

Co-operator: Colby Hanson

Objective:

1. To compare corn monocrop with corn intercrop in terms of forage yield and quality.
2. To improve the quality of the forage diet, and be able to meet the protein requirement of beef cattle.

Background: Corn intercropping with cover crops is an attractive option to beef producers in Alberta to help mitigate the effects of changing climate. Winter feeding costs are a major contributor to the overall cost of production for beef cattle producers in western Canada (Krause et al., 2013). Grazing standing corn is an option with great potential to extend the grazing season into the fall and winter months to reduce winter feeding costs (McMillan et al., 2018).

In addressing the shortfall in corn forage crude protein for beef cattle, producers can use crude protein additives (Damiran, Lardner, Larson, & McKinnon, 2016) or good legume hay (Krause et al., 2013) to supplement corn forage crude protein for beef cattle (Omokanye, 2016). However, this process adds extra costs to already expensive beef production. Corn intercropping with legumes or other annual crops is an option to consider for improving forage corn crude protein content (Dahmardeh, Ghanbari, Syasar, & Ramroudi, 2009) at minimal extra cost.

Table 39: Treatment List and Design:

Treatment Number	*Acronym*	*Treatment Name*
1	C-M	Corn monocrop
2	C-P	Corn intercrop with field peas
3	C-C	Corn intercrop with cocktail mixture
4	P	Pea monocrop
5	C	Cocktail mixture

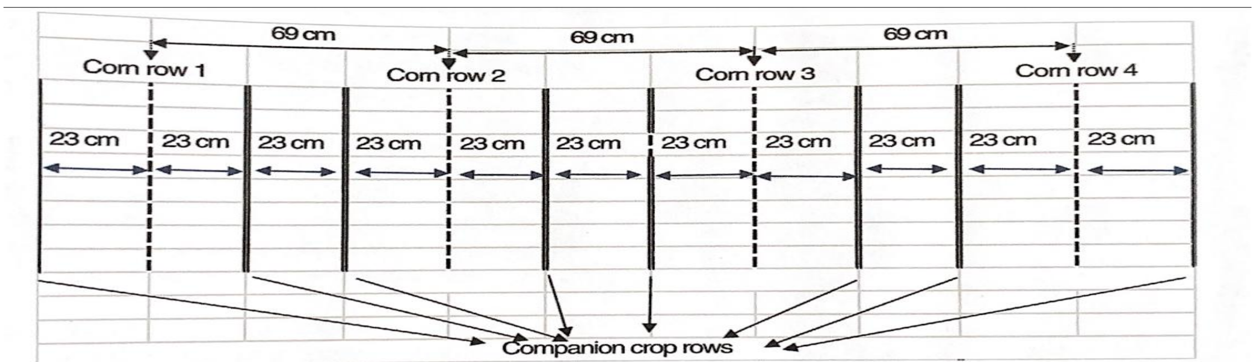


Table 40: Results and Discussion:

	Yield (tonne/ac)	*Crude Protein*	*TDN*	*Calcium*	*Phosphorus*	*Potassium*	*Magnesium*	*RFV*
CORN MONOCULTURE	11.37	4.11	34.61	0.12	0.08	0.62	0.06	143.71
CORN + PEAS MIX	13.93	5.11	32.97	0.08	0.15	0.75	0.08	111.54
CORN + COCKTAIL MIX	13.45	3.03	31.66	0.08	0.06	0.38	0.05	146.68
PEAS	2.01	12.6	64.93	1	0.18	1.49	0.18	137.55
COCKTAIL MIX	3.37	13.06	61.14	1.34	0.21	3.11	0.27	164.59

From this table, it is notable that corn with peas mix appears to yield better than the other two options. On the other hand, corn and polyculture (cocktail) mix seems to have better relative feed value. Future replicated trials of this nature would be required to verify these apparent results.

Acknowledgement: The current project is funded by Canadian Agricultural Partnership Program under the Adaptive Innovation Stream.

Demonstration Pasture Setup for Showcasing Continuous vs. Specialized Grazing Cell Designs, Fencing, and Various Watering Systems

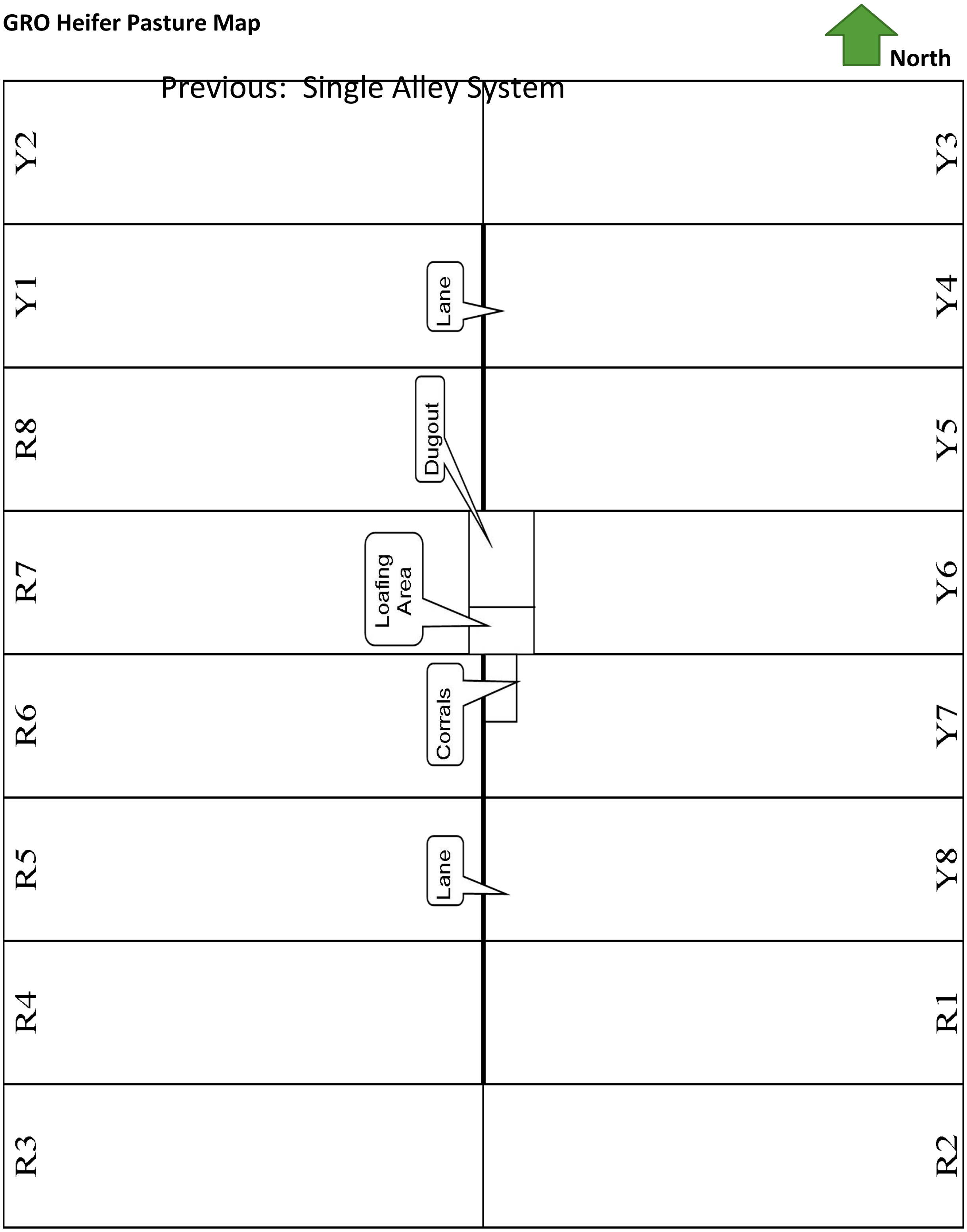
Abstract

One of the biggest challenges for Alberta ranchers is to manage the ever-shrinking land base available to them in such a way that both pastures and the land remain healthy, productive and sustainable for future generations. Despite the considerable amount of research and scientific proof available relating to land and herd management, the adoption of improved management is still limited by an inability to foresee the impact that new changes in practices would have on cattle production, grass production for overall economic returns and resource management on the ranch. Producers can read about a lot of management strategies that are already proven to be helpful in increasing the bottom line (profit) for their operation; however, it is almost impossible to believe in the applicability to their own operation unless they see it beforehand and can analyze the pros and cons of each grazing system, water systems, styles of fencing, and their impact on overall grass production.

History & Field Design

The pasture was established in 1979 and was originally used for steers. In 1988, the first heifers were put into the pasture and have remained ever since. The 160-acre pasture is split into 16 paddocks; approximately 10 acres each. There is a central watering/ loafing area as well as a handling facility. The perimeter is fenced with 4 double strand barbed wire, and cross fencing is done with 2 single strand barbed wire that is powered with a solar electric fence. Each paddock is rotationally grazed to allow alternate periods of grazing and rest. If managed properly, these rest periods allow the grass a chance to replenish nutrients after defoliation and, therefore, increase grass production. In a continuous grazing situation some forage resources are continually stressed (no rest); while others may be underutilized as the animals will repeatedly graze the most palatable species. In this situation the preferred species will begin to decline and less palatable species or weeds will begin to dominate the pasture. The existing pasture layout is single alley system. (See schematic diagram on next page).

GRO Heifer Pasture Map



Objectives

- Demonstration of practical applicability of different types of cell design strategies used in rotational grazing systems.

- Demonstration of different types of fencing materials and watering system site locations and types to best fit with different types of cell design patterns used in rotational grazing systems.

Methodology

We aim to develop the current Heifer Pasture into a site for future research and as a demonstration center for producer learning activities. With the "GRO Educational Pasture Demonstration" project we aim to showcase how to make sustainable grazing choices for producers not only in our community, but with an applicability to the entire north central Alberta region. The different types of cell designs will prepare producers to tackle drought situations as well as higher moisture situations, which have been two of the most common challenges in the last 10 years for producers. (See schematic diagram of the proposed upgraded changes on next Page).

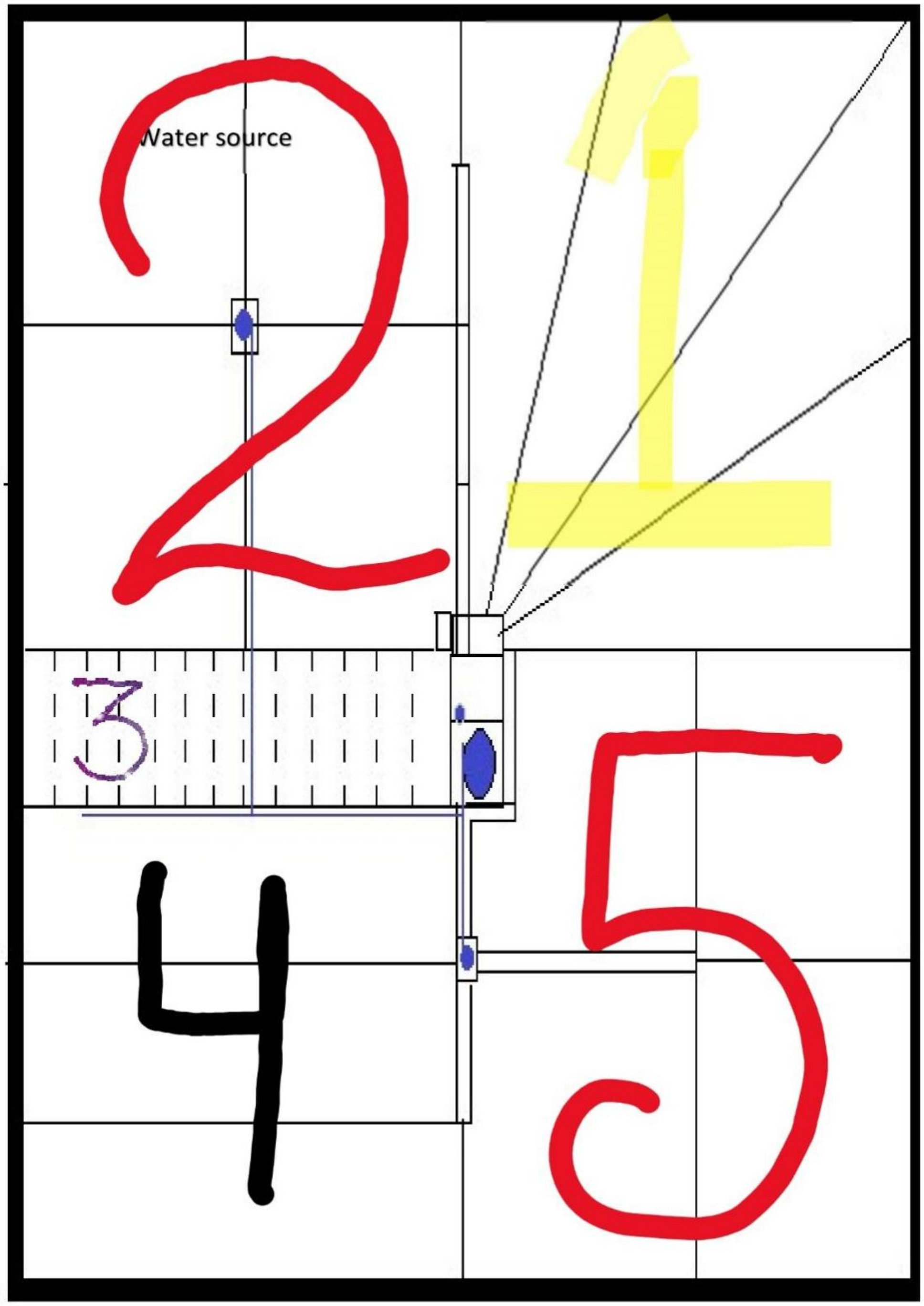
When water holding capacity in pasture lands is enhanced, a producer's ability to mitigate severe weather patterns increases, either by retaining effective rainfall, or by having enough ground cover to avoid erosion from large rainfall events. By seeing first hand the different effects that differing cell designs have on the land, producers will be able to make informed decisions on their own operations.

The Heifer Pasture was previously set up to showcase just one type of cell grazing system. It used a common alley as a walkway to access different paddocks and a central water system. This system is great except in situations of higher rainfall. With low lands, the continuous use of the alley by the animals created problems for the animals (hoof rot, difficulty accessing water, more time spent near the water and less out grazing), as well as the land (compaction in the alleyway).

Based on different topographical situations, a producer may have to make use of more than one type of grazing cell design and subsequently would need to change their current fencing arrangement in order to minimize the damage caused by the formation of livestock walking trails.

North

Proposed Cell design systems for demonstration at GRO: Five different Cell Design Demonstration and three different watering systems.



We want to set up this demonstration of different grazing cell designs to showcase different possible situations so that producers can easily see the pro and cons of each system and what would work best on their own operation without taking a financial risk that would be involved with upgrading the whole farm, based solely on theory.

1. **Wagon-Wheel or Pie System:** The benefit to this system is that it is very cost effective and less laborious to operate. Flexibility of movement is pretty good with this system as all of the paddocks funnel nicely to the central watering area. The paddocks end up being long and narrow, which again tends to cause uneven utilization and bit of overutilization at the hub, or center of the system.
2. **The Square Cell Center System:** The square paddocks allow for more even utilization of the forage and provide good manure distribution. In some cases, where there is no existing water pressure system, it can be costlier to put in. Installation of a more permanent system keeps the fencing cost low and requires little labour in cattle movement.
3. **Portable or Strip Grazing Method for Mob Grazing/High Intensity Grazing**: Grazing for a very short duration with high stock density followed by recovery periods mimics the historic prairie grazing patterns of American bison. This system facilitates uniformity of the pasture for grass utilization, manure spread and a very effective way to control weed species. In this system, there are three permanent fences, and one moving portable fence which creates multiple long rectangles across the pasture. The portable fences give you flexibility on the size of each paddock based on number of animals and allows access to new grass each time that you move the fence. A disadvantage of this system is that it is very labor intensive and producers need to invest time in order to train animals to electric fencing.
4. **Continuous Grazing System:** Continuous grazing has been the traditional way to graze cattle throughout generations. In this system the cattle graze a pasture for an extended amount of time with no, or infrequent rest to the plants from grazing. The biggest advantages to this method are low fencing cost, low daily management requirements, and when stocking rate is correct, acceptable animal gains. This method is unfortunately the most common currently practiced and through current research studies is showing to negatively impact soil health. It also promotes the growth of weed species over time, as the animals pick their favorite plants to graze and leave the weed species to become prolific. Continually grazing a pasture with too many animals, or in year with slow forage growth, will lead to reduced forage availability, quality and animal growth.
5. **The Rectangular One Alley System:** This system is quite common and is relatively inexpensive to set up. A benefit to having rectangular paddocks is that the shape of the paddock makes a bale grazing setup easy. One of the downsides to the alley system is the excess manure and urine that ends up in the alleyway. Also, based on how intensely you manage the long rectangular paddocks, they will usually become over utilized closest to the water and underutilized at the far end.

Water systems

Proper use of fencing and water systems to manipulate the grazing requirement and efficient distribution of manure. Our demonstration pasture will have different types of temporary and permanent watering systems that can be used as per the producer's requirements, keeping land constraints in mind. Using resourcefulness and creativity, these water systems can be custom designed to best fit long or short term profitability of the ranching operation. Some examples that we would be showcasing are:

- Turkey's Nest: Elevated earthen reservoir with woven polyethylene liner
- Gravity-flow systems
- Solar-powered or gas-powered pumping systems
- Well based system
- Above ground pipeline

This demonstration will be showcasing economically and environmentally feasible grazing management practices to promote health, safety and welfare of animals, as well as the lands that they live on for future generations.

Possible Outcomes

- Increased productivity of pasture will increase the beef production which in turn will reduce the cost of production per kilogram of beef.
- Reduction of the labor required for handling more livestock will increase the carrying capacity and increase the labor efficiency in term of production of the same amount of beef.
- Healthy productive pasture with proper grazing management will have less weed pressure, more biodiversity above and below the pasture land (i.e microbes, insects, earthworms etc.).
- To demonstrate that grazing cattle has the potential to be both economically and environmentally sustainable.

Heifer Pasture Comparative Soil Report 2022

2022 was another interesting year, and again the Heifer Pasture produced well, considering the weather conditions. As reported elsewhere in this report, stocking rates continued to increase despite the weather. Pastures were left in with an adequate amount of residue and in good shape for 2023. Rotations remained the same in 2022 with a second year for mob grazing, two rotationally grazed pastures and one continuously grazed paddock. Soil samples were taken to determine if there was any impacts that could be determined from these different systems.

This is the third year for soil and microbial analysis of the heifer pasture. Continued points of interest for the physical, chemical and biological aspects of the pasture soils are as follows:

Physical Changes:

- Changes to the physical structure of the soil include infiltration, penetration, organic matter and bulk density. Differences in infiltration evened out in 2022, possibly due to better conditions early in the year followed by relative dryness in all paddocks. Organic matter and bulk density of the second rotational pasture seemed to be outlying numbers, are different than the past year, and are not easily explainable. Further analysis is required in the future to determine why these figures were so different or if there was just some error in sampling or analyses.

Chemical Observations:

- The pH or acidity of all four pasture soils has increased somewhat, bringing the most acidic soils into a healthier position. Changes of two full pH points in a year as evidenced in the continuous and mob grazing pastures speak to the likelihood of differences other than true soil changes and these will have to be investigated further in subsequent years.
- Available phosphorous is one macronutrient that appears to be low across the board, and no replacement is obvious for it again in 2022. Natural breakdown appears to be slow or even inadequate for replacement to meet the full needs of the pasture plants, but this warrants further investigation.
- Potassium figures seem to have decreased across all pastures in 2022, perhaps to reduced organic matter breakdown in dry conditions and little mineral soil replacement.
- Most sulphur figures have increased in 2022. An explanation for these increases is not yet forthcoming and continues to call sampling or analysis into question.
- Most micronutrients appear to be in adequate supply and are not as yet impacted by paddock management again in 2022. Boron levels have appeared to increase markedly and further investigation is required for this micronutrient.

Biological Observations

Continued observations of the biological nature of the soil have brought forward the following points:

- The rotationally grazed field in general appear to have the most balanced, acceptable biological numbers and ratios across the board in 2022.
- Many mob grazing estimated biological numbers and ratios are declining in 2022, possibly leading to the conclusion this intensive pasture management system might not be the best for soil biology. Pseudomonas, Gram-negative bacteria, soil anaerobes, and total microbial activity are all down in mob grazed soils, for example. Further study will be required to see if these are a series of outliers in the mob grazed pasture or whether there are some concerns for the biology of the mob in a very intensively grazed situation.
- A number of estimates and ratios are also decreasing in the continuously grazed pasture in 2022, it seems. The continuous stress put on plants in this grazing system might account for the impact on microbial populations.
- A large number of outlying figures or unusual changes in microbial populations have oddly occurred in 2022. We are unsure if these outliers are environmental or analytical in nature and need to be further studied in 2023.

Generally speaking, it appears as if the soil microbial population are still improving in the rotational paddocks and have checked in the mob grazing field in 2022, compared to the continuously grazed one. More observations, perhaps in a broader or more replicated scale, as well as continued assurance on the accuracy of sampling and analysis, will be required to understand the full impact of different management regimes on pasture soil health. The actual extensive table with theses figures contrasted and compared is available from the GRO office upon request.

GRO- leased pasture as an educational setup for showcasing Rotational grazing cell designs, Fencing, and various watering types

We had a series of Video on YouTube Channels to make learning accessible.

- **Grazing Research *Westlock, AB* with Sandeep Nain**
  - https://youtu.be/Yu4AmiE01pI
- **Heifer Pasture Project Update - June 2022**
  - https://youtu.be/rUlq1V48Itw
- **Mob, Continuous and Rotational Grazing - GRO Heifer Pasture Project**
  - https://youtu.be/udAsh9VB_zo
- **Mob Grazing Basics at the GRO Heifer Pasture**
  - https://youtu.be/UBdJPKLgPdA
- **Cell Design & The Heifer Pasture Project**
  - https://youtu.be/yZSVc18oa0Y
- **Heifer Pasture Update with Tom Krawiec**
  - https://youtu.be/0eSntPPEVec
- **Early Entry Days - When to Start Rotating Cattle**
  - https://youtu.be/meoBkLmpnyM
- **Fencing Tips and Tricks with Tom Krawiec**
  - https://youtu.be/TJ8H_t3hrQM

Soil Conservation Analyst Report

Introduction: The Soil Conservation of Marginal Land initiative has come a long way from where it started two and a half years ago, and there are a lot of learnings to date. The initial premise was to use one producer's land as a demonstration farm for techniques to promote productivity and a positive economic return on poorly producing marginal soils. This was quickly found to have too high a risk for one individual to bear, and the ability to fully analyze the economic impact of these changes was unlikely to be realized in the short term of this project. Additionally, we discovered that even marginal land, when treated in an appropriate manner, can be both productive and profitable. That manner includes reduced tillage, appropriate fertility, adequate rotations including pulses and forages, careful pest management and minimal traffic to manage soil compaction. The project is still working on discovering which types of soil amendments could also have a positive impact. So, with these learnings, GRO continues to work on individual project which can have positive impacts on marginal soils rather than attempting a whole-farm approach. Many of those projects are reported elsewhere in this report, but some of them involve propriety products or have not been able to be conducted in a manner that could result in valid, reportable conclusions. Some of those trials are discussed in general terms in this summary.

Foliar Nitrogen Fixation:

Increased emphasis has been placed on minimizing farming's greenhouse gas footprint, especially when ensuring adequate fertility. Being able to produce nitrogen from the air right in the field would help to decrease greenhouse gases very effectively, through the reduction in greenhouse gases such as:

- Carbon dioxide through the creation, distribution and application of granular fertilizer,
- Methane through the gassing off of traditional fertilizers when applied in certain ways,
- Nitrous oxide, a powerful greenhouse gas emitted during some fertilizer applications.

A number of large companies are marketing biological products that purport to trap atmospheric nitrogen usable by the plant. There was a great deal of interest in these products in 2022. Many large and small scale trials of bacteria which, when applied to the leaves of cropping plants take atmospheric nitrogen out of the air and deposit it on plants for their use. The most common type of trial was to have these products applied to crops that were fully fertilized prior to seeding. Many of these trials and demonstrations did not show any significant differences in yield. This was in fact the case in one trial supported by GRO, where fully fertilized fields had these biological products applied at the proper stage. No differences in yield, bushel weight or protein content was seen in wheat or oats. Neither did the soil samples show any nitrogen sparing as a result of the application.

Other, small, replicated plot trials were conducted on canola and barley, but in these cases, required spring applied nitrogen was reduced by 15%. A biological foliar nitrogen fixer was applied at roughly the four-leaf stage to attempt to make up for that nitrogen reduction. In the end, no significant yield reduction was identified in these replicated trials, neither was there a reduction in protein content or soil nitrogen. So, it is possible these results point to the scenario of nitrogen fixers actually working only when there is a shortage of nitrogen in the growing plant. Further research and investigation of these foliar nitrogen fixers is definitely required to either determine if they actually do spare the nutrient demand or whether we need to look elsewhere for means to reduce the greenhouse gas footprint of current agriculture.

Pest identification and comparisons

Over the course of the season, a wide variety of insects and diseases were scrutinized, some of these observations were supporting the soil conservation initiative. Soil microbes were observed and compared over a wide variety of soil types and production practices. Crop pests and diseases were also observed under these circumstances, where we concluded through these tests that improving soil health while maintaining a viable soil microbe population may also have an impact on harmful microbes and pest larvae. Of course, further work on this would be required to validate these discernment.

Another study compared insect and disease infestations in mono versus poly-culture in small, plot-sized plantings. Again, no immediate significant differences were observed when comparing same species under the two planting regimes. In many cases, insect populations and disease infestations were low in both plantings, so whether inter-cropping has some local ability to protect susceptible crops has yet to be determined.

Insect pests were also observed under a variety of tillage regimes, and again with most pest populations being low in 2022, no clear determination could be made between the amount of tillage done and the level of pest infestations in the field. Further and more detailed studies would need to be conducted to determine if actual differences among tillage regimes can be identified.

These and a number of other insect pests and diseases were observed and analyzed in through the perspective of marginal land sustainability. Continued studies will occur to help advise producers on the best procedures to consider for marginal land.

Perennial Cereal Demonstration:

This was the third harvest year for the perennial cereal demonstration.

ACE -1 perennial rye struggled in 2022. The stand looked weak, harvest was low, and the crop was badly affected by ergot. Did the florets stay open longer due to the dry conditions at the time, was the nutrient levels so low the plants were over stressed and could not easily mature, or were there other, as yet undetermined considerations in play? Soil tests in the spring may indicate if some attempt at fertilization, broadcast or midrow banded, may be of value. Plant health studies may also be of value mid-season, including observations of tiller numbers, plant height, etc. Discussions with producers who also have had long-term seedings of Ace-1 have also noted a reduction in plant vigor and an increase in ergot in the third year of harvest.

Perennial wheat: The Kernza perennial wheat continued to produce an excellent stand, thick, tall and green, and while the bushel weight continues to be marginal, the yield in bushels was maintained in a difficult year. So, while there may be a need for continued breeding, particularly locally, the surprising hardiness and growth of an intermediate wheatgrass outcross to produce a perennially growing cereal may best be represented by wheat rather than rye.

Soil Insecticide Treatment

2022 turned out to be a bad year for various species of cutworms in annual crops. Some fields were over the action threshold and required treatment. There was a concern that the strong insecticides needed for control of cutworms may have an impact on the overall biological health of the soil, so samples were taken and analyzed for estimates of biological condition. Paired analysis was done for 12 soil health indicators, and it did not appear that there was a long-term impact on the soil biota, with 7/12 of the factors listed as higher for the insecticide treated field, and an average of 10% more favorable indicators in that portion of the crop's soil. These paired, benchmark soil samples were taken about a month after the application of a soil-based insecticide, so it does not appear as if the treatment had a short- or long-term effect on soil biota, and that soil-based insecticides can be applied without concern for soil health. It was not possible, however, to conduct a complete survey of non-target insects or other fauna to see if any impact from the use of an insecticide had an impact on them. Increases in cutworm populations often follow a several-year cycle, so time will tell if this is an ongoing concern for soil and faunal health, but for the time being, decisions on economic thresholds on cutworms will not have to include a consideration of the impact on soil biota.

Hemp production

To assist with the Organic Alberta tour and conference, plots of hemp were planned, replicated and seeded, using a variety of organic seed treatments and two varieties to show the state of current hemp production and how producing it in north central Alberta is impacted. There was a great deal of learning and demonstration from these plots, as hemp was seen to be a crop of great interest in 2022. Despite the later seeding date and difficult growing year, the two varieties of hemp, one strictly for seed, the other more of a dual-purpose variety. Both varieties produced an adequate plant stand, growth height and seed yield, regardless of the biological seed treatment used.

There was considerable private contract research conducted to be on the cutting edge of growth, nutrient supply, crop production and agricultural protection. This contract research was started, effectively completed and reported. Work such as these projects not only kept GRO's research skill at a top-notch level, but also enhanced our reputation at a local, provincial and national level while having a positive impact on the organization's bottom line. The Soil Conservation Analyst was pleased to participate in many of these private research projects while ensuring the financial situation remains as favorable as possible. Several other projects were conducted to enhance our knowledge of sustainability for local soils, many of which are reported subsequently in this report.

Cropland Versus Pasture Soil Analysis Year Two

Year two of comparing pasture versus cropped soils was no less unusual than the first year of these paired soil analyses. Adequate moisture in the springtime led to very dry conditions in the summer and into the fall when these samples were retaken in GPS samples of a split quarter in the County of Barrhead. Upland and lowland sampling of crop, now converted to alfalfa hayland, and long-term pasture was conducted in September of 2022, and samples sent to A & L Labs. Comparisons were made to other corresponding areas of the field and to the past year, with the following results:

Physical Structure

Fourteen pressure penetration observations were taken at each of four locations then averaged out again this year. Soil penetration results were virtually unchanged compared to 2021 results, except that with the additional hardness due to recent dry conditions, all attempts to push the probe into the ground at all locations reached 200 pounds of pressure at 2 inches. And while the difference has reduced at reaching 300 pounds of pressure between the pasture and crop land soils, it still appeared that the pasture soils were more difficult to penetrate than the cropped-forage soils.

Despite the dryness of the soils, water infiltration rates were increased in all instances save one. The crop upland infiltration period was less than a minute, down from several minutes the year before, indicating that the infiltration reading might have accidently been place over some form of a soil fissure, but the other samples were into the 15-19 minute range in 2022, indicating that this reading might have much more to do with environmental conditions than soil quality changes.

Soil Chemistry

Soil samples were analyzed from 14 six-inch-deep soil cores per soil type. The pasture soils still had higher organic matter percentages, but most of the organic matter ratings decreased, surprisingly. Soil acidity levels, based on pH assessments were virtually unchanged, with pastures being near neutral and the crop-forage field being near 5. The pasture fields continued to have higher season available N, and most of the other applicable nutrients were quite unchanged as well, reflecting potential applications and crop removals. Calcium remained in a similar pattern to previous years as well, higher in pasture samples and low in the formerly annual cropped areas. Base saturation of most nutrients did not seem to be problematic in any soil. Copper, continued to be higher in the cropland samples, possibly due to past supplementation but boron was higher in pastures and very low in formerly cropped soils, indicating a potential need for supplementation in the future. Aluminum levels were also higher in the cropped samples, but saturation levels remain low, indicating there is not currently a reason for concern.

Biological Analysis

Biological analysis of soils is the most direct mechanism of assessing soil health through a variety of environmental conditions, but as the soils continue to regenerate, a study of the changes in soil biota help to indicate overall microbial condition And while A & L Labs ViTellus program only provides estimates of the soil biota based on non biological calculations, it is based on extensive research and observations, and can be seen to be reasonably valid enough of the time that we can base our discussions on these calculation. Some of the continued apparent differences in soil biology are:

- Anaerobic bacteria appear to continue to be higher in both lowland samples. A spring with adequate moisture would continue the trend of waterlogged soils where bacteria not requiring oxygen would thrive. As was mentioned previously, this is not necessarily a sign of poor biology but rather one of topographical variability.
- Gram-negative bacteria still seem to be higher in the pasture samples, regardless of topography, and in 2022 the lowland areas seem to have greater Gram-negative bacterial concentrations than their upland counterparts, which would make sense with greater moisture availability producing more bacteria.
- Nitrogen fixing bacteria appear to have evened out between the pastures and the former cropland in 2022, likely a result of the recent growth of alfalfa in the cropping area, with its symbiotic relationship with these bacteria. This is an indication that at least some biota associated with soil health could be rapidly enhanced with the right crop seeded, reducing the need for applied nitrogen fertilizer.
- Overall bacterial activity seems to be generally down right across the board, in 2022, likely a result of ongoing dry conditions having an additive effect on the soil biota. This trend will be a concern if dry conditions continue. Despite this, the overall biological quality ratings appear to be improving across the board, likely having taken the dry conditions into account when assessing this rating.
- Pseudomonas species ratings are all over the map in 2022. Pasture ratings both remain high, while the lowland crop rating is up and the upland crop rating is down. This might be in response to the inclusion and more rapid growth of forages in the formerly cropped lowland area, but continued observations will be required to confirm this.
- Trichoderma have decreased in the lowland pasture but increased everywhere else. The reason for these changes may become clear with more future observations.

- Active carbon, while down across the board in a dry situation, appears to be evening out between the former cropland and the pasture, potentially indicating the inclusion of soil building legumes may help to rejuvenate a tired cropped soil.
- General rhizobia species appear to be down across the board as well, but the lowland crop-forage area appears to have its population more closely mirroring the pasture numbers, again possible indicating the benefit of forages in a rotation where there is at least some moisture in some of the season.
- Lowland crop-forage Gram-positive bacteria numbers seem to be approaching those of the pasture samples as well, again potentially indicating a return to greater soil health in the presence of some early season moisture. Hopefully, the formerly cropped upland areas will see their Gram-positive numbers rebound in the presence of adequate moisture throughout the season in 2023.
- Total bacteria numbers also appear to favor the pasture samples while the lowland area is increasing to match the pasture figures. This adds extra credence to the theory that, with at least some adequate moisture in season, cropland can have its soil health increase as forages are included in the rotation.

As in 2021, more detailed, numerical picture of these results can be obtained by contacting the GRO office. There appears to be a trend that forage growth is helping to improve the biological health of formerly cropped soil, but continued benchmark sampling of this quarter will help to confirm this over time.

It has to be reemphasized these results are unreplicated and statistically unsupported, but they certainly appear to point towards an interesting trend of forage cropping and some periods of adequate moisture improving the biological health of soil while doing side-by-side comparisons of a cropped area returned to forages. The capture of nitrogen, storage of carbon, and creation of stable soil aggregates in the new forage area may help direct greenhouse gas reduction strategies in the future as further observations are conducted on these and other similar situations.

Impact of Anhydrous Ammonia on Soil Microbes, 2022

With the large jumps in fertilizer prices, anhydrous ammonia remains a popular, efficient, cost-effective means of applying nitrogen fertilizer. Dry conditions may affect its efficacy, but a knowledge of that and care to ensure proper placement and post application packing ensures it remains one of the best means of applying this necessary nutrient. Our soil tests in 2021 seemed to indicate there was not long-lasting impacts of regular anhydrous applications in field situations, but what that a one-off situation? As environmental conditions vary does anhydrous have a deleterious impact on the microfauna of the soil. Continued sampling of paired fields, one with yearly applications of anhydrous, one with more conventional applications of fertilizer were again compared to determine if the health of soil with anhydrous ammonia applied is maintained over the years.

On October 13, 2022, soil samples were taken from two adjacent fields in the County of Barrhead, one which had had regular applications of anhydrous ammonia (**the AA, anhydrous ammonia, field**) and one that did not (**the NAA, no anhydrous ammonia field**). Only a single set was able to be sampled again in 2022, so that any statistical analysis is still inappropriate, but continued differences may strongly point to trends of soil composition. The AA field had a canola crop in 2022, and the NAA field had a hemp crop. Both crops are known to be high nutrient users and non-nitrogen fixers. The AA field was maintained as a reduced tillage regime, and the NAA field had a more conventional tillage program. In addition to the benchmark soil tests taken for chemical and microbial analysis, the following physical analyses were continued in both fields:

- Penetrometer readings to determine the depth to which 200 and 300 lbs of pressure on an instrument will go into the soil.
- Bulk density samples, which a known dry volume of soil for each field were roughly analysed at the GRO facility for unit dry weight per a specific volume.
- Infiltration, the time it takes a known volume of water to get absorbed by a set area of soil down a metal cylinder with an open bottom.

From these physical analyses, there were only slight differences noted. This year, the AA field could be penetrated deeper but both fields were harder to penetrate in 2022, likely due to late season dry conditions. The NAA soil is slightly more dense, possibly due to lower organic matter, and the AA soil had faster water infiltration, possibly for the same reason.

Impact of chemical tests conducted on these fields include organic matter, pH, a number of nutrients and base saturation percentages. Potential differences derived from these tests include:

- A pH that is very slightly lower in the AA field (5.9 versus 6.0 in the NAA field) , but when the 2022 analysis is taken in isolation, a .1 pH difference would not be considered statistically different.

- A 27% higher organic matter content in the AA field in 2022, possibly still due to the rotation and tillage regime.
- Continued high levels of most macronutrients in the AA field in 2022, likely due to continued supplementation with granular fertilizers in addition to the anhydrous applied.
- Micronutrients, cation exchange capacities, and base saturation differences continued to bear a great deal of similarities between the two fields, with nothing outstanding to report in 2022.

While most of the microbial analyses are calculated figures in the A & L Lab analysis, it is based on a great deal of research and reflects determinations of markers that the lab determines to be indicative of various populations. In 2022, there appeared to be the following differences:

- The trichoderma population took a big jump in both fields, but the population in the AA field was determined to be much larger and considered to be high by their ratings, and as soil improving fungi may have long-term beneficial impacts for the AA soil. The increase in both soils could be partially due to time of year and environmental conditions.
- The active level of carbon appears to be higher in the AA field, but the CO2 respiration number is quite similar in the two fields, possibly indicating a more active microbial population in the NAA field, but similar in the release of greenhouse gases at the time of sampling.
- The AA field has an edge in the total microbial activity, being 17 % higher than the NAA field in 2022, but surprisingly the biological quality rating for the NAA field went from a 3 to a 5 while the AA field rating stayed at 4 for a second year. More study will be required to understand the significance of this.
- Rhizobium populations appeared to have leveled out to similar levels in 2022, likely as a result of being two years out of a pulse crop.
- The general fungi numbers have also leveled out to similar numbers, but both numbers are still considered low for these post-harvest samplings.
- Gram-positive bacteria still appear higher (23%) in the AA field in 2022, possibly indicating a more hardy, robust microbial population, able to withstand a changing environment.
- The estimated pseudomonas levels also appear similar in both fields, while some of the pseudomonas/nutrient ratios have changed likely due to fertility additions.
- Gram-positive/Gram-negative ratio are still listed as low in both fields, while a numerical improvement is noted.
- The overall biological index tends to favor the AA soil, while the microbial sustainability index is virtually identical between the two fields in 2022

Conclusion:

It is still inappropriate to state any conclusions from this survey of fields over the years, since we do not have any appropriately controlled trials and replications, it is still encouraging that it appears there is not an immediate, serious, deleterious impact from using anhydrous ammonia in field applications. With the overall biological index still appearing to favour the AA field, the confidence in the relationship between anhydrous application and in-field soil health is increasing. It is not an easy task to find fields sufficiently similar to make comparisons such as these valid, but if we cannot have replications by fields, perhaps we can rely on repeat observations over time. With those replications over time, and a continued similarity between fields that have anhydrous applied and those that do not, confidence in the assertion that anhydrous ammonia does not have a long-term, negative effect on most soil biota hear in north central Alberta will increase.

Summary of Differences Between Bale Grazed and Non-Bale Grazed Areas 2022

Areas where bales are grazed are a distinctly different colour throughout the grazing/haying year (photo from Sangudo area, 2021).

Bale grazing is the practice whereby bales of hay or silage are strategically placed for cattle to consume over the non pasture season. There are many options in this practice, whether it be managed to only a few eaten at a time over a small, intense area or a more extensive open system not involving any temporary fencing. Regardless of the actual practical application of this technique, bale grazing can have some longer-term impact on the soil, its nutrient concentration, and its living soil microbes. Years after bales have been grazed, there is still a visible difference in the growth of the forages in those areas. They often appear to be greener and, in some ways, healthier than the surrounding areas. We have wondered whether this visible difference is due strictly to the additional nutrients deposited there from the feeding process and the bale itself, or whether there is some alteration in the soil microbiome in addition to the soil nutrient content. A multi-year observational study is being conducted to attempt to determine the impact of bale grazing on soil biota.

In 2021, soil samples were taken in a hayland near Sangudo, Alberta. These samples were taken in a location where it was obvious a bale was placed for grazing in the winter of 2020-2021. A paired benchmark sample was also taken in a soil nearby. These samples were GPSd for future reference. In addition, samples were taken in an area where the intent was to bale graze in the winter of 2021-2022. A spot was sampled and flagged for the placement of a bale to be grazed. A nearby spot that was not to have a bale placed on it was also tested to act as a control (known as the “ungrazed areas”). The bale grazing did occur in the winter and samples were taken and sent to the CARA Soil Health Lab for analysis.

Physical Analysis

Many physical or soil structural attributes were measured in the grazed versus non-grazed comparisons. The results obtained are somewhat inconsistent. The soil aggregate stability was rated slightly lower in the originally bale grazed area than the non grazed neighboring one but in the newly grazed area it is the opposite by a similar factor, and the stability is higher after grazing than before. A similar pattern was established in the water infiltration rate, with a more rapid one in the in the original bale grazed area than the ungrazed one, and a much slower one in the recently grazed area than the neighboring ungrazed one. Even the bulk density was unusual, with the that figure of the originally bale grazed area being denser and more mineralized than the neighboring ungrazed area, another change from the previous year's analysis, but the recently grazed area was, as expected less dense than the ungrazed neighboring area. Even the physical characteristic of soil penetration seems confusing, with figures for soil depths at a certain number of pounds of pressure being shallower for both of the bale grazed areas being shallower than the neighboring ungrazed averages. These physical measurement comparisons are quite counterintuitive and bear further study. Does the original concentration of high microbiotic organisms have even more activity than normal in the bale grazed areas, actually bringing favorable levels of various indicators down even further than the originally ungrazed areas? Having more established sites of bale grazing starting in the winter of 2022-23 will be helpful to further understand the impact of bale grazing on soils of marginal lands.

Chemical Results:

The area that was bale grazed in the winter of 2020-21 still appeared to be greener nearly two years after, in the fall of 2022. Some of the chemical analyses, however, were back down to a level like the non grazed area, which makes one wonder if the results were rather ephermeral or the sampling or analysis was not 100% accurate. Regardless, some of the chemical analyses of that area and the comparison of the area bale grazed in the winter of 2021-22 are:

- Organic Matter: 20 months after bale grazing, the organic matter is the same between the grazed and non-grazed areas; one grazed area was even lower than the nearby non-grazed area. This might be indicative of the short-term nature of the benefits bale grazing, some inaccuracy in the 2022 collection or analysis or simply the nature of the environment or location involved. The locations where the bale grazing occurred in the winter of 2021-22 followed the original pattern established the year earlier, where the bale grazed location had a much higher organic matter than the neighboring non-grazed location.
- Phosphorous: The level in the 2020-21 grazed areas appears to have remained high compared to the ungrazed areas. In increased level of phosphorous been repeated in the 2021-22 grazing as well, higher than pregrazing and higher than the ungrazed area.
- Potassium: Levels of potassium continued to be higher in the bale grazed areas when compared to the pre grazed number and the ungrazed locations, showing a pattern on higher nutrients in the grazed area. Both the 2020-21 grazing and the 2021-22 comparison appeared to be up to four times higher in the bale grazed areas. This pattern is repeated in with the micronutrients as well, although not all to the same extent.

Microbial Results:

- About 20 months after being bale grazed it appears as if the bacterial biomass is back down to a more normal level, but the more recently bale grazed area has higher bacterial activity than in older bale grazed area, possibly indicating an increase in bacterial breakdown of the additional organic matter and animal waste that was deposited during feeding.

- The fungal biomass is also lower than it was in last year's sample in the 2020-2021 grazed area. It is strangely and uncharacteristically high in the neighboring ungrazed area. The area where the bale was grazed last winter is also comparatively high, much higher than was prior to the bale grazing and higher than the neighboring ungrazed area.
- The fungal to biomass ratios, however, are low in the bale grazed areas, and higher in ungrazed portions of the field, perhaps indicating that the non-fungal soil biota are more mobile and respond to increases in nutrients more rapidly, having an impact on this indicator
- Protozoa of most types are high in the bale grazed areas, and low in the ungrazed areas, with the exception of amoebae in ungrazed compared to the newly bale grazed area, again potentially indicating the motility of protozoa towards the area where higher nutrients were once deposited by the bale grazing.
- Similarly, nematode dry weights were higher in both grazed areas. Last year the newly grazed area was particularly high; this year it is still higher but not unreasonably so, and the newly bale grazed area is higher than the pregrazed analysis and the neighboring ungrazed areas which could indicate past high nematode activity in the grazed areas.

The over all biological ratings still favored both bale grazed areas, compared to the neighboring non bale grazed areas. The physical and chemical overall ratings favored the areas not so grazed. The overall soil quality ratings favored the areas not bale grazed, both the older areas and the recently bale grazed. It is possible this is an outlying set of analyses, or specific to the soil in the Sangudo area, so it is good we have expanded our comparisons to the Westlock, Pibroch and Lac La Nonne areas. After the onset of this project, it was determined more work and replications are necessary to attain better results more rapidly. Three additional bale grazing comparative sites were established in 2022, one on pasture with what is considered marginal land, one in an area traditionally considered more productive, and one in an area infested with creeping thistle on GRO's heifer pasture. It is anticipated this section of the Annual Report will be much larger in 2023, with a greater diversity of results and discussions.

The bottom line from this comparison appears to be that there are a variety of differences in chemical and microbial concentrations between those areas that have been bale grazed compared to those that have not. Time and future soil analyses will tell if there is a long-term soil benefit to bale grazing. It is likely, however, that other benefits of this practice are more quickly and obviously realized, benefits such as keeping cattle manure and urine in a field for immediate use there, less fuel used in bale transport, and less time and materials used in spreading beef waste products out in the field to dispose of there.

Soil Amendment Pasture Trial -2022

Biochar

Wood Ash

In 2021, varying rates of biochar and wood ash were applied on replicated square meters of pasture that were protected from grazing by impervious cages. While there was the odd cage that appears to have been moved a bit during the grazing period of 2022, the identifying flags still indicated where the bulk of the applications occurred. Research referenced in past Annual Reports had supplied estimated beneficial amounts of wood ash or biochar that should be applied to enhance the soil and promote growth. Ranges of these amounts were each applied in four replications. Yields from every plot were taken each year then averaged out by type for ranking.

2022 Results:

A forage cut was attempted on August 27th of 2021, initially using a hand sickle. That method, while accurately collecting most of the plant material, proved to be impractical from a time standpoint, so a weed trimmer, a more efficient if less accurate method of harvest was used. When analyzing the samples, it was seen that the weed trimmer results yielded much less weight on average than the hand trimmed ones, so the data was not statistically analyzed due to this anomaly, but rather the low yielding method plots were recalculated to better reflect the expected actual yield method, averaged, noticeable outliers removed and ranked for a general understanding of what may have happened. In 2022, a more appropriate self-propelled silage harvester was used. In general terms, after two years, the following rankings were determined by averaging the yield from the four replicated square meter protected plots of each treatment, then ranking those averages:

Treatment	2021 Ranking	2022 Ranking	Average Ranking over 2 years
2.5 MT/ac Biochar	1	1	1
1.0 MT/ac Biochar	2	2	2
5.5 MT/ac Wood Ash	3	6	4.5
Control	4	3	3.5
2.5 MT/ac Wood Ash	5	4	4.5
5.5 MT/ac Biochar	6	5	5.5

While the results from this trial cannot be considered significant again in 2022, there still appears to be some potential for differential results to be determined as time goes on. It is interesting to note particularly the yields the low amount of biomass from the 5.5 Mt/ac biochar treatment. Despite a recommendation from previous research, it is possible that 5.5 MT/ac of biochar per acre is too hot for our local soils and pasture plants, as it remains near the bottom of the ranking for the second year running. There also could be a better means of biochar activation which may have ensured a better yield in the shorter term, while a high level of biochar might have a favorable long-term impact on pasture soils. It may be required to wait at least two years to see that result, but that might be too large of a price to pay for that later enhancement in yield. When the high rate is compared to the more moderate rate of biochar which is so far ranked the highest producer for the second year running, it may provide some understanding as to the optimum application rate for biochar on local established pasture. More research on its use for pasture may be necessary.

The potential indications from these replicated plots may demonstrate potential application rates for further, larger scale trials. While understanding the soil biology is critical in trials such as these, the edge impacts on one-meter square plots has been determined to be too great on the soil microflora to obtain valid results. Larger scale trials will be needed for a valid, complete soil microbial scan.

To summarize the 2022 results, the consistent, appropriate means of harvesting the plots used was more effective. The small-scale self-propelled forage harvester was used on all plots, followed by bagging, weighing, drying and reweighing. A single cut was conducted in 2022, which still proved to be the most efficient. There is a need, however, to check the cages prior to grazing the rest of that paddock to ensure the security of their exclusion. It is likely that a third year of the current trial will be attempted to gather further yield data prior to a large-scale redesign and plot size expansion. While larger scale strip trials bring in their own inherent risk of error, they would likely reduce any edge effect in the soil analysis. A plot harvest prior to grazing would make for a more practical analysis of grazing production while a soil biological analysis would indicate the impact of rates of wood ash or biochar on the underground microbial population.

Pest Monitoring & Disease Survey

Partner: Producers from Counties of Barrhead, Westlock, and Woodlands. A very special thanks goes out to Shelley Barkley, with the provincial government Alberta Pest Monitoring Network, for her coordination and compilation of the results of these surveys.

The Gateway Research Organization (GRO) participated in the Prairie Pest Monitoring Program again in 2022. The objective of this program is to develop an early warning system for crop pests, with an emphasis on insects and diseases. Being forewarned means that scouting, information workshops, and control operations can be carried out in the affected areas before crop losses occur. Last year, GRO helped survey for cutworms, canola pests, pea leaf weevil, diamondback moth, bertha armyworm, and wheat midge. GRO and a variety of other individuals and organizations participate in surveys set up by the Alberta Pest Monitoring Network (APMN) to give producers a general idea on which pests to focus as to whether they would have a potential impact on their operations. Here are some of the results from 2022:

Key Results – 2022 – Barrhead

Cutworms:

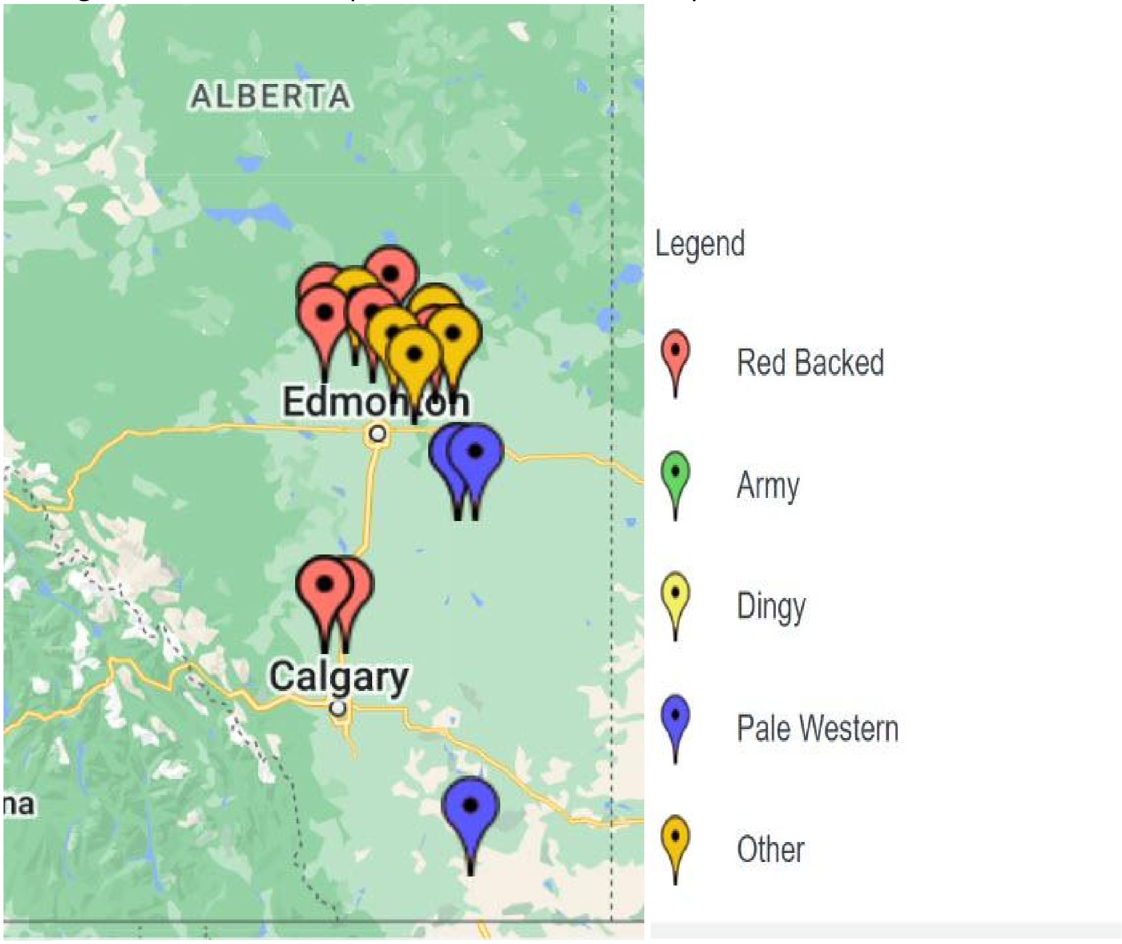
For the first time in several years, economically significant cutworm damage has been noted in north central Alberta. Cutworms are the caterpillar of some Owlet moths in the Noctuidae family. Most cutworms overwinter as larvae or pupae, emerge in the spring, become moths and lay eggs on specific portions of host plants. The eggs rapidly hatch and grow into the damaging larvae stage. They attack plants at various locations, specific to their species, as follows:

- Subterranean cutworms such as the pale western cutworm feeds almost entirely below the soil surface on roots and underground stems.
- Tunnel dwelling cutworms, like the black cutworm, cut plants at the soil surface and draw them back into a tunnel for consumption.
- Surface feeding cutworms, including the army cutworm, cut seedlings off at the surface and feed on leaves of more mature plants.
- Climbing cutworms, with the variegated cutworm being one, cut seedlings down but also feed on foliage and flower buds.

Army cutworms

Cutworms are attracted to volunteer plants growing after harvest late in the fall as a location to lay eggs for larval growth and pupation, so clean fields at that time of year is one method of reducing overwintering populations. Seed treatments also help, but field scouting in the spring is also important. Seeing bare patches in the field as the crop emerges is one sign of cutworm damage and digging up seed rows near the edge of this damage to find cutworms will help to positively identify the pest. If the areas are extensive and growing, chemical control may be necessary. Speak to your agronomist for more details regarding cutworm control.

In 2022, economic populations of red-backed and black cutworms were found in municipalities in the GRO area. Some economically damaging levels were found, and controls applied. The Pest Monitoring Network accepted samples of cutworm for identification and maps for potential damage were created. The typical cycle for cutworms follows a two-to-four-year increase in populations until predatory species escalate to control them. 2023 would be a year to carefully monitor fields in the spring for early cutworm damage. The attached map indicates locations and species of cutworms found:

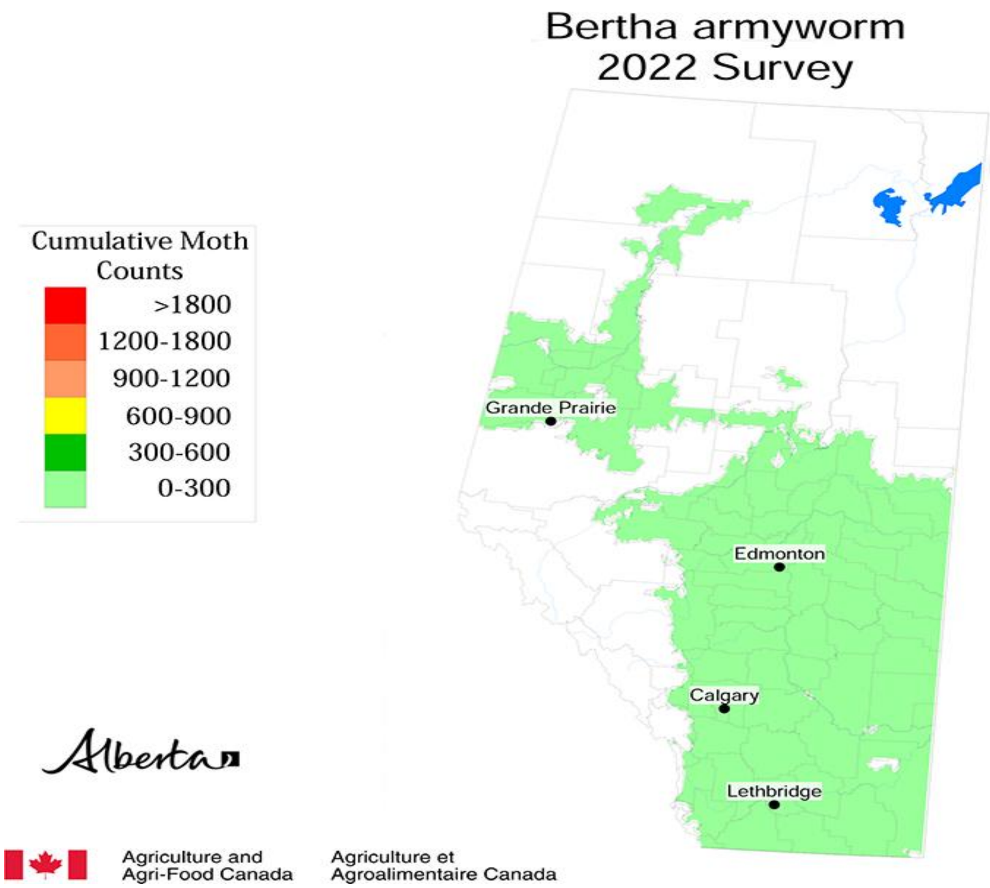


BERTHA ARMYWORM

In order to catch outbreaks and help producers minimize losses due to bertha armyworm, it is necessary to maintain a good monitoring system using pheromone traps. The number of moths caught in the traps informs us of the risk of damaging populations with a three-to-five-week lead time.

Bertha armyworm populations are normally kept in check by such factors as weather and natural enemies. Potential damage may be more or less severe than suggested by the moth count data depending on weather, crop conditions and localized population dynamics. Research has clearly shown that very few fields are ever affected in an area with moth catches less than 300. Even at higher moth counts, field scouting is critical for pest management decisions since field to field and even within field variations can be very large. Given that the timing of infestations is quite variable, it is difficult to determine which and when such economically damaging infestations can occur, so that while the survey can indicate general area populations, field scouting in season is absolutely essential to determine local risk.

In 2022 the total of the GRO field moth trapping numbers in The County of Barrhead averaged 128.5, well below potentially economically damaging estimated populations. Non-GRO trapping in the County mirrored what we found, with totals ranging from 2 to 119, all well below threshold numbers. In fact, as the map below indicates, no area in the province appeared to have a threat of economic bertha armyworm damage in 2022.



CANOLA SWEEPS

A complete survey of pests in canola is conducted by sweeping a number of canola fields in early flower. All the pests are identified and if there appears to be an outbreak of any species, producers are notified for potential action to be taken. In 2022, the following pest numbers were identified in five swept fields in the County of Barrhead:

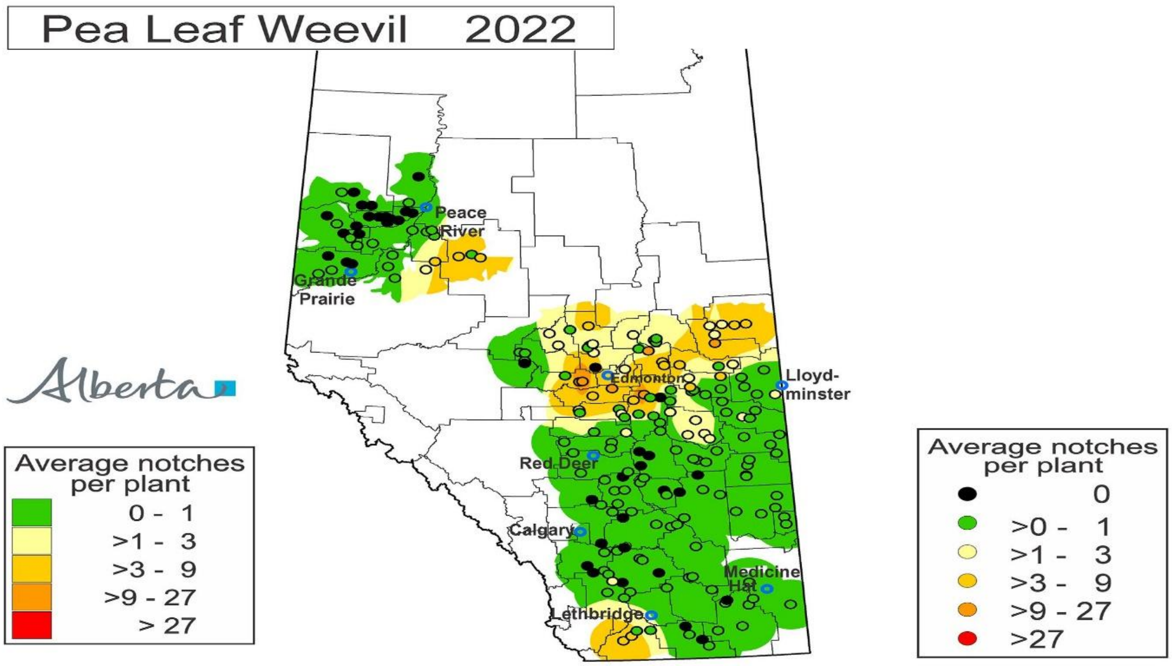
- **Lygus bugs** and nymphs: An average of 6 lygus adults were found per 25 sweeps, well below the threshold at that time of 37. No immature nymphs were collected in these sweeps.
- 1.2 **leafhoppers** were collected per 25 sweeps in the canola field. There would need to be a several thousand times more leafhoppers present for there to be a concern by the pest alone, but if these insects were highly infected with the phytoplasma bacteria that causes a condition known as aster yellows, a much lower number would be a concern. Fortunately, the physical symptoms of aster yellows was not noticed at all in 2022.
- One **diamondback moth** was found in all 125 sweeps, a very low number indeed, and only nine larvae were present, indicating there was no issue with diamondback in the County of Barrhead.
- No **cabbage seed pod weevils** were collected in these sweeps, indicating a low probability of a weevil infestation in the foreseeable future.

Diamondback Moth

It is generally accepted that diamondback moth adults don't overwinter in the prairies, and that most infestations occur when adult moths arrive on wind currents in early spring from the southern or western United States or northern Mexico. While there have been suspicions that in mild winters, diamondback moth do survive in Alberta, there has yet to be any proof. To assess the population, a network of monitoring sites has been established across the province. Our site in the County of Barrhead in 2022 did not attract a single diamondback moth. It will not be known until next spring as to whether or not there will be a flight of adults to cause an infestation in 2023.

Pea Leaf Weevil

Experience has shown us that high numbers of pea leaf weevil adults in fall will likely mean significant infestation levels in the following spring. The timing and intensity of spring damage is strongly related to the onset of warm conditions (>20^{o}C) for more than a few days in April or May. The earlier the weevils arrive in fields, the higher yield loss potential. Extended cool weather delays weevil movement into the field. Yield impact is lower if the crop advances past the six-node stage before the weevils arrive. Adult weevils chew chunks out of leaves. This damage is minor compared to the later damage done by the larvae, which burrow into roots and destroy them as well as the nitrogen fixing nodules. This year, three fields in the County of Barrhead were surveyed for pea leaf weevil. The average number of notches per plant at the 4.8 median leaf stage was 1.5, well below an action threshold, but the population continued to exist in the County. The damage was most commonly noted on the third or fourth node leaf, which is when potentially economic damage may occur. Timing and environmental conditions will determine if there is a greater risk in 2023 for the pea leaf weevil on our pea crops. Faba beans have also been seen to have feeding notches in leaves but they do not seem to be a favored host for the weevil, and there did not appear to be any feeding on the lupin leaves that was observed. The attached map indicates north central Alberta is at the highest risk in the province of pea leaf weevil causing damage to roots and nitrogen-fixing nodules. The Alberta Pulse Growers' website reports that the economic threshold is 30% of the seedlings having notching on the basal clam leaf at the 2-5 leaf stage.

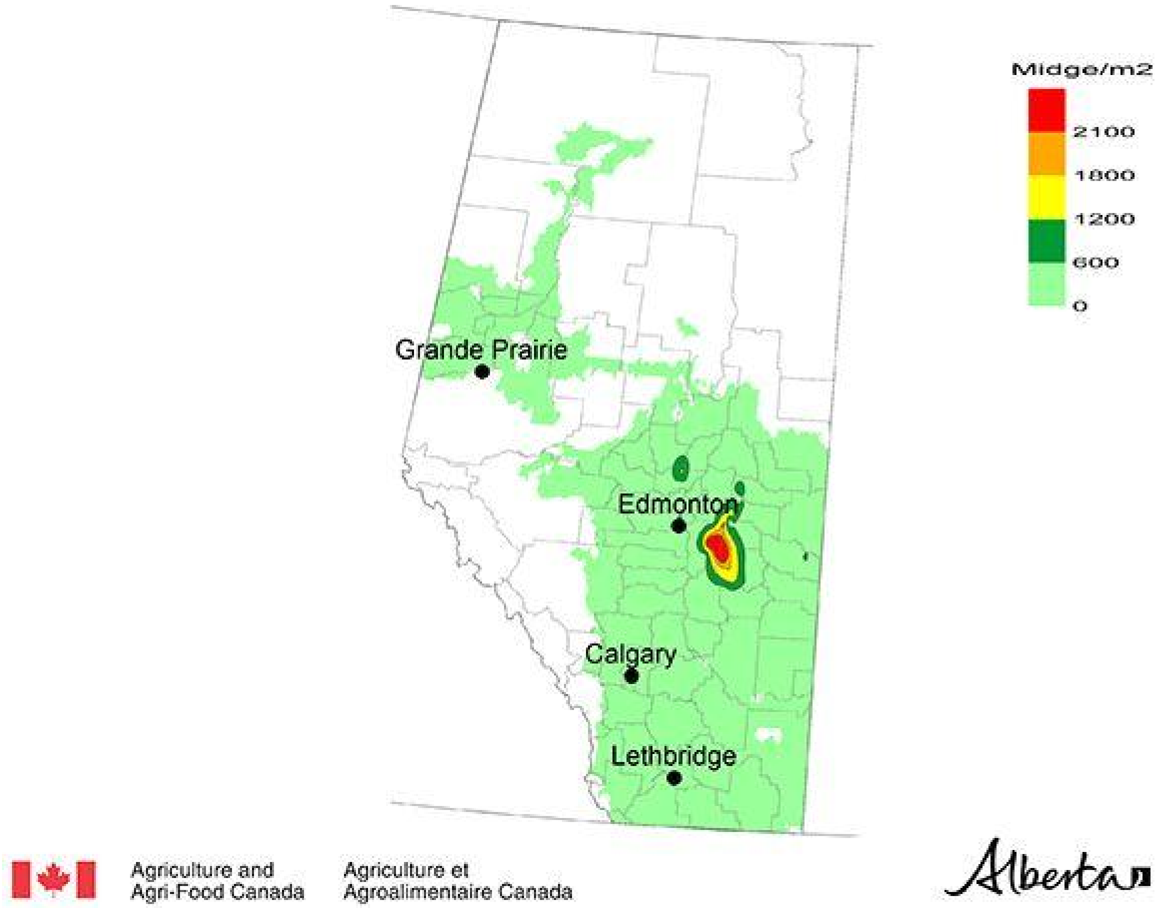


WHEAT MIDGE

Wheat midge is an insect that increases in numbers in wet years. These populations can vary drastically from field to field, and we try to sample wheat adjacent to the previous years' wheat crops in order to pick up populations if they are present. There is no definitive way to know exactly the risk in any given field so scouting when the wheat comes into head is critical. The numbers shown here give a general trend of midge populations. Individual fields will have a different risk.

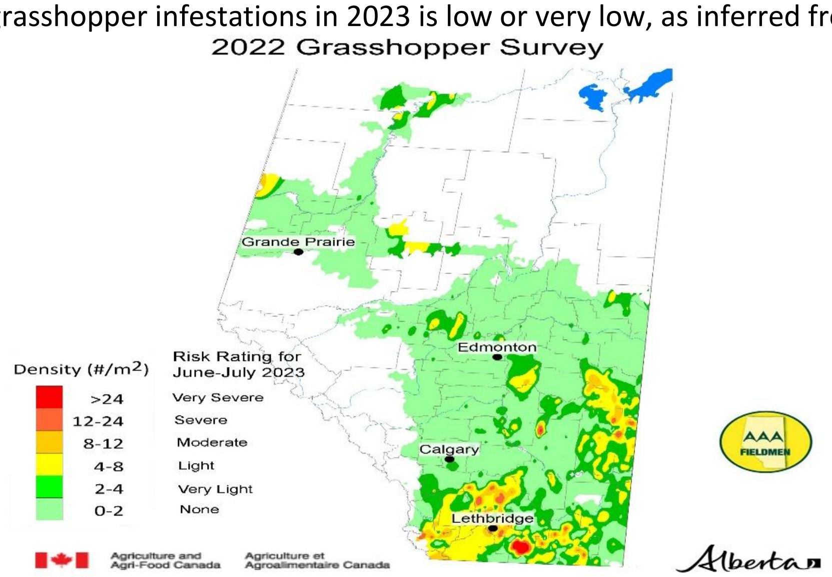
These numbers are generated by taking soil samples from wheat fields after harvest using a standard soil probe, with the protocol requiring at least a dozen cores being taken per sample. While no wheat midge eggs were observed in the soil from the County of Barrhead, in season observations indicated existing populations, and seed samples also indicated wheat midge damage. Current mapping appears to indicate the risk of economic wheat midge infestations for 2023 in north central Alberta are low.

Wheat Midge Populations, 2022



Grasshoppers

The 2022 Grasshopper survey for north central Alberta indicates the risk of damaging grasshopper infestations in 2023 is low or very low, as inferred from the map of the 2022 survey.



Insect Survey Results – 2022 – Westlock

Cutworms

As was noted in the Barrhead report, black and red backed cutworms were reported in Westlock County as well, and as this appears to be the upswing of the cycle for this family of moths, seed treatment should be considered, and cutworm scouting should occur early in the season. These practices should continue to occur for a few years until conditions of parasitism and disease start building to keep the populations in check.

Bertha Army Worm

In 2022, there were eleven bertha army worm traps set up and observed by companies and producers in Westlock County, so there is no need for GRO to provide additional traps. These producers and companies should be commended for their season-long work and rapid reporting of their results. Trapped numbers ranged from 2 to 214, indicating the need for individual scouting of fields in subsequent years to ensure isolated, field-scale outbreaks do not occur, causing isolated but still field-scale economic damage.

Canola sweep samples

Four canola fields were swept in the early flower stage in Westlock County. The following pests were collected in those sweeps:

- 22 **lygus bug** adults were collected in the 100 sweeps, resulting in about .22 adults per sweep, well below any threshold for concern. No nymphs were collected at the time of these sweeps, also indicating a reduced threat of lygus populations in the potentially damaging pod stage of the crop.
- No **diamondback moth** adults were collected in the Westlock sweeps, and only 15 larvae or an average of .15 per sweep, well below any action threshold for the pest.
- No **cabbage seed pod weevils** were collected in the sweeps, continuing the belief that there is not a concern about this pest in north central Alberta.
- One wasp and one non-pest caterpillar were identified in the sweeps, indicating a healthy, diverse insect population in these fields.

Pea Leaf Weevil

Pea leaf weevil infestations were discovered again in 2022 in Westlock County. Three sites were surveyed in the Westlock area. As in the Barrhead area, continued infestations of pea leaf weevil were noted, with average infestation at about 2.8 notches per plant, surveyed at an average of the 4.9 leaf stage. One field had significantly higher damage than the other two, indicating a need to scout individual fields, despite the general low numbers in the County.

Wheat midge (soil)

While no eggs were detected in the fall soil survey of wheat fields from the samples in Westlock County, midge damage was noted in wheat seed samples, and females were noted in crop at the time egg-laying flights would be occurring. Traps similar to diamondback moth set ups have been developed, and with time, perhaps a more analytical prediction can be determined using these advanced materials.

INSECT SURVEY RESULTS – 2022 – WOODLANDS

CUTWORMS:

While no reports of significant cutworm damage had been reported to the Pest Monitoring Network from Woodlands County, it is fairly safe to assume that if there are buildups of this pest elsewhere in north central Alberta, the possibility exists for some in the farming area of Woodlands County. Fields should be observed at crop emergence to minimize losses in 2023 from these pests.

BERTHA ARMY WORM:

GRO set up and monitored one trap for the Pest Monitoring Network in Woodlands County this year. Private industry conducted two more. Numbers of bertha army worm were low in all traps. GRO's set caught and average of 29 throughout the entire season, while private industry's two trap sets caught 0 and 25. The risk of bertha army worm infestations remain low in Woodland County.

CANOLA FIELD SWEEPS

Two canola fields were swept at early flowering in Woodlands County this year, with the following results:

- .76 **lygus** adults per sweep and 0 nymphs were collected, indicating a low risk of significant lygus damage under normal field conditions.
- .16 **diamond back larvae** per sweep were found, and no adults, pointing to a low chance of economically damaging pod chewing later in the season.
- 0 **cabbage seed pod weevils** were found in the sweep samples, confirming the belief that these damaging pests have not gained a foothold in the County as yet.

WHEAT MIDGE (SOIL)

Two sets of soil samples were taken after harvest for observations on wheat midge eggs in Woodlands County. One egg was found from these samples, and it was parasitized. While the risk of wheat midge appears to be low from this sampling, in season scouting observations in the area should continue to ensure unexpected outbreaks do not happen.

Conclusion:

GRO continues to conduct pests survey appropriate for its area. We thank all the producers who allowed us to conduct these surveys on their land and look forward to continuing to help provide the most current accurate information to the producers of the area with their support and assistance.

Regenerative Alberta Living Labs Annual Report

A process of collaborating with partner organizations, meeting with producers, and negotiating with AAFC that began in 2020 met with success in June of 2022 when the Regenerative Alberta Living Lab (RALL) project was officially approved. [Government of Canada launches nine new living labs: collaborative on-farm solutions to combat climate change in agriculture - Canada.ca]

"*Maximizing Agricultural Solutions through Integration of Beneficial Management Practices*" is funded through Agriculture Agri-Food Canada (AAFC)'s Agricultural Climate Solutions-Living Labs program. The $1,720,270 of in-kind and cash contributions provided by industry will be supplemented by $5,291,783 from AAFC and $2,400,000 of collaborative research and development support over five years, making this a $9,412,053 project.

Signatory to the agreement with AAFC is the Alberta Conservation Association (ACA). The project is managed by the Food Water Wellness Foundation (FWWF), with partners FFGA, GWFA, GRO, WCFA, NPARA, MARA, BRRG, LARA, ARECA, and Organic Alberta providing producer engagement, knowledge transfer and education support. Partners McCain, Quattro Farms, Union Forage, MyLand and Hudson Carbon offer additional in-kind and cash support.

The project has at its heart more than 100 producers who will be working with the science and socio-economic team to collect data on soil carbon sequestration and ecological goods and services resulting from the implementation of beneficial management practices (BMPs) on approximately 500,000 acres across the province. The overall goal is to improve soil health, reduce costs of production, and sequester carbon in the soil using regenerative agriculture. This will include but is not limited to cover cropping, intercropping, relay cropping, adaptive multi-paddock grazing, and the use of perennials and animals in cropping systems. This Living Lab will also amplify and support traditional ecological knowledge and efforts of First Nations, including producing a summary of guidelines and good practices for ethical engagement.

Work has begun on the following components:

Soil Sampling and Lab Analysis

A big part of the project includes three rounds of soil sampling (years 1/2, 3 and 5), with approximately 1500 cores per round. We sample to a depth of 1 metre. Back in the lab we will look at total carbon, total organic carbon, total nitrogen, the biology in the soil through genomics, both classic and biological nutrient availability, soil aggregate stability, texture, bulk density and a host of other variables.

Soil Mapping

Building on the data collected through FWWF's soil carbon quantification project, this Living Lab will make accessible farm-scale soil maps for the core participants from the year 2020 with data from 2022 coming next year.

Knowledge Transfer
Workshops and field tours have begun to be organized by the partner organizations and will continue throughout the five years of the project to bring together shared understandings of both producers and scientists in the project while celebrating successes and working through challenges.

Plant and Grazing App
It is important to have cost-effective and useful data related to grazing management and plant communities that encompasses both pasture and crop land throughout the growing season. To achieve that, the project is developing apps that will enable each producers' unique conditions and management practices to be gathered and studied in relation to their soil and carbon sequestration data.

Socio-Economic and GHG data collection
Olivier LaRocque from FWWF has begun reaching out to producer participants to begin socio-economic data collection. This data will be essential in evaluating the economic feasibility of the various BMPs looked at within the project.

Keri Sharpe from FWWF is beginning to gather management data from producer participants that will enable estimation of GHG emission reductions throughout the project.

Post Secondary Education Extension

GRO is pleased to support practical approaches to higher education in many ways. In 2022, we worked with a number of educational institutions to further their knowledge, conduct cooperative research, and gain some insight ourselves.

MacEwan University

MacEwan University has a strong project-based learning program where not-for-profit organizations come up with concepts for small groups to research and recommend further actions. We collaborated with four separate groups to give them ideas and set up work projects for them. While not all of the projects returned concise summaries that could easily fit into an annual report, a selection of them have been attached, below. Others are available upon request from the GRO office.

Cooperative Projects included:

<u>SUST 301 Sustainability Challenges:</u> Public Volunteer Engagement to Help Address Climate Change

<u>NURS 424: Fostering Resilience in Priority Populations</u>: How to Build Partnerships with Indigenous Communities to Help Address Food Insecurity Through Self Production

<u>POLS 244: Sustainable Agriculture Policy Review</u>

University of Alberta:

We were fortunate to be able to work with D**r. Derek Mackenzie** on a practical project dealing with several blends of compost, synthetic fertilizer, wood ash, gypsum and biochar to determine productivity, soil improvement and greenhouse gas release from these blends. A small scale replicated three-site, single year project was set up, with the help of several dedicated grad students, GRO staff and summer students. Data on plant growth, yield, crop quality and greenhouse gases was obtained and analyzed from all three projects, and the results from this project are included elsewhere in this report.

Humate trial: **Dr. Linda Gorim**, WGRF (Western Grains Research Foundation) Chair in Cropping Systems: Dr. Gorim has set up a trial studying the effects of varying levels of humate in a crop rotation program. GRO and other research organizations have completed the second year of this trial, and the results are available elsewhere in this report.

Participation with Dr. Gorim's, class: E**xploring Field Crop Agronomy (Plant Science 210)** Faculty of Agriculture, Life & Environmental Sciences. GRO, BRRG, and Breton Plots were tour sites for this class. 2022 was the second year for GRO participation in PL 210, with the number of students increasing yearly. It involves field trips to locations such as ours help learners go beyond the classroom to gain a career edge in a global marketplace.

Portage College

Weed Control Course Support: Michael Schulz, M.Sc. E.P P. Biol. Instructor, Natural Resources Technology NRES 110 Weeds and Weed Control

The description of this Course is: "Weeds and Weed Control" focuses on the identification and control of weeds. Weed species covered include the common, noxious, and prohibited noxious weeds of Alberta. A selection of weed species will be grown in a greenhouse setting so that they can be observed throughout their life cycles. Various methods of weed prevention and control including mechanical, cultural, biological, and chemical methods are presented. Issues with weeds, such as the problems caused by them, legislative requirements, and herbicide resistance will be discussed. This course includes certification as a Pesticide Applicator Assistant, as well as in the Workplace Hazardous Materials Information System (WHMIS) and Transportation of Dangerous Goods (TDG).

GRO was pleased and proud to assist in the collection of a number of species of weed seeds for a very practical college level course that helps students identify Alberta's prohibited and noxious weeds right from the seedling stage through to maturity. This instruction will help produce new weed inspectors for municipalities and private industry through a thorough knowledge of restricted plants as well as their impact on agriculture and the environment. This activity has introduced potential staff to GRO while providing a means of reducing weed populations in general. Weed seeds collected included, with appreciation to the following municipalities:

- Red Bartsia: Manitoba (recommended location to source seeds courtesy of the Alberta Invasive Species Council)
- Dalmation Toadflax: Stettler County
- Yellow Toadflax: Westlock County (to be sourced in 2023)
- Field Scabious: County of Barrhead
- Himalayan Balsam: County of Barrhead
- Ox-Eye Daisy: County of Barrhead
- Leafy Spurge: County of Barrhead
- Absinth Wormwood: Stettler County
- Yellow Clematis: Summer Village of Rochon Sands
- Common Tansy: Town of Westlock
- Scentless Chamomile: Town of Westlock
- Creeping Thistle: Town of Westlock

School Tours:

Classes came in the spring and fall from R.F. Staples Secondary School to tour facilities, learn about agriculture and check out the plot equipment. These will continue in 2023.

Tour of BYU Hawaii Alumni, staff member, and a producer from Mongolia

This tour was arranged through a series of connections and was very well received. The arrangements were made in 2022 but the tour occurred in 2023, so more information will follow in subsequent reports.

WIL Project, MacEwan University POLS 244

How to Build Partnerships with Indigenous Communities

Principles of Community Development

- A key principle of community development is formulating projects and goals based on the community partner's requests - outcomes should be created in partnership with those who will benefit from the project (Reifsnider et al., 2021).
- We need to work from a strength-based approach; identify community strengths and develop what already exists within the community (Lin et al., 2020)
- Communities need to be active partners in the project to ensure long-term sustainability of the initiative (Lin et al., 2020)

How to be a Community Ally

- Demonstrate reconciliation in action:
  - Do not speak on behalf of the Indigenous community; create space for them to speak (Hyett et al., 2018).
  - Trust Indigenous leaders and community members; they possess knowledge about their lands and community and are the experts in these areas (O'Brien, 2022)
  - Recognize and respect Indigenous knowledge - acknowledge there are ways of knowing other than your own (Hyett et al., 2018).
  - Taking on a supportive role in the project rather than a leading role (Hyett et al., 2018).

Identify a Community Champion

- A passionate, visible, and trusted community member with the ability to engage other community members (Worthy et al., 2016).
- Acts as a catalyst - they volunteer to help with initiatives (Worthy et al., 2016).
- They are enthusiastic about community building and inspire others to connect with actions and projects (Worthy et al., 2016).
- Community Champions are key members in connecting the community with external organizations - they act as a knowledge broker and liaison between the members of the partnership (Lindsay et al., 2019).

Relationship Building

- This is an important process that needs to be completed prior to project initiation (Bharadwaj, 2014).
- Previous projects and initiatives have failed because they did not form proper relationships with the communities and did not understand food security from an Indigenous perspective (Robin, 2019).
- It is important not to rush the relationship building process as this will lead to omission of the community's voice and disengagement from community members (Bharadwaj, 2014).

Megan Croy, Mike Heale, Levi Klassen, Kevin Wong
4th year Baccalaureate Nursing Students, MacEwan University

Tasks for Community Relationship Building:

- Preparation and Learning; this task happens prior to initial contact
  - Gain knowledge of Indigenous Peoples; including their history within Canada, how colonialism impacts communities today, and community contexts and protocols
  - Understand the history of research and Indigenous Peoples; historically research projects have disempowered Indigenous communities
  - Gain knowledge about Indigenous ethical principles (Lin et al., 2020)
- Work with established organizations and existing working groups who have more experience with the community. This will help guide your starting point (Bharadwaj, 2014).

Sources to help understand Indigenous history in Canada:

- Treaty Talk (https://www.treatytalk.com/)
- *Structures of Indifference* by Mary Jane Logan and Adele Perry

How to Achieve Community Engagement

- Engage young people – if they are invited into the process, children and youth are powerful collaborators who have much to contribute to the success and well-being of their communities (Genuis et al., 2015)
- Engage families – the role of the family is key as this is a place of knowledge sharing (Genuis et al., 2015)
- The community champion will help dispel myths or misinformation and ensure interventions are appropriate for that community.
- Empower community members to negotiate for interventions that will provide support in ways that are meaningful to them (Ungar, n.d., p. 34)
- Establish community reference groups to guide the project with a cultural lens (O'Brien et al., 2022)

How to Build Partnerships with Indigenous Communities (Croy, Heale, Klassen, & Wong) 3

Steps to Implement an Indigenous Community-Centered Project

Step 1: Pre-project phase

- Establish a forum for discussion; there is no set project goal at this stage
- Explore common themes and interests between Indigenous communities and external organizations
- Listen to the priority population to determine which communities have which concerns
- Participate in meetings with interested communities, this facilitates discussion and engagement between community members and external organizations

Step 2: Community consultation

- When you have determined a project you would like to pursue, a delegate with connections to the community or the community champion will contact the Chief and community to determine whether or not it is a project they would like to pursue.
- This delegate will initially act as a liaison between the external organization and the community to increase success in developing working relationships

Step 3: Community entry

- Direct meetings between external organizations and community
- Meetings may happen over weeks or months in order to mutually agree upon project goals, logistics, and ethical considerations
- Important to have a community advisor during this step to ensure protocol and cultural rules are followed

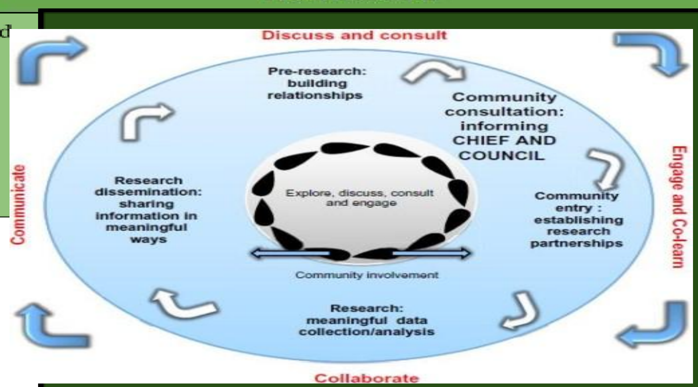
Step 4: Project phase

- Initiation of project and community engagement
- Hire community project assistants and students
  - Local high school students and post-secondary students
  - Community members seeking employment
- Ensure inclusivity to all community members who express interest
- Include community Elders and teachers

Step 5: Results dissemination

- Discuss approval to disseminate information during the early consultation phase
- Ensure reports are co-authored with designated community representatives
- Acknowledge the participation and assistance of community members
- Ensure shared findings are relevant to the community
- When communicating results to the community, verbal communication may work best (Bharadwaj, 2014)

The First Nations centered research framework



(Bharadwaj, 2014, p. 19)

WIL Project, MacEwan University POLS 244

Harmful Strategies to Avoid

- Organization acts as an expert in determining the need, the solution, and the program design
- Resources and solutions are brought into a community without consent and community collaboration.
- The organization holds exclusive control of resources, data, program activities.
- The goal of the project is to advance the standing of the organization.

(Bharadwaj, 2014)

It is important that we change from a research-based approach to a **community-based approach**. This will allow the community to be an equal partner in the project. This approach will foster the development of genuine partnerships between Indigenous communities and external organizations (Bharadwaj, 2014).

Final Report

Spring 2022

Devin Shaw, Sarah Wolfe, Sellega Nour

Our goal with the WIL and Gateway Research Organization Partnership (GRO) was to give recommendations to them about increasing Indigenous engagement and actively listening to the history and knowledge of Indigenous peoples as it relates to their Living Labs application and their organization. We hope that our recommendations assist in the success of the Living Labs project, and that the GRO can use them into the future.

Challenges

Currently, agricultural practices in the Saskatchewan Prairies are practiced on 3-4 million acres of First Nations land reserve. Old estimates suggest that in the Saskatchewan Prairies area alone, 20% of the land is used by Indigenous people who identify themselves as First Nations farmers. However, the current number is much more likely to decline across the broader agricultural activities in those lands in the upcoming years. Another concern expressed by Indigenous farmers is that soil quality is being degraded by Non-indigenous farmers when land is leased to them. No studies have been examined about the effects on the health of agricultural lands of First Nations reserve. Despite studies indicating that Canada's soil quality is degrading on leased land compared to privately owned lands due to unrestricted soil conservation practices. Indigenous farmers involved in land leasing have also expressed concerns that racial tension exacerbated the mistreatment of their leased land.

Indigenous farmers are often excluded from the Canadian agricultural narrative. Some of the challenges we faced on this project was the lack of private-for-profit or even non-profit organizations with incentives that promote Indigenous agricultural practices. This lack of incentives to support and promote Indigenous participation and collaboration limits the outreach of Indigenous farming. Essentially, what we were looking for during our research was a privatefor-profit or non-profit organization who can help Indigenous farmers get involved in commercial farming and advanced agricultural business through partnerships and collaborations.

An organization that can help them mitigate the high risk associated with large-scale operations.

In addition, contemporary academic scholarships and information on indigenous farming activities are scarce. In fact, information about land leasing and capacity, indigenous agricultural practices and research development was not captured by census data. A report of this kind only emerged in January 2019 by Statistics Canada. Indigenous farmers have emphasized the importance of the role of academic and government institutions to make partnerships mutually beneficial and equitable. Academic barriers have affected Indigenous communities' ability to govern their own land. Institutional barriers to post-secondary education has been an ongoing challenge for Indigenous farmers. Postsecondary institutions that are slow to adapt to indigenous students and generally have low representation of Indigenous students which further hinders participation and partnership.

Jurisdictional Scan

A key area of our project with the Gateway Research Organization was conducting a thorough jurisdictional scan. Our jurisdictional scan included searching various jurisdictions for other organizations and government entities, whether within agriculture or otherwise, for programs that we could use for inspiration or emulation with the GRO. Finding policies and programs that others have used to affect and increase Indigenous engagement in their fields allowed us to gain insight into effective modes of collaboration with communities.

We found some practical ideas through our jurisdictional scan. Primarily, as previously discussed with Jay, we took particular interest in the National Energy Regulator's Indigenous

Advisory Committee. In that context, the Indigenous Advisory Committee's role is to provide advice, from the diversity of its members' Indigenous perspectives to the Board of Directors. While the Canada Energy Regulator's Indigenous Advisory Committee relates to pipeline projects, the philosophy and practice could be adapted to the GRO in working on the Living Labs project and beyond.

Next, relating to our secondary recommendation regarding attracting Indigenous students to the GRO, we found the Ivan Anekahew award. This is an award for organizations that are increasing their amount of Indigenous employment/contributing to Indigenous employment. This idea is also something that wouldn't look exactly the same in the context of the GRO, but the motive behind it can be adapted to our situation. On top of incentivizing young Indigenous workers wanting to get involved in agriculture, this would be a good PR program for the GRO, which is something that our partner told us they would like to work on.

Similar to the last item, 4-H Ontario is about getting Indigenous youth involved. It works to engage youth in agriculture and raise awareness of the job opportunities in the agricultural sectors. This is something that could be applied to GRO, and it played a role in our internship idea. This is a unique and effective way to increase engagement in the agriculture sector and within the GRO itself.

Recommendations

Our main solution to the Gateway Research Organization is to introduce an Indigenous Advisory Committee that will focus on Indigenous agricultural practices as well as sharing knowledge and working together to find solutions to issues that are taking place on the farms within their communities. We recommend that the GRO reaches out, not only to Indigenous farmers across Alberta directly, but also to extend the Committee to Indigenous organizations that are involved in the Indigenous agricultural sectors.

The GRO could host this Advisory Committee as often as they find sustainable, whether that is once a year, every six months, or every three. Another option is to have these communities and organizations submit a small report updating the GRO on any concerns they may have or projects that they could focus on for that term, that also aligns with the GRO's projects, such as regenerative agriculture, composting, and carbon sequestration.

As a long-term goal that would be a great opportunity for the GRO in terms of Indigenous involvement and increasing the number of Indigenous voices, we suggest a "Gateway" scholarship and internship initiative. This scholarship would help fund Indigenous youth who are committed to studying agriculture in post secondary school as well as grant them the opportunity to intern at the GRO upon their graduation. Not only would this initiative help the GRO reach their goals of Indigenous relations and incorporation of Indigenous history and knowledge, but it also increases the incentive for Indigenous students to pursue agriculture in post secondary.

To conclude this report, we faced many challenges with regards to limited information and Indigenous initiatives within the agricultural sector. These challenges caused a great deal of difficulty for our research report. With limited resources and information regarding Indigenous agricultural practices the basis of our research was not optimistic. However, we believe that our suggestions can bridge the gap between Indigenous voices and the agricultural sectors. Through our jurisdictional scan we were able to come up with a lot of inspiration and ideas for the GRO to emulate. From here, it is up to the GRO whether to follow our recommendations or not, but we hope we had an impact on the opportunities to increase Indigenous engagement in the agricultural community. It was a privilege to work with the GRO, thank you for the opportunity.