Gateway Research Organization

2021 ANNUAL REPORT

Cropping

Forage & Livestock

Environment

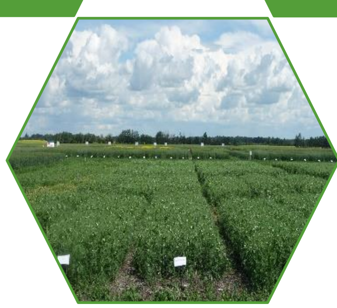

Table of Contents

Chairperson's Report

Justin Nanninga

Hello, on behalf of the Board of Directors at Gateway Research Organization, I would like to recognize our members and supporters. We hope this support continues to grow in the coming years.

Another year has passed and is in the books. 2021 has been another challenging year, from a wet 2020 to extreme heat and dryness in 2021. Who would have thought!

This upcoming year GRO has some very exciting projects and events planned. Please mark your calendars to attend these events.

GRO is an unbiased research group, doing research for farmers of our area. This research is directed by farmers who sit on the board. This work is very important and I would recommend that anyone interested get involved.

Last but certainly not least, a big Thank You to our fantastic staff. Sandeep our very talented Manager. Rick does a great job with our plots and equipment. Amber plans events and does everything media-related. Jay our Soil Conservation Analyst and also Kabal keeps our plots in pristine condition. GRO would not be one of the leading Applied Research Associations without such a great staff.

Thanks again for your continued support.

Manager’s Report

Sandeep Nain

Greetings to all GRO members and supporters. The year 2021 saw a shift from direct involvement of Alberta government in agriculture research to an arm’s length body, “RDAR” (Results Driven Agriculture Research). RDAR was created by mix of producers, academia, researchers and industry stakeholders and are mainly responsible for managing all of the agricultural research related project in Alberta. We were successful in securing a couple of additional grants from this new funding agency. Most of these grants will run till 2023.

Again, the weather was very finicky with an extreme hot spell of about three weeks in June to July and overall lower than average rainfall for the area that resulted in decline in average yields for most crops. GRO had been able to continue the success of completing small plot research and demonstration projects despite all hurdles. About 150-pages of this Annual Report for 2021 is the culmination of a lot of hard work by **Rick Tarasiuk, Jay Byer** and **Kabal Singh** along with our summer students.

The work we do truly would not be possible without the support of our Board of Directors and local producers who believe in the value that farmer-led applied research associations provide to the industry. In 2021, we had 9 farmer collaborators to help us run over 2500 research plots and some field scale trials in Westlock and the County of Barrhead.

The highlight of the year was GRO’s efforts in hosting a total of 6 in-person field days in between restrictions with Covid 19 regulations. The events were well-attended and turned out to be very successful. Our virtual networking sessions focusing on regenerative agriculture and livestock related topics was once again a super hit event with constant attendance of over 100 people joining us weekly.

We are working with educational institutions such as University of Alberta, Lakeland and Olds College on many research projects in the coming years. The intent is to bring more core research to the local producers. Our producer Board of Directors is playing key a role in identifying current crop and forage related issues and how GRO can come to assist with solutions.

Overall, we are in best position for operational aspects regarding the crop and forage research and extension work in north central Alberta.

I would like to thank the outgoing directors, **Bill Visscher, Janine Paly, Dale Greig and Justin Nanninga** for their outstanding commitment to GRO and its board over the years.

We look forward to the upcoming season-of 2022. No doubt it will be filled with a new set of challenges, but I believe with our joint efforts we will accomplish the mission for our organization. We will reinforce our efforts to meet regularly with the provincial and municipal governments to ensure that we receive the necessary financial support to continue serving the regional farming community. We will continue to keep our members informed of GRO's activities and the benefits of our organization.

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

- Our website is: **www.gatewayresearchorganization.com**
- On Twitter at: **@GatewayResearch**
- On YouTube and Facebook at: **Gateway Research Organization**
- Find us on Instagram at: **gatewayresearchorganization**

Agricultural Research and Extension Council of Alberta (ARECA) Report

Alan Hall: Executive Director

Hello from ARECA. We are most pleased to continue to support GRO in the work you are undertaking with your members and other farmers and ranchers in the area you serve.

It has been a challenge to secure expertise and financing for Forage and Applied Research Association operations. RDAR, the new Results Driven Agricultural Research not for profit company set up to help finance agriculture research and extension, is a breath of fresh air. RDAR has been very supportive of both operational and project funding for GRO and the other Associations.

ARECA has been working hard with Farm Rite and all Associations in working out future financial support for Associations from RDAR. On the operational funding side, our collective effort has resulted in RDAR investment of $2 million dollars per year to support core operations of Associations for each of 2021 and 2022. Further, RDAR has agreed to consider increased annual operational funding and move to up to 5-year agreements rather than the annual agreements as is the current practice. This will provide much improved financial stability for Associations.

We are currently in early discussions with the Province of Alberta in identifying priorities and programs that they will support through the new 5-year Ag Policy Framework Agreement currently being negotiated with the federal government that will kick in come 2023. Under the current APF agreement, there is over $40 million per year funding for projects – some at the individual producer level, and project funding supporting efforts of Associations, Commissions, and others. GRO and other Associations have aggressively tapped into this source of project financing.

With the disappearance of the **Alberta Agriculture specialists**, ARECA and Associations have secured 2-year funding to provide a call center service that individual producers access for forage, livestock, crops, rental and custom rates…. etc. Additionally, we have been able to provide some new funding for GRO and other Associations for their use in paying costs such as speakers, field days, development of information materials and workshops.

ARECA is very grateful for the support GRO has provided to help bring the Environmental Farm Plan (EFP) services to individual ranchers and farmers. Over 3,000 producers have up to date EFP's in place. A number of these are involved with supply chains who are using EFP as part of their sustainable sourcing and purchasing of livestock and crops from producers. We are currently in discussions with Saskatchewan that could lead to providing EFP services there.

ARECA has been working closely **with Canadian Forage and Grassland Association** in the development of the Habitat module that is now part of the EFP. We have also been working with CFGA and several Forage and Applied Research Associations in the development of the

Grasslands Carbon Trading Protocol that is now being tested across Canada, including some locations in Alberta

The Province of Alberta has asked ARECA to help out with bringing some **mental health workshops** to farm families and to develop recommendations for consideration to strengthen mental health support services for farmers and farm families in future. We are partnering **with Ag Safe Alberta** in conducting both on line and in person "In the Know" workshops around Alberta this winter. These have been very successful last year in Ontario and Manitoba and are run by mental health professionals with farming backgrounds. Manitoba and Ontario had several hundred farm families utilize the "In the Know" workshops.

ARECA is working very **closely with AFIN (Alberta Forage Industry Network)** in engaging a wide range of farmers, ranchers, farm organizations, researchers, agribusiness… in developing a strategy to advance forages on a number of fronts. This will be leading to the development of a 5 year, multi-million-dollar forage extension and research program to address the priorities and outcomes identified in the strategy. This is work that will be undertaken over the coming months, will involve GRO, and in the end will provide new financial support to GRO for forage related extension and research activities around grazing, winter feeding, watershed, forage seed, hay export and environmental benefits. More to come later on this initiative as it is just getting under way.

ARECA is working with Associations, Food and Water Wellness Foundation and other groups in the development of the new Living Labs program that is being supported by Agriculture and AgriFood Canada.

We are also working with a number of national, regional and provincial organizations who will be contracting with Agriculture and AgriFood Canada in delivery of the individual producer grants for beneficial management practices around grazing, cover crops and fertilizer usage leading to reductions in Green House Gas emissions and increased carbon sequestration. A neat spin off of this is improved soil health for both productivity and environmental benefits to individual producers. Increased productivity, increased profits, reduced risk and environmental benefits are all benefits that farmers will see in their businesses.

These two programs will be rolling out to farmers in the coming months and we look forward to working out details with GRO as to any involvement GRO would like to have in bringing these programs to their members and other farmers in the area GRO serves.

ARECA provides a strong support role in helping Associations like GRO in a number of ways. We highly value the strong leadership from and support of GRO and look forward to the coming year with eager anticipation.

Compliments to GRO for a successful 2021 and all the best to GRO in your coming year.

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Acknowledgment of our Sponsors

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 thanks to "Jubilee Feedlot, Pibroch Colony, Tom McMillan, Dean Wigand, Justin Nanninga, Peter Smerychynski, Ray Marquette, Colby Hanson and Randy Pidsadowski" for their support.

- 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.

2021 Extension Activities

Amber Kenyon

It is hard to believe that another year has passed. With the ability to host in person events once again, 2021 saw an interesting mixture of in person and online extension activities. Throughout this year we continued to grow our YouTube channel, posting regular videos. On which we are currently up to 460 subscribers. This has been a terrific way to bring producers regular updates on what GRO is up to, as well as providing a long term informational resource for producers to access. The ability to host in person events this summer allowed us to meet with so many of you, and to use the great information gathered from these as content for the channel as well.

Throughout the year, we continued with our 'Coffee Shop Talk' series on YouTube. These videos are typically 35-50 minutes in length and have us featuring a local producer talking with an expert about current issues affecting agriculture. We had the opportunity this past year to speak with Stuart Austin from Australia regarding their current deal with Microsoft surrounding carbon credits, our previous agricultural minister Devin Dreeshen regarding government policies, Dr. Jan Slaski and Ken Coles about the progress that hemp production has made in the province, and Dr. Richard Bazinet with Calvin Raessler regarding grass-fed beef from a fatty acid profile standpoint. These are just a small sample of the informative videos that we now have available to producers.

Our YouTube channel currently hosts 55 videos on all manner of agricultural topics. Some of the topics that we covered in short 3-5 minute videos are on; riparian areas, our humalite trials, fencing, the feed value in canola, beekeeping, crop trials in the garden, and how trappers and farmers can work together. We have found this to be a terrific and entertaining way to bring new information to producers, and to provide our members with a long-term graphic resource. To access this initiative, simply look up 'Gateway Research Organization' on YouTube.

Another thing that we carried over this winter from last year, is our Wednesday Night Networking (WNN). These are bi-weekly networking sessions that we have been doing in conjunction with Steve Kenyon from Greener Pastures Ranching. Steve, who is a former board member, donates his time and joins a special guest every second week to take part in what can be best described as a Q&A at the end of a presentation. These have been wildly successful, with 60-100 attendees each night. We also record these sessions and share them on our podcast, which can be found by searching 'Gateway Research Organization' on iTunes, Spotify, Google Podcasts, or on Podbean. To date we have over 14,000 downloads of 27 episodes with topics covering everything from regenerative potato growing and livestock watering systems to the similarities between cattle handling and human handling. With some big agricultural names like Temple Grandin, David Irvine, Dylan Biggs, and Dr. Richard Bazinet, these sessions have drawn a lot of attention to our extension efforts. These 'WNN' nights have also led to increased attention being drawn to the research that we do, with many questions being asked about our perennial grain trials and our Heifer Pasture Project. I even had the opportunity to discuss the Heifer Pasture Project with Clay Conry from the Working Cows Podcast. That episode can be found by searching 'Working Cows' on any of the podcast platforms.

As restrictions eased, we made a gradual return to in person events throughout the summer. Some of the highlights were; hosting the Grade 9 Agriculture class from R.F. Staples Secondary School for a tour of the GRO facilities, hosting one of Dr. Linda Gorim's classes from the University of Alberta as they toured our perennial and humalite plots, our first Heifer Pasture Walk since we revamped the layout and management style of the GRO Heifer Pasture, our Pulse and Oilseed Field Day with Alberta Pulse Growers and Alberta Canola, our Forage tour, our annual Cut the Crop Tour, WheatStalk with Alberta Wheat and Barley Commission, and even a tour with FP Genetics. All of these events were very well attended and it was such a pleasure to have the opportunity to see everyone again!

I want to thank each and every one of our members for their continued support. None of the work that we do would be possible without all of you. We have some big plans for the year ahead, and I cannot wait to continue working with you and promoting the excellent initiatives happening within our research community.

Regional Cereal Variety Trials

Co-operators: Randy Pidsadowski- SW-17-61-26-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 on **May 05,** Barley **May 06**, Oats/Triticale/Flax **May 07**
Seeding Specifics	Fabro zero-till drill Seeding depth: $1^{1/4}$ inch for all. **Seeding Rates:** 25 plants/ft^2 – Feed & Malt Barley 31 plants/ft^2 - HRS & CPS Wheat, 29 plants/ft^2 - Triticale 28 plants/ft^2 - Oats 84 plants/ft^2 - Flax Seed treatment: Raxil
	RVT - Project Description
Fertilizer/ac	**Fertilizer: Fall Applied:** 70 lbs/ac Actual N 60 lbs/ac Actual K **Spring Applied:** Side banded: 24.55-0-14.73-9.82 203.65 lbs/ac 50 lbs/ac Actual N 30 lbs/ac Actual K 20 lbs/ac Actual S For Malting Barley: 24.55-0-14.73-9.82 @ 122.4lbs/ac 30 lbs/ac Actual N 18 lbs/ac Actual K 12 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	Glyphosate(Pre-emergence): 0.78L/acre May 14 Curtail M 750ml/acre June 07 Poast 300ml/acre & Curtail M 750ml/ac June 25 (Flax only) Reglone @ 750ml/ac Sept. 14 (Flax)
Rainfall	Recorded from May 1 to Sept 15, 2021: **187.70mm**
Harvest Date	August 18 (Feed & Malt Barley) September 10 (HRS and CPS Wheat) September 14 (Triticale) September 14 (Oat) October 04 (Flax)

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; key characteristics 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 barley is 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.

Gateway Research Organization

Table 2: Barley: 2021

Name		Height		Lodging		Protein		Yield					Bushel Weight		Test Weight		TKW	
		cm		(1-9)		%		kg/ha		% of AC Metcalfe	bu/ac		lbs/bu		kg/HL		g	
AC METCALFE	TWO Row	78	a-e	1	-	13.1	bcd	5581	c-f	**100**	103	cde	60.5	ab	74.6	ab	49.4	ijk
AB BREWNET	TWO Row	81	a-d	1	-	14.1	a	4896	g	**88**	91	f	57.3	f	70.7	f	51.2	e-i
AB PRIME	TWO Row	78	a-f	1	-	13.8	ab	5545	c-f	**100**	103	cde	58.6	def	72.3	def	48.6	jk
TR19175	TWO Row	69	g-k	1	-	13.2	bc	5369	d-g	**97**	100	def	56.0		69.2		51.6	c-g
CDC RENEGADE	TWO Row	83	a	1	-	13.2	bcd	5125	fg	**92**	95	ef	57.5	f	71.0	f	55.4	a
AB CATTLELAC	SIX Row	83	a	1	-	13.1	cde	5326	fg	**96**	99	ef	58.6	def	72.3	def	44.6	l
AB TOFIELD	SIX Row	75	c-h	1	-	12.3	f-i	5270	fg	**95**	98	ef	59.0	cde	72.8	cde	47.8	k
ESMA	TWO Row	66	i-l	1	-	11.4	jk	6461	ab	**116**	120	ab	59.6	a-d	73.5	a-d	50.4	f-j
KWS KELLIE	TWO Row	59	l	1	-	10.8	kl	6700	a	**120**	124	a	59.5	a-d	73.4	a-d	53.6	abc
KWS CORALIE	TWO Row	65	jkl	1	-	10.5	l	6380	ab	**115**	119	ab	57.6	ef	71.1	ef	51.0	f-i
TORBELLINO	TWO Row	64	kl	1	-	11.8	ij	6090	abc	**110**	113	abc	59.2	bcd	73.1	bcd	51.5	c-h
AB HAUGE	TWO Row	73	d-i	1	-	12.3	f-i	5527	c-g	**99**	103	c-f	58.7	def	72.4	def	51.2	d-i
TR18747	TWO Row	80	a-d	1	-	13.0	cde	5328	efg	**96**	99	def	59.6	a-d	73.5	a-d	53.8	ab
TR18748	TWO Row	78	a-f	1	-	12.5	d-h	5972	b-e	**107**	111	bcd	60.2	abc	74.3	abc	52.4	b-f
TR18749	TWO Row	83	ab	1	-	12.9	c-f	5479	c-g	**99**	102	c-f	59.7	a-d	73.7	a-d	54.0	ab

TR19758	TWO Row	71	f-k	1	-	12.4	e-i	6069	abc	**109**	113	abc	60.7	a	74.9	a	49.7	g-k
AB WRANGLER	TWO Row	81	abc	1	-	12.6	c-h	6004	bcd	**108**	112	bc	59.6	a-d	73.6	a-d	51.9	b-f
RGT PLANET	TWO Row	70	g-k	1	-	10.9	kl	6691	a	**120**	124	a	59.7	a-d	73.6	a-d	51.4	d-i
CDC COPELAND	TWO Row	75	b-g	1	-	12.2	ghi	5590	c-f	**101**	104	cde	59.2	bcd	73.1	bcd	53.2	b-e
CDC AUSTENSON	TWO Row	68	h-k	1	-	13.0	cde	5351	efg	**96**	99	def	59.0	cde	72.8	cde	53.3	a-d
AAC SYNERGY	TWO Row	78	a-f	1	-	12.1	hi	6072	abc	**109**	113	abc	59.1	bcd	72.9	bcd	49.5	h-k
TR17255	TWO Row	72	e-j	1	-	12.8	c-g	5568	c-f	**100**	103	cde	59.6	a-d	73.5	a-d	48.2	k
LSD P=.05		7.47		.		0.681		644.62			11.88		1.401		1.723		2.093	
Standard Deviation		4.53		0		0.413		391.21			7.21		0.849		1.044		1.27	
CV		6.12		0		3.32		6.81			6.75		1.43		1.43		2.49	

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

Highlighted row = Among the top-performing variety for the year 2021 at Westlock site.

Gateway Research Organization

Table 3: Malt Barley: 2021

Name		Height		Lodging		Protein		Yield					Bushel Weight		Test Weight		TKW	
		cm		(1-9)		%		kg/ha		% of AC Metcalfe	bu/ac		lbs/bu		kg/HL		g	
AC METCALFE	TWO Row	77	abc	1	-	13.2	a	5850	bcd	**100**	109	bcd	59.8	a	73.7	a	51.6	cd
CDC COPELAND	TWO Row	71	cde	1	-	12.2	de	5805	cd	**99**	108	cd	58.7	ab	72.4	ab	54.3	b
AAC SYNERGY	TWO Row	73	a-d	1	-	12.4	cd	6040	abc	**103**	112	abc	58.6	ab	72.3	ab	51.2	cde
AAC CONNECT	TWO Row	66	e	1	-	13.0	ab	5484	d	**94**	102	d	58.3	ab	71.9	ab	51.9	cd
CDC BOW	TWO Row	69	de	1	-	12.3	d	5094		**87**	95		56.7	c	70.0	c	52.8	bcd
CDC FRASER	TWO Row	72	b-e	1	-	11.9	ef	6147	abc	**105**	114	abc	57.4	bc	70.8	bc	53.3	bc
LOWE	TWO Row	79	ab	1	-	11.7	f	6363	a	**109**	118	a	58.6	ab	72.3	ab	57.2	a
CDC COPPER	TWO Row	66	e	1	-	11.7	f	6244	ab	**107**	116	ab	58.8	ab	72.6	ab	50.7	de
CDC CHURCHILL	TWO Row	72	b-e	1	-	11.9	ef	6104	abc	**104**	113	abc	58.7	ab	72.4	ab	48.3	f
AB BREWNET	TWO Row	80	a	1	-	13.7		5784	cd	**99**	108	cd	56.3	c	69.5	c	51.8	cd
TR17255	TWO Row	70	cde	1	-	12.7	bc	6007	abc	**102**	111	abc	59.3	a	73.2	a	49.1	ef
LSD P=.05		7.46		.		0.391		414.15			7.82		1.475		1.828		2.262	
Standard Deviation		4.38		0		0.228		241.43			4.56		0.866		1.073		1.328	
CV		6.06		0		1.86		4.04			4.11		1.49		1.49		2.55	

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

Highlighted row = Among the top-performing variety for the year 2021 at Westlock site.

Hard Red Spring (HRS) Wheat – The Canadian Grain Commission currently classes 56 varieties under the Canadian Western Red Spring (CWRS) class. HRS 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): is a special-purpose wheat class of 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 & CWHWS Wheat: 2021

Name	Height		Protein		Yield					Bushel Weight		Test Weight		TKW	
	cm		%		kg/ha		% of AC Carberry	bu/ac		lb/bu		kg/HL		g	
AC CARBERRY	80	b-f	15.1	d-i	4533	e-h	**100**	67	f-j	68.3	abc	84.7	ab	41.3	b-f
AAC BRANDON	77	d-g	15.6	bcd	5025	a-e	**112**	75	a-f	68.0	a-d	84.0	abc	41.3	b-f
AAC VIEWFIELD	75	e-h	15.3	c-g	4926	b-e	**109**	73	b-f	68.7	ab	84.7	ab	39.7	def
SHEBA	83	abc	14.6	ijk	4232	h	**94**	63	j	67.7	b-e	83.0	c-f	38.7	fgh
REDNET	88	a	16.1	ab	4671	d-h	**103**	69	e-j	69.0	a	85.0	a	42.3	b-f
AAC LEROY VB	83	abc	15.0	e-i	4861	b-f	**107**	72	b-g	67.3	c-f	82.7	c-g	40.0	c-f
SY TORACH	72	gh	15.4	c-f	4367	fgh	**97**	65	g-j	68.0	a-d	83.7	a-d	33.0	i
ELLERSLIE	81	b-e	14.2	kl	4284	gh	**95**	64	ij	65.3	h	81.0	h	34.3	i
AAC REDSTAR	79	c-f	14.7	h-k	5143	a-d	**114**	77	a-e	67.0	d-g	82.3	d-h	43.7	a-d
CDC SKRUSH	80	b-e	15.0	e-i	4885	b-e	**109**	73	b-f	66.0	gh	82.0	e-h	35.3	ghi
AAC RUSSELL VB	79	c-f	15.2	c-h	5205	abc	**115**	77	abc	68.0	a-d	84.0	abc	42.0	b-f
AAC HODGE VB	85	ab	14.4	jkl	5254	ab	**117**	78	ab	68.0	a-d	84.0	abc	40.0	c-f
BW1093	70	h	15.0	e-i	4570	e-h	**101**	68	f-j	66.0	gh	81.7	fgh	34.7	hi
BW5045	78	c-f	15.2	c-g	4896	b-e	**109**	73	b-f	66.0	gh	81.3	gh	41.0	c-f
AAC HOCKLEY	74	fgh	15.5	cde	4923	b-e	**109**	73	b-f	67.7	b-e	83.7	a-d	39.3	efg
BW5055	81	b-e	15.1	d-i	4680	d-h	**104**	70	d-j	66.3	fgh	81.7	fgh	35.0	hi
AAC WHITEHEAD VB	78	c-g	15.6	bcd	4834	b-f	**107**	72	b-h	66.0	gh	82.0	e-h	44.0	abc
AAC TOMKINS	77	d-g	14.9	f-j	5146	a-d	**114**	77	a-e	67.0	d-g	83.0	c-f	42.0	b-f
BW5031 CL VB	79	c-f	15.1	d-h	4756	c-g	**106**	71	c-i	67.3	c-f	83.3	b-e	44.0	abc
PT598 CL	76	d-h	14.0	l	5511	a	**122**	82	a	66.3	fgh	82.0	e-h	41.7	b-f
AAC BROADACRES VB	78	c-g	14.9	f-j	5199	abc	**115**	77	a-d	68.7	ab	85.0	a	45.3	ab

SY CAST	80	b-e	16.1	a	4658	d-h	**103**	69	e-j	66.7	efg	82.3	d-h	42.0	b-f
SY BRAWN	82	a-d	15.7	abc	4311	gh	**96**	64	hij	65.3	h	81.0	h	34.7	hi
CS RESOLVE	88	a	15.1	d-i	4925	b-e	**109**	73	b-f	66.7	efg	82.3	d-h	46.7	a
SY CROSSITE	81	b-e	14.9	g-j	4970	b-e	**110**	74	b-f	66.7	efg	82.3	d-h	42.7	a-f
SY GABRO	85	ab	14.6	ijk	4843	b-f	**107**	72	b-g	67.3	c-f	82.7	c-g	43.0	a-e
LSD P=.05	6.29		0.531		496.01			7.35		1.13		1.34		4.04	
Standard Deviation	3.84		0.324		302.45			4.48		0.69		0.82		2.46	
CV	4.82		2.14		6.26			6.24		1.03		0.98		6.11	

AC Carberry was the check for trial.

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

Highlighted row = Among the top-performing variety for the year 2021 at Westlock site.

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Table 5: CPSR & CWSP Wheat: 2021

Name	Height		Protein		Yield					Bushel Weight		Test Weight		TKW	
	cm		%		kg/ha		% of AC Carberry	bu/ac		lb/bu		kg/HL		g	
AC CARBERRY	76	b-e	15.3	b	4548	g	**100**	68	g	68.3	a	84.3	a	42.7	fg
AAC BRANDON	79	ab	15.9	a	4921	efg	**107**	73	efg	67.3	ab	83.3	ab	43.3	ef
AAC PENHOLD	63	h	15.2	b	4853	efg	**106**	72	efg	65.7	d	80.7	de	46.0	cd
HY2082	67	gh	15.0	bc	5220	cde	**114**	78	cde	67.3	ab	83.3	ab	47.7	bc
HY2095	75	b-f	14.3	f	5117	def	**112**	76	def	65.7	d	80.7	de	51.0	a
WPB WHISTLER	71	efg	13.2	g	5677	bc	**124**	84	bc	64.3	e	79.7	e	45.3	cde
CDC REIGN	82	a	14.7	cd	4725	fg	**103**	70	fg	67.7	ab	83.3	ab	40.7	gh
SY RORKE	71	d-g	14.3	ef	5229	cde	**114**	78	cde	67.0	bc	82.7	bc	39.3	hi
HY2074	78	abc	14.6	def	5113	def	**112**	76	def	68.0	ab	83.3	ab	46.3	cd
CS ACCELERATE	73	c-f	14.5	def	5276	cde	**115**	78	cde	65.7	d	81.0	de	37.3	i
LNR15-1741	73	c-f	14.4	ef	5162	de	**112**	76	def	67.0	bc	82.7	bc	38.7	hi
HY2090	70	fg	14.6	de	5462	cd	**119**	81	cd	65.3	de	81.0	de	49.0	ab
AC ANDREW	75	b-f	12.8	h	6196	a	**135**	92	a	66.0	cd	81.3	cd	44.0	def
PASTEUR	76	bcd	13.5	g	6096	ab	**133**	91	ab	67.3	ab	83.0	ab	40.3	gh
LSD P=.05	5.33		0.304		401.24 - 502.29			6.01 - 7.49		1.18		1.33		2.43	
Standard Deviation	3.18		0.181		0.02t			0.02t		0.7		0.79		1.45	
CV	4.32		1.25		0.59t			1.15t		1.06		0.97		3.31	

AC Carberry was the check for trial. **Highlighted row = Among the top-performing variety for the year 2021 at Westlock site.**

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

Oats are a valuable part of crop rotation. They provide disease and insect breaks from 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 soils organic matter content.

Table 6: Oats: 2021

	Height		Lodging		Yield					Bushel Weight		Test Weight		TKW		Protein	
Name	cm		(1-9)		kg/ha		% of CDC ARBORG	bu/ac		lb/bu		kg/HL		g		%	
CDC ARBORG	98	a	1.7	bc	5276	abc	**100**	138	abc	46.4	a	57.3	a	41.9	bc	13.8	a-d
AC MORGAN	92	ab	2.9	ab	5386	ab	**102**	141	ab	46.4	ab	57.3	a	44.3	a	12.2	e
CS CAMDEN	85	c	1.7	bc	5789	a	**109**	151	a	44.8	abc	55.3	abc	44.0	ab	13.3	bcd
OT2129	80	c	1.0	c	5211	bc	**99**	137	bc	44.8	abc	55.3	abc	43.2	ab	13.1	cd
CDC SKYE	84	c	1.3	bc	4607	d	**87**	121	d	45.0	abc	55.5	abc	38.7	d	14.5	a
AAC DOUGLAS	82	c	2.5	abc	5431	ab	**103**	143	ab	43.3	c	53.5	c	41.7	bc	13.2	bcd
ORE LEVEL 48	85	c	1.6	bc	3910	e	**74**	103	e	45.1	abc	55.6	abc	40.3	cd	13.9	ab
ORE LEVEL 50	83	c	1.3	bc	4399	de	**84**	115	de	45.8	ab	56.5	ab	43.4	ab	13.3	bcd
KALIO	86	bc	1.3	bc	4818	cd	**92**	126	cd	44.4	bc	54.8	bc	40.4	cd	13.0	d
ORE3541M (Filler)	86	bc	4.0	a	4368	de	**83**	114	de	46.6	a	57.5	a	39.8	cd	13.8	abc
LSD P=.05	6.74		1.50 - 2.14		533.21			13.99		1.983		2.412		2.318		0.776	
Standard Deviation	3.93		0.14t		310.84			8.16		0.877		1.066		1.351		0.453	
CV	4.57		31.45t		6.32			6.33		1.94		1.91		3.23		3.38	

Means followed by the same letter or symbol do not significantly differ (P=.05, Student-Newman-Keuls). **Lodging score low = better standability**

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Triticale is the first man-made crop species, 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: 2021

	Height	Yield		Bushel Weight	Test Weight	TKW	Protein
Name	cm	kg/ha	bu/ac	lb/bu	kg/HL	g	%
AB STAMPEDER	84 -	5289 b	79 b	58.4 b	72.0 b	60.2 -	12.9 a
BREVIS	86 -	6531 a	97 a	63.0 a	77.7 a	56.1 -	11.8 b
LSD P=.05	22.08	726.026	10.846	2.799	3.729	4.395	0.657
Standard Deviation	6.28	206.662	3.087	0.797	1.061	1.251	0.187
CV	7.37	3.5	3.52	1.31	1.42	2.15	1.52

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

Highlighted row = Among the top-performing variety for the year 2021 at Westlock site.

Flax grown mainly in cool northern climates. High omega-3 fatty acid and fiber in flax are some of the health benefits. It is used in livestock feeding, human consumption, and many other industrial uses. 2021, was not a good year for the crops. The flax plots were very uneven (CV was 40%). The reason may be due to excessive heat and less moisture in June of 2021. As a result, the flax trial data is not available.

Acknowledgments:

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

Alberta Wheat Commission

Alberta Barley

Gateway Research Organization

Regional Pulse Variety Trial

Co-operators: Justin Nanninga- NW-5-62-2-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 our 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 pulses 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 details:

Trial	Date Seeded Soil Temp	Seed Depth (in)	Fertilizer Seed Placed	Fertilizer Side Banded	Herbicides	Rate	Date
RVT Yellow Peas	April 30 8^0 C	2	11-52-0 58 lbs/ac	8.1-0-36.9-9.2 162 lbs/ac	Viper ADV	404ml/acre	June 8
RVT Green Peas	April 30 8^0 C	2	11-52-0 58 lbs/ac	8.1-0-36.9-9.2 162 lbs/ac	Viper ADV	404ml/acre	June 8
RVT Fababeans	April 30 8^0 C	2	11-52-0 58 lbs/ac	8.1-0-36.9-9.2 162 lbs/ac	Viper ADV	404ml/acre	June 8

Harvested :

Yellow Peas & Green Peas: August 30, 2021

Fababeans: September 17, 2021

Soil Test at site

Nitrogen (lbs/ac)	Phosphorus (lbs/ac)	Potassium (lbs/ac)	Sulphur (lbs/ac)	pH (0-14)	CEC (meq/100g)	Organic Matter (%)

23	56	208	20	5.7	20.8	5.1

Table 9: Green Peas - 2021

Variety	Maturity Rating	Yield bu/ac
CDC Limerick	Medium	58.2
Bluman	Medium	64.3
CDC Forest	Medium	73.7
CDC Rider	Medium-Late	60.7
Garde	Medium	52.1

Table 10: Yellow Peas - 2021

Variety	Maturity Rating	Yield bu/ac
CDC Amarillo	Medium	62.8
AAC Aberdeen	Medium	71.6
AAC Ardill	Medium	66.4
AAC Barrhead	Early	57.1
AAC Beyond	Medium	60.4
AAC Carver	Early	60.5
AAC Delhi	Medium	66.4
AAC Julius	Medium	62.8
AAC Lacombe	Medium	60.0
AAC Profit	Medium	69.5
CDC Canary	Early	57.6
CDC Inca	Medium	67.5
CDC Lewochko	Medium	63.0
CDC Spectrum	Medium	65.8
LN4228	Medium	48.5

Table 11: Fababeans – 2021

Variety Name	Maturity Rating	Yield bu/ac
Snowbird	Early	49.8
CDC-219-16	Early	48.2
DL-Nevado	Medium	50.3
DL-Tessoro	Medium	59.8
Fabella	Medium	64.1
Malik	Medium	44.4

Highlighted row = Among the top-performing variety for the year 2021 at Westlock site.

Demonstration trial 1

APG identified TWO potential trials that address common agronomic questions from the producers in Alberta, which dovetails in with "Plot to Field", APG's field-scale research program.

The funding from APG and GRO board of directors steered to have these plots demonstration in Barrhead County in 2021.

The first demonstration was a simple demonstration of inoculation options including double inoculation

- Dr. Jagroop from APG shared the information with local producers about demonstration research trials at our field day in July 2021.

Treatment	Inoculant
1	Liquid
2	Peat
3	Granular
4	Double Inoculant
5	No Inoculant

Pea Variety: AAC Barrhead

Seed treatment: Cruiser Maxx Vibrance

This demo trial was harvested on September 01, 2021

Graph 1: Yield Comparison – Demo 1 (Peas)

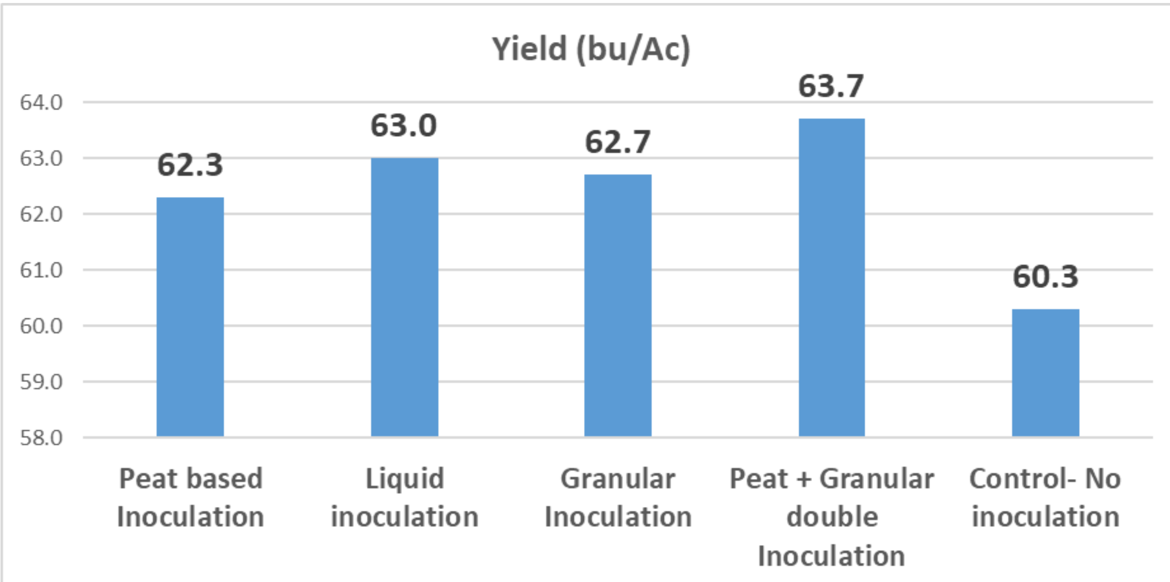

Table 12: Result of APG inoculant demo 1

	Treatment Name	Height		Yield			
		Cm		Bu/Ac		kg/Ha	
1	**Peat based Inoculation**	75	-	62.3	-	4191	-
2	**Liquid inoculation**	80	-	63.0	-	4254	-
3	**Granular Inoculation**	77	-	62.7	-	4224	-
4	**Peat + Granular double Inoculation**	75	-	63.7	-	4286	-
5	**Control- No inoculation**	75	-	60.3	-	4072	-
	LSD P=.05	4.0		10.9		710.7	
	Standard Deviation	2.1		5.8		377.5	
	CV	2.8		9.3		9.0	

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Demonstration trial 2: Applied research trial of comparing the phosphorus rate at seeding

Treatment	P (lbs/acre)
1	0
2	15
3	30
4	15 + No Insecticide

Pea Variety: AAC Barrhead ; Seed treatment: Cruiser Maxx Vibrance

**Trial was harvested on September 01, 2021

Graph 2: Yield Comparison – Demo 2 (Peas)

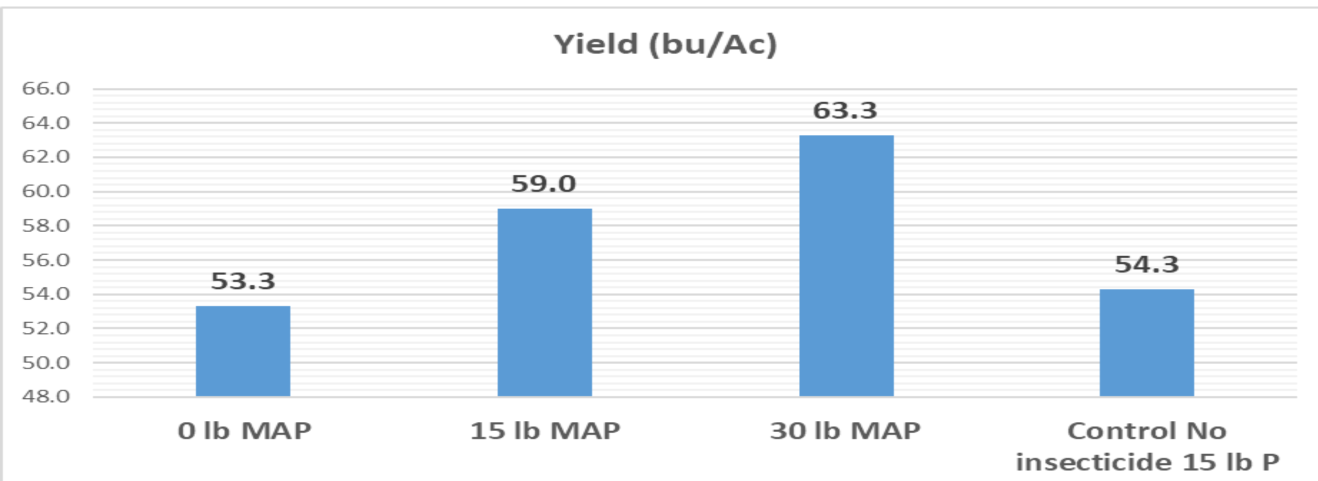

Table 13: Result of APG Phosphorus rate demo

	Treatment Name	Height		Yield			
		cm		bu/ac		kg/ha	
1	**0 lb MAP**	68	-	53.3	b	3595	b
2	**15 lb MAP**	77	-	59.0	ab	3977	ab
3	**30 lb MAP**	77	-	63.3	a	4247	a
4	**Control No insecticide 15 lb P**	71	-	54.3	b	3655	b
LSD P=.05		7.27		5.4		375.06	
Standard Deviation		3.64		2.7		187.73	
CV		4.99		4.7		4.85	

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

Trials Funded by Alberta Wheat Commission 2021

Co-operators: Randy Pidsadowski- SW-17-61-26-W4

GRO - Local Wheat Varieties Comparison Trial

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 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 seed or go with older proven choices. As producer run applied research organization, it is mandated for GRO to provide an unbiased source of information regarding this decision-making process. If producers can choose from the information grown in their area, with local conditions including average rainfall, soil type, and agronomic practices, they would be most likely to maximize performance for selected wheat variety and their profitability.

Objective: Side by side comparison of all the locally popular wheat varieties in the western part of north central Alberta to analyze yield and other agronomic characteristics.

Table 14: Local Wheat Varieties - Project Description	
Seeding Date	05-May-21
Seeding **Seeding depth**	Fabro zero-till drill : $1^{1/4}$ inch
Fertilizer/ac	**Fertilizer: Fall Applied:** 70 lbs/ac Actual N 60 lbs/ac Actual K **Spring Applied:** Side banded: 24.55-0-14.73-9.82 203.65 lbs/ac 50 lbs/ac Actual N 30 lbs/ac Actual K 20 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	Glyphosate(Pre-emergence): 0.78L/acre May 14 Curtail M 750ml/acre June 16
Rainfall	Recorded from May 1 to Sept 15, 2021: **187.70mm**
Harvest Date	14-Sep-21

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Table 15: GRO Local Varieties 2021

No.	Variety Name	Wheat Class	Height cm		Falling Number	Days to maturity # of days
1	**AAC Brandon**	CWRS	80	cd	333	99
2	**AC Carberry**	CWRS	84	bc	374	97
3	**CS Jake**	CWRS	82	bcd	444	97
4	**AAC Leroy VB**	CWRS	80	bcd	446	98
5	**AAC Viewfield**	CWRS	75	ef	435	97
6	**Ellerslie**	CWRS	84	bc	390	98
7	**AAC Redstar**	CWRS	81	bcd	515	99
8	**CDC SkRush**	CWRS	79	de	481	97
9	**CDC Landmark VB**	CWRS	81	bcd	543	100
10	**Parata**	CWRS	85	b	338	97
11	**AAC Redberry**	CWRS	82	bcd	408	97
12	**AAC Starbuck VB**	CWRS	79	de	427	100
13	**AAC Wheatland VB**	CWRS	78	de	455	101
14	**Zealand**	CWRS	96	a	398	97
15	**CS Accelerate**	CPSR	73	f	320	99
16	**AAC Crossfield**	CPSR	80	cd	413	104
17	**AAC Goodwin**	CPSR	82	bcd	505	98
18	**AAC Penhold**	CPSR	65	g	435	97

19	AC Foremost	CNHR	66 g	426	97
20	KWS Alderon	CWSP	68 g	364	109
LSD P=.05			4.47		
Standard Deviation			2.7		
CV			3.43		

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

The falling number test is used to evaluate the amount of sprout damage in Canadian wheats. Alpha-amylase is an enzyme found in sprout-damaged wheat. If germination occurs there is a dramatic increase of this enzyme. A high falling number or the longer it takes the stirrer to fall indicates the wheat is sound and satisfactory for most baking processes. A No. 1 Canada Western Red Spring wheat normally has a falling number greater than 350 seconds.

Table 16: GRO Local Varieties – Yield 2021

		Yield				% of	Bushel Wt		Test Wt		TKW		Protein		Gluten	
No.	Name	kg/ha		bu/ac		Check	lb/bu		kg/HL		G		%		%	
1	AAC Brandon (Check)	4945	c-f	73	c-f	100%	68.1	abc	84.1	a-d	43.1	ef	14.9	abc	37.7	a
2	AC Carberry	4849	c-g	72	c-g	98%	67.5	a-e	83.3	a-f	42.1	f	15.0	ab	36.6	abc
3	CS Jake	4587	fgh	68	fgh	93%	68.3	abc	84.2	a-d	36.3	jkl	15.0	ab	36.9	ab
4	AAC Leroy VB	5191	b-e	77	b-e	105%	67.7	a-d	83.6	a-e	43.2	ef	14.3	b-e	34.8	bcd
5	AAC Viewfield	5147	b-e	76	b-e	104%	68.1	abc	84.1	a-d	39.7	gh	14.6	a-e	36.1	abc
6	Ellerslie	4809	d-g	71	d-g	97%	66.2	de	81.7	ef	35.9	kl	14.0	de	34.6	cd
7	AAC Redstar	4606	fgh	68	fgh	93%	66.2	de	81.7	ef	40.1	g	15.1	ab	36.9	a
8	CDC SkRush	4797	efg	71	efg	97%	66.5	cde	82.1	def	35.4	l	15.0	ab	36.4	abc

9	**CDC Landmark VB**	4506	gh	67	gh	91%	68.4	ab	84.4	ab	43.7	ef	14.4	a-e	36.4	abc
10	**Parata**	4892	c-f	73	c-f	99%	66.0	de	81.5	ef	37.7	ijk	14.9	abc	35.8	abc
11	**AAC Redberry**	4390	h	65	h	89%	66.1	de	81.5	ef	38.1	hi	15.0	ab	37.7	a
12	**AAC Starbuck VB**	4876	c-g	72	c-g	99%	68.2	abc	84.2	a-d	43.5	ef	15.3	a	37.7	a
13	**AAC Wheatland VB**	5170	b-e	77	b-e	105%	68.1	abc	84.0	a-d	42.1	f	14.7	a-e	36.6	abc
14	**Zealand**	3805	i	57	i	77%	68.3	ab	84.3	abc	37.8	ij	14.1	cde	36.3	abc
15	**CS Accelerate**	4915	c-f	73	c-f	99%	65.7	e	81.1	f	35.7	l	14.0	de	33.0	d
16	**AAC Crossfield**	4637	fgh	69	fgh	94%	66.9	a-e	82.5	a-f	48.7	a	14.8	a-d	35.8	abc
17	**AAC Goodwin**	5253	bc	78	bc	106%	68.7	a	84.7	a	44.7	de	14.8	a-d	35.8	abc
18	**AAC Penhold**	5207	bcd	77	bcd	105%	66.5	cde	82.1	c-f	45.9	cd	13.9	e	32.7	de
19	**AC Foremost**	5459	b	81	b	110%	66.7	b-e	82.3	b-f	48.2	ab	12.8	f	30.8	e
20	**KWS Alderon**	6450	a	96	a	130%	63.3	f	78.1	g	46.8	bc	12.0	f	28.4	f
LSD P=.05		320.082 - 500.488		4.769 - 7.412			1.786		2.208		1.859		0.835		2.114	
Standard Deviation		0.021t		0.021t			1.08		1.336		1.125		0.505		1.279	
CV		0.57t		1.12t			1.61		1.61		2.72		3.5		3.62	

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

AAC Brandon is new check for wheat trials.

Highlighted row = Among the top performing variety for the year 2021 at Westlock site.

AWC funded trial: Ultra early vs Regular seeding dates and its effect on maturity, yield and quality.

Ultra-early seeding of spring wheat is accomplished by planting at soil temperatures of 2 - 6 degrees Celsius. This is much earlier than traditional seeding temperatures (10 - 12 degrees C). It has the potential to increase yield, improve grain quality and result in earlier maturity. Ultra-early seeding should allow the crop to miss damage caused by wheat midge (*Sitodiplosis mosellana*) and fusarium (*Fusarium graminearum)*. It could also lower the cost of herbicides as the crop closes canopy sooner and reduces weed competition. Another benefit is there is enough time for the crop to ripen naturally, thus potentially reducing the use of pre-harvest herbicides.

Need and Potential Outcomes:

There is a need within the province for spring wheat to gain maturity sooner to thwart the stresses created by frost and damp weather at harvest, causing downgrading of the grain. There is also a need for the crop to escape damage caused by wheat midge and fusarium at heading time. Spring wheat should require less pesticide and potentially reduce the risk of pesticide residues if it is seeded and matures early.

The potential benefits and outcomes include a higher quality crop (grade protection), potentially reduced pesticide use, and earlier harvest date (spreads harvest workload and reduces stress).

Treatments:

2 varieties (*AAC Brandon*, medium-late maturity, and *AAC Connery*, early maturity)

2 planting dates (ultra-early date, 2 - 6^0 C soil temp and normal seeding date, 8 – 10^0 C soil temp, (approximately 12-14 days apart))

3 seeding rates (Low: 200, Medium: 300 and High: 400 viable seeds/m2).

The trial is seeded in a randomized block design with 4 replications.

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Table 17: Agronomic details for the trial:

Early Seeding: Seeded April 19, 2021, soil temperature: 5.5 ° C		
Normal Seeding: Seeded May 05, 2021, soil temperature 10 ° C		
Seed depth for both seedings: 1.25 inch		
Rainfall recorded from May 1 to Sept. 15, 2021: 187.70 mm or 7.39 inches		
Fertilizer: Fall Applied:		
	70 lbs/ac Actual N	60 lbs/ac Actual K (from blend
Spring Applied:		
	Side banded: 24.55-0-14.73-9.82	203.65 lbs/ac
	50 lbs/ac Actual N	
	30 lbs/ac Actual K	20 lbs /ac Actual S
	Seed placed: 11-52-0	58 lbs/ac
	6.38 lbs/ac Actual N	30.16 lbs/ac Actual P
	Glyphosate (Pre-emergence)	May 14, 2021
	Curtail M 750 ml/ac	June 16, 2021
Harvested:	September 10, 2021	

Acknowledgment:

Thanks for support from the Canadian Agricultural Partnership (CAP) and the Alberta Wheat Commission (AWC) for the three years of funding (2020 – 2022) for the project

Table 18: Ultra-early wheat trial - 2021

Variety	Seeding Rate	Seeding Time	Height cm		DTM # of days		Protein %		Gluten %	
AAC Brandon	Low	Ultra Early	75	d	126	a	15.9	ab	39.6	ab
AAC Brandon	Medium	Ultra Early	78	a-d	123	ab	15.4	bc	38.4	ab
AAC Brandon	High	Ultra Early	77	bcd	124	a	15.9	abc	39.7	ab
AAC Connery	Low	Ultra Early	78	a-d	125	a	15.9	ab	39.3	ab
AAC Connery	Medium	Ultra Early	75	cd	124	a	15.7		39.2	ab
AAC Connery	High	Ultra Early	80	ab	123	ab	15.2	c	37.9	b
AAC Brandon	Low	Regular	79	a-d	121	bc	16.1	ab	39.8	ab
AAC Brandon	Medium	Regular	79	a-d	118	de	15.8	abc	39.5	ab
AAC Brandon	High	Regular	82	a	118	cde	15.7	abc	39.4	ab
AAC Connery	Low	Regular	80	abc	119	cd	16.3	a	40.1	a
AAC Connery	Medium	Regular	81	a	118	de	15.7	abc	38.9	ab
AAC Connery	High	Regular	80	a-d	115	e	15.5	bc	38.1	b
LSD P=.05			4.624 - 4.810		2.95		0.723		1.999	
Standard Deviation			2.285t		2.05		0.501		1.389	
CV			3.66t		1.7		3.18		3.55	

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

(Low: 200, Medium: 300 and High: 400 viable seeds/m2).

Higher seeding rates tends to reduce the days to maturity in both seeding times

Table 19: Ultra-early wheat trial – 2021

Variety	Seeding Rate	Seeding Time	Yield kg/ha		Yield bu/ac		Bushel Wt lb/bu		Test Wt kg/HL		TKW g	
AAC Brandon	Low	Ultra Early	4445	cde	66	cde	68.3	ab	83.8	bcd	43.8	a
AAC Brandon	Medium	Ultra Early	5338	ab	79	ab	68.0	bc	84.0	bc	43.5	a
AAC Brandon	High	Ultra Early	4893	bc	73	bc	68.3	ab	84.0	bc	41.8	b
AAC Connery	Low	Ultra Early	4273	de	63	de	66.8	d	81.8	f	40.5	bcd
AAC Connery	Medium	Ultra Early	3941	e	59	e	66.8	d	82.5	ef	39.0	d
AAC Connery	High	Ultra Early	4356	cde	65	cde	66.8	d	82.8	def	39.3	d
AAC Brandon	Low	Regular	4846	bcd	72	bcd	68.5	ab	84.5	ab	43.5	a
AAC Brandon	Medium	Regular	5280	ab	79	ab	68.8	ab	84.5	ab	44.8	a
AAC Brandon	High	Regular	5529	a	82	a	69.0	a	85.3	a	43.8	a
AAC Connery	Low	Regular	4916	bc	73	bc	67.0	d	82.8	def	40.0	cd
AAC Connery	Medium	Regular	4923	bc	73	bc	67.3	cd	83.0	cde	40.0	cd
AAC Connery	High	Regular	5260	ab	78	ab	67.3	cd	83.0	cde	41.0	bc
LSD P=.05			589.69		8.7		0.81		1.08		1.68	
Standard Deviation			409.9		6.05		0.57		0.75		1.17	
CV			8.48		8.44		0.84		0.9		2.8	

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

Conclusions

This limited database of seeding dates versus yield parameters does not allow us to draw many conclusions at this point in time. The only trends we are seeing so far include that the days to maturity (DTM) appear to be longer when ultra-early seeding is used, and the longer season variety had a higher bushel weight. More site-years and data are required to determine further significant conclusions.

Canola Performance Trial 2021

Co-operator: Ray Marquette – SW-11-60-2-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 2021, the trial includes a total of 12 standard varieties and 19 straight cuts from three herbicide-tolerant systems (Liberty Link, Roundup Ready, and TruFlex).

Table 20: Agronomic details for the trial:

CPT - Project Description	
Seeding Date	May 17, 2021
Seeding	Fabro zero-till drill
Seeding Depth	¾ inch
	CPT - Project Description
Fertilizers	**Deep Banded: 34.4-0-7.94-5.29 = 377.89lbs/ac** • 130 lbs/ac Actual N • 30 lbs/ac Actual K • 20 lbs/ac Actual S **Side Placed: 11-52-0 = 76.92 lbs/ac** • 8.5 lbs/ac Actual N • 40 lbs/ac Actual P
Herbicides	• Roundup (RR entries) 270 gai/ac June 11, 2021 • Liberty (LL entries) 1.6 l/ac June 11, 2021
Mowed Down	October 04, 2021

Summary:

Both trials (standard and straight cut) were sprayed at the 3-6 leaf stage. There was hot and dry spell of one month (mid June to mid-July). Normally, this is the crucial time for plants growth. Due to drought condition, plants were unable to grow well. As a result, both CPT trials grown in Barrhead County were not harvested.

POGA Milling Oats Trial-2021

Co-operators: Randy Pidsadowski- SW-17-61-26-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. "Year 2016-21"

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. 2021 was comparatively very dry year for both locations in Alberta. The two weeks of excessive heat was detrimental for oats. Therefore, overall yield were lower compared to previous years.

Background

Oat production in Alberta has been on a relatively steady decline since 2011. Oats has earned the status of major Canadian export crop from a domestic crop status. According to Prairie Oat Grower's Association (POGA), an estimate of 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 two oat varieties grown in Alberta, Morgan and Derby 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 and both Morgan and Derby are consistently at or below that amount. Therefore, oat producers in Alberta need an oat variety that can consistently beat the yields of Morgan and Derby but has the higher β-glucan amounts that the oat miller desire. To emphasize this fact, since 2015 Grain Millers has 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 variety 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, the functional attribute 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, but this issue is moving west, towards Alberta. Neither Morgan nor Derby varieties 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 stay profitable in the oat production. The β-glucan content in oat may vary with change 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 yield 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.

Methodology

Eleven milling oat varieties were tested in 2021. Based on the soil fertility recommendations, fertilizers were added to maintain the optimal levels of growing condition. Seeding rates were calculated based on 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 or hand weeding methods (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 2021 growing season was very dry throughout the year.

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Soil Information – GRO – Westlock - 2021

Nitrogen (lbs/ac)	Phosphorus (lbs/ac)	Potassium (lbs/ac)	Sulphur (lbs/ac)	pH (0-14)	CEC (meq/100g)	Organic Matter (%)
85	34	242	38	5.9	23.6	7.1

Table 21: Agronomic details for the POGA Trail 2021

Location:	Peace Region	Westlock
Seeding Date:	May 01st, 2021	May 06th, 2021
Harvest Date:	Sept 23th, 2021	September 15, 2021
Soil Temp:	14.5^0 Celsius	9^0 Celsius
Soil Moisture:	Adequate	Very good
Seeding Depth:	¾ inch	$1^{1/4}$ inch
Fertility total Nutrients (Actual lb/acre)	**112 N-30 P2O5-15 K2O-10 S**	**56.38 N-30.16 P205-30 K20-20 S**
Herbicides applied to the trial	Pre-burn Roundup @ 1L/acre (May 26)	Pre-emergence Roundup 0.78L/Ac on May 14
Herbicides applied to trial	In Crop Stellar XL @405 ml/ac (June 04) In Crop Lontrel XL@138 ml/ac (June 22)	In crop Broad leaf: Curtail M (750 ml/ Acre) on 7 June
Fungicides applied to the trial	None	None
Rainfall (mm)	128.78 mm	187.70 mm

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

Results and Discussion

2021 was not the best year to show the high yield potential for the varieties in Alberta. It was very dry compared to the five-year average. We have about 75% less precipitation in both sites with a spell of two weeks with temperature ranging more than 30 C which is very unusual for northern Alberta. Overall Westlock area still fared well and had an average site yield of 139 bu/acre compared to just 23 bu/acre in the Peace region site. The quality of grain was also sustainably lower in the Peace region site with a lower average test weight (33 Kg/Hl), a lower average thousand kernel weight (32 g) and a higher average hull percentage (27%) compared to the Westlock site with an average of 56 Kg/Hl test weight, TKW of 43 g and 17% hull percentage.

Table 22: Yield - 2021 Comparison

		Westlock			Peace Region		
	Variety	% of AC Morgan	Yield bu/ac		% of AC Morgan	Yield bu/ac	
1	**AC Morgan**	100	161	a	100	19.6	de
2	**CS Camden**	93	150	a	145	28.5	a
3	**Kalio**	88	141	a	111	21.8	b-e
4	**OT3112**	87	140	a	117	22.9	a-e
5	**CDC Ruffian**	91	147	a	109	21.3	cde
6	**AC Summit**	75	121	b	99	19.4	e
7	**AC Arborg**	93	150	a	141	27.6	ab
8	**CDC Endure**	89	143	a	129	25.2	a-d
9	**CDC Skye**	72	115	b	104	20.3	de
10	**AAC Douglas**	92	148	a	104	20.3	de
11	**ORE3541M**	71	115	b	138	27.1	abc

Table 23: Other results from the POGA trial 2021 Westlock Site.

		Height cm		**Lodging (1-9)**		**Test Weight kg/HL**		**TKW g**		**Maturity Days**	
1	**AC Morgan**	93.7	ab	1.0	-	56	bcd	43	bc	96.7	-
2	**CS Camden**	88.0	b	1.0	-	54	cd	44	ab	98.7	-
3	**Kalio**	85.0	b	1.0	-	54	d	41	cd	98.0	-
4	**OT3112**	71.7	c	1.0	-	54	d	44		97.0	-
5	**CDC Ruffian**	88.3	b	1.5	-	57	bc	43	abc	97.3	-
6	**AC Summit**	87.0	b	1.6	-	59	a	40	d	98.3	-
7	**AC Arborg**	98.0	a	1.0	-	58	ab	46	a	96.7	-
8	**CDC Endure**	92.7	ab	1.2	-	56	bcd	44	abc	97.0	-
9	**CDC Skye**	88.3	b	1.0	-	55	cd	42	bc	97.0	-
10	**AAC Douglas**	85.0	b	1.0	-	55	cd	44	ab	98.7	-

11	ORE3541M	84.7	b	1.8	-	57	bc	41	cd	97.0	-
LSD P=.05		6.22		0.8		1.739		1.81		1.3	
Standard Deviation		3.65		0.10		1.20		1.25		0.76	
CV		4.18		30.07		2.15		2.92		0.78	

Lodging score (1 to 9) where 1 = Straight and 9 is flat

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

The most popular oat variety of Alberta, AC Morgan was the highest yielding variety for 2021 in Westlock followed by AC Arborg and CS Camden. For the beta-glucan percentage in oats, variety OT 3112 (about 5%) was highest in both sites, which was consistent with our previous year's results (2019-2020). CDC Endure had the highest groat weight (plumper oat) at the Westlock site which is one of the preferred parameters for the grain millers.

Table 24: Other results from the POGA trial 2021 Peace Site.

		Height cm		**Lodging (1-9)**		**Test Weight kg/HL**		**TKW G**	
1	**AC Morgan**	38.2	b	1	-	31.1	cd	29.6	-
2	**CS Camden**	39.4	b	1	-	32.8	bcd	30.2	-
3	**Kalio**	38.5	b	1	-	31.4	cd	30.8	-
4	**OT3112**	36.1	a	1	-	27.9	de	33.2	-
5	**CDC Ruffian**	41.5	ab	1	-	38.2	ab	28.2	-
6	**AC Summit**	45.3	a	1	-	41.7	a	33.4	-
7	**AC Arborg**	37.2	b	1	-	31	cd	31.0	-
8	**CDC Endure**	40.3	b	1	-	34	bc	29.0	-
9	**CDC Skye**	28.1	c	1	-	25	e	32.4	-
10	**AAC Douglas**	40.1	b	1	-	34.2	bc	34.4	-
11	**ORE3541M**	40.8	ab	1	-	37.7	ab	35.6	-
LSD P=.05		4.683				4.83		1.81	
Standard Deviation		3.228				0.05		1.248	
CV		8.3				3.35		2.92	

Lodging score (1 to 9) where 1 = Straight and 9 is flat

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

Test weight is an important indicator of grain milling quality. AC Summit had the highest test weight at Westlock as well as the Peace Region. At Westlock site, the test weight was not significantly different among the varieties.

Table 25: The Beta-Glucan results from the POGA trial of 2021.

		Westlock (GRO) – 2021		Peace Region (SARDA) – 2021	
	Variety	**Hull percentage (%)**	**Flour BG (%, db)**	**Hull percentage (%)**	**Flour BG (%, db)**
1	**AC Morgan**	16.97	3.5	17.76	3.5
2	**CS Camden**	20.38	4.0	38.37	4.0
3	**Kalio**	18.37	3.6	30.45	3.8
4	**OT3112**	22.96	4.9	24.14	5.1
5	**CDC Ruffian**	14.64	3.3	34.01	3.9
6	**AC Summit**	20.92	3.4	40.24	3.4
7	**AC Arborg**	20.42	3.8	20.71	4.2
8	**CDC Endure**	15.08	4.1	28.65	4.5
9	**CDC Skye**	14.82	4.0	29.05	4.2
10	**AAC Douglas**	18.08	3.7	18.55	4.1
11	**ORE3541M**	12.43	3.6	18.39	3.8

Beta Glucan results: The beta-glucan content of the 11 different milling varieties ranged between 3.3% and 5.1%, with the lowest reported for CDC Ruffian and AC Summit at Westlock and the Peace Region respectively. OT3112, CDC ENDURE and CDC SKYE were the highest beta-glucan varieties at both locations which is the same as 2020.

Conclusion:

There is a significant effect of location and varietal difference for the yields as well as beta-glucan levels in 2016, 2017, 2018, 2019, 2020 and 2021. Environmental conditions affected yield capacity of a variety to a higher degree than the effect on Beta-glucan levels.

Similar to the yields in 2020, OT3112 had shown to be great milling oat and has the potential to replace the CDC Endure with high yield, specifically in Westlock, and high beta-glucan and good test weight, which are preferred characteristics for the grain millers.

Crop Year	Top 3 Varieties for Beta Glucan at Westlock		
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		
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

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Table 26: Overall Summary of the trial: Yields from 2016 to 2021

	Yield	Overall Average	2021	2020	2019	2018	2017	2016
Milling Oats	% of AC Morgan	Yield (Bu/Ac)	Yield (Bushel/Acre)					
AC Morgan	100	204	161	203	243	226	212	178
CS Camden	98	200	150	211	241	206	226	167
CDC Seabiscuit	103	211	-	205	239	212	208	189
OT3112	87	177	140	213	-	-	-	-
CDC Ruffian	100	203	147	206	219	207	245	193
AC Summit	92	189	121	178	245	203	217	167
CDC Arborg	101	206	150	208	244	221	-	-
ORE3542M	98	199	-	183	214	201	-	-
CDC Norseman	102	208	-	190	222	213	-	-
CDC Endure	100	203	143	194	249	226	-	-
CDC Skye	92	188	115	211	237	-	-	-
CDC Orrin	99	202	-	-	-	218	221	168
Souris	86	175	-	-	-	-	194	155
CDC Minstrel	92	188	-	-	-	-	202	174
Triactor	104	212	-	-	238	229	208	172
Akina	101	206	-	-	-	221	222	176
Kalio	69	141	141	-	-	-	-	-
AAC Douglas	73	148	148	-	-	-	-	-
ORE3541M	56	115	115	-	-	-	-	-

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Table 27: Beta-glucan(%) contents in milling oats from 2016 to 2021

Milling Oats		2016		2017		2018		2019		2020		2021	
	Average	Westlock	Peace	Westlock	Peace	Westlock	Peace	Westlock	Peace	Westlock	Peace	Westlock	Peace
AC Morgan	3.8	3.9	4.1	3.8	4.2	3.9	3.4	3.9	3.7	3.9	3.8	3.5	3.5
CS Camden	4.3	3.7	3.9	4.4	4.6	4.4	3.8	4.4	5.2	4.7	4.3	4.0	4.0
CDC Seabiscuit	4.2	3.7	3.7	4.6	4.6	4.4	3.7	4.5	4.2	4.6	4.0		
OT3112	5.2									6.1	4.8	4.9	5.1
CDC Ruffian	3.5	2.7	3.3	3.8	3.9	3.6	2.7	3.6	3.7	4.3	3.5	3.3	3.9
AC Summit	4.1	3.6	3.7	4.3	4.4	4.3	3.7	4.3	4.6	4.8	4.5	3.4	3.4
CDC Arborg	4.1					4.4	3.8	4.2	4.3	4.6	3.6	3.8	4.2
ORE3542M	4.0					4.0	3.5	3.8	4.2	4.4	3.8		
CDC Norseman	4.5					4.5	3.8	4.7	4.4	4.8	4.6		
CDC Endure	4.6					4.7	4.2	4.5	4.7	5.2	4.6	4.1	4.5
CDC Skye	4.6							4.5	5.0	4.9	5.0	4.0	4.2
CDC Orrin	3.8	3.2	3.7	4.4	4.0	4.1	3.4						
Souris	4.3	3.6	4.4	4.9	4.4								
Kara	4.2	3.6	3.7	4.3	5.0								
CDC Minstrel	3.7	2.9	3.5	3.9	4.3								
Triactor	4.1	3.5	3.7	4.4	4.5	4.4	4.0	4.1	4.3				
Akina	4.4	3.8	3.7	5.0	4.9	4.8	4.0						
Kalio	3.7											3.6	3.8
AC Douglas	3.9											3.7	4.1
ORE3541M	3.7											3.6	3.8

Regional Silage Trial

Co-operators: Peter Smerychynski- SE-10-60-2-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. Plot size was 1.37 meters wide (6 rows with 9-inch spacing) by 7 meters long. Silage was harvested, 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/m^2 that 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 size 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 size.

Table 28: Soil results – Barrhead & Westlock

SOIL INFORMATION - 2021

LOCATION	Nitrogen (lbs/ac)	Phosphorus (lbs/ac)	Potassium (lbs/ac)	Sulphur (lbs/ac)	pH (0-14)	CEC (meq/100g)	Organic Matter (%)
BARRHEAD (SILAGE SITE)	25	66	236	29	4.3	17.3	3.6
WESTLOCK	85	34	242	38	5.9	23.6	7.1

Regional Silage Trial - Barrhead

Barley, Triticale, Oats

Seeded June 1, 2021

Seed depth: 1 inch

Rainfall: From June 1 to August 10, 2021: 100.3 mm or 3.94 inches

Fertilizer:

Fall Applied: 82-0-0 110 lbs/ac 90 lbs/ac Actual N

Side banded: 23.16-0-17.05-7.35 102 lbs/ac

23.62 lbs/ac Actual N 17.39 lbs/ac Actual K 7.50 lbs/ac Actual S

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

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

Glyphosate + Heat 360g a.i./ac + 10g/ac May 24, 2021

Frontline 500 ml/ac June 23, 2021

Harvested: Barley & Oats: **August 13, 2021**; Triticale: **August 20, 2021**

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, 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 Bow:** A two-row, hulled malting barley. Combines good agronomic performance and physical grain quality with resistance to covered smut and stem rust.
- **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, newly released variety previously called TR18645.
- **Sundre** – A high yielding six-row barley variety with good disease resistance.
- **AB Hauge**: 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 row, 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.

Table 29 for Silage Yield.

Barley Silage 2021												
		Variety Name	**Height**	**Yield**	**Check**	**CP**	**TDN**	**Calcium**	**Phosphorus**	**Potassium**	**Magnesium**	**RFV**
			cm	**Tonnes/Ac**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**
1	Two Row	CDC Austenson	65	8.0	100	11.7	64.0	0.24	0.16	0.91	0.10	129
2	Six Row	AB Advantage	73	7.2	90	12.8	62.1	0.33	0.17	1.14	0.12	114
3	Six Row	AB Cattlelac	64	7.6	96	12.7	63.2	0.30	0.16	1.13	0.13	127
4	Two Row	AB Wrangler	64	8.5	107	12.5	65.6	0.25	0.13	1.14	0.10	164
5	Two Row	Altorado	59	8.8	110	12.2	65.3	0.20	0.19	1.13	0.11	127
6	Six Row	Amisk	57	7.9	99	13.1	64.3	0.32	0.16	1.25	0.12	135
7	Two Row	Canmore	64	8.7	109	10.8	64.0	0.29	0.14	1.16	0.10	140
8	Two Row	CDC Bow	68	8.1	102	10.8	62.9	0.32	0.13	0.99	0.11	122
9	Two Row	CDC Cowboy	94	9.0	112	10.5	62.1	0.24	0.16	1.01	0.11	116
10	Two Row	CDC Maverick	82	8.8	110	9.9	61.6	0.26	0.13	0.86	0.11	129
11	Two Row	Claymore	62	8.0	99	11.5	62.6	0.27	0.14	1.04	0.10	130
12	Two Row	AB Prime	62	8.6	108	10.9	62.8	0.24	0.14	1.05	0.11	127
13	Six Row	Sundre	66	8.0	100	11.5	59.8	0.33	0.13	0.97	0.12	121
14	Two Row	AB Hague	70	8.6	107	11.5	63.1	0.22	0.13	1.13	0.11	124
15	Six Row	AB Tofield	64	9.5	119	11.6	62.1	0.30	0.15	1.28	0.13	122
16	Two Row	CDC Churchill	56	9.0	113	11.7	64.0	0.32	0.15	1.09	0.11	143
17	Two Row	Stockford	70	9.2	115	11.2	62.7	0.38	0.16	1.03	0.12	126
18	Two Row	Esma	55	8.4	105	11.7	64.3	0.19	0.15	0.91	0.10	161

Harvested @ Soft dough stage	Check: CDC Austenson	Yield: Adjusted @ 65% Moisture
TDN: Total Digestible Nutrients	RFV: Relative Feed Value	Highlighted: Top performing variety by yield in 2021
CP: Crude Protein		Highlighted: Top performing variety by RFV in 2021

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 for Silage Yield.

Triticale/Wheat Silage 2021											
	Variety Name	Height	Yield	Check	CP	TDN	Calcium	Phosphorus	Potassium	Magnesium	RFV
		cm	Tonnes/Ac	%	%	%	%	%	%	%	%
1	Taza	96	7.4	100	10.9	65.3	0.17	0.23	1.15	0.11	169
2	AAC Delight	79	8.7	118	11.3	68.7	0.18	0.17	0.92	0.12	197
3	Bunker	84	8.3	113	9.4	62.2	0.19	0.15	1.02	0.12	139
4	Sunray	80	9.5	129	10.4	65.8	0.23	0.13	1.56	0.11	153
5	AB Stampeder	72	7.8	105	9.3	62.8	0.15	0.14	0.83	0.14	146
6	AAC Awesome	73	8.5	115	9.7	61.7	0.18	0.09	1.46	0.12	153
7	AAC Paramount	68	7.1	96	9.8	61.8	0.15	0.13	1.07	0.11	141

8	AC Andrew	66	7.3	98	10.0	59.1	0.21	0.13	1.58	0.15	116
9	AC Sadash	75	7.7	103	10.1	62.0	0.21	0.14	1.50	0.12	146
10	KWS Alderon	60	7.9	107	11.3	65.0	0.13	0.15	1.36	0.12	166
11	WPB Whistler	58	6.9	93	11.7	63.5	0.21	0.13	1.57	0.15	148

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
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.

Table 31 for Silage Yield.

Oats Silage 2021											
	Variety Name	Height	Yield	Check	CP	TDN	Calcium	Phosphorus	Potassium	Magnesium	RFV
		cm	Tonnes/Ac	%	%	%	%	%	%	%	%
1	CDC Baler	67	8.8	100	10.1	57.3	0.23	0.14	1.08	0.13	110
2	AC Morgan	68	7.8	89	11.5	58.9	0.24	0.17	1.08	0.11	134
3	AC Juniper	68	7.0	80	10.9	57.7	0.25	0.19	1.34	0.15	115
4	CDC Arborg	76	7.7	87	10.9	59.7	0.24	0.17	1.04	0.11	145
5	CDC Haymaker	62	7.8	89	10.0	56.5	0.24	0.18	1.24	0.11	106
6	CDC Nasser	72	7.9	91	10.4	57.3	0.29	0.17	1.22	0.14	111
7	CS Camden	63	7.6	86	9.9	55.5	0.23	0.16	1.05	0.12	108
8	Murphy	57	8.9	101	9.5	55.2	0.21	0.17	1.13	0.13	105
9	ORE3542M	68	7.3	84	10.1	57.4	0.18	0.16	1.08	0.10	108
10	CDC-SO-1	68	6.7	77	9.7	56.7	0.21	0.15	0.92	0.11	125
11	CDC Endure	65	8.3	95	10.0	56.7	0.20	0.17	1.11	0.10	114
Harvested @ Milk stage TDN: Total Digestible Nutrients CP: Crude Protein			Check: CDC Baler RFV: Relative Feed Value			Yield: Adjusted @ 65% Moisture Highlighted Row: Top performing variety by yield Highlighted Row: Top performing variety by Relative Feed 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 - 2021

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.

4. 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.

5. 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.

6. 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.

7. 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.

8. 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.

9. 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.

10. Turnip

Seeding Rate: 2-5 lbs/acre

Turnip requires 30 to 60 days to first grazing

Some varieties are better than others for grazing purpose.

Table 32: Agronomic information of trial

LOCATION	WESTLOCK	BARRHEAD
SEEDING DATE:	31-May-21	1-Jun-21
HARVEST DATE:	25-Aug-21	26-Aug-21
SOIL MOISTURE:	Adequate	Adequate
SEEDING DEPTH:	3/4"	3/4"
FALL APPLIED NUTRIENT (ACTUAL LB/ACRE)	**70 N-0 P_2O_5-60 K_2O**	**90 N-0 P_2O_5-0 K_2O**
SPRING APPLIED NUTRIENTS (ACTUAL LB/ACRE)	**31.38 N-30 P_2O_5-15 K_2O-10 S**	**30 N-30 P_2O_5-17.39 K_2O-7.50 S**
HERBICIDES APPLIED:	Glyphosate + Heat @ 360 g/a.i./ac + 1 0g/ac (June 4) rogued 2-3 times	Glyphosate + Heat @ 360 g/a.i./ac + 10 g/ac (May 24) rogued 2-3 times
RAINFALL (MM)	113.7 mm	100.3 mm

Table 33 for Silage Yield.

RDAR Results Driven Agriculture Research

FARMER – LED APPLIED RESEARCH

GATEWAY RESEARCH ORGANIZATION

Alternative Silage - 2021 – Barrhead

	Variety Name	Height	Yield	Crude Protein	TDN	Calcium	Phosphorus	Potassium	Magnesium	RFV
		cm	Tonnes/Ac	%	%	%	%	%	%	%
1	CHICORY	35	0.5	25.5	56.9	1.92	0.15	2.37	0.66	165
2	FORAGE BRASSICA	44	4.9	22.4	58.7	1.79	0.15	2.27	0.36	161
3	FORAGE KALE	41	1.6	23.8	59.3	2.05	0.16	2.46	0.48	153
4	FORAGE RADISH	65	6.2	14.6	56.1	1.49	0.16	1.54	0.30	96
5	FORAGE TURNIP	47	4.9	23.0	56.2	2.51	0.18	1.87	0.43	167
6	MAX RADISH	94	7.1	12.9	55.3	1.00	0.12	1.37	0.22	97
7	MILLET	80	7.4	10.8	60.6	0.39	0.12	1.21	0.34	124
8	PHACELIA	60	2.5	17.8	55.9	2.55	0.19	2.25	0.42	123
9	PLANTAIN	45	2.8	18.7	59.9	1.56	0.16	1.44	0.24	134
10	SORGHUM SUDAN GRASS	111	7.8	9.3	38.2	0.40	0.11	1.11	0.28	78

****Chicory plots were eaten by deers**
Harvested yield: On Ground Only
TDN: Total Digestible Nutrients

RFV: Relative Feed Value
Yield: Adjusted @ 65% Moisture
Highlighted Row: Top performing variety by yield (green)or relative feed value (yellow).

Table 34 for Silage Yield.

RDAR Results Driven Agriculture Research

FARMER – LED APPLIED RESEARCH

GATEWAY RESEARCH ORGANIZATION

Alternative Silage - 2021 – Westlock										
	Variety Name	Height	Yield	Crude Protein	TDN	Calcium	Phosphorus	Potassium	Magnesium	RFV
		cm	Tonnes/Ac	%	%	%	%	%	%	%
1	CHICORY	44	3.6	15.5	56.3	1.06	0.24	3.74	0.35	122
2	FORAGE BRASSICA	59	8.0	17.6	55.8	1.80	0.20	3.11	0.31	131
3	FORAGE KALE	52	6.9	14.5	49.9	3.23	0.14	3.12	0.45	103
4	FORAGE RADISH	92	9.4	13.3	48.8	1.67	0.14	2.05	0.27	89
5	FORAGE TURNIP	52	4.1	14.2	49.4	3.08	0.10	1.76	0.39	135
6	MAX RADISH	113	9.8	13.0	52.7	1.19	0.09	1.80	0.16	112
7	MILLET	118	12.6	11.0	63.1	0.24	0.09	0.88	0.24	109
8	PHACELIA	71	4.7	12.8	54.4	2.38	0.14	2.22	0.25	110
9	PLANTAIN	56	6.4	13.3	55.7	1.53	0.11	1.76	0.16	105
10	SORGHUM SUDAN GRASS	147	11.8	8.4	51.4	0.26	0.11	0.89	0.18	92

Harvested yield: On Ground Only

TDN: Total Digestible Nutrients

RFV: Relative Feed Value

Yield: Adjusted @ 65% Moisture

Highlighted Row: Top performing variety by yield (green) or relative feed value (yellow).

Spring/Winter Cereal Silage - 2021

Table 35: Agronomic information of trial

LOCATION	WESTLOCK	BARRHEAD
SEEDING DATE:	31-May-21	1-Jun-21
HARVEST DATE:	19-Aug-21	20-Aug-21
SOIL MOISTURE:	Adequate	Adequate
SEEDING DEPTH:	$1^{3/4}$"	1"
FALL APPLIED NUTRIENT (ACTUAL LB/ACRE)	**70 N-0 P_2O_5-60 K_2O**	**90 N-0 P_2O_5-0 K_2O**
SPRING APPLIED NUTRIENTS (ACTUAL LB/ACRE)	**15.12 N-30 P_2O_5-0 K_2O-10 S**	**30 N-30 P_2O_5-17.39 K_2O-7.50S**
HERBICIDES APPLIED:	Glyphosate + Heat @ 360g/a.i./ac + 10g/ac (June 4) **Frontline @ 500ml/ac (June 22) - In Crop**	Glyphosate + Heat @ 360g/a.i./ac + 10g/ac (May 24) **Frontline @ 500ml/ac (June 22) -In Crop**
RAINFALL (MM)	113.7 mm	100.3 mm

Table 36 for Silage Yield.

RDAR Results Driven Agriculture Research

FARMER – LED APPLIED RESEARCH

GATEWAY RESEARCH ORGANIZATION

Cereal Mix Silage - 2021 – Barrhead												
	Variety Name		**Height**		**Yield**	**CP**	**TDN**	**Calcium**	**Phosphorus**	**Potassium**	**Magnesium**	**RFV**
			cm	**cm**	**Tonnes/Ac**	**%**	**%**	**%**	**%**	**%**	**%**	**%**
1	**PRIMA /** CDC AUSTENSON	**Fall Rye** / Barley	44	65	7.5	10.4	57.0	0.26	0.18	1.39	0.13	127
2	**PRIMA /** CDC BALER	**Fall Rye** / Oat	45	88	8.5	9.0	55.2	0.28	0.16	1.53	0.15	101
3	**PRIMA /** TAZA	**Fall Rye** / Spring Triticale	48	81	5.5	17.7	64.1	0.36	0.23	2.74	0.19	130
4	**AAC WILDFIRE /** CDC AUSTENSON	**Winter Wheat** / Barley	40	66	7.7	13.0	57.4	0.26	0.18	1.53	0.14	125
5	**AAC WILDFIRE /** CDC BALER	**Winter Wheat** / Oat	45	89	8.4	11.4	55.8	0.31	0.15	1.56	0.16	125
6	**AAC WILDFIRE /** TAZA	**Winter Wheat** / Spring Triticale	44	87	4.4	15.1	60.7	0.29	0.22	1.83	0.17	124
7	**BOBCAT /** CDC AUSTENSON	**Fall Triticale** / Barley	40	65	7.1	13.1	59.1	0.34	0.18	1.39	0.16	131
8	**BOBCAT /** CDC BALER	**Fall Triticale** / Oat	40	88	7.8	12.6	56.6	0.35	0.18	2.01	0.17	116
9	**BOBCAT /** TAZA	**Fall Triticale** / Spring Triticale	41	87	4.7	16.9	61.5	0.32	0.20	2.12	0.15	125

10	**LUOMA /** CDC AUSTENSON	**Fall Triticale /** Barley	49	66	8.0	11.3	57.7	0.34	0.13	1.42	0.13	115
11	**LUOMA /** CDC BALER	**Fall Triticale /** Oat	42	91	8.5	13.7	57.6	0.29	0.20	1.66	0.15	117
12	**LUOMA/** TAZA	**Fall Triticale /** Spring Triticale	48	86	6.5	13.5	58.3	0.30	0.23	1.89	0.14	115
13	**METZGER /** CDC AUSTENSON	**Fall Triticale /** Barley	41	67	6.5	12.0	58.0	0.32	0.17	1.41	0.13	126
14	**METZGER /** CDC BALER	**Fall Triticale /** Oat	39	91	8.7	10.8	55.2	0.31	0.17	1.74	0.15	114
15	**METZGER /** TAZA	**Fall Triticale /** Spring Triticale	41	90	5.0	12.4	57.6	0.25	0.23	1.72	0.13	124
16	CDC BALER	Oat		95	10.9	7.9	53.9	0.30	0.13	1.33	0.15	108
17	CDC AUSTENSON	Barley		69	9.7	8.9	55.7	0.33	0.13	1.23	0.13	106
18	TAZA	Spring Triticale		88	6.6	24.8	58.7	0.60	0.25	3.53	0.22	146
19	**BOBCAT**	**Fall Triticale**	43		3.2	24.5	59.8	0.48	0.26	3.40	0.20	136
20	**LUOMA**	**Fall Triticale**	44		3.6	9.0	54.7	0.20	0.23	1.30	0.12	107
21	**METZGER**	**Fall Triticale**	33		2.2	24.1	59.7	0.52	0.26	3.62	0.18	142

Harvested @ Late Milk stage (Cereal)
TDN: Total Digestible Nutrients
RFV: Relative Feed Value

CP: Crude Protein
Yield: Adjusted @ 65% Moisture
Highlighted Row: Top performing variety by yield (green) or relative feed value (yellow).

APG identified 2 potential trials that address common agronomic questions that we receive. The first focusing on P fertility and seed safety, which dovetails in with "Plot to Field", our field scale research program. The second trial is a simple demonstration of inoculation options including double inoculation. To have valuable statistically valuable data, testing across multiple years is required.

Table 37 for Silage Yield.

RDAR Results Driven Agriculture Research — FARMER – LED APPLIED RESEARCH — GRO GATEWAY RESEARCH ORGANIZATION

Cereal Mix Silage - 2021 - Westlock													
	Variety Name		**Height**		**Yield**	**CP**	**TDN**	**Calcium**	**Phosphorus**	**Potassium**	**Magnesium**	**RFV**
			cm	**cm**	**Tonnes/Ac**	**%**	**%**	**%**	**%**	**%**	**%**	**%**
1	**PRIMA /** CDC AUSTENSON	**Fall Rye /** Barley	53	85	12.2	9.7	63.9	0.34	0.15	1.90	0.12	141
2	**PRIMA /** CDC BALER	**Fall Rye /** Oat	47	109	10.9	10.8	61.7	0.26	0.19	1.75	0.13	161
3	**PRIMA /** TAZA	**Fall Rye /** Spring Triticale	52	97	8.7	9.2	63.9	0.20	0.19	1.12	0.09	172
4	**AAC WILDFIRE /** CDC AUSTENSON	**Winter Wheat /** Barley	46	87	12.3	8.7	61.9	0.35	0.12	1.98	0.11	129
5	**AAC WILDFIRE /** CDC BALER	**Winter Wheat /** Oat	46	111	10.9	10.9	58.9	0.23	0.27	1.01	0.14	137

6	**AAC WILDFIRE /** TAZA	**Winter Wheat /** Spring Triticale	47	98	7.8	13.2	68.7	0.26	0.24	2.41	0.15	153
7	**BOBCAT /** CDC AUSTENSON	**Fall Triticale** / Barley	45	89	12.6	10.6	65.7	0.32	0.16	1.98	0.12	144
8	**BOBCAT /** CDC BALER	**Fall Triticale** / Oat	46	106	9.9	10.3	60.2	0.28	0.19	1.04	0.13	136
9	**BOBCAT /** TAZA	**Fall Triticale** / Spring Triticale	48	95	6.9	11.7	69.9	0.38	0.18	2.79	0.13	120
10	**LUOMA /** CDC AUSTENSON	**Fall Triticale** / Barley	54	81	12.3	11.2	67.9	0.37	0.16	2.66	0.13	147
11	**LUOMA /** CDC BALER	**Fall Triticale** / Oat	48	102	10.6	10.1	59.0	0.24	0.18	1.11	0.12	137
12	**LUOMA/** TAZA	**Fall Triticale** / Spring Triticale	56	97	8.6	14.4	70.1	0.34	0.20	2.83	0.13	133
13	**METZGER /** CDC AUSTENSON	**Fall Triticale** / Barley	49	87	11.7	9.9	64.2	0.46	0.21	3.06	0.16	107
14	**METZGER /** CDC BALER	**Fall Triticale** / Oat	49	110	11.8	9.9	64.8	0.27	0.16	2.44	0.10	127
15	**METZGER /** TAZA	**Fall Triticale** / Spring Triticale	46	98	7.5	9.3	58.0	0.27	0.20	1.34	0.13	127
16	CDC BALER	Oat		110	13.5	9.1	58.7	0.33	0.19	1.20	0.15	137

17	CDC AUSTENSON	Barley		91	14.7	10.2	66.1	0.25	0.18	1.16	0.12	191
18	TAZA	Spring Triticale		111	10.4	18.8	78.3	0.57	0.23	4.48	0.20	128
19	**BOBCAT**	**Fall Triticale**	45		4.3	17.9	76.4	0.56	0.29	4.12	0.20	122
20	**LUOMA**	**Fall Triticale**	48		5.4	9.7	65.6	0.16	0.19	1.18	0.09	170
21	**METZGER**	**Fall Triticale**	42		3.4	17.7	76.2	0.51	0.24	4.48	0.18	113

Harvested @ Late Milk stage (Cereal)		CP: Crude Protein
TDN: Total Digestible Nutrients		Yield: Adjusted @ 65% Moisture
RFV: Relative Feed Value		Highlighted Row: Top performing variety by yield (green) or relative feed value (yellow).

Cereal-Legume Silage – 2021

Table 38: Agronomic information of trial

LOCATION	WESTLOCK	BARRHEAD
SEEDING DATE:	31-May-21	1-Jun-21
HARVEST DATE:	19-Aug-21	20-Aug-21
SOIL MOISTURE:	Adequate	Adequate
SEEDING DEPTH:	$1^{1/4}$"	$1^{1/4}$"
FALL APPLIED NUTRIENT (ACTUAL LB/ACRE)	**70 N-0 P_2O_5-60 K_2O**	**90 N-0 P_2O_5-0 K_2O**
SPRING APPLIED NUTRIENTS (ACTUAL LB/ACRE)	**16.38 N-30 P_2O_5-0 K_2O-10 S**	**15.13 N-30 P_2O_5-0 K_2O-10 S**
HERBICIDES APPLIED:	Glyphosate + Heat @ 360g/a.i./ac + 10g/ac (June 4) **Basagran @ 910ml/ac (June 22) - In Crop**	Glyphosate + Heat @ 360g/a.i./ac + 10g/ac (May 24) **Basagran @ 910ml/ac (June 22) - In Crop**
RAINFALL (MM)	113.7 mm	100.3 mm

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Table 39-40 for Silage

RDAR Results Driven Agriculture Research

FARMER – LED APPLIED RESEARCH

GATEWAY RESEARCH ORGANIZATION

Pea Mix Silage - 2021 – Barrhead												
	Variety Name		Height		Yield	Crude Protein	TDN	Calcium	Phosphorus	Potassium	Magnesium	RFV
			cm	cm	Tonnes/Ac	%	%	%	%	%	%	%
1	**CDC AUSTENSON**	**Barley**	68		8.7	8.4	58.0	0.41	0.11	1.53	0.15	100
2	**CDC BALER**	**Oat**	94		9.4	9.8	58.6	0.33	0.14	1.74	0.16	120
3	**TAZA**	**Spring Triticale**	90		7.2	11.0	66.2	0.19	0.24	1.16	0.14	167
4	**CDC AUSTENSON /** CDC MEADOW	**Barley** / Field Pea	67	36	8.4	11.3	66.7	0.45	0.18	1.34	0.17	139
5	**CDC BALER /** CDC MEADOW	**Oat** / Field Pea	96	35	9.0	12.3	61.6	0.24	0.24	1.04	0.15	136
6	**TAZA /** CDC MEADOW	**Spring Triticale** / Field Pea	91	50	6.1	11.5	66.0	0.69	0.17	1.21	0.20	153
7	**CDC AUSTENSON /** CDC JASPER	**Barley** / Forage Pea	68	41	8.7	11.5	66.3	0.40	0.14	1.35	0.15	155
8	**CDC BALER /** CDC JASPER	**Oat** / Forage Pea	93	36	9.0	8.4	56.9	0.38	0.10	2.33	0.16	102
9	**TAZA/** CDC JASPER	**Spring Triticale** / Forage Pea	95	48	6.8	14.6	68.8	0.65	0.21	1.13	0.21	174
10	**CDC AUSTENSON /** SNOWBIRD	**Barley /** Fababean	68	49	8.0	10.4	64.6	0.27	0.18	1.08	0.15	141

11	**CDC BALER /** SNOWBIRD	**Oat /** Fababean	98	42	9.0	10.0	60.5	0.23	0.19	1.02	0.14	140
12	**TAZA /** SNOWBIRD	**Spring Triticale** / Fababean	91	53	6.1	11.0	64.2	0.21	0.21	1.07	0.14	148
13	**CDC AUSTENSON /** DL TESORO	**Barley** / Fababean	66	48	7.4	10.4	64.5	0.28	0.15	1.63	0.13	128
14	**CDC BALER /** DL TESORO	**Oat** / Fababean	96	51	8.3	12.6	61.3	0.33	0.19	1.59	0.17	124
15	**TAZA /** DL TESORO	**Spring Triticale** / Fababean	93	59	6.0	10.3	63.3	0.26	0.21	0.97	0.14	157
16	**CDC AUSTENSON /** DL LACROSS	**Barley** / Forage Pea	66	51	8.4	9.6	63.6	0.31	0.21	1.53	0.14	128
17	**CDC BALER /** DL LACROSS	**Oat** / Forage Pea	93	49	9.0	10.9	62.6	0.50	0.16	1.28	0.20	133
18	**TAZA /** DL LACROSS	**Spring Triticale** / Forage Pea	88	66	5.3	9.6	63.4	0.26	0.17	1.13	0.12	141
19	**CDC AUSTENSON / DL** DELICIOUS	**Barley** / Forage Pea	67	71	8.0	12.2	68.0	0.83	0.17	1.19	0.25	151
20	**CDC BALER /** DL DELICIOUS	**Oat** / Forage Pea	94	58	9.0	10.4	59.0	0.31	0.19	1.26	0.16	123
21	**TAZA /** DL DELICIOUS	**Spring Triticale** / Forage Pea	93	88	6.6	11.4	62.8	0.52	0.22	1.32	0.19	140

TDN: Total Digestible Nutrients	Yield: Adjusted @ 65% Moisture
RFV: Relative Feed Value	Highlighted Row: Top performing variety by yield (green) relative feed value (yellow)

Results Driven Agriculture Research

FARMER – LED APPLIED RESEARCH

GATEWAY RESEARCH ORGANIZATION

Pea Mix Silage - 2021 - Westlock												
	Variety Name		**Height**		**Yield**	**Crude Protein**	**TDN**	**Calcium**	**Phosphorus**	**Potassium**	**Magnesium**	**RFV**
			cm	**cm**	**Tonnes/Ac**	**%**	**%**	**%**	**%**	**%**	**%**	**%**
1	**CDC AUSTENSON**	**Barley**	88		10.5	10.3	65.3	0.43	0.15	1.47	0.13	150
2	**CDC BALER**	**Oat**	114		9.3	10.8	59.1	0.35	0.18	1.52	0.14	115
3	**TAZA**	**Spring Triticale**	107		7.4	9.3	64.3	0.22	0.18	1.15	0.10	147
4	**CDC AUSTENSON /** CDC MEADOW	**Barley** / Field Pea	94	49	10.1	9.9	62.4	0.49	0.15	1.45	0.13	122
5	**CDC BALER /** CDC MEADOW	**Oat** / Field Pea	117	55	10.4	10.0	58.9	0.41	0.14	1.30	0.15	119
6	**TAZA /** CDC MEADOW	**Spring Triticale** / Field Pea	108	59	7.0	11.6	63.8	0.93	0.17	1.35	0.21	139
7	**CDC AUSTENSON /** CDC ABERDEEN	**Barley** / Forage Pea	89	79	10.7	9.7	62.6	0.63	0.11	1.38	0.15	120
8	**CDC BALER /** CDC ABERDEEN	**Oat** / Forage Pea	117	60	9.5	11.1	61.6	0.79	0.14	1.41	0.18	135
9	**TAZA/** CDC ABERDEEN	**Spring Triticale** / Forage Pea	108	73	7.9	10.4	63.6	0.67	0.15	1.06	0.16	148
10	**CDC AUSTENSON /** SNOWBIRD	**Barley /** Fababean	92	61	9.4	10.5	64.5	0.43	0.13	1.46	0.14	149

11	**CDC BALER /** SNOWBIRD	**Oat** / Fababean	122	61	8.9	9.8	57.8	0.39	0.14	1.78	0.15	113
12	**TAZA /** SNOWBIRD	**Spring Triticale** / Fababean	108	73	7.2	9.9	63.4	0.47	0.16	1.13	0.17	135
13	**CDC AUSTENSON /** DL LACROSS	**Barley** / Forage Pea	90	65	10.7	10.7	64.7	0.53	0.11	1.23	0.14	151
14	**CDC BALER /** DL LACROSS	**Oat** / Forage Pea	118	56	9.5	9.9	60.5	0.54	0.12	1.45	0.16	120
15	**TAZA /** DL LACROSS	**Spring Triticale** / Forage Pea	102	77	7.0	9.8	63.4	0.41	0.15	1.13	0.13	144
16	**CDC AUSTENSON /** DL DELICIOUS	**Barley** / Forage Pea	93	104	8.8	10.5	64.2	0.96	0.13	1.21	0.23	135
17	**CDC BALER /** DL DELICIOUS	**Oat** / Forage Pea	113	82	9.3	10.5	61.0	0.73	0.11	1.31	0.19	125
18	**TAZA /** DL DELICIOUS	**Spring Triticale** / Forage Pea	110	106	8.2	9.5	62.8	0.57	0.16	1.06	0.16	137

TDN: Total Digestible Nutrients	Yield: Adjusted @ 65% Moisture
RFV: Relative Feed Value	Highlighted Row: Top performing variety by yield (green) or relative feed value (yellow).

Perennial Forage Trials – Seeded in 2020

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 ranchers 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

Rainfall recorded from May 1 to July 10, 2021: 100.6 mm or 3.96 inches

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

Preburn: Glyphosate @1L/ac + Heat @20g/ac	June 19, 2020
Basagran @800ml/ac (Grasses, Legumes & Mixes)	September 3, 2020
Assure @150ml/ac	September 3, 2020

Harvested: Grasses: June 28,2021; Legume and Mixes: June 29, 2021

Seeding Information:

Table 41: Grass Species

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	Kirk	7	9.59	7.5
Green Wheatgrass	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 42: 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 43: Grasses + Legumes Mix

Species	Variety	Seeding Rate (lb/A)	Seeding Area m2	grams/plot
Mixes				
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

Observation & Results:

The harvest stage for perennial grasses was in between the R4-R5 growth stage (Anther emergence/anthesis to Post anthesis/fertilization). While, for the legumes, it was between early bud - late flowering. Yield is first cut from the second year of establishment, adjusted to 65% moisture.

Table 44: Yield (Grasses)

Yield - 2021			
	Variety	**Height(cm)**	**Yield (tonne/acre)**
Meadow Brome	Fleet	120	2.21
	AC Admiral	111	0.59
Hybrid Brome	AC Success	114	2.74
	AC Knowles	118	2.54
Wheatgrasses			
Pubescent	Greenleaf	88	1.02

Crested Green Wheatgrass	Kirk	95	1.89
	AC Saltlander	-	-
Italian Ryegrass	Randita	-	-
Orchardgrass	Blizzard	54	0.41
	Killarney	88	1.96
Tall Fescue	Courtney	59	0.22
Timothy	Grindstad	87	1.48

Table 45: Yield (Legumes)

Yield (Legumes) - 2021			
	Variety	**Height (cm)**	**Yield (tonne/ac)**
Alfalfa	AC Grazeland	61	3.60
	20-10,	56	2.21
	Halo	59	2.72
	Rangelander	61	3.05
	Rugged	59	3.07
	Spreder 4	56	2.38
	Spredor 5	58	2.35
	AC Yellowhead	46	2.37
	44-40	58	1.82
	PV Ultima	58	4.53
	Rambler	58	2.75
	Spyder	53	2.25
	Assalt	55	2.12
	Dalton	56	2.67
	Phabalous	58	2.79
Sainfoin	AC Mountainview	77	3.07
	AAC Glenview	76	2.46
Cicer Milk Vetch	Veldt	28	0.47
	Oxley 2	32	0.42

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Table 46: Yield (Grasses & Legume Mixes)

Yield - 2021			
	Variety	**Height (cm)**	**Yield (tonne/ac)**
Mix 1	Fleet Meadow Brome	126	4.62
	AC Yellowhead	56	
Mix 2	AC Success Hybrid Brome	130	4.35
	AC Yellowhead	60	
Mix 3	AC Knowles Hybrid Brome	131	4.55
	AC Yellowhead	62	
Mix 4	Fleet Meadow Brome	129	4.54
	Spredor 5	65	
Mix 5	AC Success Hybrid Brome	131	4.28
	Spredor 5	65	
Mix 6	AC Knowles Hybrid Brome	131	4.44
	Spredor 5	66	
Mix 7	Fleet Meadow Brome	126	4.64
	AC Yellowhead Alfalfa	62	
	AC Mountainview Sainfoin	72	
Mix 8	AC Success Hybrid Brome	124	4.28
	AC Yellowhead Alfalfa	63	
	AC Mountainview Sainfoin	74	
Mix 9	Fleet Meadow Brome	126	4.63
	AC Yellowhead Alfalfa	67	
	AC Mountainview Sainfoin	75	
	Veldt Cicer Milk Vetch	-	
Mix 10	AC Success Hybrid Brome	126	4.29
	AC Yellowhead Alfalfa	65	
	AC Mountainview Sainfoin	82	
	Veldt Cicer Milk Vetch	-	
Mix 11	Fleet Meadow	126	4.53
	Greenleaf Pubescent WG	-	

	AC Yellowhead Alfalfa	64	
Mix 12	AC Success Hybrid Brome	122	4.25
	Greenleaf Pubescent WG	-	
	AC Yellowhead Alfalfa	61	
Mix 13	Salinemaster	122 96	4.67

Acknowledgment: The current project is funded by the Canadian Agricultural Partnership Program under the Adaptive Innovation Stream. The project will collect data in 2021 and 2022.

Intercropping Trial – 2020-2022

Co-operator Name: Ray Marquette – SW-11-60-2-W5

Objective:

1. To provide unbiased, current, and comprehensive regional data regarding the yield, nutritional quality, and economics of annual crops alone or in a mixture in Alberta.

2. To provide unbiased, current, and comprehensive regional production data regarding the establishment, dry matter yield, nutritional quality, and economics of forage-type crops seeded along with cash crops for grazing post-harvest.

3. To identify soil health parameters when the crop is grown as mono-crop versus a more diverse system and how the introduction of livestock helps the soil health of land using various feed mixtures for livestock production.

Background:

Longer crop rotation for growers is proven to be a helpful strategy for the overall profitability and the sustainability benefits linked with improved soil health and decreased diseases and pest pressure. However, in reality, there are plenty of growers around our area who are still staying with a typical wheat-canola-wheat-canola rotation. This type of tight rotation is detrimental to long-term agriculture. Most producers are rotating the types of canola (herbicide systems) and types of wheat (CPS vs HRS), with very few going with a legume in their crop rotation. The introduction of the potentially option of annual legumes will help the overall cropping system and will diversify rotation. In addition, a crop of grasses seeded in intercropping with legumes also contains a higher percentage of protein, an important quality factor, especially in wheat. With increased diversity of plant species underground and above ground intercropping also increases the biological microbial diversity that is a key factor when considering strategies for maintenance of soil health and land fertility.

One of the aims for sustainable and profitable agriculture is to have an increased output per acre of the available arable land in a growing season. The greater efficiency of intercrops than that of the sole crop in converting absorbed nutrients to seeds/grains can contribute a yield advantage (Chowdhury and Rosario, 1994). In addition, the web of root mass systems provides an expanded root surface area to which non-mobile nutrients (P and K) in particular are diffused (Dong et al., 2008). Intercropping is advantageous over mono-cropping in providing the following benefits:

- Greater land-use efficiency
- Greater yield stability
- Increased competitive ability against weeds

• Improved nutrient efficiency with favorable exudates from the component legumes

It is reported that grain legume- cereal mixed intercrops are better at exploiting natural resources as compared to the sole crops of different plant species (Hauggaard-Nielsen et al., 2003, 2006). It is also reported that grain-legume crops can cover their nitrogen demand from atmospheric nitrogen and therefore intercropped with cereals would compete less for soil mineral nitrogen (Hauggaard-Nielsen et al., 2006). On the other hand, legumes or pea plants in monoculture may often lodge heavily, making harvesting very difficult and cause yield losses. When intercropping pea with cereals like wheat/oat as a standing support culture, lodging can be avoided (Lauk et al., 2006).

Most current recommendations on the use of polyculture crops are coming from anecdotal sources or from countries where shrinking arable land use has forced producers to go with the multi-crop options to enhance land-use efficiency. The ability to assess the economics and feasibility of growing two or more crops together will help Alberta producers understand the potential of this method to enhance their farm's productivity and profitability. This information on yield, quality, and economics will be directly compared to select harvestable cash crops (oats and wheat) with legume/pulse crops that are commonly grown for cash crops or feed. The inclusion of high nutritive value annual forages, including chicory and plantain which are known for increased energy and protein content, and reduced neutral detergent fiber (NDF) for beef cattle rations. These could have an environmental, economic, and production benefit to Alberta producers. Currently, there has been limited research focusing on replicated trials to establish baseline information on these cropping systems. Understanding the regional adaptability of these new mixtures will be key for Alberta producers to make the most economic decisions for their operations.

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 using the companion crop or ‘high nutritive value’ annual crops. This approach could benefit Alberta producers in mitigating the risk of crop failure and increasing the overall productivity of the farm. Innovative high value crops such as quinoa are included. The project will distribute information to producers across Alberta via written reports, newsletters, websites, and presentations at seminars, field days, and tours.

Deliverables:

- Feasibility of cash crops grown alone and grown in a mix.
- A minimum of three site years of production information (yield and quality) of mono-crop vs. intercrops mixtures, in Alberta.
- Economic information on the use of mono-crop vs. intercrops mixtures and companion forages for livestock feed.

Table 38: Treatment List

Treatment Number	*Treatment Name*
1	Yellow Peas (AAC Chrome)
2	Clearfield Canola
3	Oats (CDC Endure)
4	Yellow Peas + Clearfield Canola
5	Yellow Peas + Oats
6	Yellow Peas + Clearfield Canola + Clover +Forage Radish
7	Yellow Peas + Oats + Clover +Forage Radish
8	Quinoa (NQ94PT)
9	Quinoa (NQ94PT) + CWRS Wheat (AAC Brandon)
10	Quinoa (NQ94PT) + CWRS Wheat + Peas
11	Quinoa (NQ94PT) + Peas
12	Quinoa (NQ Red)
13	Quinoa (NQ Red) + CWRS Wheat
14	Quinoa (NQ Red) + CWRS Wheat + Peas
15	Quinoa (NQ Red) + Peas

Project Description	
Seeding Date	25-May-21
Seeding depth	1 inch
Fertilizer/ac	**Deep Banded:** 34.4-0-7.94-5.29 227 lbs/ac **Sided Banded:** 11-52-0 58 lbs/ac
Herbicide	Glyphosate(Pre-seed): 0.78L/acre May 14 **Roguing has been done 2-3 times**
Mowed Down	24-August-21

Due to excessive heat and severe moisture stress, the trail establishment stand was not uniform to get any meaningful data for the year 2021. As a result, the trial was mowed down in late August 2021. Hope for a better growing season in 2022 to see what intercropping options will work in north central Alberta.

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

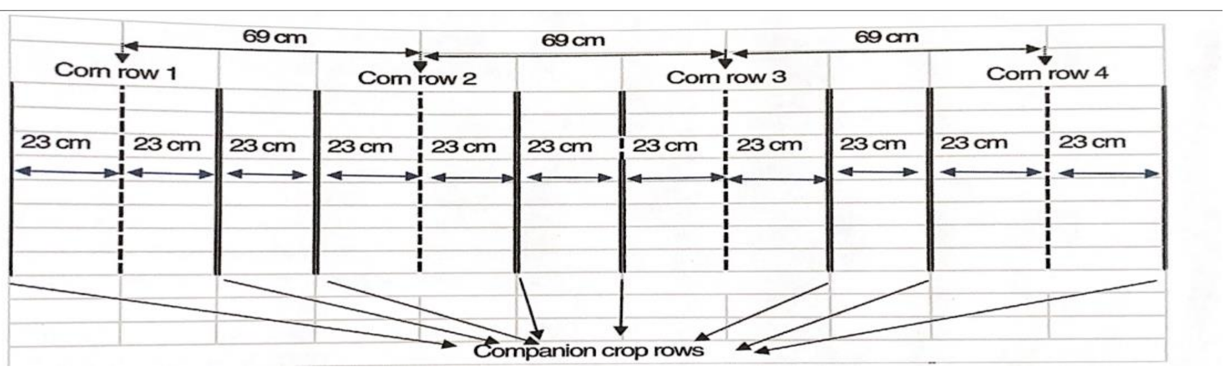


Table 40: Results and Discussion:

	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	140.54
CORN + COCKTAIL MIX	13.45	3.03	31.66	0.08	0.06	0.38	0.05	146.68
PEAS alone	2.01	12.6	64.93	1.00	0.18	1.49	0.18	137.55
COCKTAIL MIX alone	3.37	13.06	61.14	1.34	0.21	3.11	0.27	164.59

Take home message:

1). Seeding peas in between 4 leaf stage corn did not have any negative impact on corn monoculture yield.

2). Results indicated that corn with peas mix appears to be better than the other two options for total yield. On the other hand, corn and polyculture (cocktail) mix seem to have a better relative feed value.

3). Although peas did not grow as well as we expected and most went flat to ground instead using corn as support. So we are planning to try growing Fababean instead of forage pea (40-10) in between corn.

4). Soil health aspectst were still under analysis and some of the observations are included in the soil conservation report later. Still future replicated trials of this nature would be required to verify these apparent results.

Acknowledgment: The current project is funded by the 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

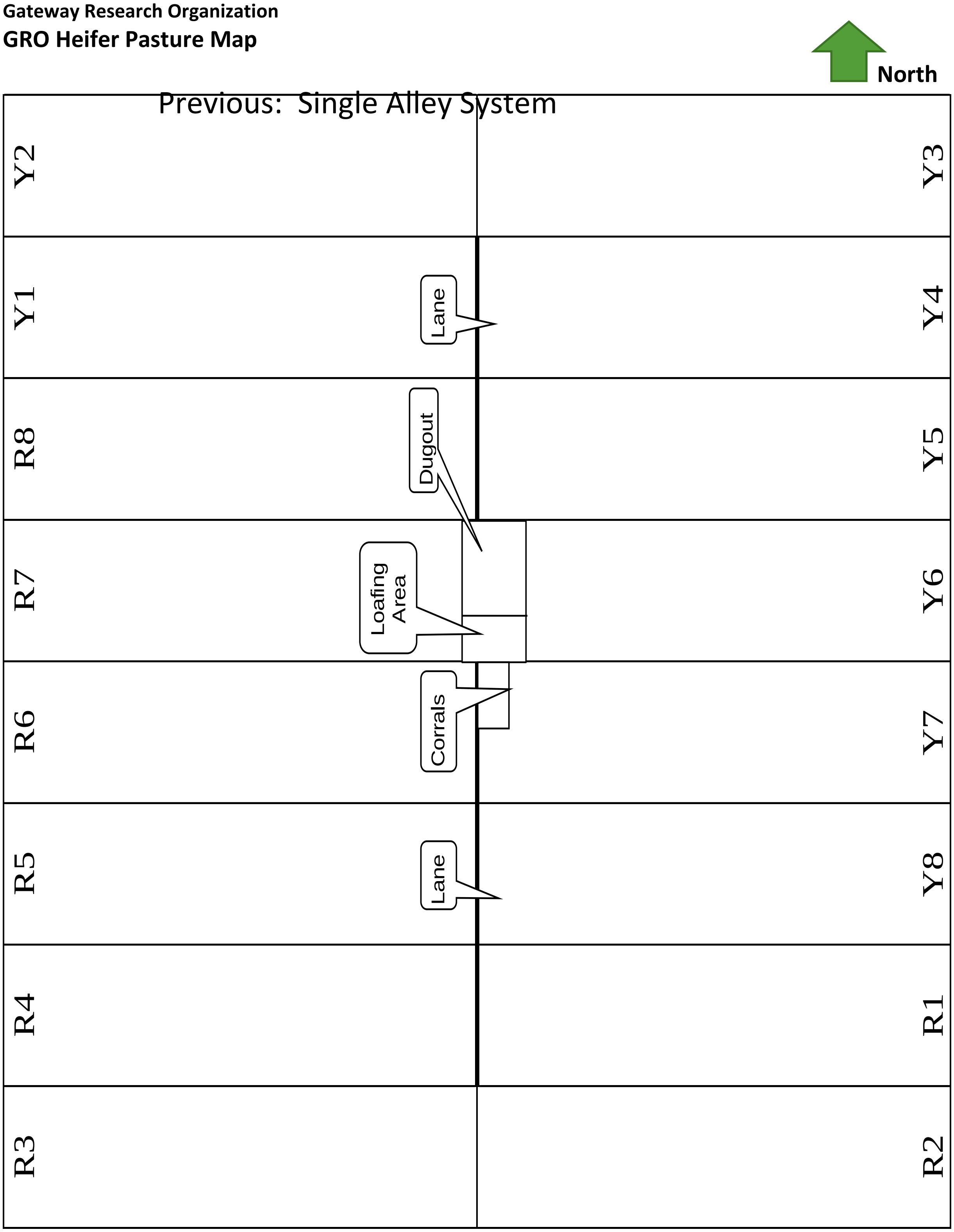
One of the biggest challenges for Alberta ranchers is to manage the ever-shrinking land base available to them in such a way that both pastures and the land remain healthy, productive and sustainable for future generations. Despite the considerable amount of research and scientific proof available relating 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).

Gateway Research Organization

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).

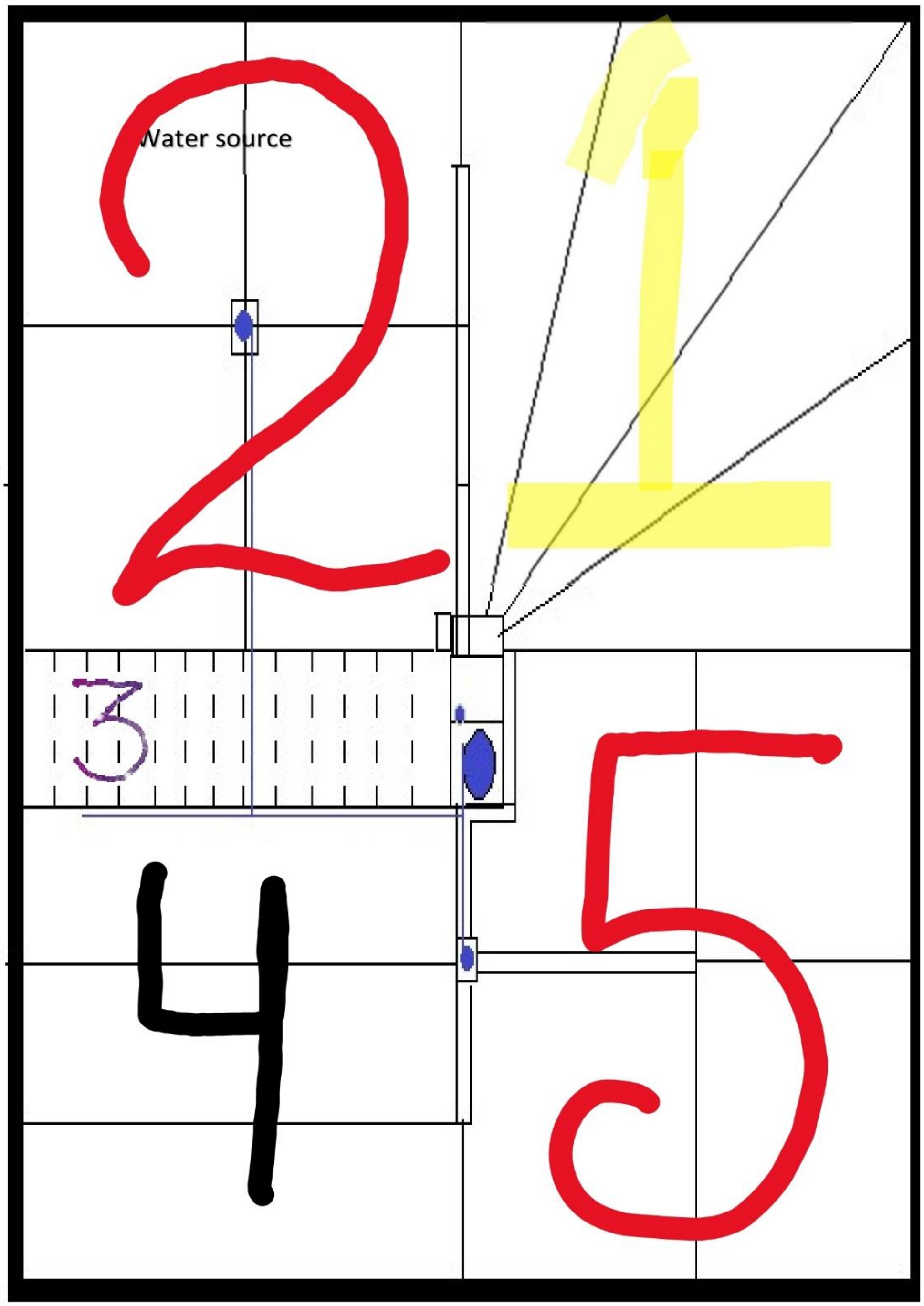
When water holding capacity in pasture lands is enhanced, a producer’s ability to mitigate severe weather patterns increases, either by retaining effective rainfall, or by having enough ground cover to avoid erosion from large rainfall events. By seeing first hand the different effects that differing 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 2021

While the 2021 growing season was a challenging one, the heifer pasture did not seem to suffer too badly. There was the same amount of heat and lack of moisture as elsewhere, but a history of good pasture management appears to have left enough organic matter and soil quality that permitted the entire field to weather the adverse conditions with a minimum of impact. Adequate but not excessive stocking and, where appropriate, rotation, also may have played a part in the ability of the various paddocks to stay green while other fields did not.

This is the second year for soil and microbial analysis of the heifer pasture. A change in management plans as well as the weather conditions may have had an impact on the soil, as well as some issues with the soil samples at the lab, necessitating a very late season shovel slice resampling of the soils for all the paddocks. A detailed study of the potential impacts of all these differences from previous years would be required to fully understand what affect these alterations may have had, but hopefully going forward, the soil samples will be able to indicate any trends happening because of the different management styles occurring on these various paddocks. For now, the following items of interest have been noted:

Physical Changes:

- Some differences in infiltration rates have been noted from early fall tests, where the conventionally grazed pasture has a faster rate. Infiltration rate is a complex measurement. For example, clay soils, when dry, have a rapid infiltration rate as water flows downward through cracks in the soil. Moist clay, however, seals up, greatly lengthening the time taken for a set amount of water to be accepted into a defined area of soil. Compacted soils from excessive traffic on them also have long infiltration periods. Very sandy soils tend to have very rapid infiltration rates as water can rapidly flow through the spaces between the comparatively large spaces between sand grains. Soils with high organic matter and improving soil aggregates tend to have moderately fast soil infiltration rates, as moisture flows down micropores between soil aggregates or left from the decomposition of rootlets. Rapid infiltration is good to a point, but if it is too fast and too deep, leaching nutrients out of the rooting zone, they can reduce the inherent fertility of the soil. So, porosity needs to be taken in context with factors such as soil texture and organic matter. That being said, it has yet to be determined that the changes noted in infiltration rates, with the continuously grazed paddock having a faster infiltration rate than the rest, is due to cracks in a dry, clay like soil with less aggregation or not. Further detailed study is required in this matter to determine if this is the case, since the organic matter is rated as acceptable in the continuous grazed pasture at this time, similar to the first year of a mob grazing paddock.

- Other physical differences such as soil penetration, organic matter, and bulk density did not follow any obvious, understandable pattern, but should serve as baseline measurements for future years' analysis

Chemical Observations

- Available phosphorous is one macronutrient that appears to be low across the board, and no replacement is obvious for it. Hopefully, sources, currently tied up, will be made available by microbes or natural breakdown to continue to provide adequate nutrition in the future without the need for added fertility
- Potassium, on the other hand, appears to be in adequate supply for the foreseeable future in all paddocks and there appears to be no immediate need for supplementation at this time.
- Sulphur is all over the map as far as the analyses are concerned, and appear to be unrelated to management of the various paddocks
- Most micronutrients appear to be in adequate supply and are not as yet impacted by paddock management

Biological Observations

While it is early days yet, there are starting to be some soil biological indications that paddock management type is having an impact. These include:

- Trichoderma populations: these soil building microbes appear to be increasing in population numbers for all the regenerative management paddocks, indicative of a soil bacteriological community that is becoming more self-sustaining.
- Free living Rhizobium species are high in all but the continuously grazed paddock, also leading to a likelihood that the mob and rotationally grazed sections are becoming more able to meet the fertility needs of the plant population.
- Estimates of the total soil bacteriological populations seems to be higher in all the regenerative paddocks. This could be an indication of improving soil health for these paddocks, but time will be needed for us to be convinced of these potential improvements.

Generally speaking, it appears as if the soil microbial population is improving in the rotational and mob grazing paddocks, compared to the continuously grazed one. Continued observations, study and subsequent economic analyses will be required to understand the full impact of different management regimes on pasture soil health.

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

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

Over the years it has been noticed that portions of pastures which have had bales grazed on them have been seen to have some obvious differences. Previously bale grazed fields often appear to have a polka dot pattern, with areas where bales were grazed appearing thick and green where the rest of the field had much thinner growth and were brown as is evidenced in the attached picture. Is it just due to the increase in organic matter associated with bale feeding and aftermath, or is there more to it than that? To consider this subject, soil samples were taken in the fall of 2021 in a number of field areas, some which have been bale grazed in the winter of 2020-21; others had not. These samples were analyzed to determine if there are any major obvious differences in the soil, whether chemical or microbial. Physical differences were also compared, but as the bale grazing was fairly recent, no major changes were noted.

Chemical Results:

As the bale grazing on these fields were relatively recent, it might be somewhat premature to expect long term chemical changes from the practice, but they still might be responsible for the difference in phrenology. The chemical differences detected to date are:

- Organic Matter: Both of the bale grazed areas in the fields were higher in organic matter than those areas not so grazed. This would make sense from the aftermath of the bales. This could have, in turn, conserved more moisture and permitted greener, lusher growth longer into the season. This additional growth could continue the more favorable moisture conditions for extended periods of time.
- Phosphorous: Levels of this element appeared to be double in the baled grazed areas. Again, there would have been an additional supply of this element from the bale residue and cattle activities themselves.

- Potassium: Levels of potassium appeared to be somewhat higher in both bale grazed areas. This could be explained solely by the residual organic matter from the aftermath of the bale grazing, possibly combined with the animal excreta left during the act of grazing.

Microbial Results:

- Anaerobes: These bacteria are higher in the bale grazed samples, possibly due to reduced oxygen levels from the bale residue on the surface.
- Total soil microbial activity: The higher numbers of soil microbes in the bale grazed areas may indicate a difference of increased activity, helping to regenerate the soil faster.
- Trichoderma: Trichoderma numbers are estimated at nearly double in the non-bale grazed area over the bale grazed sampled portion of the fields, again possibly indicating a faster rejuvenation of the soil where bales are not grazed compared to areas of bale grazing that might have had limited oxygen in soils covered by manure and grazing aftermath.
- CO2 respiration: The downside of potential increased microbial populations is the potential for additional respiration and the release of carbon dioxide gas. While microbes help to create soil aggregates and sequester carbon, greenhouse gases are to some extent negating the benefit of soil carbon storage.
- Gram-Positive Bacteria: Again, bale grazed areas appear to have higher concentrations of Gram-positive bacteria than the areas not so grazed. As excessive levels of Gram-positive bacteria may outcompete favorable Gram-negative bacteria, thereby decreasing both the more favorable bacteria and the soil health index based on these bacteria.
- Mineralizable Nitrogen: Again, possibly because of the additional organic matter from the bale aftermath or cattle feeding activity, there was additional nitrogen introduced into the soil. This apparent higher level of nitrogen in the bale grazed areas would encourage growth and carbon sequestration, but there would many more parameters that would need to be controlled to determine the actual impact of the bale grazing itself.
- Actinomycetes are potentially problematic Gram-positive bacteria and appear to be present in higher concentration in the bale grazed areas, indicating a risk of outcompeting the more favorable bacteria in that area.
- The PERP (percent saturation of phosphorous)/Pseudomonas ratio also favors the bale grazed areas. This might mean a healthier environment for bacteria in general in the bale grazed areas.
- The samples from areas not bale grazed appear to have a better ratio of boron to rhizobium related bacteria, which may indicate a skewing of the nitrogen fixing bacteria population.

It is also interesting to note the recently bale grazed sample was analyzed to have an exceedingly high level of nematode activity, which may contribute to soil health in the short and long term.

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

Introduction:

As investigations to organically add nutrients to a soil, treatments such as wood ash and biochar are being considered. Wood ash is the product of burning tree bark and fiber to produce power, get rid of leftover material, etc. In other countries, applying wood ash to the soil is a means of putting virgin soil into production. Souza do Espirito Santo et. al. (2018) indicated the application of wood ash on to established pasture increased plant height and tillering. Biochar is made from organic biomass that is partially combusted in the presence of limited oxygen, and is said to increase yield through P and K fertilization and soil microbe activation (Mannan et al, 2021). An attempt was made on local established pasture to determine if:

- yield increases that could occur using these soil amendments on pasture in the short and long term
- more carbon could be sequestered using these soil amendments, and
- soil structure, chemistry and biology could be improved with these amendments.

Materials and Methods:

Small, (1 meter x 1 meter) randomized, replicated caged plots were planned and established in 2021. Two rates of wood ash (2.5 and 5.5 MT/ac), and three rates of biochar (1, 2.5 and 5.5) MT/ac were measured. It was recommended by the supplier to try a low rate of biochar, and that the highest rate may cause some burning if conditions were not ideal for the application. The treatments were applied on June 23rd of the year. The day was overcast, and rain was expected later, so we rushed out to apply the treatments. Unfortunately, the rain did not materialize, and the day got quite hot, over 30 Celsius. Some plant burning was noted on the high biochar treatments a few days after application, but by the time it was noticed, it was too late to ameliorate the situation.

Results:

A cut was attempted on August 27th, 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 general terms, after the first year, the following rankings of plot yield were estimated:

Highest: 2.5 Mt/ac Biochar added

1.0 Mt/ac Biochar added

5.5 Mt/ac Wood Ash added

Control (no Wood Ash or Biochar added)

2.5 Mt/ac Wood Ash added

Lowest: 5.5 Mt/ac Biochar added

Discussion:

While the results from this trial cannot be considered at all significant, there does seem to be some potential for differential results to be determined in the future. It is interesting to note particularly the yields from the high level of biomass from the 5.5 Mt biochar treatment. One plot had the highest yield of all while the other three reps were amongst the lowest of the 24 plots. Is it possible that the one high-yielding plot managed to overcome the potential burning impact of the high biochar addition, while the other three could not, and is this an indication of what the yield might be in subsequent years? Time will tell as we look forward to harvesting and calculating results in 2022 and beyond.

In addition, the changes in the soil, particularly its biota, will be interesting to see as the biochar and wood ash have their impact. The chemistry and physical nature of the soil may also be impacted by the soil amendments. Comprehensive, replicated soil analyses will be taken in 2022 to determine if an influence could be noted this early, or whether it will take longer for the full impact to show in a soil sample. While replication of soil tests is essential for determination of actual changes in the soil, biological test results are so complex that there will likely be a matrix of potential changes and that only intuitive analysis of overall soil improvement is likely from this test, based on a myriad of potential differences to the soil chemistry, biology, and structure.

While it was assumed that the year of application was too early to observe any differences in the results from the various treatments and therefore the change in harvest method midstream was not considered a major issue, the consistency in the differences of harvest method is an indication that appropriate experimental design is essential to successful result generation and significance determination. A third method, one with a mechanical harvester, followed by raking, collection and weighing, originally thought to be unnecessary for this low number of small plots, will likely be the preferred method of collection in the future. It is also possible that several cuts will be taken in 2022 to simulate the rotational or mob grazing which is being tried in a number of other paddocks in the heifer pasture.

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Gateway Research Organization

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, 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 close rotation of 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 for 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 the crops over the last 30 years. Application of chemical fertilizer 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 spore and disease occurrence on the roots (clubroot trial).
4. Assessment of soil health at the start of trial (year 1) and the end of trial (year 3).

Project Plan:

The project started in the fall of 2019 to 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 the 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

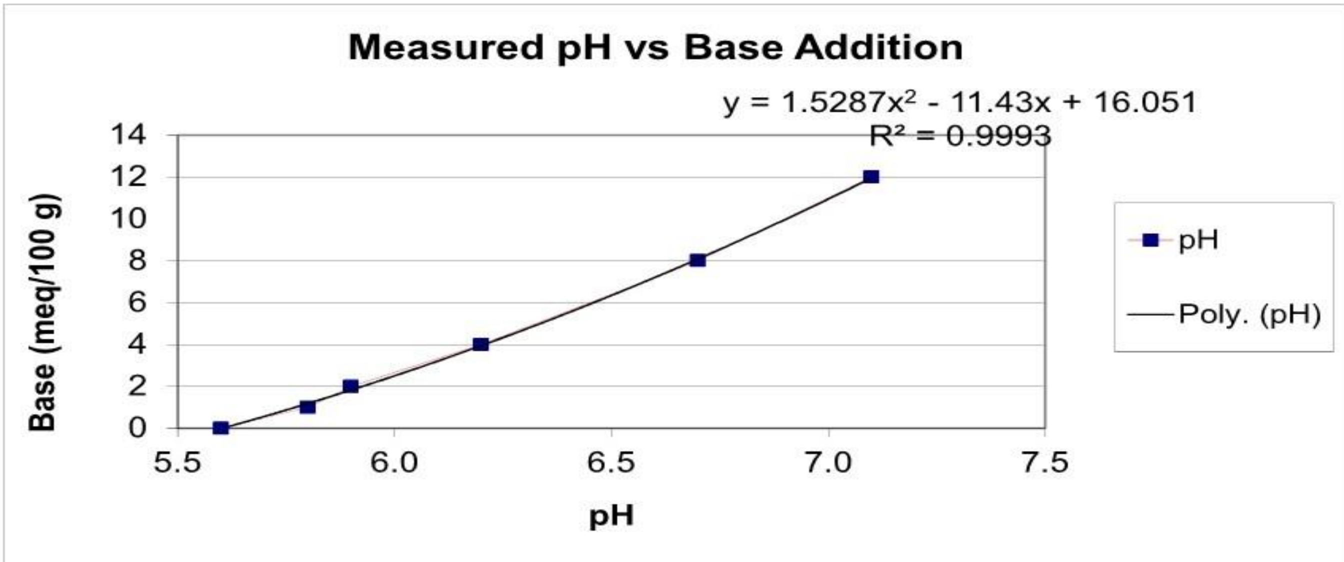
Trial Design:

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

Gateway Research Organization

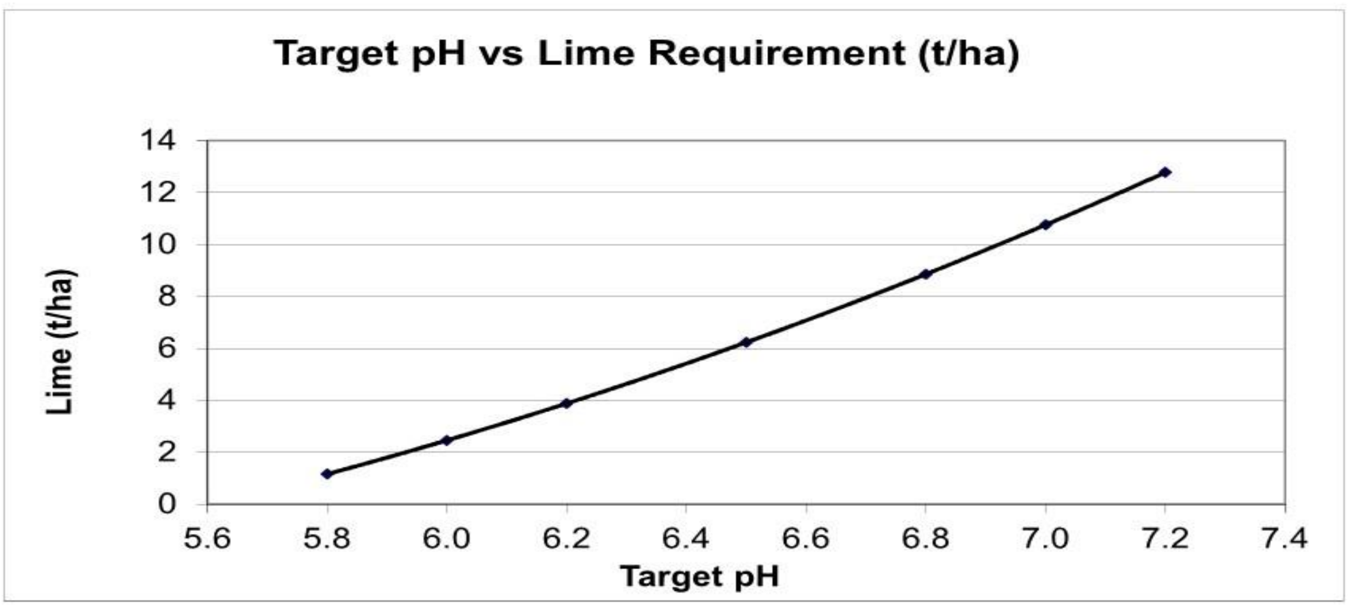
Soil pH Curve of Topsoil (0-3")

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
$CaCO_3$ (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**

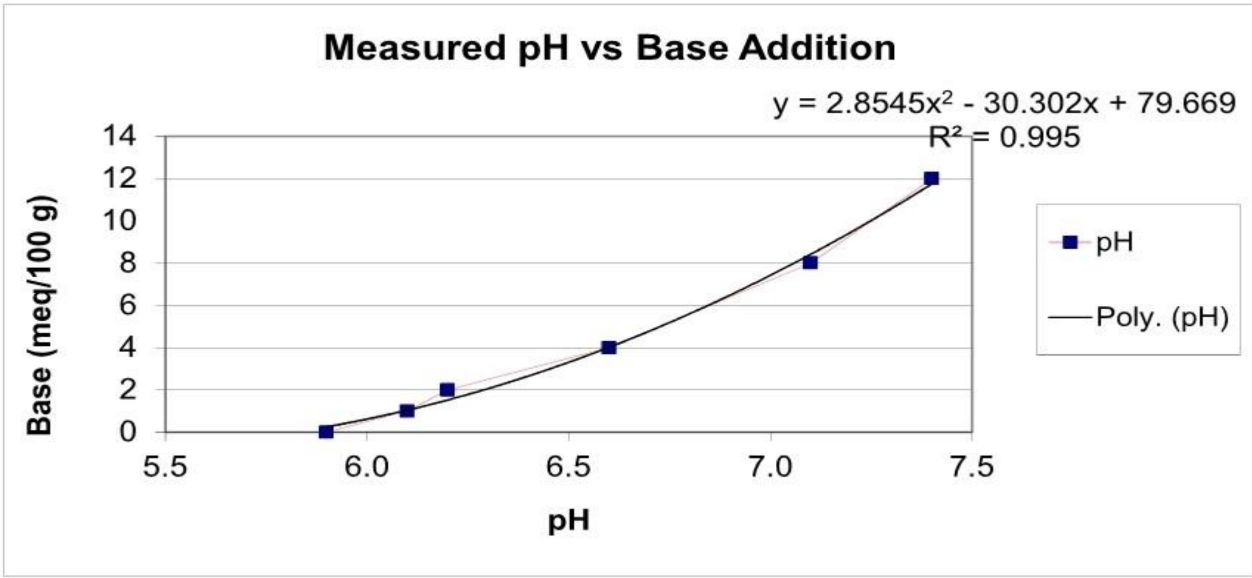


Note: Only valid within pH range measured

Gateway Research Organization

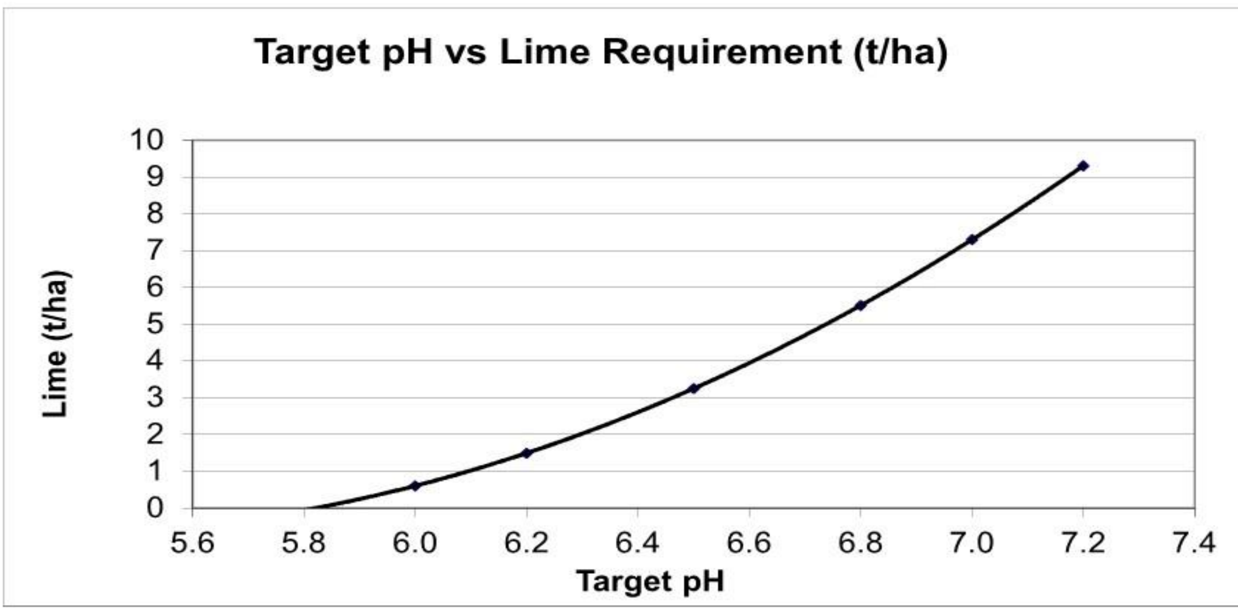
Picture: Soil pH Curve of Lower Soil (3-6")

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

Gateway Research Organization

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

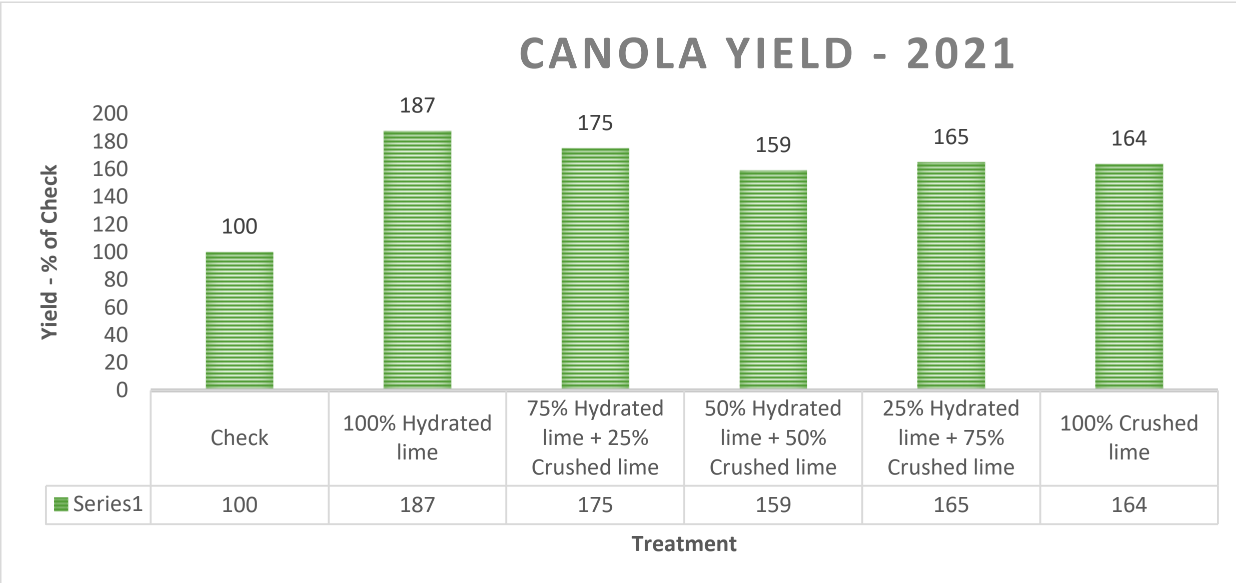
	Treatment	Crushed lime (ton/acre)	Hydrated lime (ton/acre)
1	Control	0.000	0.000
2	100% Hydrated lime	0.000	0.647
3	75% Hydrated lime +25% Crushed lime	0.275	0.485
4	50% Hydrated lime +50% Crushed lime	0.550	0.323
5	25% Hydrated lime +75% Crushed lime	0.824	0.162
6	100% Crushed lime	1.099	0.000

Lime Application: Lime was applied in each plot using Scott's lime applicator as in the previous year. Our target was 5% more than the calculated numbers above taking minimal loss into account. After each plot was fertilized, the exact amount of lime was measured. The whole site was rototilled to a four-inch depth after the lime application.

Agronomic information:

	Project Description
Seeding specifics	May 26, 2021 $1^{1/4}$ inch peas & wheat, $^{3/4}$ inch canola
	Project Description
Fertilizer/acre	• **Peas** – Side banded: 8.07-0-36.92-9.23 162 lbs/ac Seed placed: 11-52-0 58 lbs/ac • **Wheat** – Side banded: 34.4-0-7.94-5.29 363 lbs/ac Seed placed: 11-52-0 58 lbs/ac • **Canola** – Deep banded: 34.4-0-7.94-5.29 378 lbs/ac Side banded: 11-52-0 77 lbs/ac
Herbicide	Eclipse 380ml/ac June 21, 2021 (canola) Viper 400 ml/ac June 21, 2021 (peas) UAN 800 ml/ac June 21, 2021 (peas) Tundra 800 ml/ac June 21, 2021 (wheat)
Rainfall	Recorded from May 1 to Sept 15, 2021: **187.70 mm**
Harvest Date (Wheat & Canola)	September 23, 2021; Peas were mowed down

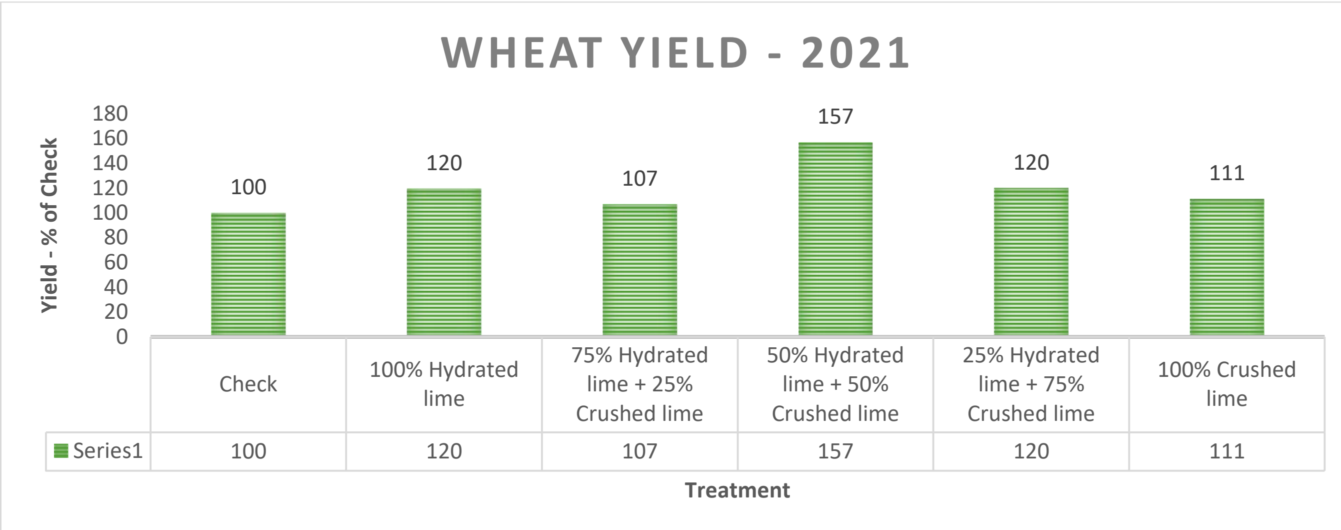
Results: Canola:



	Treatment	Height cm		Yield Kg/ha		Yield bu/ac		% of Check
1	**Check**	82	-	961	b	17	b	**100**
2	**100% Hydrated lime**	84	-	1804	a	32	a	**187**
3	**75% Hydrated lime + 25% Crushed lime**	85	-	1684	a	30	a	**175**
4	**50% Hydrated lime + 50% Crushed lime**	85	-	1530	a	27	a	**159**
5	**25% Hydrated lime + 75% Crushed lime**	85	-	1587	a	28	a	**165**
6	**100% Crushed lime**	87	-	1574	a	28	a	**164**
	LSD P=.05	8.18		232.478 - 351.363		4.188 - 6.217		
	Standard Deviation	5.43		0.062t		0.059t		
	CV	6.44		1.95t		4.12t		

The canola results show that the check had less yield than all the liming treatments. The range was up to an increase of 87% in yield.

- **Wheat**



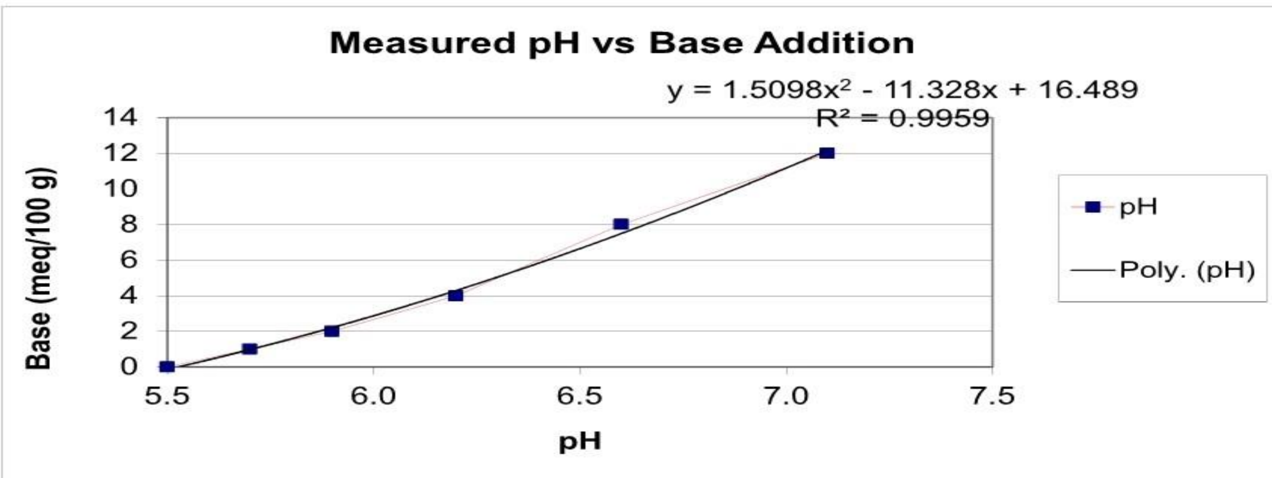
Treatment	Protein		Gluten		Yield				Test Wt		TKW	
	%		%		Kg/ha		% of Check	bu/ac		kg/HL		g	
Check	17.9	ab	43.0	a	1921	b	**100**	29	b	79.4	a	38.4	-
100% Hydrated lime	18.3	a	43.1	a	2332	b	**120**	35	b	72.68	b	38.23	-
75% Hydrated lime + 25% Crushed lime	17.9	ab	42.1	b	2078	b	**107**	31	b	75.65	ab	37.63	-
50% Hydrated lime + 50% Crushed lime	17.8	ab	42.5	ab	3074	a	**157**	46	a	77.65	ab	38.2	-
25% Hydrated lime + 75% Crushed lime	17.7	b	42.6	ab	2333	b	**120**	35	b	78.48	ab	39.28	-
100% Crushed lime	17.8	ab	42.1	b	2175	b	**111**	32	b	76.73	ab	36.93	
LSD P=.05	0.528		0.619		501.697			7.33		5.899		2.758	
Standard Deviation	0.351		0.411		318.43			4.65		3.914		1.79	
CV	1.96		0.97		13.73			13.47		5.1		4.67	

The lime application had a variable effect on the wheat crop. The range was a 57% of increase in yield. More data needs to be collected to establish a clear trend on the impact of lime on wheat yield and quality

2. Liming effect on Clubroot

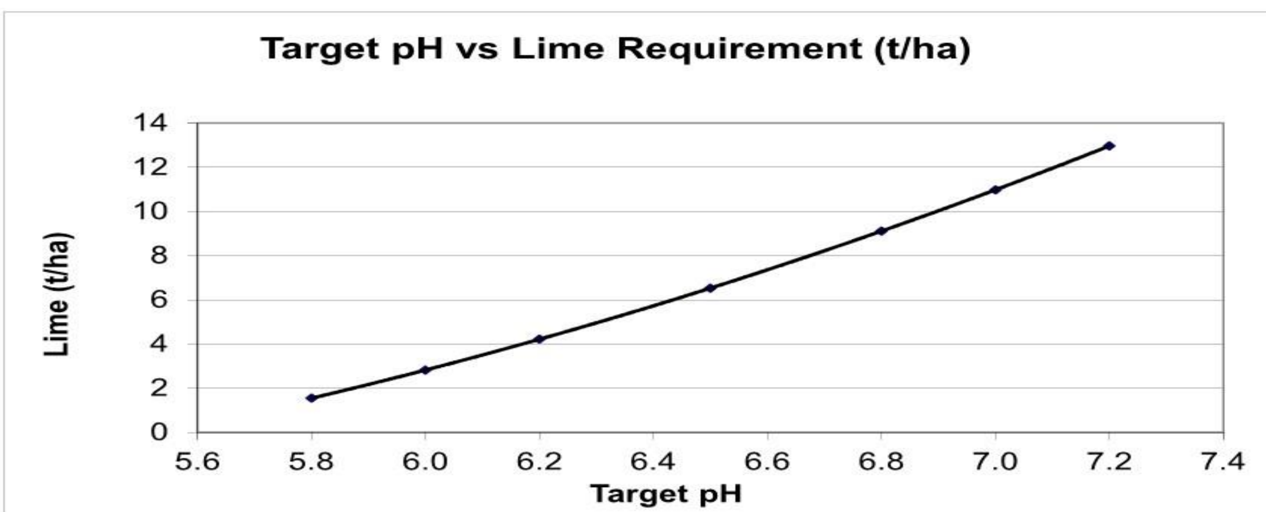
Soil pH Curve of topsoil (0-3”)

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

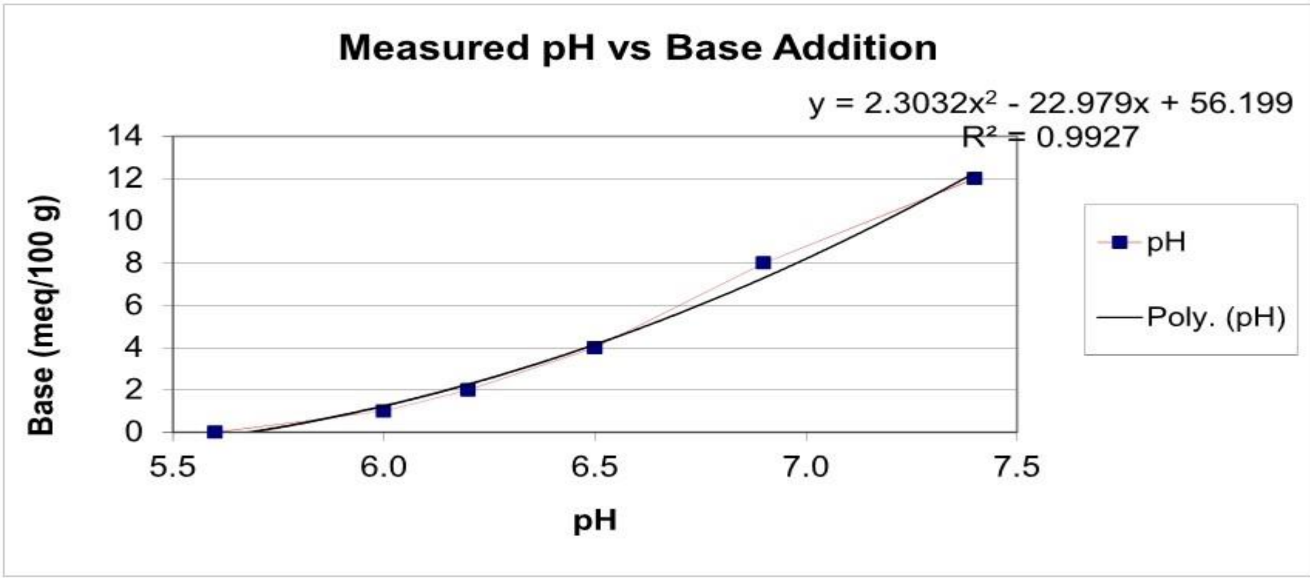
Target pH	**5.8**	**6.0**	**6.2**	**6.5**	**6.8**	**7.0**	**7.2**
Base Required (me/100g)	1.6	2.9	4.3	6.6	9.3	11.2	13.2
$CaCO_3$ (mg/kg)	794	1448	2163	3350	4673	5631	6650
Lime Required (t/ha)	**1.5**	**2.8**	**4.2**	**6.5**	**9.1**	**11.0**	**13.0**



Note: Only valid within pH range measured

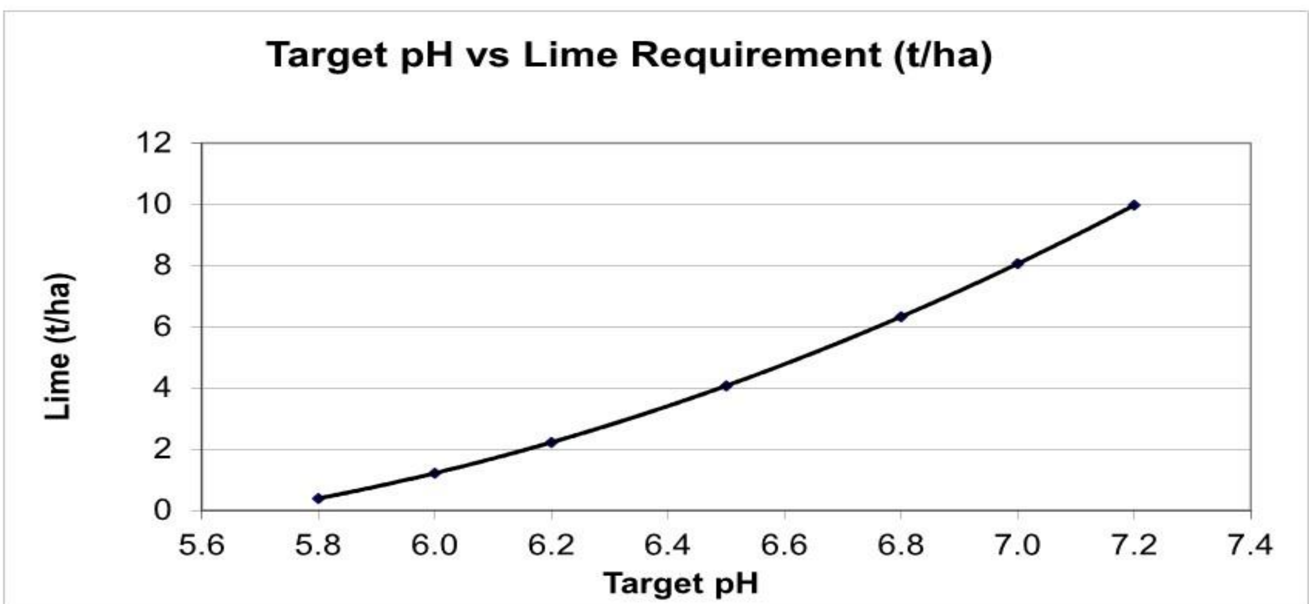
Picture: Soil pH Curve of lower soil (3-6")

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
CaCO3 (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 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	0.000	0.000
2	100% Hydrated lime	0.000	0.647
3	75% Hydrated lime +25% Crushed lime	0.275	0.485
4	50% Hydrated lime +50% Crushed lime	0.550	0.323
5	25% Hydrated lime +75% Crushed lime	0.824	0.162
6	100% Crushed lime	1.099	0.000

Lime Application: The lime was applied in each plot with using Scott's lime applicator. Later, the whole site was rototilled to a four-inch depth after the lime application.

Agronomic information:

	Project Description
Seeding specifics	May 27, 2021 Depth - ½ inch
	Project Description
Fertilizer/acre	Producer Applied: 44 lbs/ac Actual N 39 lbs/ac Actual K Deep banded: 34.4-0-7.94-5.29 291 lbs/ac Side banded: 11-52-0 58 lbs/ac
Herbicide	Eclipse 380ml/ac June 22, 2021 (canola)
Rainfall	Recorded from May 1 to Sept 15, 2021: **187.70 mm**
Harvest Date	September 23, 2021

Future Plans:

The soil samples for pH analysis will be taken from individual plots before seeding in 2022. This will help us see the efficiency of achieving the targeted pH for each treatment. In addition, soil samples for in-depth biological assessments will be taken from each treatment.

Acknowledgment: The current project is funded by **Graymont** and Canadian Agricultural Partnership Program under the Adaptive Innovation Stream. The project will collect data in 2021 and 2022.

2021 Disease Assessment

	Treatment	DS	DS%	DI%	DSI
1	Check (No Lime)	2.19	73.00%	72.50%	0.53
2	100% HL	1.31	43.67%	40.00%	0.17
3	75% HL; 25% CL	1.29	43.00%	41.25%	0.18
4	50% HL; 50% CL	1.55	51.67%	46.25%	0.24
5	25% HL; 75% CL	1.31	43.67%	45.00%	0.20
6	100% CL	1.51	50.33%	48.75%	0.25

2020 Disease Assessment

	Treatment	DS	DS%	DI%	DSI
1	Check (No Lime)	2.98	99.33%	100.00%	0.99
2	100% HL	2.57	85.67%	90.00%	0.77
3	75% HL; 25% CL	2.85	95.00%	99.00%	0.94
4	50% HL; 50% CL	2.86	95.33%	100.00%	0.95
5	25% HL; 75% CL	2.93	97.67%	100.00%	0.98
6	100% CL	2.88	96.00%	98.00%	0.94

Disease Severity Index was calculated by clubroot severity percentage multiplied by the clubroot incidence percentage

****HL Hydrated Lime *CL Crushed Lime DS Disease Severity DS% Disease Severity % DI Disease Incidence % DSI Disease Severity Index***

- In the clubroot of canola trial, there was a **noticeable difference within treatments compared to the check.** The observed clubroot infection was worse in the check where no lime was applied. The liming application had a visual observable positive impact on canola plant health.

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 was 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 novel organic amendments that are is a C-rich material formed by pyrolysis (heating) of biomass in an oxygen-limited environment (Chan et al. 2007). Sugarbeet 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

Agronomic Information

Seeded May 27, 2021		
Seed Depth: $1^{1/4}$ inch		
Rainfall recorded: May 1 to Sept. 15, 2021: 187.70mm or 7.39 inches		
Fertilizer:		
Seed Placed: 11-52-0	58 lbs/ac	
	6.4 lbs/ac Actual N	30 lbs/ac Actual K
Side Banded: 8.07-0-36.92-9.23	162.5 lbs/ac	

13.11 lbs/ac Actual N	60 lbs/ac Actual K	15 lbs/ac Actual S
Roundup + Heat	360g/a.i./ac + 10g/ac	June 4, 2021
Viper + UAN	400 ml/ac + 800 ml/ac	June 21, 2021
** Roguing – 2 times		
Harvested: September 08, 2021		

Results from 2021:

No.	Name	Height cm		Yield kg/ha-		Yield bu/ac		TKW g	
1	**Control**	49	-	1992	-	30	-	215	-
2	**Aglime**	49	-	1975	-	30	-	219	-
3	**Bio-char -Compost**	48	-	2121	-	31	-	220	-
4	**Wood Ash**	47	-	2035	-	30	-	214	-
5	**Beetroot Sludge lime**	48	-	1930	-	29	-	222	-
	LSD P=.05	2.77		390.48		5.81		9.348	
	Standard Deviation	1.8		253.45		3.77		6.067	
	CV	3.73		12.61		12.64		2.78	

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

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 will be seeded with Canola in 2022.

Analysis in 2022

- ✓ Soil health assessments for the individual plots will be done at the end of 2nd year.
- ✓ Economic analysis: Cost analysis and ROI calculation will be done by an economics specialist at the end of the project.

Acknowledgment: The current project is funded by **RDAR** (Results Driven Agriculture Research)**.** The project will collect data in 2021 and 2023.

Humalite Trial

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 the 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. CWRS Wheat Cultivar AAC Brandon was seeded as a first-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 in on wheat. The humalite to be used have a particle size within 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 27, 2021		
Seed Depth: $1^{1/4}$ inch		
Rainfall recorded: May 1 to Sept. 15, 2021: 187.70mm or 7.39 inches		
Fertilizer:		
Seed Placed: 11-52-0	**58 lbs/ac**	
	6.4 lbs/ac Actual N	30 lbs/ac Actual K
Side Banded: 29.77-0-15.79-3.95	**379.89 lbs/ac**	

	113.11 lbs/ac Actual N	60 lbs/ac Actual K
	15 lbs/ac Actual S	
Roundup + Heat	360g/a.i./ac + 10g/ac	June 4, 2021
Axial Xtreme	500 ml/ac	June 14, 2021
** Roguing – 2 times		
Harvested: September 08, 2021		

Table- Trial Yield

Urea	H Rate lbs/ac	Height cm	Spad Rating (Chlorophyll Reading)	TKW g	Grain/head #	Protein %	Yield Kg/ha	Yield Bu/ac
Zero	0	59.0	48.7	37.3	204	17.5	2692	40
Zero	100	58.8	46.2	38.5	205	17.3	2679	40
Zero	200	57.8	47.1	37.1	233	17.3	2418	36
Zero	400	56.5	47.5	37.2	183	17.5	2371	35
Zero	800	56.3	46.8	37.2	195	17.1	2337	35
Half Rate	0	59.3	47.6	37.6	217	18	2174	32
Half Rate	100	60.3	49.3	37.8	213	18.1	2458	37
Half Rate	200	60.5	47	37.4	229	18.1	2626	39
Half Rate	400	59.0	49.1	38.5	224	18	2654	39
Half Rate	800	60.0	47.9	37.1	208	18.1	2643	39
Full Rate	0	59.8	47.9	38.5	228	18.4	2738	41
Full Rate	100	59.5	47.9	37	242	18.3	2767	41
Full Rate	200	58.5	46.5	38	211	18.2	2409	36
Full Rate	400	59.3	46.2	37.7	232	18.2	2446	36
Full Rate	800	59.3	47.7	36.6	220	18.2	2636	39

Gateway Research Organization

Table: Soil Health

Urea	H Rate lbs/ac	Active Carbon	Soil Respiration	pH (1-14)	Total Nitrogen	Total Carbon	Total Organic Carbon	Ammonium	Nitrate
Zero	0	390.1	403.3	4.9	2	25.2	24.7	6.6	7.9
Zero	100	322.3	539.6	4.9	2	25.7	25	7	8.7
Zero	200	302.9	497.0	4.9	2	25.9	26	9	9.1
Zero	400	351.0	670.5	4.9	2	25.8	25	10	14.0
Zero	800	393.1	603.2	4.9	2	25.8	25	9	15.5
Half Rate	0	284.7	573.8	4.8	2	25.0	24	8	21.1
Half Rate	100	297.0	627.0	5.0	2	25.5	25	8	22.8
Half Rate	200	272.0	580.9	4.9	2	26.2	26	8	20.4
Half Rate	400	318.8	507.4	4.9	2	26.3	26	8	21.2
Half Rate	800	279.4	502.7	4.9	2	24.8	25	9	24.1
Full Rate	0	293.6	451.8	4.8	2	25.0	24	8	24.5
Full Rate	100	252.4	539.3	4.9	2	25.7	25	7	21.3
Full Rate	200	294.7	573.8	4.9	3	26.4	26	8	23.2
Full Rate	400	286.1	545.3	4.8	2	25.3	25	8	24.8
Full Rate	800	307.0	563.0	4.8	2	25.5	25	9	20.0

H= HUMALITE

The first-year results somewhat impacted by high temperature and low rainfall in 2021.

This is an ongoing project. The results on soil health and other parameters will be concluded at the end of the experiment (2022 December). Keep in touch for updated information.

Acknowledgment: The current project is funded by **RDAR** (Results Driven Agriculture Research)**.** The project will collect data in 2021 and 2023.

RDAR
Results Driven Agriculture Research

Utilizing Winter Cereals for Forage, Grain and Improving Soil Health

Objectives & Deliverables

1. Evaluation of the establishment of fall-seeded crops under different stubble heights, seeding rate, 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.

Seed crops into **2 stubble heights** (Canola and Peas)

Fall Seeded:

Winter Wheat (Wildfire, Pintail)
Fall Rye (Prima, Hazlet)
Triticale (Bobcat, Metzger) possibly more from Mazen at Olds College/FCDC
CCC Mix 1 (oats, millets, brassica, peas, hairy vetch)
CCC Mix 2 (winter cereals, hairy vetch)

Spring Seeded:

Winter Wheat (Wildfire, Pintail)
Fall Rye (Prima, ?)
Triticale (Bobcat, Metzger, ??)
CCC Mix 1 (oats, millets, brassica, peas)
CCC Mix 2 (??)
Spring Wheat (AAC Brandon)

This trial was seeded in Fall 2021. The plant emergence data has been taken before the snow. Further information will be included in the annual report 2022.

RDAR
Results Driven Agriculture Research

Adaptive Management On Marginal Lands Under Continuous Cropping in North Central Alberta

Background: Marginal land for our project is defined as land with limitations for profitable agricultural production and under continuous annual crop production for four consecutive years. We hypothesize that profit from crop production on such land has increased risks of disease and pests and might not be worth the inputs applied. For example, clubroot infestations are of increasing concern and the degradation of soil quality including increased greenhouse gas (GHG) emissions are occurring in these areas. Although producers might be lucky to gain a net profit out of these marginal lands with occasionally steep grain prices and favorable environmental conditions, it is very important to understand the long term economic and environmental consequences of a range of management options in these challenging conditions.

Optimizing economic returns while maintaining the productive capacity of marginal lands may require looking at alternative management to what is currently being practiced. Producers have to manage marginal lands carefully, based on the limitation they have. For example, growing crops that can be grazed by livestock will lower risks of losses from early frosts. Perennial crops can break disease and pest cycles while increasing soil carbon sequestration and improving the soil's resilience to changing climates. Fertility management plans will improve nutrient recovery from sandy soils, where chances of nutrient leaching are greater than with clay or loam soil.

Partnering municipalities currently have conservation programs in place. We plan to work with those program participants to collect data on the long-term economic feasibility of adaptive management projects as compared to portions of the land under current management. Additional measurements, estimates, and information about soil carbon sequestration, greenhouse gas (GHG) emissions, and other co-benefits will also be collected. Participation in this comparative project will be voluntary for farmers and ranchers making conservation efforts.

The study area will include seven collaborating counties in north central Alberta, the County of Barrhead; Lac Ste. Anne County, M.D. of Lesser Slave River, Thorhild County Westlock County, and Woodlands County, and Yellowhead County. Clubroot infestations were confirmed on more than 50 fields in four of these six counties[1]. Disease incidence probability increases with the more moisture available.

Sites for data collection will target lands classified as Class 4 (Severe Limitations) to Class 7 (Unsuitable), based on the Land Suitability Rating System (LSRS) for spring grains[2] as these are most likely to show benefits from adaptive management. Soil limitations in the area are primarily due to cold temperatures and excess moisture. Table 1 shows the results of a preliminary analysis of the AGRASID[3] soils database and the Annual Crop Inventory[4] where close to 70% of the cropland in the six counties continuously grew an annual crop (e.g. various combinations of canola, wheat, barley or peas) each year from 2014 to 2017. About 20% of this area of continuous annual cropping is on marginal lands (LSRS > 4).

Table 1. Extent of continuous annual cropping (2014 to 2017) on marginal lands (class 4 to 7).

County	Continuous Annual Crop Area[4] (acres)	Continuous Annual Crop on Marginal Lands[3] Area (acres)	% of Continuous on Marginal Lands (%)
County of Barrhead	148,939	16,938	11
Lac Ste. Anne County	59,928	6,577	11
M.D. of Lesser Slave River	10,103	786	8
Westlock County	331,964	80,941	24
Woodlands County	16,104	2,370	15
Yellowhead County	20,894	7,684	37
Total	587,931	115,297	20

Outcome: The project will document/monitor current management practices for each farmer cooperator and apply adapting management techniques and diagnostics to identify and address the limitations for each parcel of land. These results will inform plans to switch to or test alternative cropping or other systems, such as cover crops, multi-stage crops, perennials, woodlots or other alternatives that may be feasible and more economically and environmentally sustainable in the long term. Results of alternative management will be documented to demonstrate changes in economic and environmental outcomes relative to current practices.

For example: The science-based estimates of soil organic carbon changes for the first 20 years of increasing perennial vs annual crops in the Parkland zone based on Canada's National Inventory Report with increased perennial instead of annual crop are - 0.55 Mg /ha /year or 0.22 t /ac /year. The following table is a quick analysis of the increase in soil carbon in tons/acre from the project. A goal for the project is a 30% adoption of adaptive management for marginal land, which would target the improvement of the 115, 297 acres.

Total Marginal	**Soil Organic Carbon (SOC)**					**Total SOC**
Assume 30% adoption	**No Till (Underseeded)**	**Year 1**	**Annual to Perennial**	**Year 2**	**Year 3**	**Yrs 1 to 3**
(ac)	**(t / ac / yr)**	**(t)**	**(t / ac / yr)**	**(t)**	**(t)**	**(t)**
34,589	**0.06**	**2,075**	**0.22**	**7,609**	**7,609**	**17,295**

The project will track changes from A) current or baseline practices to B) new adaptive management strategies chosen by each farmer cooperator, including details of:

- Initial site-specific characteristics and limitations (e.g. climate, moisture, fertility, nutrients, pH, infiltration, bulk density)
- Inputs (e.g. fertilizers) and outputs (e.g. yield)

- Production economics (e.g. contribution margins from AgriProfit cropping alternatives[5])
- Changes in soil health (e.g. soil carbon, infiltration, bulk density, fertility)
- Net GHG emissions using the Holos6 tool in common units of carbon dioxide equivalent (e.g. CO2e)
- Identification of co-benefits (e.g. riparian improvements, expected impacts on water quality, climate adaptation)
- Tracking may occur on a sub-field basis, where there is interest

Tracking inputs and yields from current and new adaptive management options will provide the information needed to calculate long-term contribution margins, as well as changes in farm-scale GHGs. Comparisons of current with adaptive management options will identify success factors to support viable management strategies. These results, along with the identification of co-benefits such as adaptation and water quality improvements will highlight improvements that can be made in other areas with similar characteristics, encouraging more widespread adoption of improved management.

The AgriProfit$[5] Cropping Alternatives approach and database developed by Alberta Agriculture and Forestry will be used as the basis for tracking inputs, yields, and contribution margins. This study has recently been expanded to include a wider range of cropping and livestock participants in various regions of Alberta. Application of these recent results will be of interest to farmers and project results will provide feedback to AgriProfit$ analysts.

The Holos[6] tool was developed to assess net GHG emissions at farm scale by scientists with Agriculture and AgriFood Canada. Holos is based on peer-reviewed science and is aligned with Canada's international reporting on GHG Sources and Sinks in Canada[7]. It will provide the basis for tracking changes in soil carbon sequestrations and GHG emission reductions. An economics component was recently added to Holos that will also help to quantify the economic aspects of management options. It is also aligned with Canada's National Inventory Report[8]. Holos has been incorporated into sustainability tools developed for the cropping sector (e.g. Canadian Fieldprint Calculator[9]). Holos has also provided the basis for evaluating GHG emissions and productivity for a number of life cycle assessments of integrated cropping and livestock systems in Canada's beef and dairy sectors.

The seven counties have similar soil limitations and environmental factors such as frost-free days, growing degree days and moisture situations. In addition, the area under continuous cropping in these counties is quite large, despite the unsuitability of some of the land for annual cropping.

Higher land prices and rental rates, the need for more inputs and challenging climatic conditions are making it increasingly difficult for farmers to realize profits from current practices on marginal lands. The project aims to work in collaboration with provincial, municipal and local applied research association experts and leading producers to identify the problem and their solution. Demonstrations of economically viable, alternative management practices will help to encourage adoption of adaptive management improvements.

This project will increase the farmer's familiarity with factors that increase long-term economic and environmental sustainability. For example, introducing more perennial pasture plants into annual cropping systems can reduce GHG emission levels from livestock production as perennial plants capture more atmospheric carbon and ultimately increase storage in the soil. The need for sustainable production practices such as intercropping are increasing while the demand for increased production, improved land use, and profitability is rising as well. So in order to balance sustainability and profitability, the producer needs to be educated about both at the same time.

With intercropping options, producers will have a greater yield advantage or a higher Land Equivalent Ratio (LER). According to the FAO10, LER is the ratio of the area under sole cropping to the area under intercropping needed to give equal amounts of yield at the same management level. LER is the sum of the fractions of the intercropped yields divided by the sole-crop yields. Learning more about this production method and its benefits to the livestock and cropping sectors in Alberta could mean increased economic gains as well as assurances that the agriculture industry is making strides in maintaining its reputation for high production standards as well as sustainability. Including forage in their crop rotation is another approach that will be beneficial for the producers. Research has shown that increased rotation impacts the net greenhouse gas (GHG) emission to the atmosphere. Management practices that concurrently improve N use efficiency and increases soil organic carbon stocks are needed for cropping systems to be net GHG sinks11. Increased familiarity will also help farmers improve record keeping which can open opportunities in new markets. So, this wide-ranging project involving research plots, demonstrations, farm figure calculations, and analyses is a new and innovative program designed to make local agriculture more profitable while reducing its impact on the environment.

2020-2021 Soil Conservation Overview

Jay Byer, Soil Conservation Analyst

The Alternative Management of Marginal Land Project continues to compare yields to soil classes. Our finding to date is that the LSRS (Land Suitability Rating System) polygons and classifications are generally too broad to be able to look at alternative land management strictly on the rated class of the soil, but rather on a more nuanced, careful observation of location, soil response to nutrition, impact of water for the area, and other factors. With so many other aspects, it's not so much what you have but what you do with it, applies to soils as well. Our project with GRO will continue to look at as many aspects of alternative land management as possible to ensure producers can assess lower quality soils and consider the appropriate form of alternative management that can minimize expenses, maximize return, and provide the most benefit to the environment. Some of the aspects where we are seeing greater benefit to preserving and enhancing marginal land through a variety of means, include:

- Bale grazing and its impact on soil health
- Application of soil amendments to annual crops and forages, including such products as humates, calcium formulations, wood ash, biochar, compost, etc.
- Forage to annual crop soil comparisons
- Soil impacts from different grazing approaches
- Polycultures and how they impact pests and soils over time.
- The impact of current fertility practices on soil health.
- Perennial cereal crops and their impact on soil health.
- Support of groups and organizations dedicated to regenerative or organic agriculture practices
- Applications to funding agencies, designed to expand GRO's ability to support provincial or more local initiatives of current agricultural topics.

In addition, we continue to support GRO through pest analysis, support of well-paid contract research, extension work in person and online, particularly with students from post-secondary municipalities, local and provincial organizations, institutions, etc.

We also consider and help to promote alternative means of controlling a wide variety of pests, new means of locating and creating riparian areas and buffer zones, etc., and how to encourage current and future generations of producers and advisers to help make agriculture as sustainable and regenerative as possible.

As time progresses with the Soil Conservation Analysis program, we continue to have our objectives adapt and evolve to meet changing weather and environment challenges. We will adaptively investigate ongoing means of meeting these challenges for agriculture in the current and future economic, management, and physical environments.

Gateway Research Organization

Year 2: 2020-2021

The 2021 growing season proved to be a challenging one for the purposes of the adaptive management on marginal land project. The year started off with restrictions to in-person communications, which reduced the ability to create economic pictures of more highly productive soils compared to those rated as lower for the purposes of annual crop production. We were grateful, however, for those producers who were able to supply GRO with yield data so that at least we could create a picture of how actual yield compared to the soil rating for that area. While there was some correspondence between the yield of lower rated land to lower yields, it was discovered that the CLI, or worse still the LSRS, polygons were so large that it would likely be better to use a more nuanced, comprehensive means of considering which acres of a field would best be considered for adaptive management, including such factors as historical yield, topography, contiguousness to other marginally producing areas, access to this and other areas of a field, soil quality, and over all farmability. With all that in mind, producers will be encouraged to continue to consider alternative management of marginal land, using this more nuanced, comprehensive approach. A more thorough discussion of the investigation of soil land rating versus current yield is included in subsequent pages of this report.

With all that taken into consideration, several projects were conducted or supported, designed to create additional tools for regeneration and adaptation of these soils deemed appropriate for change. These projects included:

- Changes to soil in pastures under various management regimes
- Soil amendments applied to pastures
- Soil amendments applied to annual cropping systems
- Humate applied to annual cropping systems
- Assessment of polyculture versus monoculture annual cropping
- Short term soil changes in poly versus monocultural silage assessment
- Pest observations in poly versus monoculture annual crops
- Soil impacts of intensive versus less intensive agricultural techniques
- Observations of innovative crops and perennial cereals
- Comparisons of nearby pastures versus annual cropland.

The 2021 growing season proved to be a very challenging one, with unprecedented heat and significantly drier than normal growing conditions. As a result of this unusual year, some projects were, of necessary, abandoned or adapted to try to at least get some data out of them. Others did not supply the full spectrum of data expected from the onset of the trial. Yet others produced unexpected results not anticipated from the setup of the trial. With all this in mind, the results presented in this report still provide some insight into potential opportunities for adaptation of marginal land, how we can lessen our footprint on these fragile areas, and how we can quickly adapt what we do to reduce the impact of farming and ranching on the environment.

This year of reduced contacts also put a crimp on extension activities related to adaptation of marginal land. While we were able to conduct several plot tours to showcase the work on adaptation of marginal land that was successful, most in-person presentations were cancelled to reduce person-to-person contact in order to reduce the impact of the pandemic. We were, however, able to pivot what we do and conduct a number of webinars, podcasts and on-line presentations to outline our objectives to Agricultural Service Boards, Forage Associations, producer groups, students at various institutions, and the general public, so that the concept of With all that taken into consideration, several projects were conducted or supported, designed to create additional tools for regeneration and adaptation of these soils deemed appropriate for change. These projects included:

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We are hopeful that 2022 will provide a more conducive environment in which to continue to investigate and promote the adaptation of marginal land in this area.

Soil Classification Versus Yields 2020-2021

Throughout the fall of 2020 and 2021, attempts were made to collect yield data off several fields and calculate net returns in order to overlay that data onto land quality maps and determine areas with a positive net return versus those without that return at the same time as having a positive impact on the environment. That data has been collected, both in a year with adequate environmental conditions (2020) and a year with unprecedented conditions of heat and inadequate moisture (2021). While these adverse conditions will have an impact on the net economics for the land type, it is theorized that high commodity prices would balance out reduced yields. And, ideally, it would have been preferred to take actual costing data from producers, restrictions placed on us by COVID-19 would make it difficult to complete a detailed HOLOS or Agriprofits data analysis, so standard compiled results from this program for the area would have to suffice.

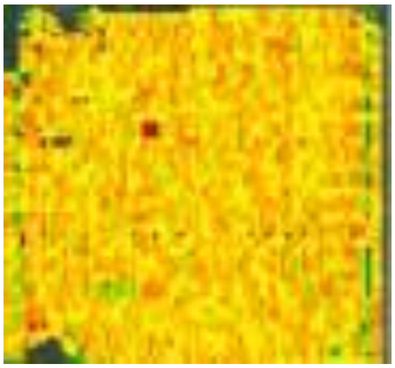
It has long been theorized that, particularly in north central Alberta, cropland soils are often quite variable, and portions of the field do not produce the yield required to make those areas profitable. This cropland has been rated in a variety of ways. Initially the most popular rating system was the CLI (Canada Land Inventory) capability rating, where soils were rated from a class 1 soil (no cropping restrictions) to a class 7 soil (not suitable for agriculture). This system, while being quite responsive to local soil conditions, did not address any environmental factors which would have an impact, so a new system was derived. LSRS stands for "Land Suitability Rating System" and includes environmental and landscape factors as well as soil composition and structure in its rating system. What we gain in completeness of analysis, though, we lose in precision, as the polygons in the LSRS system are even larger, on average, than the old CLI system.

Our initial analysis of comparing polygons of different rating systems to maps obtained from yield monitoring did not correlate very well, since much of the apparent marginal land was too small to be identified, even in the CLI system. Further, there was some blending of yield mapping accuracy, which caused a muddling of the yield results over those marginal areas. It was therefore decided that soil land classification, in and of itself, would not be an appropriate metric for determining what would be considered marginal land.

Our second hypothesis, then, was if we were to rather compare yield monitoring maps for repeated years, we would get a better picture of lower yielding areas of a field for whatever reason, we could consider these as candidates for areas to be taken out of production. Subsequently, producers could make intuitive, independent decisions on which areas of a field would truly be economic and climatic draws on net field return, based on all the factors we have gathered, and consider alternative management of these areas. It is therefore recommended that, while we can support a variety of means of alternative management, considering which parts of a field should be seeded into forages or planted to become riparian areas should be more of a holistic process, using all the information available to a producer. Alternative management of these areas also could reduce greenhouse gases and increase carbon sequestration. Some of these means include:

- Long term yield and input analysis of sub-par producing portions of the field to truly discover areas of long-term negative economic areas.
- Analysis of soil analysis information such as CLI and LSRS to identify areas of a field at risk of creating a negative net income.
- A practical evaluation of field size and shape to ensure any conversion of marginal land to alternatives uses does not create a net, full field increase in greenhouse gas production.
- Development of beneficial management practices based on research and observations analyzed from actual local on-farm changes already made by producers.
- Research into the best, most efficient, alternative soil management strategies for that microenvironment.
- Investigations into novel alternative soil regeneration possibilities as an opportunity to conduct on farm citizen science which may be incorporated into larger scale research and demonstrations without committing the entire production acreage into risky, innovative and possibly non immediately economic returns.

Also, suddenly changing an entire farm into an alternatively managed operation at once, one of the original objectives of this program, may prove to be a risky, expensive business that may involve excessive work, stress and negative economic returns that may result in farm insolvency. It is therefore recommended that small, incremental changes to farms would be a preferable, more viable, long-term approach. This might also serve to be acceptable and more palatable to producers new to regenerative soil management, particularly among those who are more risk averse, either of necessity, practicality, or personality.



Typical yield monitor output LSRS polygon examples Old CLI type rating map

Ongoing observations will continue to ensure these conclusions are accurate. Greater detail can be obtained through repeated comparisons, and if marginal rate applications can be obtained that too would increase the validity of these observations. In the meantime, small scale, practical research, demonstrations, and observations supporting alternative management and regenerative agriculture will continue to ensure appropriate information and advice is supplied to producers.

Short Term Poly versus Monoculture Soil Impacts

Polyculture fields, those seeded to several species concurrently, are known to exhibit several favorable soil characteristics, including increased porosity, greater water holding capacity and enhanced microbial biodiversity. These factors have been observed over the long haul, but are there short-term impacts as well? The following observations were conducted in areas of one field that have three different cropping patterns: monoculture, low-diversity polyculture, and high diversity polyculture:

Monoculture corn (MC) seeded in mid-May, fertilized to soil test.

Low diversity polyculture, (LDP) seeded at the same time to corn and peas with similar fertility

High diversity polyculture, (HDP) seeded at the same time as the others with similar fertility, but to a sixteen species blend including sunflowers, forage turnip, vetches, plantain and other varied crops, fertilized to the same extent as the other two areas.

Quality and quantity data are reported elsewhere in this report, but the observations contained in this article consider the potential differences resulting from a current crop year only. And as these are observations only and are not statistically replicated, they should be taken as such and only considered as potential considerations for further investigations.

Potential Physical Changes

Soil Penetration: Of the three samples taken, the LDP location seems to have the greatest penetration (4.5 inches for MC, 7.6 inches for LDP and 4.5 inches for HDP to 300 PSI). While it is likely premature to assume the difference in rooting depth of the two species involved leads to a mellower soil, but that might be a conclusion that can be drawn with further research and longer trials.

Water Infiltration: Again, the non-replicated short-term nature of this trial does not allow for significant differences to be determined, but it is possible that the shallowest rooting of the MC soil could lead to the fastest water penetration, followed by the greater diversity of the other two samples (1.75 minutes for MC, 4.4 minutes for LDP and 8.7 minutes for HDP).

While more individual indications of better soil characteristics tend to lead to the conclusion of better soil quality, it is still premature to conclude the difference in organic matter (7.9% for MC, 9.7% for LDP, and 8.9%) for HDP is due to their respective croppings, it still leads to the possibility this could be addressed by further research

Potential Chemical Changes

Cation Exchange Capacity (CEC) is the ability of a soil to make some nutrients plant available. The CECs report for these soils are: 15.9 (MC) 20.9 (LDP) and 15.9 (HDP). While the numbers are curious, and again point to short term improvements occurring with a low diversity polyculture crop, we cannot be sure this is the case without more comprehensive, replicated data.

Nitrogen Use Efficiency (NUE) is a representation of the current nitrogen status of the soils which were all fertilized the same. The NUE for these soils are 77 (MC) 97 (LDP) and 17 (HDP). If we were to read these figures on face value, it would make sense that a diverse crop is taking full advantage of the available nitrogen, the pulse crop is actually exuding nitrogen to make the figure higher and the monoculture is using what it can to grow, but again, these are not replicated results.

Most of the other chemical differences did not appear to be of interest except for the hydrogen base saturation, so further discussion of these factors will be left for more detailed research.

Potential Microbial Changes

Again, all these differences seen here are potentially just due to chance since these results are not from controlled replications, statistically analyzed plots, but they may indicate trends that could direct future appropriate research. Some of the interesting observations are as follows:

- Active Carbon: The highest number for the greatest potential carbon release was found in the monocrop sample.
- Anaerobes: The highest number of anaerobic bacteria was found in the LDP sample, possibly indicating a higher level of incomplete nutrient breakdown.
- Trichoderma: Trichoderma, on the other hand, was found to be lowest in the LDP sample, another microbe which, while positive in the short term, could be contrary to good regeneration of the soil in the long term.
- Gram Negative Bacteria: Gram negative bacteria, considered the most favorable for soil regeneration were found at the highest levels in the HDP sample.
- Gram Positive Bacteria: These bacteria are generally not considered good for soil regeneration were found to be lowest in the HDP samples.
- Rhizobium: Rhizobium, a diverse group of nitrogen fixing bacteria was found at the highest level in the HDP sample, which bodes well for soil diversity for this cropping program.
- Actinomycetes: Low levels of actinomycetes is positive to keep the physical and chemical condition of the soil improving, and these appear to be numerically lowest in the HDP sample.
- Total Bacteria: The generally positive number of total bacteria is highest in the HDP soil sample.
- The ratios calculated from these microbial numbers, considered indicators of soil health, also reflect these diverse figures, generally mirroring what individual results might indicate.

If the bulk of these differences when compiled together lead to any indication, it might be that a low diversity polyculture may be the fastest way to improve soil quality, while high diversity polyculture may create the healthiest microbial soil conditions in the long term.

Report on Mono Versus Polyculture Pests 2021

Insects and diseases can have a major impact on crops. Producers are constantly on the lookout for efficient means to reduce this impact. Igbozurike (1978) and Power (1987) have identified polyculture cropping as one means of changing the impact of both pests and diseases on annual cropping. GRO decided to compare both fields and small plots of polyculture and monoculture crops to see if any immediate differences in pests could be determined in these locally grown materials.

Commonly grown local monoculture crops were compared to the same species in nearby polyculture situations, observed at the same time and plant stage to see if obviously different infestations of pests or diseases could be determined. These crops and pests include:

- Canola: Flea Beetles, Root Maggots, Diamondback Moths, Bertha Armyworm, Clubroot, Sclerotinia Blackleg
- Cereals: Root rot, Wireworms, Cutworms, Wheat Midge, Cereal Leaf Diseases, Ergot and Fusarium
- Pulse: Pea Leaf Weevil, Chocolate Spot, Lygus Bugs, and Seedling Disease Complex.

While the cropping year started off with relatively normal soil moisture and temperatures, it quickly progressed into one of dry soil and extremely hot temperatures. These conditions proved to not be conducive to this type of research. Attempts were made to compare all these pests in polyculture plots and fields to nearby monoculture areas as follows:

- Seedling diseases showed no differences were found in small and large plot analysis with root wireworms and cutworms in polyculture plots of wheat compared to monoculture test plots nearby. No damage to wheat in either type of cultivation was determined due to these seedling pests.
- Similarly, while flea beetle damage was seen in both small monoculture canola plots and adjacent polyculture ones, the chewing was less than 25% leaf damage in all cases, and, therefore not determined to be at a threshold level. Untreated canola was used for these small plots, replicated trials, and no difference could be determined between average flea beetle damage on the thinly emerged polyculture versus the monoculture Argentine canola. In order to more accurately determine if any differences in flea beetle damage can occur in poly versus monoculture canola, more research would need to be conducted

into appropriate plot size, seeding date and seeding rates, and a more conducive growing year with a better mono and polyculture crop emergence needs to occur.

- Sweeps were conducted and roots pulled mid-season in adjacent canola fields, comparing canola plants in polyculture fields to those in a neighboring monoculture field to have a non-statistical look at insect pests on canola plants in nearby fields seeded one day apart. The numerical values of signs of root maggot damage on 100 plants was .35 per plant in the monoculture plant versus .37 in the polyculture plants and 12 lygus per 25 sweeps in the polyculture field versus 4 in the monoculture field. As these were uncontrolled observations that left so many variables to chance or prior planning (Seed treatments, average seeding depth etc.) no conclusions can be drawn from these results except in order to conduct legitimate comparisons, more factors need to be controlled.
- Fababeans were compared later in the season for chocolate spot, pea leaf weevil damage, and apparent lygus bug pod damage in polyculture versus monoculture situations. No obvious patterns could be determined to differentiate between these two types of cropping systems on beans for these pests.
- Canola roots were also pulled after harvest from polyculture and monoculture fields to look at insect and disease damage throughout the fields. 100 roots were pulled from each of six fields, three mono and three polycultures. The results are in the table below but still do not provide enough data to indicate any trend on any of these conditions. Again, more controlled work would need to be done to come up with more reliable results.

Crop Type	Maggot Damage	Root Rot Damage/100	Sclerotinia Signs	Blackleg Sign
Poly Polish	10	4	5	1
Mono Arg	13	0	0	2
Poly Arg	6	5	0	7
Mono Arg	10	5	2	18
Poly Arg	21	2	0	8
Mono Arg	19	3	0	7
Ave Poly	12.3	3.7	2.7	3.3
Ave Mono	13.7	2.7	0.7	9

- Wheat plants were observed for potential wheat midge and root rot damage. Polyculture wheat in small plots had a numerical average of nine potential wheat midge observations per hundred heads whereas monoculture wheat appeared to have 14 such observations. Wheat roots were also pulled and observed for root rot signs. Polyculture plants had 15 signs of root rot and monoculture (treated seed) had 12.

Gateway Research Organization

Given the hot, dry nature of the year, the small size of some of the plot tests, differences in field treatments, and the short-term nature of some of the polyculture fields, very few differences have been identified, and none of these differences were tested in such a manner that significance could be determined. Further research will be required to better understand the size of the plots required to appropriately test each insect and disease issue, the length of time a field was in polyculture cropping, and the appropriate sampling size to determine if each of these pests are actually impacted by polyculture.

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Acknowledgement: The current project is funded by Canadian Agricultural Partnership (Environmental Stewardship Program) for this initiative. The project will collect data in 2021 and 2022.

Update on Establishment and Production Practices of Perennial Cereals

GRO has generated significant interest by evaluating perennial cereals for local survivability and growth in north central Alberta. This interest is due to the expectation that we should be able to seed these cereals once and yet harvest grain and fodder from them for several years, reducing costs of seed, planting and weed control.

ACE-1 is a perennial cereal (PC) rye, originally developed in Germany and adapted to Canadian conditions by Ag Canada in Lethbridge, Alberta. Kernza was developed by the Land Institute out of Salina, Kansas. through selecting favorable populations of intermediate wheatgrass lines.

In 2020, ACE-1 perennial rye and Kernza perennial wheatgrass were seeded on June 19th. 50 lbs of 11-52-0 was placed with the seed, and 363 lbs of a 27.5-2.5-15-5 blend was sidebanded. A preburn of Roundup had been applied, and Curtail M at the 750 ml/ac rate controlled initial weeds. The major concern for the winter of 2020-2021 was plant winter survivability. While normal seeding rates were used in 2020, 2021 emergence was only a few plants per square foot. This lower plant stand of both species was quickly overcome, however, by heavy tillering of the crop as the plants rapidly created a full canopy, shading the soil and preventing the growth of other species. Despite the hot, dry conditions, both ACE-1 and Kernza grew to nearly four feet in height, with more than an adequate number of head per square foot. The early anthesis of ACE-1 appeared to reduce the concentration of ergot, a significant problem on annual and even fall rye, given the unusual growing conditions in the summer of 2021.

From a yield perspective, both perennial cereals easily matured into a harvestable crop. While grain yields seemed not to be the highest for annual or even winter type cereals (36 bu/ac for ACE-1 and 18 bu/ac for Kernza) and the uncleaned bushel weights were light (51 lbs for the ACE-1 and 12.3 lbs for the Kernza), there is still an interest in total productivity over the entire lifespan of these two crops, especially when including the forage value for these crops, to be evaluated in subsequent years.

One interesting aspect of these perennial crops is the depth of rooting. It has been shown that perennial cereals can root as deep at ten feet. GRO viewed these plants by digging a slot with a backhoe to see about how deep we could find cereal roots. After their second growing season, and while there was not a massive root mass yet, fine root hairs were seen as far as eight feet deep. The photo shows the GRO team having dug pits beside the crop to view the current rooting depth. Further rooting evaluations and the impact on soil will be studied as for the duration of the trial.

Impact of Anhydrous Ammonia on Soil Microbial

Anhydrous ammonia is a popular, cost-effective means of applying nitrogen fertilizer, but some are concerned about the impact this means of nutrient management has on soil health and biodiversity in north central Alberta. Large quantities of applied anhydrous ammonia are known to have an impact on the microbial population of some soils (de Graaf et al, 2019), but do not necessarily appear to have a long-term impact with more moderate rates of application on more proximal locations (Biederbeck et al, 1995). Soil samples were taken in the summer of 2021 to compare the physical, chemical, and microbial characteristics of a local field with a history of anhydrous compared to a neighboring one which has not been so treated.

On September 17th, 2021, soil samples were taken from two adjacent fields in the County of Barrhead, one which had had regular applications of anhydrous ammonia (the AA field) and one that did not (the regular field). A single series of soil sampling was conducted, so that any statistical analysis is impossible, but largely different numbers may indicate trends to these differences. The AA field had a more diverse rotation including pulses, and the regular field followed a more typical wheat-canola-wheat rotation. Both fields had wheat as a crop in 2021. The AA field had a reduced tillage regime, and the regular 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 completed 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 was sent to the CARA Soil Health Lab in Oyen for density analysis, along with extra soil for additional microbial observations. It does not appear that we will receive these results by the time of printing this publication.
- 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. The conventional field was able to be penetrated deeper, possibly because of that additional tillage while the AA field had faster infiltration, possibly as a result of less compaction.

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 slightly lower in the AA field, indicating slightly less acidification from the more traditional fertility program and a somewhat more conducive growth environment for plants.
- A 33% higher organic matter content in the AA field, possibly due to the rotation and tillage regime.
- Much higher immediately available nitrogen in the anhydrous field (58 in the AA field compared to 14 in the conventional one), likely because of the diverse rotation including pulses.
- Phosphorous levels four times as high in the AA field, possibly from past fertility or organic matter breakdown.
- Potassium and sulphur levels nearly three times higher in the AA field, possibly for the same reasons.
- Micronutrients and base saturation differences were not that great, generally.

Microbial analyses proved to show more apparent differences:

- Trichoderma are 67% more prevalent in the regular field which could be a significant if these tests were to be replicated in these fields. Both levels of trichoderma could be still considered low by A & L's rating.
- The active level of carbon appears to be higher in the AA field, but the CO2 respiration number is higher in the regular field, possibly indicating a more active microbial population in the regular field at the time of the sampling anhydrous was applied.
- The general fungi number is 13% higher in the regular field, but both numbers should be considered low for these post-harvest samplings.
- There appear to be as much as 30% more rhizobium in the AA field, likely because of the fababeans in the rotation.
- Gram positive bacteria also appear about 30% more abundant in the AA field, possibly indicating a more hardy, robust microbial population, able to withstand a changing environment.
- Pseudomonas soil health is better in the AA field, as is the ratio of Pseudomonas to phosphorous saturation, likely indicating the healthy population of this family of microbes in the presence of anhydrous fertility.
- Gram-positive/Gram-negative ratio is identified as better in AA field, likely indicating an overall healthier microbial population in the diversely cropped anhydrous field.
- The fungi:bacteria ratios to organic matter and pH tended to favor the regular field but that could be a false narrative due to the somewhat lower levels of those two parameters.

Conclusion:

The bottom line, and the overall microbial sustainability index, seem to favor the AA field. This trial was designed to get some indication if repeated anhydrous ammonia applications had a deleterious effect on the soil biology. With the large number of microbial factors apparently favoring the anhydrous field, it is safe to say there appears to be no major long term negative impact of anhydrous on the soil life. It is beyond the scope of this trial though, to say that these number of favorable impacts actually indicate a positive influence from anhydrous. As always, more study is required to positively indicate the usefulness of anhydrous ammonia as a fertilizer.

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Cropland Versus Pasture Soil Analysis

When we consider local soils, it is often thought one way to regenerate them and improve soil structure is to put them into long term forage and that the position on a slope may have a factor in how these soils regenerate over time. Soil tests were taken on four benchmark soil sites of a quarter section in the County of Barrhead to analyze upslope versus lowland pasture versus annual cropland. Four such samples were taken on September 7, 2021, with the hope that these GPS'd locations will be able to be revisited over time to see how long term pasture stacks up again recently seeding forage fields. Subsamples were sent to both A & L Labs and CARA Soil Health Lab in the hope that the most comprehensive soil health report could be obtained. At the time of writing this, the Soil Health Lab results have not been received, but the hope is that they may be made available shortly.

Physical Structure

One parameter that indicates soil health is soil penetration, or the depth to which a soil probe can go before a certain amount of pressure is required to go deeper. The comparisons here seem to show similar conditions between the lowland soils of both crop and pasture, and the same comparison of both the paired highland soils. This might be a result of long-term soil impacts both physical and biological. The infiltration timing, however, did not follow this pattern, with both pasture samples being similar but the cropped soil water infiltration was fast in the lowland and slow in the upland soil. This comparison should continue to be monitored over time.

Soil Chemistry

As expected, both pasture soils had higher organic matter than the cropped areas, and if you compare within the tillage regimes, the lowland areas had higher organic matter than the corresponding upland areas. Similarly with pH, both cropland fields had much lower pHs than the paired pasture areas. The pasture fields also appeared to have the highest season-long available nitrogen. Potassium was also higher in both pasture samples. Calcium, as well, seemed to be higher in pasture samples. Copper, however, was higher in the cropland samples, possibly due to supplementation. Aluminum levels were also higher in the cropped samples, but not so high as to cause issues with nutrient availability or root pruning.

Biological Analysis

The important criteria of soil biology indicate the health, resiliency, and functionality of that ecosystem. Many biological soil health criteria are evaluated when samples are sent in for analysis. This gives us an understanding of the biological health of the field and indicates, to some extent, the sufficiency of the soil to regenerate and rejuvenate. Some of the obvious differences in soil biology are:

- Anaerobic bacteria appear to be higher in both lowland samples. This makes sense as these areas are likely to have been under water and in low oxygen (anaerobic) conditions after a heavy rain or in spring snow melt. High levels of anaerobes are not necessarily a sign of poor soil health, though, as they are more a sign of physical conditions than inappropriate biology.
- Gram-negative bacteria seem to be higher in the pasture samples, regardless of topography. Gram-negative microbes are a sign of good, soil-building biology and have an overall positive impact on the condition and fertility of the soil
- Nitrogen fixing bacteria also appear to be higher in both pasture samples. These obviously add nitrogen back into the soil, whether they are attached to a plant or not, and are positive for the health of the soil.
- Overall bacterial activity seems to be higher in both the upland and lowland pasture samples compared to the cropping ones. Bacterial activity is a necessary component of rhizosphere health.
- Pseudomonas species are higher in the pasture samples as well. These Gram-negative (Gram staining is a method of identifying bacteria into different classes) bacteria can quickly colonize plant roots, help with growth stimulation and even help to suppress plant diseases through antibiotic secretion while helping to cycling vital nutrients.
- Trichoderma, as well appear to be higher in both pasture samples. These opportunistic soil fungi play many positive roles in soil function, including biological control of pathogenic fungi, plant growth promotion and nutrient solubilization
- Active carbon, a sign of soil building organic matter in the soil, was more than double in both the pasture samples compared to the neighboring uphill and lowland annual crop samples.
- Rhizobia are as much as a factor of ten higher in the pasture samples than the cropped ones. These nitrogen fixing bacteria fix nitrogen from the air after becoming established in the plant root and help to improve soil fertility
- Soil Gram-positive bacteria again appear to be several factors higher in the pasture samples. These spore forming bacteria are very hardy, can survive over a wide variety of environmental conditions and help soils adapt equally as fast to these changing

conditions, but if they overwhelm the Gram-negative bacteria, they might have a deleterious effect on soil rejuvenation.

- Total bacteria numbers also appear to favor the pasture samples, regardless of whether the sample was taken from the upslope portion of the grazing area or the lower area nearer to a slough. This indicates these soils are more adaptable to a changing climate than the nearby annually cropped sites.

A more detailed, numerical picture of these results can be obtained by contacting the GRO office. This baseline data will prove to be very useful as we go back to resample these areas that were GPS'd for precise location in subsequent years.

From these results, as unreplicated and statistically unsupported as they are, it appears as if long term pasture fields of lower quality soils have better, more adaptable biota that will assist in the trapping of carbon and potentially reducing greenhouse gases. As further studies and sampling of these fields continue, it will be interesting to see if this hypothesis is proven.

Sustainable Agriculture Practices through Carbon Sequestration: A Literature Review for Gateway Research Organization

By: Carmen Hamel, Rianna Boyle, Celina Vipond, Kayle Nicholetts, and Devin Cooney

MacEwan University

In 2021, MacEwan University approached GRO to partner with students who were to tasked with investigating an issue for us. The first one was to look at means of assessing carbon sequestration. Attached are the introduction and conclusions from the study group. Further such study groups have been arranged for 2022 on similar topics.

Introduction:

Climate change poses a significant threat to the agricultural industry, yet this industry contributes a significant proportion of greenhouse gas emissions, accelerating climate change. With carbon dioxide emissions increasing globally, an important ecological imbalance is occurring. Soil is fundamental in storing carbon, but conventional agricultural practices and land-use changes release the carbon from the soil into the atmosphere, which takes decades to return to original soil organic carbon (SOC) stock and depletes soils physically and nutritionally. The implementation of reduced tillage systems has started the process of restoring SOC stock. By maintaining and accumulating carbon in the soil, not only is atmospheric carbon fixed, but soil fertility and stability also increase. There is a drastic need for soil health improvements through regenerative grazing practices and crop management to increase the rate of soil carbon storage. The agriculture sector is eager to find innovative sustainable methods to meet production demands for a growing population without increasing environmental pressures that impact their bottom line.

Soil health is crucial in ensuring the carbon cycle operates efficiently; the healthier the soil is, the more carbon it can sequester and hold while providing beneficial nutrients to the species that depend on it. Conventional grazing practices have deteriorated agricultural soils and the surrounding ecosystems. To overcome this challenge, farmers can introduce sustainable grazing practices. Along with grazing practices, conventional cropping practices have an adverse impact on the carbon stock in the soil. To address this issue, introducing alternative methods that improve the sustainability of agriculture can help by conserving or enhancing the soil organic matter.

Gateway Research Organization (GRO) has taken the initiative to help Alberta farmers incorporate sustainable practices that can mitigate climate change and increase the stability and profitability of their operations through research and accessibility work. Their values encompass the United Nations Sustainable Development goals of zero hunger, good health and well-being, responsible consumption and production, climate action, and life on land (United Nations, 2015). As an organization, GRO aims to improve nutrition and promote sustainable agriculture, ensure a pattern of sustainable production and consumption, combat climate change, and restore plus promote the sustainable use of agroecosystems well into the future.

They disseminate their research and demonstrate results through traditional means of annual reports, website articles, tours, field days, and contributions to province-wide and provincial government compilations to get maximum exposure for their work. GRO is leading the way among other research organizations into the live digital world with podcasts, webinars, and online assistance, ensuring that in this current environment of social distancing, that word of what they do and how they do it is still being distributed to the broadest possible audience.

Conclusions:

Sustainable agricultural practices, such as improving soil health, adopting regenerative grazing techniques, and using alternative cropping methods, are essential tools to mitigate climate change as well as increase the profitability of farming operations. By incorporating these practices, improvements will be made to soil health, which directly benefits the productivity and efficiency of farms; soil carbon sequestration, which allows the soil to act as an effective carbon sink and reduce the stress of climate change; and improved biodiversity, which creates improved habitats for native species. Farmers can play a pivotal role in protecting the environment while maintaining profit margins and feeding the world. GRO seeks to find and prove the efficacy of these practices by making them accessible to farmers through a research lens.

It would be pertinent to consider Traditional Ecological Knowledge (TEK) from Indigenous peoples and Indigenous farmers across Turtle Island for future research. These traditional knowledge systems may have knowledge of the land, cultivation practices, and climate adaptation strategies that have not previously been considered. It is also essential that we recognize and honor that the original stewards of these lands are Indigenous peoples and that there are centuries worth of knowledge embedded within the cultures, languages, and ceremonies of the diverse tribes and nations. Their knowledge is precious, especially when considering our relationship with the land that sustains us and how to benefit the ecosystems surrounding us mutually. An effective way to achieve this goal is to include community consultation and education processes of gathering and sharing information and formal research of environmental practices for mutual benefit to Indigenous and farming communities.

Alberta Soil Health Benchmark Monitoring Project

The Chinook Applied Research Association is heading a provincial initiative funded by the Canada Agricultural Partnership (CAP) designed to generate a data base of soil parameters related to physical, biological and chemical indicators. The Alberta Soil Health Benchmark study is led by CARA's Soil Health and Crop Management Specialist Dr. Yamily Zavala. Dr. Zavala was instrumental in the development of CARA's Soil Health Lab (CARASHLab), the first farmer-focused lab evaluating physical and biological soil qualities in western Canada. The lab utilizes protocols from Cornell University and the former Canadian SoilFoodWeb Lab.

Eleven of Alberta's applied research and forage associations participate in the soil health benchmark study, working with farmers and ranchers in several soil zones throughout the province. Each group documents field history and management information and uses the same protocols when collecting soil samples. Samples are received and processed through CARA's Soil Health Lab. Dr. Zavala supervises analysis of biological and bio-physical characteristics, including soil respiration rate, texture and wet aggregation stability, the level of active carbon rate and total and potential biological biomass. Analysis of chemical components are currently contracted to A & L Labs and the University of Alberta's soil lab determines the total organic carbon, carbon and nitrogen levels. All information is being summarized into a data base which will help generate strategic management practices targeting specific regional soil constraints in the future. Monitoring (re-visiting) sample sites will help determine if those managements are working or not. Funding for the Benchmark project wraps up in 2022, but further verification of management practices at over 200 of the original benchmark sites will made through a new project supported by Results Driven Agricultural Research (RDAR).

The CARASHLab generates a comprehensive report for each site sampled, which is compiled and shared with the local association and landowners. The report captures a picture of the soil health and is a point of reference for comparison to future sampling or following management changes. It includes measurements of the individual soil indicators as well as a ranking of whether the measurement is an area of concern or constraint for over-all soil productivity. Suggestions for mitigation or improvement of problem soil components may also be added to the soil score card. Discussion of the soil health report cards have been the focus of several extension activities held by participating producer associations.

Although not all samples collected to date have been processed or added to the data bank, Dr. Zavala has observed a few trends from samples collected to date. Compaction and poor water infiltration are common concerns at many sites and are often associated with lower biological components. She has observed a great diversity of beneficial soil creatures including, protozoa functional groups, fungal hyphae and nematode feeding groups as well as predatory species. Each soil sample evaluated has it own *'biological signature'* with no two samples having the same biological *'fingerprint'*. The biology in some soils just needs to be *'woken up'* whether from adding diversity to the forage mix or crop rotation, maintaining green growth longer during the growing season or adding biological amendments to the soil. Specific strategic management practices and recommendations will be identified during the final phases of the Benchmark Study as well as the management verification project which is just beginning. The Benchmark Study is intended to be a working tool that helps managers better understand soil health, how various management practices impact it and which practice might contribute to improving land resilience. It is Dr. Zavala's intention that it continue to grow and provide valuable information to producers into the future.

Note: 1525 soil samples, from 1138 fields managed by 434 farmers have been received to date under Soil Health Benchmark study. Data from analysis of samples submitted by individual farmers or as part of other studies will also be included in the data base.

Submission N / Land Location	Farmer Id No.	Sample No.	Depth (cm)
NW 32-90-23-W5M	B2	507	0-15

% Sand	% Silt	% Clay	Textural Class:	
28	41	31	Fine	Clay loam

Soil Health Analysis: Biophysical & Others

	Indicator	Results 507	Score 507	Constraint(s)
Physical	Wet Aggregate Stability (%)	59	90	
	Water Infiltration (min)	9	99	
	Bulk Density (g/cm3)	0.85	95	
	Compaction Depth/cm (200psi)	15	100	
	Compaction Depth/cm (300psi)	25	17	Deep rooting, drought resistance, water availability, nutrient uptake, plant growth and yield, subsurface pan/deep compaction/restrictive layer
	Mean Physical Health:		80	80
Biological	Organic Matter (%)	5.7	97	
	Active Carbon (ppm)	239	5	Water infiltration, microbial biomass growth and activity, nutrient cycling, carbon storage, aggregate stability, bulk density, nutrient availability, supply of labile carbon
	C:N Ratio	11	99	
	Microbial Respiration (mg CO_2/g)	0.98	90	
	Mean Biological Health:		72	72
C	pH	5.6	33	Slight acidity
	Soluble Salts (EC)	0.32	91	
	Extractable P (ppm)	39	85	

	Extractable K (ppm)	240	0	K High
	Magnesium (ppm)	698	0	Mg High
	Iron (ppm)	143	0	Excessive Fe
	Manganese (ppm)	17	1	
	Zinc (ppm)	7.1	1	
	Other nutrient Rating (0-4)		2	2
	Mean Chemical Health:		44	44
Overall Soil Health Score:			66	Medium

Add-On Tests

Physical and Biological Indicator Scores are calculated using the cumulative normal distribution function for Coarse, Medium, and Fine textural classes. Depending on the measured soil texture distribution, this worksheet identifies the appropriate soil textural class and uses the corresponding Scoring Function. Each Indicator Score represents the percentage of all samples scoring at or below the measured value when compared across the complete sample database. Chemical Indicator Scores are not based upon the normal distribution. Soil pH, Extractable P, and Extractable K are scored as follows: a) pH Score of 100 for pH 6.25-7.25, Score of 0 for pH >= 7.7 and <=5.4, b) P Scores were base on 25 + 5 ppm optimun P levels c) K Score of 100 for >=74.5 ppm, Score of 0 for <= 20 or 200 ppm. Other Nutrients Rating are determined on a scale of 0-4, representing the sum of Scores for Mg, Fe, Mn, and Zn and follows: a) Mg Score of 1 for > 33 ppm, 0 for <= 33 ppm, and 0 for > 200ppm, b) Fe Score of 1 for < 25 ppm, 0 for >= 25 ppm, c) Mn Score of 1 for < 50 ppm, 0 for >= 50 ppm, d) Zn Score of 1 for > 3ppm, 0 for <= 3 ppm and 0 for > 10ppm. Indicator Scores are assigned a color grade using the follows system: Very High, Score of 80-100 (Blue); High, Score of 60-80 (Green); Medium, Score of 40-60 (Yellow); Low, Score of 20-40 (Orange); Very Low, Score of 0-20 (Red). For Other Nutrients Ratings, a Score of 1 is best (blue) and 0 is worst (red). The Other Nutrients Rating is then converted to a 1-100 scale as follows (4, 100), (3, 56), (2, 11), (1, 4), and (0, 0). The Mean Physical, Biological, and Chemical Health Scores are calculated as the average of the Indicator Scores within each category. The average of the Mean Physical, Biological, and Chemical Health Scores is the Overall Soil Health Score. The Overall Soil Health Score is categorized using the following scale: Very High, >= 85; High, >= 70; Medium, >= 55; Low, >=40; Very Low, < 40.

Pest Monitoring & Disease Survey

Partner: Producers from Counties of Barrhead, Westlock, and Woodlands. A very Special thanks to Shelley Barkley, Alberta Agriculture

The Gateway Research Organization (GRO) participated in the Prairie Pest Monitoring Program in 2019. The objective of the Prairie Pest Monitoring Program is to develop an early warning system for crop pests, with emphasis on insects and disease. 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 surveyed for pea leaf weevil, diamondback moth, bertha armyworm, Cabbage Seedpod weevil, and Wheat Midge.

INSECT SURVEY RESULTS – 2021 – BARRHEAD

BERTHA ARMYWORM (BAW)

In order to catch outbreaks and help producers minimize losses 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 3 to 5 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 because experience has shown that field to field and even within field variations can be very large.

LLD	TRAP AVERAGE
SW-16-60-5-W5	179

CABBAGE SEEDPOD WEEVIL (CSPW)

Cabbage seedpod weevil overwinters as an adult so the risk of infestation is further indicated by the adult population of the preceding fall. Winter conditions also appear to have an impact on populations with mild winter favoring build-up of populations and expansion of their range.

These numbers are generated from sweep net samples (180 degree sweeps).

We track the population of other insects in these sweeps as well. These go into long term data sets that will help us research their population trends over time from individual fields.

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LLD	CSPW in 25 sweeps	Lygus Adult	Lygus Nymph	Leafhopper	Striped Flea beetle	crucifer	Other Flea Beetle	Turnip beetle	DBM Adult	DBM larva	Wasp <5 mm	Wasp >5mm	honey bee	bee but not honey	caterpillar
ne-4-60-2-W5	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0
sw-10-60-4-W5	0	6	6	0	0	0	0	0	0	0	0	0	0	0	1
sw-12-58-3-W5	0	28	37	1	1	1	0	0	0	0	0	0	0	0	0
sw-17-60-5-W5	0	7	1	0	0	0	0	0	0	0	0	0	0	0	0
ne-31-61-2-W5	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0

Diamondback Moth (DBM)

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 the spring from the southern or western United States or northern Mexico. In mild winters there is suspicion that diamondback moth do overwinter in Alberta. To assess the population, a network of 43 monitoring sites has been established across the province. This network is meant to act as part of an early warning system for diamondback moth and should be used in conjunction with crop scouting.

LLD	Trap Average
NW-32-59-2-W5	0

Pea Leaf Weevil (PLW)

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 (>20ºC) 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 6 node stage before the weevils arrive. The numbers represented here are generated from assessing feeding damage on 10 plants in 5 locations in a field.

Legal Land Description					Average Node Stage	Total Notches	Average notches/Plant
c	6	60	2	5	4.38	52	1.04
c	17	61	1	5	4.28	29	0.58
c	26	60	3	0	3.92	20	0.4
c	31	61	2	5	4.12	224	4.48
c	6	60	2	5	4.38	52	1.04

WHEAT MIDGE (WM)

Wheat midge is an insect that increases in numbers in wet years. Numbers can vary drastically from field to field and we try to sample wheat adjacent to the previous years' wheat 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 field 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 standardized soil probe.

The risk level as shown on our maps is as follows:

- 0 midge will be displayed as light grey (No infestation)
- 2 or less midge will be shown as dark grey (<600/m^2)
- 3 to 5 will be shown as yellow (600 to 1200/ m^2)
- 6 to 8 will be shown as orange (1200 to 1800/ m^2)
- 9 or more will be shown as red. (>1800/ m^2)

LEGAL LAND DESCRIPTION	TOTAL MIDGE	VIABLE	PARASITOID
sw-10-60-2-W5	0	0	0
sw-27-60-4-W5	0	0	0
sw-20-58-3-W5	0	0	0
ne-3-59-3-W5	0	0	0

INSECT SURVEY RESULTS – 2021 – WESTLOCK

CABBAGE SEEDPOD WEEVIL (CSPW)

LLD	CSPW in 25	Lygus Adult	Lygus Nymph	Leafhopper	Striped Flea	crucifer	Other Flea Beetle	Turnip beetle	DBM Adult	DBM larva	Wasp <5 mm	Wasp >5mm	honey bee	bee but not	caterpillar
sw-6-60-26-W4	0	8	2	0	0	0	0	0	0	0	0	0	0	0	0
se-31-57-26-W4	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0
se-8-58-25-W4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
se-14-60-25-W4	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
se-32-61-24-W4	0	11	1	0	0	0	0	0	0	0	0	0	0	0	0

PEA LEAF WEEVIL (PLW)

Legal Land Description					Average Node Stage	Total Notches	Average notches/Plant
c	19	60	24	4	4.2	45	0.9
c	20	57	26	4	5.38	177	3.54
c	7	60	24	4	4.8	26	0.52
c	3	56	3	5	4.04	64	1.28
c	26	60	3	5	3.92	20	0.4

Wheat midge (soil) (WM)

Wheat midge is an insect that increases in numbers in wet years. Numbers can vary drastically from field to field and we try to sample wheat adjacent to the previous years' wheat 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 field 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.

Legal Land Description					total Midge	Viable	Not viable	Parasitoid
sw	16	61	26	4	0	0	0	0
sw	12	60	27	4	0	0	0	0
sw	11	59	27	4	0	0	0	0
ne	7	58	26	4	2	2	0	0

Insect Survey Results – 2021 – Woodlands

Cabbage Seedpod Weevil (CSPW)

LD	CSPW in 25	Lygus Adult	Lygus Nymph	Leafhopper	Striped Flea	crucifer	Other Flea Beetle	Turnip beetle	DBM Adult	DBM larva	Wasp <5 mm	Wasp >5mm	honey bee	bee but not	caterpillar
sw-22-63-5-W5	0	14	4	2	0	0	0	0	0	1	0	0	0	0	0
nw-10-54-8-W5	0	36	24	0	0	0	0	0	0	1	0	0	0	0	0

Wheat midge (soil) (WM)

Legal Land Description	total Midge	Viable	Parasitoid
sw-13-62-6-W5	0	0	0
se-3-63-6-W5	1	0	1