MACKENZIE APPLIED RESEARCH ASSOCIATION [MARA]

ANNUAL REPORT 2013

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Mission and Purpose of MARA

MARA is a not for profit, producer managed and driven applied research association that conducts agriculture and environmental research from its base in Fort Vermilion, Alberta. The central aims of MARA are to conduct relevant crop and livestock research and demonstration trials, develop fertilization strategies and innovative means to manage soils and lands to enhance production while protecting the environment. Extension work to deliver new and improved management practices, research data and emerging information are at the heart of our mission. MARA recognizes the unique climate, soils and seasonality of this region and our role to provide producers with best management practices based on sound, verified science applied to this region. Our ultimate goal is to provide means to reduce production costs, improve marketing of crops, develop new means to protect soils and improve the sustainability our greater environment while improving producers' margins.

Board of Directors 2012-2013

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Personnel and Contact Information for MARA staff

The permanent staff of MARA includes James P. Ludwig Ph. D, Coordinator/Manager and Jacob Marfo Ph. D, Assistant Coordinator/Manager. Jim was trained as a population ecologist at the University of Michigan and worked as a consultant to government agencies at all levels in Canada, the United States, Universities and the private sector from 1965 to the present. He managed organic farms in Ontario and Nova Scotia from 1996 - 2010, planned and managed large-scale reclamation contracting from 1980 - 1997, and conducted research on the effects of environmental contaminants from 1965 - 1996, principally in the Great Lakes region. Jim joined MARA in September 2013 on a two-year term contract. Contact information: work phone 780-927-3776, home phone 780-927-4927, cellphone 780-285-0843; email ludwig41@telus.net; Box 646, Fort Vermilion, Alberta T0H 1N0.

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Permissions to Use Data and Reports from MARA

MARA exists to create new scientific data for use by the agricultural community in northern Alberta. Permission is granted to all members of MARA to use data contained in all MARA reports and publications to improve management of their lands. However, if any data are used for publications, academic purposes or in agency publications, permission should be sought in writing from MARA and appropriate credit given to MARA. Trial work performed for private businesses and results of all of those studies are the property of those businesses. Permission to use any of those data gathered for private funders must be sought from the funding group, business or agency.

Acknowledgements

Many individuals and organizations have contributed to the success of MARA over the years. Our success in 2013 depended on the individuals and organizations who donated their time, expertise, material resources, equipment and lands in support of MARA's mission to provide research and extension services to our agricultural communities in northern Alberta.
We extend our profound gratitude to local companies including Prairie Coast Equipment, (La Crete), UFA (La Crete), Pioneer Seeds (Fort Vermilion), Richardson Pioneer (High Level), Neufeld Petroleum (La Crete) and Brett Young Seeds for supporting our large scale crop cultivation. We are extremely grateful to **all the local producers** that helped by donating inputs, time, equipment and labour to cultivate and manage our first large scale grain plots and help transport the grains to the elevators.

We are also grateful to the following:
From the Agricultural Research and Extension Council of Alberta: Ty Faechner, Director; Jacqueline Lavigne; Ashley Steeple; and Fiona Briody (Environmental Farm Plan).

From Mackenzie County: Joulia Whittleton (Chief Administrative Officer), Bill Kostiw, Ross Mercredi, Colleen Nate, Grant Smith (Mackenzie County Agricultural Fieldman), Agricultural Services Board staff and Councillors Bill Neufeld, Walter Sarapuk, J.W. Driedger and. Dicky Driedger (former) and Eric Jorgenson.

Local Cooperating Producers: Manfred Gross (Soil data), Frank Bueckert (organic oats data), and John Simpson (canola data), Greg Newman (wheat midge data), Raymond Dyck (wheat midge data), Bill Boese (wheat midge data)
Alberta Agriculture and Opportunity Fund: Dale Chrapko, Fred Young.
Alberta Agriculture and Rural Development: Alexander Fedco.
Agriculture and Agrifood Canada: Dr Jennifer M. Fetch
Mighty Peace Watershed Alliance: Adam Norris.
Other Alberta Applied Research Associations: BRRG at Forestburg; CARA at Oyen; NPARA at Manning; and SARDA at Falher.

Contracting Research Partners: Brett Young Seeds, (Mr. Don Roubos); Canterra Seeds, Dr. Erin Armstrong, David Hansen, and Edwin Pensaert; Active Agri-Products Inc. (Dr. Ranil Waliwitiya); DSW Consulting (Scott Walker), Agriculture and Agrifood Canada Organic Oats Breeding Research-BORG (Dr. Jennifer Mitchell Fetch).

Report from James P. Ludwig, Coordinator/Manager

2013 was a challenging year for MARA with the abrupt resignation of Ravinder Pannu, the former Research Coordinator at the height of the planting season for RVTs and other varietal research plots. Regardless, MARA's board members stepped forward to oversee the planting season, developing the research plantings and plots successfully by mid-June. The summer months provided generally good growing conditions and the plots matured nicely by mid-September. 950 small plots were harvested successfully in 2013 research trial programs for three government agencies and five private clients under the leadership of the Assistant Manager/Coordinator, Jacob Marfo Ph. D., hired on August 15, followed by James P. Ludwig Ph.D., Coordinator/Manager on September 9. Limited water quality research on the nutritional and bacterial status of farm dugouts was completed in the spring and fall.

Throughout 2013, Mackenzie County and MARA participated in negotiations for the sale to the county of the lands, buildings and equipment of the closed Fort Vermilion AgCanada Research Center. For the previous eight years, MARA had leased these lands and exceptional facilities from the federal government. The sale to the county was completed in late November. A long-term lease to MARA was finalized over the winter, 2014. This arrangement will secure this land and facilities base for MARA. When joined with our vigorous local support for MARA's applied research and extension missions, this will guarantee a healthy MARA for the foreseeable future. MARA will have a land base of over 400 acres with an excellent set of buildings and equipment to devote to these missions under a long-term lease with Mackenzie County.

The balance of the Fall was devoted to improving relationships with clients, meeting with agency staff members, establishing liaison with numerous interested parties and exploring cooperative projects with several other ARECA applied research associations. Proposals for expanded water quality monitoring studies, reactivated forages and livestock programs and soils courses tailored to the needs of our local farmers all were developed successfully. A new five-year research program was signed with the Alberta Canola Producers Council and agreements for further research renewed or developed with six other private business entities for 2014.

MARA hosted its annual general meeting, several workshops on best management practices, participated in the June Rocky Lane agricultural fair and hosted the August 9 -10 first Mackenzie County Annual Agricultural Fair as our major extension events of 2013. In November, Jacob received the training to deliver Environmental Farm Plans and began to train farmers; four sessions of ten farmers each were scheduled for early 2014. A targeted soils course for farmers and gardeners was proposed, funded and developed under the Mackenzie County Agricultural Services Board. These courses will be presented in February and March, 2014 at two locations and will integrate educational materials and PowerPoint presentations provided by the 4R nutrient stewardship program.

In summary, MARA completed a year that began with serious internal challenges in good financial health, with a healthy backlog of work for 2014, several new clients from the private sector, new agency-supported applied research pending for 2014, and renewed vigor for our extension mission developed from applied research for agriculture in northern Alberta.
James P. Ludwig Ph.D, Coordinator/Manager

President's Message

The last year has been one of transition for MARA. In April 2012 the Federal Government withdrew from the Fort Vermilion research station. The MARA board chose to look at this as an opportunity rather than a setback for agriculture research in the region. With the help of Mackenzie County we were able to obtain a short term lease of the facility. This allowed the County time to show their support for agriculture in the region by purchasing the land, buildings and equipment from the Federal Government. MARA with the help of a grant from the provincial government then purchased the equipment from the County. Over the last few months the board also negotiated a twenty-five year lease for the land base and buildings from the County.

In September of last year we hired two research scientists to lead the research program. I would like to formally welcome Dr. Jacob Marfo and Dr. James Ludwig to the research station. Their experience and training is a valuable asset in our region.

I believe we now have a solid foundation on which to build a very valuable and comprehensive research program that will help agriculture to thrive and expand in this region.

As with all organizations MARA's needs are ongoing. As a priority we have identified some of the buildings on the research site for replacement in the near future. We are setting up a capital fund to begin to address these issues. As a start to this the board chose to farm the land that was not used for research last summer. With generous donations from Agriculture input companies and the commitment of many local farmers, MARA was able to raise over seventy-five thousand dollars toward this end. The success of last year leads us to continue the cropping program for another year.

I would like to once again thank the Mackenzie County, all the businesses, and individuals that made last year such a success. I am excited about the future of MARA as a regional asset and organization that we can all be proud of.

Thank You,

Greg Newman
President MARA

Honourable Verlyn Olson, Minister of Agriculture and Rural Development touring MARA's workshop in Fort Vermilion Alberta. With him are Mackenzie County Councillors and MARA Board Members

ARECA's Annual Message

A year in review...

Agricultural Research and Extension Council of Alberta

Message from ARECA's Executive Director

2013 provided opportunities as we **repainted the wagon**! We began by evaluating and refining the operational and Board functions of ARECA for the benefit of our Association members, clients and partners. We hired a consultant, John Souman with Can-Europe Consulting, who is an expert in the field of strategic planning to visit each of our Associations. At the same time, the ARECA Board moved to becoming a governance board with the coaching of Graham Gilchrist and revised the policy manual. To support the policy, the Board approved an operational manual for ARECA (these documents are posted on the ARECA information folder that can viewed by all).

Over the past eleven months, we've spent a tremendous amount of effort and resources to address issues of conflict resolution, organizational restructuring and policy governance. We utilized the expertise of John Souman and adopted a new structure recommended by Mr. Souman which provides more transparency, clarity and accountability for our member Associations. With these changes, we expect all aspects of our operations, including communications, succession planning and HR, will be improved to better serve all ARA's and Forage Associations.

The ARECA board has taken training with Graham Gilchrist to improve our understanding and implementation of **policy governance**. One focus was the separation of our governance and operational policies which has resulted in simplification of the policy manual. A review process has been established in the new policy manual which will help the board to review the manual in its entirety over the next twelve months.

As we move forward with **ARECA's new structure**, the Forage & Livestock Team, Crops, Environment and Planning Team have put together new Terms of Reference. The team chairs are Lacey Ryan (CARA) Environment, Kabal Gill (SARDA) and Tom Fromme (NPARA) Crops, Morgan Hobin (PCBFA) Forage/Livestock and Dianne Westerlund (CARA) Planning. The Planning Team consists of Association managers and has worked with the Executive Director to put together the ARECA business plan and budget for 2014.

A special meeting was held last fall at which the ARECA bylaws were changed. The new bylaws have been posted and they expand the ARECA board to include three managers who are voting members on the Board. Currently, these positions are filled by Nora Paulovich with NPARA and Laura Gibney with FFGA. The third manager will be added to the Board at the time of the ARECA Annual General meeting in Leduc on March 5.

Our Chair, David Eaton along with board members Herman Wyering and Association staff Dianne Westerlund (CARA), Ken Coles (FS) and myself were active in **telling a great story** to government and the opposition. The meetings began with the Minister of Agriculture in February and were followed by a meeting with the Calgary caucus in the spring and the Rural Caucus in November. A brief which was an overview of ARECA and its members was provided at each meeting. Our delegation met with the Opposition and their Agriculture critic in early January to discuss ARECA and Association's impact and outcomes.

The **ARECA website** continues to about 4000 page views per month while the e-newsletter has about 55% readership. The Twitter (@ARECAResearch) account became functional in August and currently, we have about 367 followers. Please make sure to follow us on **@ARECAResearch** and get the word out.

Data for crop varieties in Alberta is generated through the **Regional Variety Testing** trials by a partnership of ARECA Associations, government and industry. RVT's compare different crop varieties side by side in actual field and weather conditions. They allow farmers to decide which variety will perform best in their soil zone, climate and management style. The pulse Regional Variety Trials received significant funding from the Pulse Cluster for the next five years.

Barley 180 What does it take to achieve 180 bus/ac? Researchers evaluated crop management strategies using the cool growing conditions of central Alberta and were successful in achieving 190 bus/ac in 1990. Despite advances in yield improvement, overall barley yield in Alberta has remained relatively low. There is interest to develop a set of Best Management Practices (BMP) and evaluate the concept of maximum yield and maximum economic yield on a field scale basis in Alberta. So far top yields in this

project have been156 & 141 bu/ac on 80 acres in central Alberta. BMP's have included plant growth regulators to keep the crop standing and prevent lodging. High nitrogen rates in the spring have been successful in improving yields along with key timing of fungicides to manage disease levels. Funding for this project is being provided by the Alberta Crop Industry Development Fund and the Alberta Barley Commission.

This summer ARECA became involved in delivering the **Environmental Farm Plan** under the leadership of Fiona Briody. She has been able to engage Commissions, agencies and producer associations with promoting it to their membership.

Our mission is to support member associations as leaders in applied agricultural research and extension in Alberta. As we go forward in 2014, I wish to thank everyone for their contributions and efforts this past year.

Ty Faechner, Executive Director, ARECA

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Applied Crop Research

The Mackenzie Applied Research Association (MARA) conducted different applied agronomic trials in the 2013 growing season. The core of the research trials was the Regional Variety Trials (RVT). MARA also conducted contract agronomic research work for Active Agri-Products (BC), Canterra (Manitoba), DSW Consulting and Enterprises-Alpine Liquid Starters (Manitoba) and Agriculture and Agri-Food Canada Organic Oats Research-BORG. In addition, there were producer initiated and producer managed trials (Simpson Family Farm). This report focusses on the RVTs and the producer run trials and excludes the contract research due contractual obligations.

1.0 Regional Variety Trials (RVTs)

Summary

The Regional Variety Trials started in 1995. It is a partnership between government, industry, and the applied research associations. RVTs are conducted throughout Alberta and in northern parts of British Columbia. MARA has been conducting RVTs since the start of the program. The data from the research sites are compiled by an RVT Coordinator and Alberta Agriculture and Rural Development for print and digital publication, including the Alberta Seed Guide (www.seed.ab.ca). In 2013, different varieties of wheat, triticale, oats, barley, flax, green and yellow peas were grown at the MARA's Fort Vermilion Experimental Farm in the Mackenzie County (latitude 58.3859598, longitude -116.0206018). The objectives of the research were:

- To provide producers with agronomic data relevant to the local environment
- To familiarize local producers with newly registered varieties available to them, and
- To contribute local agronomic data to the provincial database

1.1 Materials and Methods

The RVTs crops MARA cultivated in 2013 were general purpose wheat (GP Wheat, 14 varieties), Hard Red Spring Wheat (HRS wheat, 20 varieties), Triticale (4 varieties), Oats (8 varieties), Two-row Barley (13 varieties), Six Row Barley (6 varieties), Green Peas (5 varieties), Yellow Peas (6 varieties) and Flax (8 varieties). In all, there were 263 RVT plots, including replications. Seeding of all crops was started and complete in the last week of May 2013 (Table 1). Seeding rates were based on the thousand seed weight of each variety, the desired plant density and germination percentage. A Fabro small plot seeder was used for the seeding. The plots were approximately 6.5 meters in length with four rows 12 inches apart (1.2 m wide). Fertilizer application was based on results of soil tests conducted in the Fall of 2012.

The trials followed a randomised block design and the number of replications varied based on the species (Table 1). Both hand rouging and herbicides were used to control weeds. Data on plant height (vine length for peas), lodging and days to maturity were recorded during the plant growth. Where appropriate, the matured plants were desiccated with Reglone + Agral 90 to speed drying.

Harvesting was done with a Hege 140 plot combine. After harvesting, the seeds were cleaned and moisture content was immediately measured. A Labtronics moisture meter (model 919, Manitoba Canada) and the relevant Canadian Grains Commission conversion table were used to determine seeds' moisture content. For wheat (both GP and HRS), an Infratec 1241 Grain Analyser (FOSS, Hillerød Denmark) was used to determine the protein and moisture content. However, because of variation in the wheat moisture content measured with the 919 moisture meter and Infratec 1241 Grain Analyser, only data from the 919 moisture meter is presented as that is what most producers possess. With the exception of flax (seeds too small), thousand seed

weight (TSW) of all the crops were determined using an electronic seed counter (model 701A-7, Davis Tool and Eng. Co).

Table 1: Regional Variety Trial Summary. Number of replications are in parenthesis

Crop	**Seeding Date**	**Fertilizer-NPK-S (g/plot)**	**Herbicide**	**Harvest Date**
HRS Wheat **(3)**	May 24, 2013	60-30-0-15 125	Liquid Achieve + Infinity	September 04
GP Wheat **(3)**	May 24, 2013	60-30-0-15 125	Liquid Achieve + Infinity	September 04
Triticale **(3)**	May 24, 2013	60-30-0-15 125	Buctril M	September 04
Barley 2-Row **(3)**	May 25, 2013	60-30-0-15 125	Liquid Achieve + Infinity	September 04
Barley 6-Row **(3)**	May 25, 2013	60-30-0-15 125	Liquid Achieve + Infinity	September 04
Oats **(3)**	May 25, 2013	60-30-0-15 125	Buctril M	September 05
Yellow Peas **(4)**	May 25, 2013	No Fertilizer 30g Inoculant	Viper + BASF 28% UAN	September 03
Green Peas **(4)**	May 25, 2013	No Fertilizer 30g Inoculant	Viper + BASF 28% UAN	September 03
Flax **(4)**	May 25, 2013	60-30-0-15 100	Plants were too short for chemical application	October 03

Statistical Analyses

The data (yield, height, TSW, percent moisture and protein) were analysed statistically using the analysis of variance (ANOVA) feature in GenStat ver. 12 (VSN International, Hemel Hempstead UK). ANOVA's normality and homogeneity assumptions were met. All means were compared at 95% confidence level ($P \leq 0.05$). Comparisons of statistically significant means were done using the least significant difference (LSD) approach. Any mean difference greater than the LSD is considered statistically different. Relationships between yield and protein content and between thousand seed weight and yield were established using regression.

LSD and CV (co-efficient of variation) are shown in each bar graph. The CV, the ratio of standard deviation to mean, measures the level of variability of the results. A lower CV indicates greater reliability of results.

RVT Results

1.2 HRS Wheat

The yield of the 20 HRS wheat varieties grown in 2013 differed statistically ($p \leq 0.005$). AAC Elie had the highest yield (99.2 bu/ac). AAC Redwater and Whitehawk yielded the least (56.8 and 60.0 bu/ac, respectively). There was no significant difference in the yield of the other varieties (Fig. 1, Table 2).

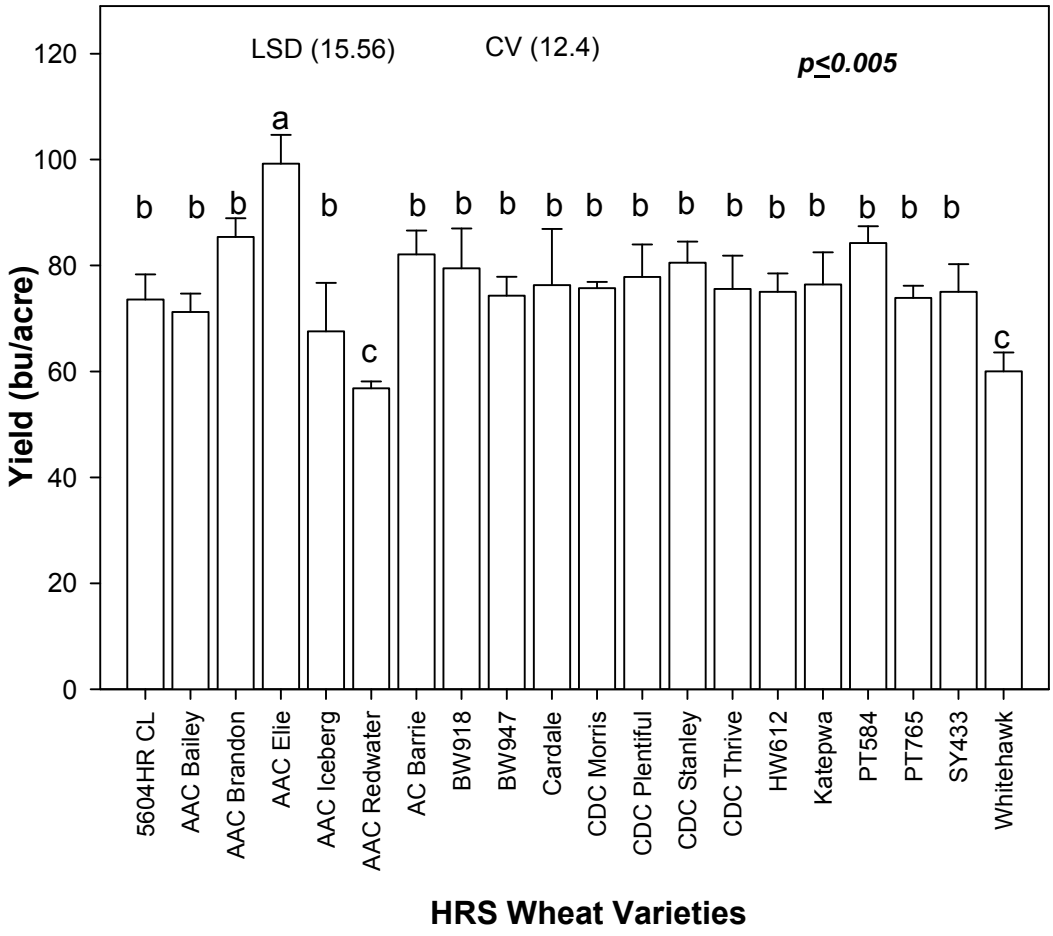


Figure 1: Mean yield of 20 HRS wheat varieties grown in Fort Vermilion, Alberta in 2013. Bars with different letters indicates significant difference (n=3). Throughout this report, a mean represented by ***a*** is significantly greater than ***b*** while ***ab*** is statistically equal to both ***a*** and ***b*** but different from ***c***. The error bars represent standard error mean (SEM).

HRS wheat protein content: The protein content of the HRS wheat ranged from 12.77 (CDC Stanley) to 15.37% (PT584). However, statistically, there was no significant difference (Table 2).

Table 2: HRS Wheat agronomic data (mean values reported, n=3)

Variety	Height (cm)	Moisture (%)	TSW (g)	Protein (%)	Yield (bu/ac)
5604HR CL	92.54	13.43	42.83	13.37	73.56
AAC Bailey	91.14	13.50	42.30	14.37	71.23
AAC Brandon	86.03	14.00	44.93	13.47	85.39
AAC Elie	86.96	13.57	44.30	14.87	99.24
AAC Iceberg	86.03	13.83	47.03	14.60	67.56
AAC Redwater	85.10	13.97	38.87	14.43	56.81
AC Barrie	91.61	13.40	46.27	15.07	82.08
BW918	95.33	13.03	41.97	15.10	79.48
BW947	96.72	14.37	41.97	13.63	74.31
Cardale	83.24	13.90	44.37	14.07	76.29
CDC Morris	87.42	13.33	39.77	14.33	75.70
CDC Plentiful	89.75	13.93	44.00	14.03	77.81
CDC Stanley	89.28	13.43	38.67	12.77	80.52
CDC Thrive	91.61	13.87	44.30	14.33	75.56
HW612	86.96	14.03	45.73	13.43	75.01
Katepwa	98.12	13.57	41.77	14.17	76.40
PT584	94.40	13.83	47.10	15.37	84.25
PT765	100.44	14.37	41.20	14.57	73.90
SY433	100.44	12.93	48.07	14.43	75.02
Whitehawk	87.42	14.03	37.17	13.63	60.03
LSD	***7.233***	***0.8089***	***5.003***	***1.64***	***15.56***
(P value)	***(p<0.001)***	***(p<0.044)***	***(p<0.002)***	***(p>0.216)***	***(p<0.005)***
CV (%)	***4.8***	***3.6***	***7.0***	***7***	***12.4***

Ready to be harvested wheat

Sean, a summer staff harvesting wheat with Hege 140 Plot Combne

1.3 GP Wheat

Yield of GP wheat ranged from 50.92 bu/ac to 74.13 bu/ac. Statistically, the results were significant ($p \leq 0.001$). AAC Chiffon and AC Andrew had the highest yield (71.59 and 74.13 bu/ac). Conquer VB had the least yield (Fig. 2, Table 3). Overall, the yields of the HRS wheat varieties were greater than that of the GP wheat.

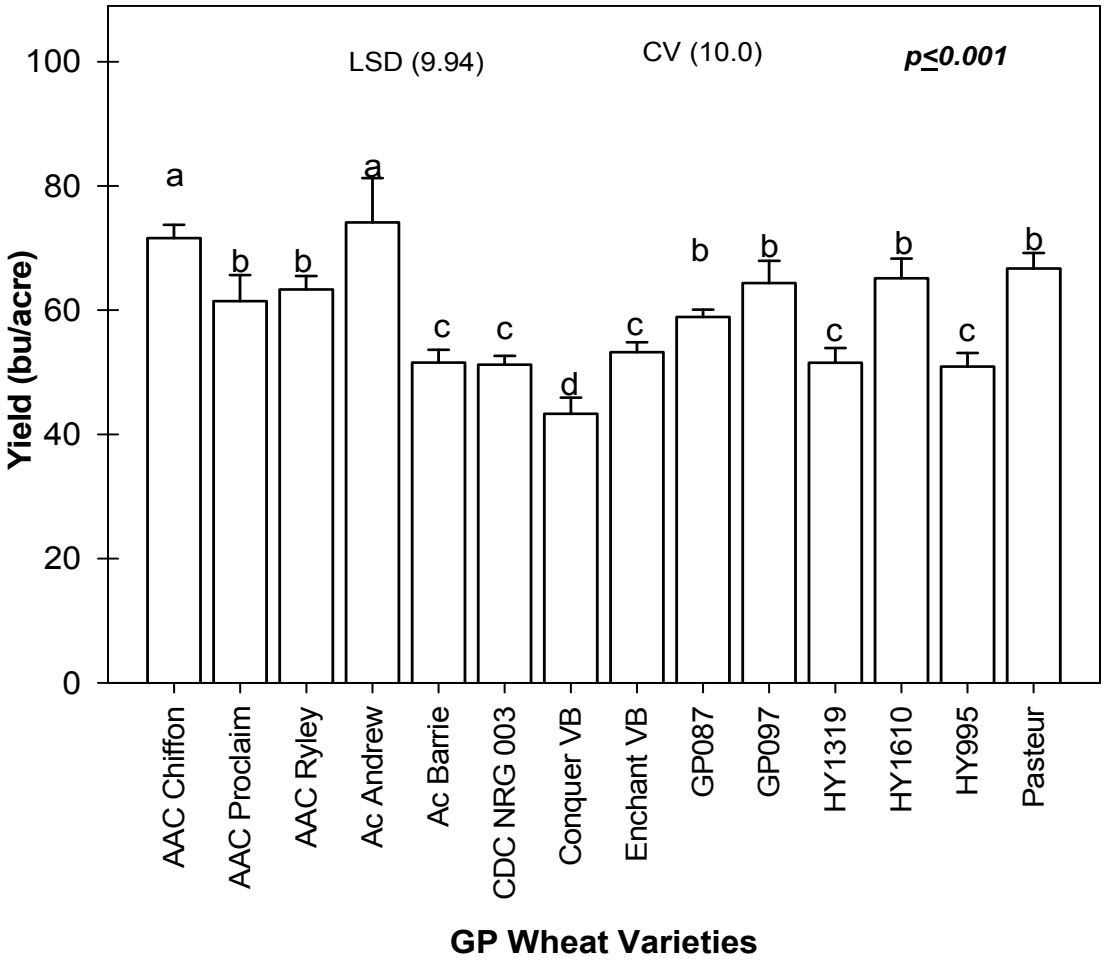


Figure 2: Mean yield of 14 GP wheat varieties grown in Fort Vermilion, Alberta in 2013. Means with different letters indicate significant difference (n=3).

GP Wheat protein content

Conquer VB had the highest protein content (15.3%, Fig. 2, Table 3). However, the same variety had the least yield. AC Andrew which recorded the highest yield had the least protein content (Fig. 2, Table 3). Generally, the GP wheat varieties that had significantly greater yield had significantly lower protein content. In other words, there was a trade-off between high yielding and low protein content (Fig. 4). Overall, the protein content of HRS wheat was averagely higher than that of the GP wheat.

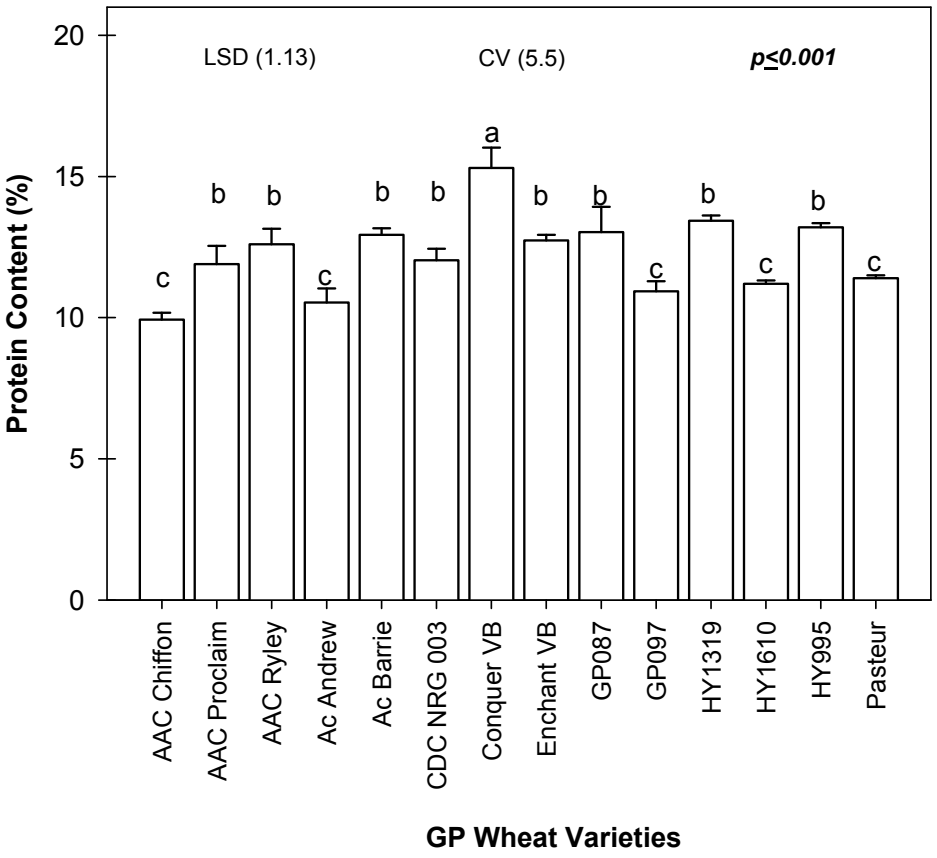


Figure 3: Mean protein content of GP wheat varieties grown in Fort Vermilion in 2013 (n=3)

Table 3: GP Wheat agronomic data (means values reported, n=3)

Variety	Height (cm)	Moisture (%)	TSW (g)	Protein (%)	Yield (bu/acre)
AAC Chiffon	77.86	12.13	53.17	9.93	71.59
AAC Proclaim	93.74	11.47	49.17	11.90	61.46
AAC Ryley	84.52	11.40	53.83	12.60	63.34
Ac Andrew	88.10	12.00	43.27	10.53	74.13
Ac Barrie	95.79	11.23	65.50	12.93	51.58
CDC NRG 003	86.57	11.33	55.93	12.03	51.22
CONQUER VB	87.59	12.13	49.50	15.30	43.34
ENCHANT VB	92.71	11.50	53.53	12.73	53.24
GP087	90.67	11.90	60.60	13.03	58.89
GP097	88.62	12.13	52.57	10.93	64.38
HY1319	72.74	11.10	54.03	13.43	51.54
HY1610	91.69	11.10	65.70	11.20	65.13
HY995	80.42	11.20	62.74	13.20	50.92
Pasteur	91.69	11.93	50.70	11.40	66.73
LSD	***9.276***	***0.633***	***12.71***	***1.130***	***9.944***
(P value)	***(p<0.001)***	***(p<0.003)***	***(p<0.041)***	***(p<0.001)***	***(p<0.001)***
CV (%)	***6.3***	***3.2***	***13.8***	***5.5***	***10.0***

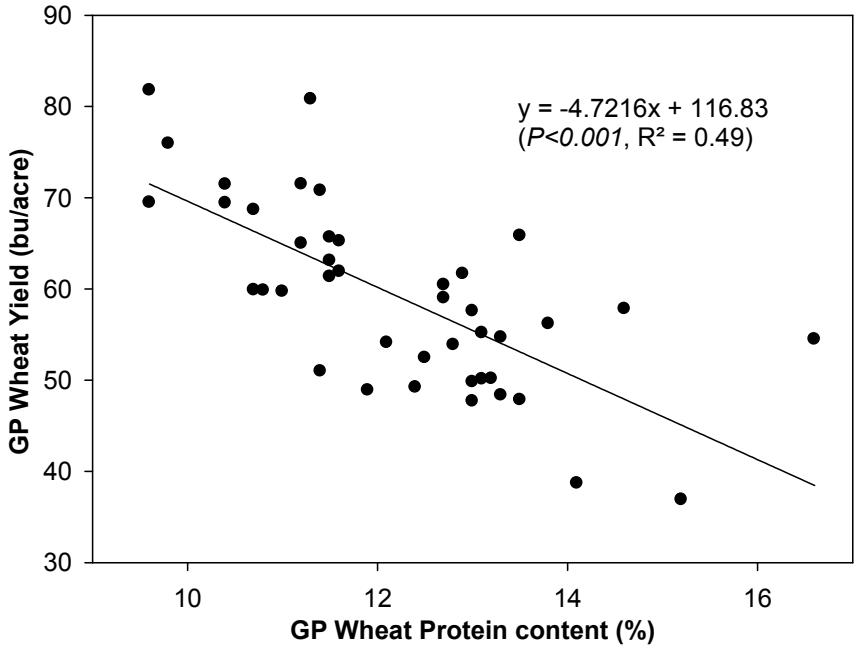


Figure 4: Relationship between protein content and yield in GP wheat

1.4 Triticale

The yield of Brevis and Sunray were averagely 19% greater than the average yields of AC Ultima and Taza (Fig. 5). However, this was not statistically significant ($p>0.171$, Fig. 5, Table 4). The implication is that in the Fort Vermilion area, any of the four varieties may produce similar yield. However, preference should be given to Brevis and Sunray in varietal selection.

Table 4: Triticale agronomic data (mean values reported, n=3)

Variety	Height (cm)	TSW (g)	Moisture (%)	Yield (bu/acre)
AC Ultima	90.17	52.81	13.27	69.01
Brevis	82.55	50.64	15.73	81.98
Sunray	89.32	53.65	14.53	81.68
Taza	93.345	54.69	15.47	68.59
LSD	***12.14***	***7.34***	***0.923***	***0.989***
(P value)	***(p=0.270)***	***(p=0.608)***	***(p<0.002)***	***(p=0.171)***
CV (%)	***6.8***	***6.9***	***3.1***	***11.3***

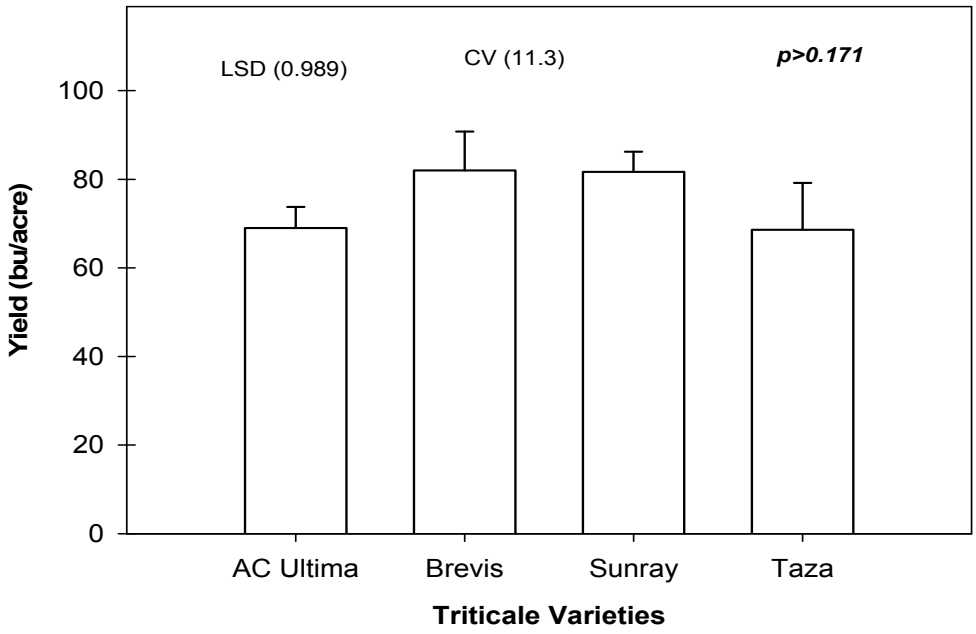


Figure 5: Mean yield of 4 Triticale varieties grown in Fort Vermilion, Alberta in 2013 (n=3)

1.5 Six-row Barley

Yield of the Vivar Six-row barley variety was significantly higher (93.22 bu/ac) than that of the other varieties (Fig. 6, Table 5).

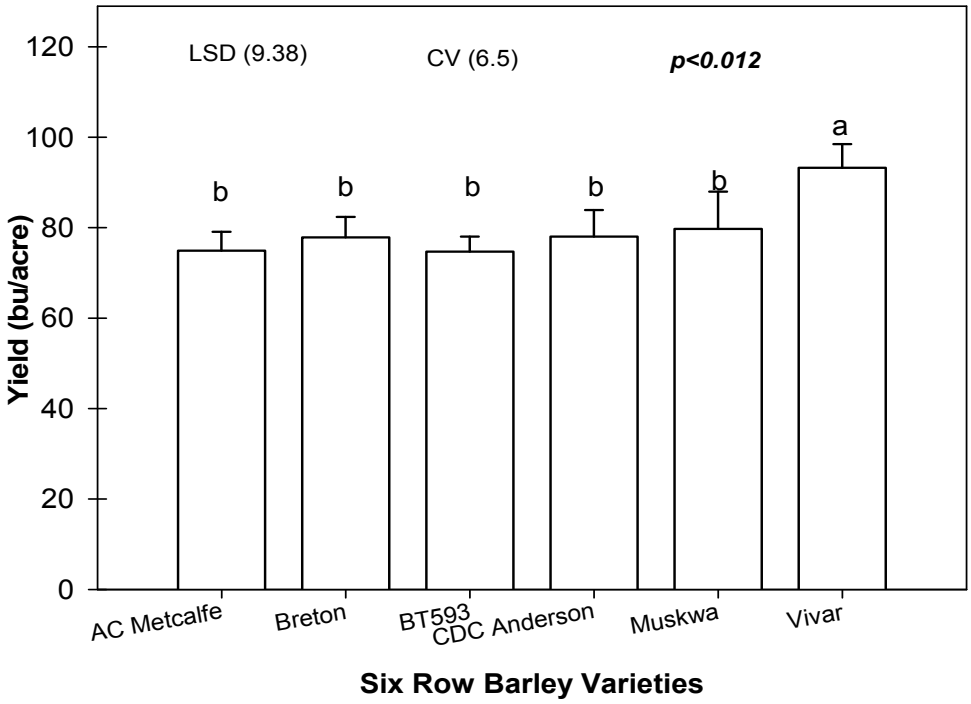


Figure 6: Mean yield of 6 Six-row barley varieties grown in Fort Vermilion, Alberta in 2013

Means with different letters indicate significant difference (n=3).

Table 5: Six-row barley agronomic data (mean values reported, n=3)

Variety	Height (cm)	Moisture (%)	TSW (g)	Yield (bu/acre)
AC Metcalfe	55.88	15.20	56.53	74.92
Breton	58.42	13.23	53.30	77.87
BT593	47.20	14.10	51.20	74.71
CDC Anderson	58.42	13.97	46.63	78.03
Muskwa	49.00	14.33	56.43	79.73
Vivar	55.67	13.67	53.10	93.22
LSD	***4.97***	***0.69***	***8.43***	***9.38***
(P value)	***(p<0.002)***	***(p<0.002)***	***(p>0.181)***	***(p<0.012)***
CV (%)	***5.1***	***2.7***	***8.8***	***6.5***

1.6 Two-row Barley

Thirteen Two-row Barley varieties were grown in the 2013 season in Fort Vermilion, Alberta (Table 6). Champion (89 bu/ac) and Xena (87.45 bu/ac) had the highest yield with CDC Clear (63.61 bu/ac) and CDC Maverick (59.78 bu/ac) recording the lowest yield (Fig. 7, Table 6). Between Champion, which had the highest yield and CDC Maverick, the variety with the lowest yield, the difference was 48.88%.

Table 6: Two-row barley agronomic data. Average of three replications is reported

Variety	Height (cm)	Moisture (%)	TSW (g)	Yield (bu/acre)
AAC Synergy	54.50	14.40	55.43	70.03
ABI Voyager	54.19	12.70	54.87	66.59
AC Metcalfe	55.77	14.90	52.73	69.45
CDC Clear	53.66	14.70	54.30	63.61
CDC Maverick	72.18	15.40	64.00	59.78
CDC Polarstar	55.25	139.00	52.10	77.18
Champion	55.88	12.90	61.10	89.00
Major	48.26	14.90	53.30	71.25
TR 07728	52.18	13.40	56.30	73.30
TR10214	58.63	13.40	54.63	68.34
TR10694	54.82	14.70	53.57	72.26
TR11698	56.20	14.90	56.03	75.56
Xena	57.15	12.90	58.13	87.45
LSD	***7.468***	***1.502***	***4.434***	***19.90***
(P value)	***(p<0.001)***	***(p>0.624)***	***(p<0.001)***	***(p>0.211)***
CV (%)	***7.9***	***6.2***	***4.7***	***16.3***

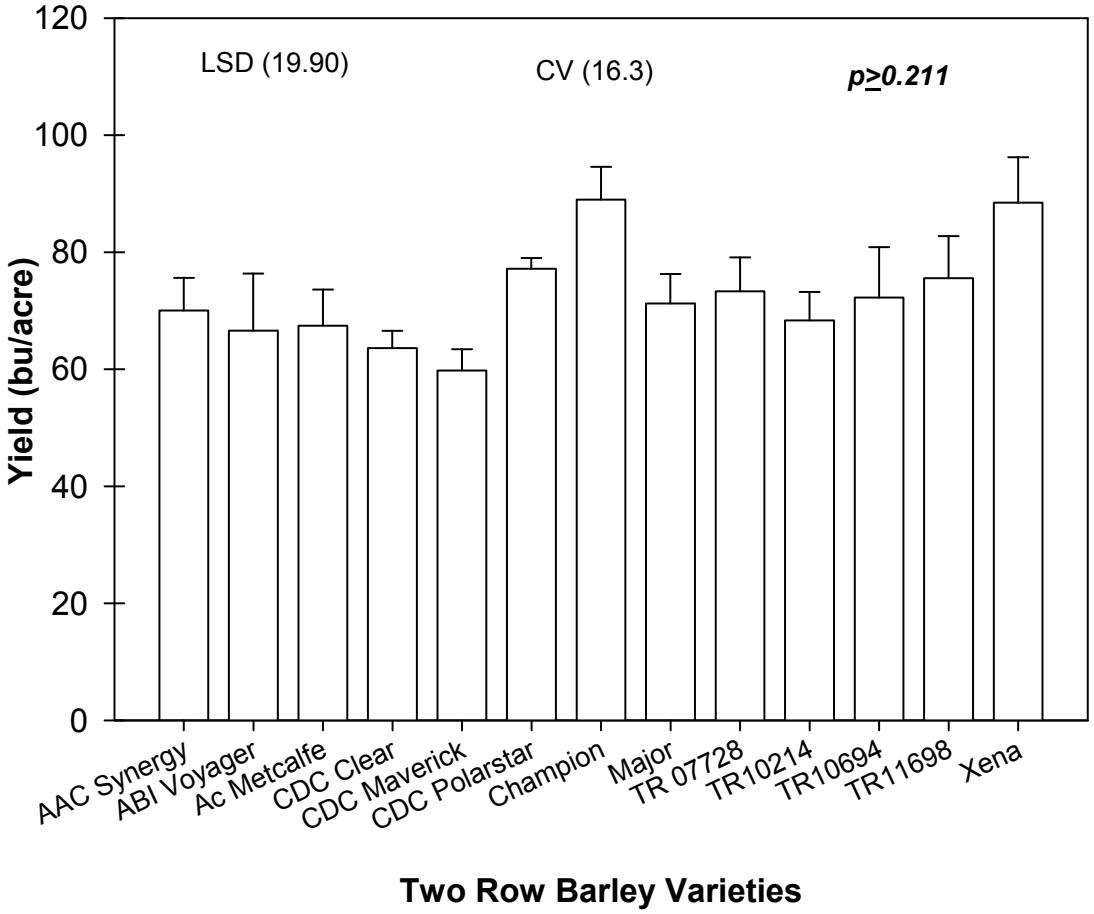


Figure 7: Mean yield of 12 Two-row barley varieties grown in Fort Vermilion in 2013
Means with different letters indicate significant difference (n=3).

1.7 Oats

In 2013, eight (8) varieties were grown in the Fort Vermilion core site as part of the RVT program (Table 7). Of the 8 varieties, AAC Deon, CDC Haymaker, CDC Nasser, CDC Ruffian and CDC Seabiscuit jointly recorded significantly higher yield than CDC Dancer, Souris and Stride (Fig. 8, Table 7). CDC Dancer had the least absolute yield (116.64 bu/ac) while CDC Ruffian recorded the highest overall yield (141.67 bu/ac).

The weight of thousand seeds (TSW) followed a similar pattern as the yield (Fig. 9). Varieties that produced significantly larger seeds also had the higher yields (Fig. 10).

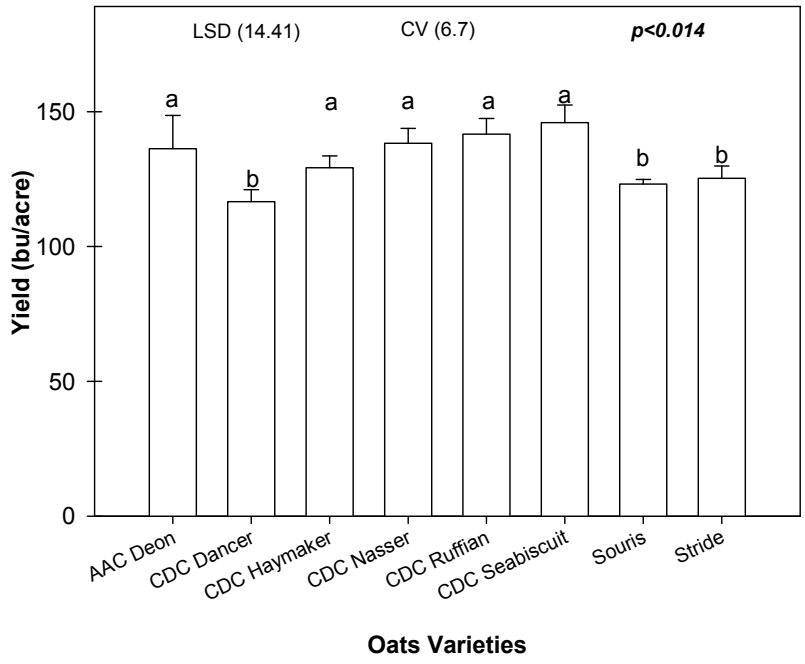


Figure 8: Mean yield of 8 Oats varieties grown in Fort Vermilion, Alberta in 2013 (n=3)

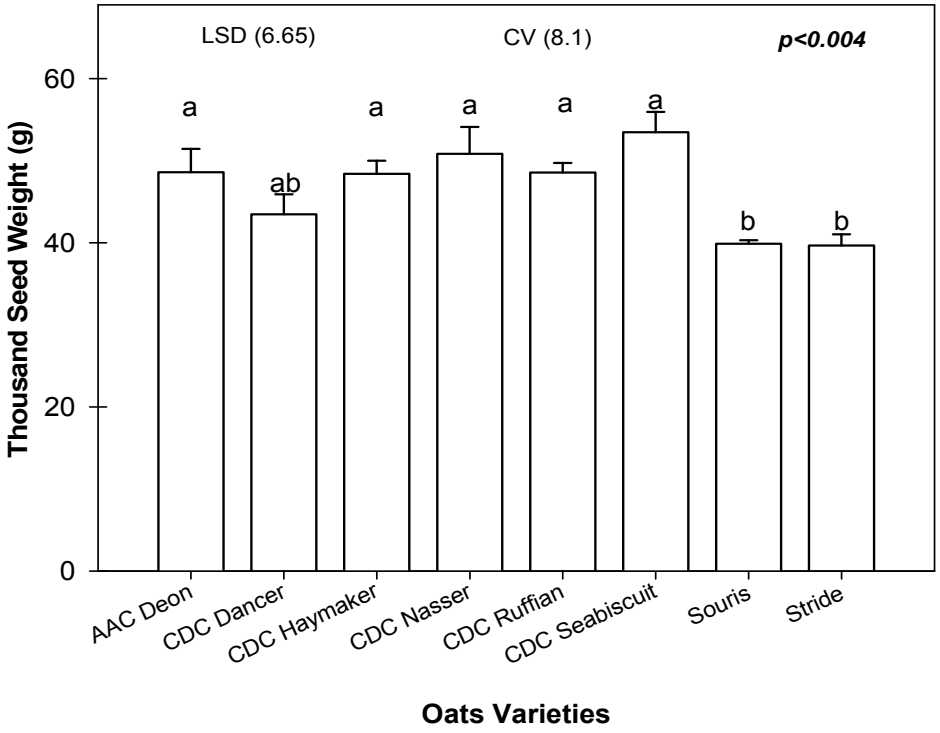


Figure 9: Average thousand seed weight of 8 Oats varieties grown in Fort Vermilion

Table 7: Oats agronomic data. Average of three replications is reported

Variety	Height (cm)	Moisture (%)	TSW (g)	Yield (bu/acre)
AAC Deon	84.64	12.37	48.60	136.29
CDC Dancer	86.48	12.00	43.47	116.64
CDC Haymaker	94.76	12.23	48.40	129.17
CDC Nasser	83.26	12.37	50.83	138.31
CDC Ruffian	83.26	12.43	48.57	141.67
CDC Seabiscuit	87.86	12.80	53.47	145.95
Souris	74.98	12.17	39.87	123.15
Stride	86.02	12.03	39.67	125.28
LSD	***10.08***	***0.862***	***6.65***	***15.41***
(P value)	***(p<0.051)***	***(p>0.591)***	***(p<0.004)***	***(p<0.014)***
CV (%)	***6.8***	***4.0***	***8.1***	***6.7***

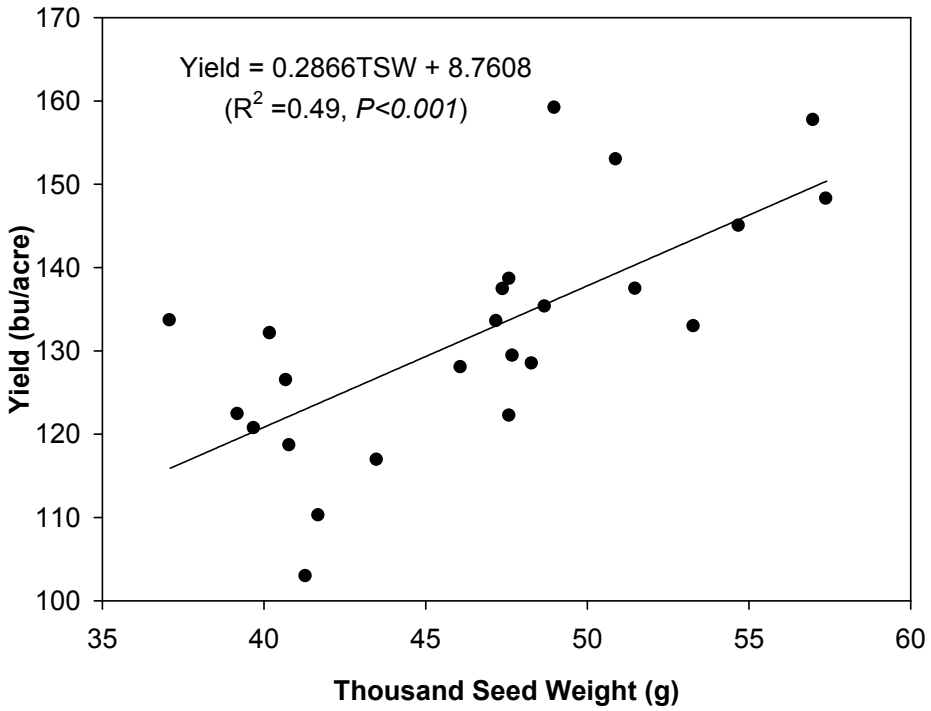


Figure 10: Relationship between TSW and yield of oats of 8 Oats varieties grown in Fort Vermilion, Alberta

RVT Oats Stand

Harvested Oats waiting to be cleaned

1.8 Yellow Peas

All the six varieties of yellow peas grown in 2013 had statistically similar yield (Table 8, Fig 11). The yield ranged from a low of 73.86 bu/ac for CDC Meadow to as high as 93.31 bu/ac in CDC Amarillo (26.33% difference). However, the difference may not be due to genetics or varietal differences because of the high co-efficient of variation (CV = 17.7%).

Table 8: Yellow Peas agronomic data. Average of four replications is reported

Variety	Vine length (cm)	Lodging	Moisture (%)	TSW (g)	Yield (bu/acre)
AAC Peace River	57.91	2.0	15.43	238.48	80.33
Abarth	59.56	3.5	15.88	276.38	77.35
CDC Amarillo	66.42	6.5	16.33	277.45	93.31
CDC Meadow	54.99	6.0	15.48	250.25	73.86
CDC Saffron	57.40	4.5	15.88	293.78	78.60
MP1902	64.26	2.5	16.18	284.75	85.97
LSD	***5.824***		***0.558***	***41.23***	***21.77***
(P value)	***(p<0.006)***		***(p<0.020)***	***(p>0.085)***	***(p>0.484)***
CV (%)	***6.4***		***2.3***	***10.1***	***17.7***

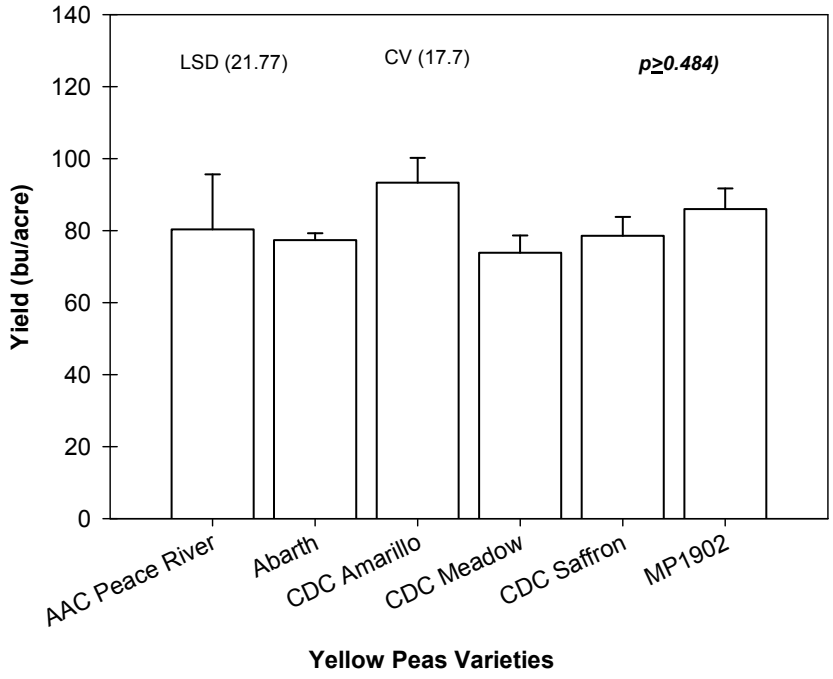


Figure 10: Mean yield of 6 varieties of Yellow Peas grown in Fort Vermilion, Alberta (n=4)

1.9 Green Peas

Five varieties of green pea (CDC Limerick, CDC Patrick, CDC Pluto, CDC Raezer and CDC Tetris) were grown in the 2013 growing season in Fort Vermilion. Statistically, the yields of the five varieties were similar except CDC Pluto which recorded significantly lower yield (Fig. 11, Table 9). The yields ranged from 49.97 bushels/acre (CDC Pluto) to 75.65 bushels/acre (CDC Limerick).

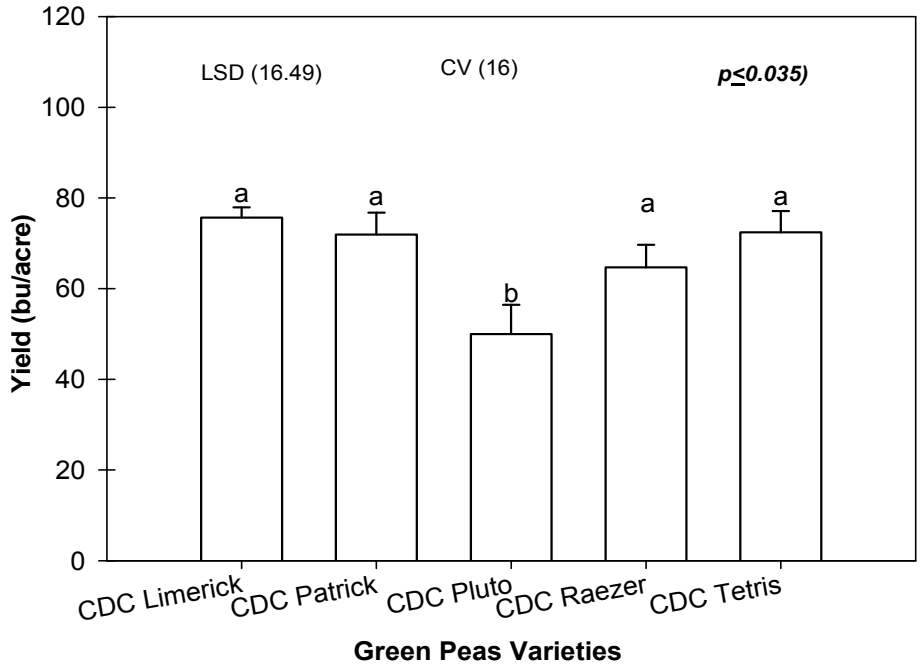
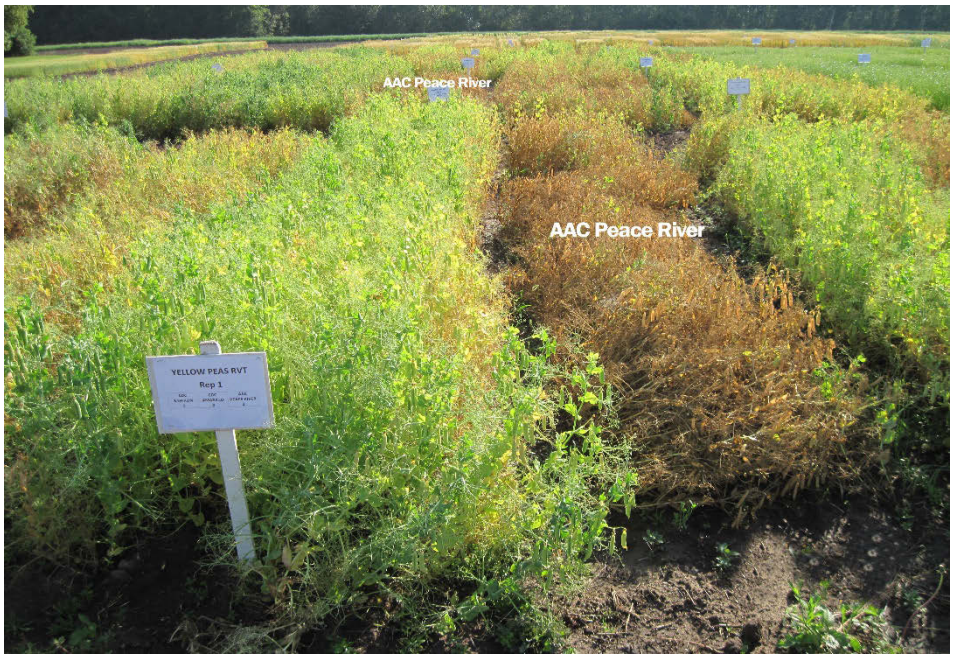


Figure 11: Mean yield of 5 varieties of Green Peas grown in Fort Vermilion, Alberta (n=4)

Table 9: Green Peas agronomic data. Average of four replications is reported

Variety	Vine length (cm)	Lodging	Moisture (%)	TSW (g)	Yield (bu/acre)
CDC Limerick	66.17	3.0	16.20	257.75	75.65
CDC Patrick	61.60	4.8	16.13	229.83	71.93
CDC Pluto	56.90	7.5	16.03	195.05	49.97
CDC Raezer	68.96	3.0	16.55	264.08	64.68
CDC Tetris	61.85	4.0	16.35	263.58	72.41
LSD	***7.24***		***0.937***	***12.01***	***16.49***
(P value)	***(p<0.030)***		***(p<0.766)***	***(p<0.001)***	***(p<0.035)***
CV (%)	***7.5***		***3.7***	***3.2***	***16***

Regional Variety Trial Peas' stand



Regional Variety Trial Peas' stand.

The AAC Peace River matured much earlier than all the other varieties

1.10 Flax

The eight varieties of flax that were grown in 2013 were AAC Bravo, CDC Bethune, CDC Glas, CDC Sanctuary, FP2325, FP2347, Prairie Grande and Prairie Saphire. The yields of AAC Bravo, CDC Bethune, CDC Glas and CDC Sanctuary were statistically equal but significantly greater than the yields of FP2325, FP2347, Prairie Grande and Prairie Saphire (Fig. 12, Table 10).

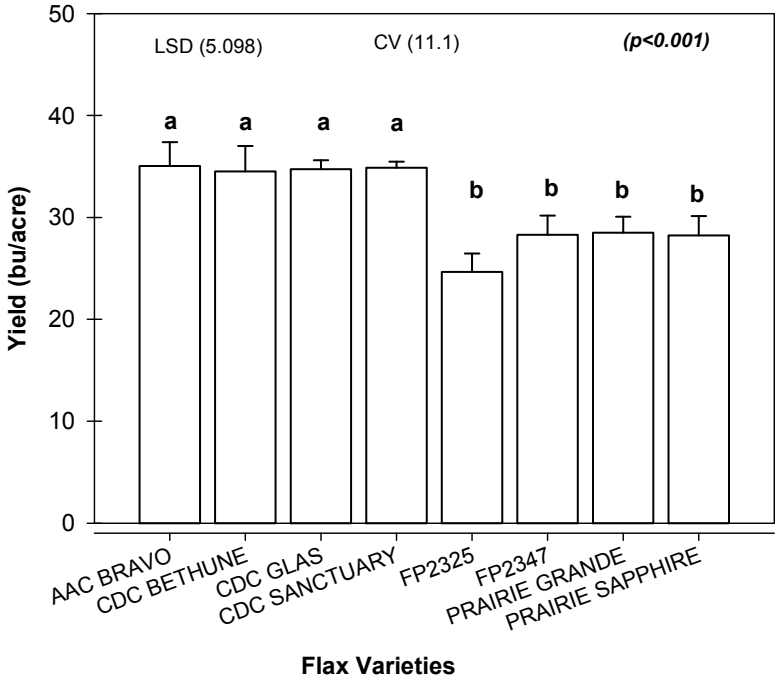


Figure 12: Mean yield of 8 varieties of Flax grown in Fort Vermilion, Alberta (n=4)

Table 10: Flax agronomic data. Average of four replications is reported

Variety	Height (cm)	Moisture (%)	Yield (bu/ac)
AAC Bravo	59.61	11.45	35.04
CDC Bethune	56.20	10.95	34.51
CDC Glas	57.94	11.7	34.72
CDC Sanctuary	59.61	11.3	34.88
FP2325	66.36	11.2	24.65
FP2347	56.12	11.3	28.29
Prairie Grande	50.88	10.15	28.50
Prairie Sapphire	57.07	11.2	28.24
LSD	***3.315***	***0.639***	***5.098***
(P value)	***(p<0.001)***	***(p<0.0368)***	***(p<0.001)***
CV (%)	***3.9***	***3.9***	***11.1***

Regional variety Trial Flax stand. Prairie Grande variety was matured and ready to be harvested several days before the other varieties were ready.

Kailey, a summer staff sampling soils in wheat field after harvesting

Kailey preparing harvested grains for cleaning and weighing

2.0: Effects of fungicide on canola yield

Sclerotina stem rot, also known as white mould is one of the most destructive diseases in canola. It is caused by the fungus *Sclerotinia sclerotiorum*. Like most fungi diseases, wet conditions increase the start and spread of the disease. Sclerotina reduces grain quality, thereby decreasing potential economic returns.

The management of the disease may be difficult as it significantly varies from year to year, farm to farm and variety to variety. To minimise losses due to sclerotina, farmers either grow resistant varieties or foliar spray recommended fungicides.

A producer (**Simpson Family Farm in Fort Vermilion, Alberta**) initiated a field scale research to test the effects of two commercially available fungicides on the yield of canola (Invigor L120). The specific objective was to determine the effects of Rovral Flo and Proline 480 SC on Invigor L120 canola yield.

Materials and Methods: The three strips (≈3 acres each) were seeded on May 24, 2013 with a John Deere 665 Air Seeder converted to air drill with GEN 300 openers at 4 inch paired row and 12 inch spacing. All the plots were fertilised with 285 pounds of 25-8-8-9 (NPKS) per acre. The fertiliser was placed in the middle of the paired rows. The three plots were sprayed with Liberty on June 20, 2013. On July 13, 2013, the fungicide treatment was applied. Two strips of approximately 3 acres each were treated with Proline 480 SC. One strip of similar size was treated with Rovral Flo. A third strip of approximately 3 acres was left as control (no fungicide). Harvesting was done in October 04 and immediately weighed with a weight wagon.

The yield ranged from 50.67 to 51.07 bushels per acre. Even though no statistical analysis was performed because of the limited replications, it is evident there was no difference in the results. The plots that were treated with Rovral Flo recorded 51.07 bushel per acre yield. Proline 480 SC treated plots produced 50.99 bushel of canola per acre. The control plot had a yield of 50.67 bushels per acre canola (Figure 13).

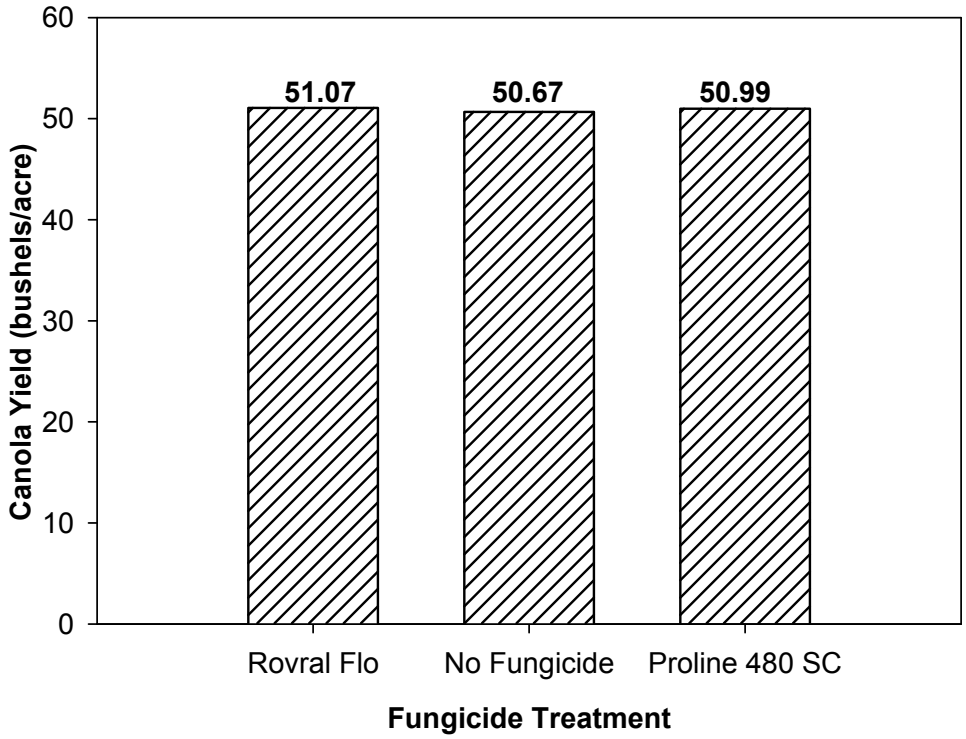


Figure 13: Effects of foliar fungicide application on yield of canola

It can be concluded that the fungicide treatment had no effect on the yield of the Invigor L120 canola. However, caution is required in the interpretation of the data. First of all, sclerotina does not occur in every canola field. Hence, if there was no infection to begin with, the fungicides would have no effect. Moreover, within the same field, the severity of infection varies from spot to spot. Secondly, there were no replications for the Rovral Flo and Control treatments to enable

full statistical analysis. Statistical power increases with increased replication. If there were enough replication and actual infection, there could have been statistically significant effects. Finally, the rotation followed by the Simpson's Family Farm might have influenced the disease. Proper rotation is known to reduce the fungus inoculums Flax, Peas, wheat and canola were grown in 2012, 2011, 2010 and 2009 respectively (4 year rotation).

MARA encourages producers to continue to initiate field experiments like the one carried out by the Simpson's Family Farm. In the design of such experiments, MARA is always ready to provide free support.

3.0 Water Quality Research in the AOF Program

MARA continued to pursue three significant water quality research projects in 2013 under the environmental program funded by the Agriculture Opportunity Fund (AOF). Twelve snowpacks were collected, eight wells were sampled in January and five dugouts were sampled three times in Spring, Summer and Fall for metals, general water quality parameters and pesticide residues.

3.1 Snow packs

Snow pack data from agricultural areas of Mackenzie County were very similar for the 2012 year samples (Table 11) with a similar range of pH values from a low of 5.41 to 7.00. Samples with electrical conductivities below 12 microSiemens were generally lacking in any substantial cations, and were below pH 5.9. However, samples with higher conductivities also had much greater cation (positively-charged ion) concentrations, particularly calcium, sodium and potassium or small amounts of manganese. These ions contribute to hardness and provoke a more alkaline pH. For example, samples with pH >6 averaged conductivities of 21.3, but those with pH <6 averaged 7.3. These mineral constituents probably appear in snow packs from wind-eroded soils, atmospheric contamination by combustion processes (e.g. wood-burning stoves or slash burning in our region) or the use of salts for roadway de-icing that are projected in the air by vehicular traffic. Nonetheless, in general these snowpacks were less modified with mineral components that most North American snowpacks, particularly snow packs near urban centres that accumulate airborne pollutants.

Table 11: Chemical analysis of 12 snow packs in the Mackenzie County (2013)

Description	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	Mean Value
pH	5.97	5.41	6.64	5.86	5.44	6.95	7	6.08	5.86	6.82	6.6	5.71	na
Temperature @ pH	17.5	17.3	17.2	17	17	16.9	16.9	16.8	16.8	17.2	17.1	17	
Electrical Conductivity	12	8	13	6	6	28	26	11	7	35	15	5	14.3
Calcium	<0.2	<0.2	1.9	0.4	<0.2	4.5	4.2	0.6	0.5	3	1.6	<0.2	1.17
Magnesium	<0.2	<0.2	0.2	<0.2	<0.2	0.2	0.2	<0.2	<0.2	0.3	<0.2	<0.2	0.1
Sodium	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	0.7	<0.4	2.4	0.7	<0.4	0.31
Potassium	<0.4	<0.4	<0.4	<0.4	<0.4	0.7	0.4	<0.4	<0.4	0.4	<0.4	<0.4	0.133
Iron	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Manganese	<0.005	<0.005	0.023	<0.005	<0.005	0.034	0.033	0.007	0.006	0.011	0.018	<0.005	0.132
Chloride	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	1.1	0.7	3.5	1.1	<0.4	0.51
Nitrate - N	0.14	0.19	0.18	0.19	0.16	0.22	0.16	0.22	0.19	0.29	0.18	0.13	0.19
Nitrite - N	<0.005	<0.005	<0.005	<0.005	<0.005	0.011	0.008	<0.005	0.006	0.008	<0.005	<0.005	0.0028
Nitrate and Nitrite - N	0.14	0.19	0.18	0.19	0.16	0.23	0.17	0.22	0.19	0.3	0.18	0.13	0.218
Sulfate (SO4)	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9	<0.9
Hydroxide	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<05
Carbonate	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6
Bicarbonate	<6	<6	9	<6	<6	18	16	<6	<6	12	7	<6	5.2
P-Alkalinity CaCo3	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
T-Alkalinity CaCO3	<5	<5	7	<5	<5	15	14	<5	<5	9	6	<5	4.25
TSD	<1	<1	6	<1	<1	14	13	2	1	15	7	<1	4.33
CaCO3 Hardness	<1	<1	5.5	1	<1	12	12	1	1	9	4	<1	3.71
Ionic Balance	<1	<1	70	160	<1	85	85	130	80	93	70	<1	

S1= Sample 1, TSD= Total dissolved solids

3.2 Wells and Domestic Water Supplies

Eight wells and domestic water supplies were sampled in 2013 (Table 12). The important differences between these eight sources were reflected by a very large variance in a number of parameters. pH varied from 7.6 to 8.6, a range typical for groundwater. However, certain other parameters including conductivity, calcium, magnesium, sodium, chloride, sulfate, hardness and total dissolved solids varied by an order of magnitude among these samples. A few parameters, notably sulfate, sodium and magnesium exceeded recommended standards for drinking water. Wells 3 and 8 were notable for their high total dissolved solids and sulfate concentrations, although none of the parameters tested were at toxic levels.

The great variance in these results (Table 12) undoubtedly mirrors a great diversity in soils of the lands that filter the waters into the aquifers feeding these wells. These data suggest that groundwater should be screened carefully before use in domestic households or livestock watering in this region. High sodium and sulfate levels in particular may pose significant health hazards to sensitive individuals or livestock. Data for those wells exceeding standards were shared and discussed with owners and appropriate actions taken.

Table 12: Chemical analysis of 8 domestic wells (W) in the Mackenzie County (2013)

Description	W1	W2	W3	W4	W5	W6	W7	W8	Mean Value
pH	7.79	7.74	8.09	8.59	7.88	7.68	7.61	7.87	7.91
Temperature @ pH	16.9	16.8	17.7	18.5	18.5	18.1	17.7	17.5	
Electrical Conductivity	312	1730	725	1740	518	272	2960	353	1076
Calcium	40.9	243	22.8	16.4	46.4	36.6	392	47.5	105.7
Magnesium	8.3	74.4	6	7.3	9.4	7.5	131	9.2	31.6
Sodium	9.9	48.1	142	346	51.8	6.2	241	3.4	106.5
Potassium	1	4.4	2.3	3	1.3	0.6	13	13.3	4.6
Iron	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	<0.01	0.01
Manganese	<0.005	0.201	<0.005	<0.005	<0.005	<0.005	0.214	0.077	0.061
Chloride	16.8	85.6	15.1	212	10.5	14.1	132	3.1	61.2
Nitrate - N	0.02	3.04	0.08	<0.01	0.12	0.07	<0.05	0.02	0.42
Nitrite - N	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	0.02	0.009	0.0003
Nitrate and Nitrite - N	0.02	3.04	0.08	<0.01	0.12	0.07	<0.07	0.03	0.423
Sulfate (SO4)	24	412	28	176	124	22	1200	41.9	253.5
Hydroxide	<5	<5	<5	<5	<5	<5	<5	<5	<5
Carbonate	<6	<6	<6	17	<6	<6	<6	<6	2.8
Bicarbonate	133	588	430	452	150	113	674	163	338
P-Alkalinity CaCo3	<5	<5	<5	14	<5	<5	<5	<5	2.8
T-Alkalinity CaCO3	109	482	353	399	123	93	552	134	281
TSD	170	1160	428	1000	317	140	2440	199	732
CaCO3 Hardness	136	913	82	71	155	120	1520	157	394
Ionic Balance	100	98	98	94	100	101	104	99	

3.3 Seasonal Variation in Mackenzie County Dugouts

Similar to the findings for wells, the five Mackenzie County dugouts tested also had extreme variability in the concentrations of dissolved substances, even greater than was recorded for the eight wells (Tables 13-17). These data also showed the great influence of local soils on water qualities, but were even more variable. This was not surprising given the fact that well waters are generally anoxic (total oxygen depletion) with reducing chemistries, whereas dugouts are generally oxygenated. The solubilities of a number of metals (e.g. iron, manganese) have their drastically depending on the absence or presence of free oxygen (termed the 'reduction:oxidation potential' or REDOX value). Surface waters often have different ionic balances compared to groundwater even when exposed to the same soil sources of loadings.

The five dugouts showed roughly a thirty-fold variance in their conductivity and total dissolved solids readings. The more highly variable parameters included sodium, chloride, magnesium and sulfates that varied by a hundred to a thousand-fold. Concentrations of virtually all substances in these dugouts were much more diluted in the late Spring samples of early June compared to August and October samples. Most parameters doubled in their concentrations over the course of the whole growing season, probably reflecting mostly evapotranspiration from the dugouts. However, not all parameters increased in 'lock-step', especially the major nutrients of N, P, and K which were likely incorporated into living plant biomass and removed from these waters as the growing season progressed. Others, such as calcium, may have precipitated into the sediments since all dugouts were mildly to strongly alkaline. High alkalinity favors the precipitation of metallic carbonates and bicarbonates. Several parameters (chlorides, sodium, magnesium, sulfates) in one or more the dugouts approached or exceeded human use standards for drinking water and could affect livestock negatively.

Table 13: Seasonal trends in Dugout ***A*** water quality

Parameter	**Units**	**Spring**	**Summer**	**Fall**	**Mean value**	**% change over year**
pH	s.u	8.39	8.22	8.4	8.33	na
Conductivity	usm/cm	3700	6330	7470	+3720	+101
Total Alkalinity	mg/l	354	784	888	+534	+151
Total Dissolved Solids	mg/l	2500	4320	5150	+2650	+106
Bicarbonates	mg/l	416	916	1030	+614	+148
Sodium (Na)	mg/l	481	1020	1110	+629	+131
Magnesium (Mg)	mg/l	218	330	389	+171	+78
Potassium (K)	mg/l	43.9	75.9	84.8	+40.9	+93
Calcium (Ca)	mg/l	63.3	97	101	+37.4	+59
Chloride (Cl^-)	mg/l	612	1080	1380	+768	+125
Sulfate (SO_4)	mg/l	871	1240	1560	+689	+79
Total Nitrogen ($NO_2 + NO_3$)	mg/l	0.07	<0.10	1.1	+1.04	+1471
Total Phosphorus	mg/l	0.05	0.05	<0.05	~0.2	

EJ

Table 14: Seasonal trends in Dugout ***B*** water quality

Parameter	**Units**	**Spring**	**Summer**	**Fall**	**Mean value**	**% change over year**
pH	s.u	7.93	7.84	8.09	8.01	na
Conductivity	usm/cm	137	197	220	185	+61
Total Alkalinity	mg/l	61	88	116	88.3	+90
Total Dissolved Solids	mg/l	77	102	128	102.3	+66
Bicarbonates	mg/l	75	108	142	108.3	+89
Sodium (Na)	mg/l	0.5	1.1	0.9	0.83	+80
Magnesium (Mg)	mg/l	2.7	3.5	4	3.4	+48
Potassium (K)	mg/l	13.6	14.6	16.5	14.9	+21
Calcium (Ca)	mg/l	15.1	22.4	29.6	22.4	+96
Chloride (Cl^-)	mg/l	3	3.3	3.4	3.2	+9
Sulfate (SO_4)	mg/l	5.8	4.1	3.4	4.4	+41
Total Nitrogen ($NO_2 + NO_3$)	mg/l	0.01	0.01	0.01	0.01	none
Total Phosphorus	mg/l	0.23	0.06	<0.05	~0.10	

Rt

Table 15: Seasonal trends in Dugout C water quality

Parameter	Units	Spring	Summer	Fall	Mean value	% change over year
pH	s.u	7.8	8.65	8.22	8.22	na
Conductivity	usm/cm	899	1310	1400	1203.00	+56
Total Alkalinity	mg/l	52	104	203	119.67	+290
Total Dissolved Solids	mg/l	613	925	944	827.33	+54
Bicarbonates	mg/l	64	107	247	139.33	+286
Sodium (Na)	mg/l	15.3	37.3	38.6	30.40	+152
Magnesium (Mg)	mg/l	54.1	90.2	91.1	78.47	+68
Potassium (K)	mg/l	6.8	15.1	15.8	12.57	+132
Calcium (Ca)	mg/l	88.1	99.2	124	103.77	+41
Chloride (Cl^-)	mg/l	22.4	68.8	68.5	53.23	+206
Sulfate (SO_4)	mg/l	395	552	485	477.33	+23
Total Nitrogen ($NO_2 + NO_3$)	mg/l	<0.01	0.02	0.31	~0.11	~3000
Total Phosphorus	mg/l	0.13	0.19	0.09	0.14	-31

Bb

Table 16: Seasonal trends in Dugout ***D*** water quality

Parameter	**Units**	**Spring**	**Summer**	**Fall**	**Mean value**	**% change over year**
pH	s.u	8.28	8.3	8.2	8.26	na
Conductivity	usm/cm	196	307	314	272.33	60
Total Alkalinity	mg/l	70	122	140	110.67	100
Total Dissolved Solids	mg/l	110	173	180	154.33	64
Bicarbonates	mg/l	86	149	171	135.33	99
Sodium (Na)	mg/l	1.4	1.8	2.2	1.80	57
Magnesium (Mg)	mg/l	6.4	8.5	9.8	8.23	53
Potassium (K)	mg/l	14.1	17.2	18.9	16.73	34
Calcium (Ca)	mg/l	19.6	36.5	37.2	31.10	90
Chloride (Cl^-)	mg/l	3.1	4.3	4.5	3.97	45
Sulfate (SO_4)	mg/l	24	31.4	29	28.13	21
Total Nitrogen ($NO_2 + NO_3$)	mg/l	<0.01	<0.01	<0.01	<0.01	nc
Total Phosphorus	mg/l	<0.05	<0.05	<0.05	<0.05	nc

Js

Table 17: Seasonal trends in Dugout ***E*** water quality

Parameter	**Units**	**Spring**	**Summer**	**Fall**	**Mean value**	**% change over year**
pH	s.u	8.25	8.21	8.2	8.22	na
Conductivity	usm/cm	264	459	469	397.33	78
Total Alkalinity	mg/l	66	104	113	94.33	71
Total Dissolved Solids	mg/l	140	240	250	210.00	79
Bicarbonates	mg/l	81	127	138	115.33	70
Sodium (Na)	mg/l	18.6	40.7	39.3	32.87	111
Magnesium (Mg)	mg/l	7.4	14.5	14.2	12.03	92
Potassium (K)	mg/l	6.9	14.3	14.2	11.80	106
Calcium (Ca)	mg/l	17.1	21.9	25.5	21.50	49
Chloride (Cl^-)	mg/l	29.8	60.2	57.6	49.20	93
Sulfate (SO_4)	mg/l	18	29	27	24.67	50
Total Nitrogen ($NO_2 + NO_3$)	mg/l	0.01	0.01	0.02	0.01	
Total Phosphorus	mg/l	<0.05	0.05	<0.05	0.05	

Tb

The dynamics of nitrogen and phosphorus in the dugouts were of particular interest because these nutrient-limiting substances are commonly associated with late summer blue-green algal blooms (cyanobacteria) that often liberate potent bio toxins and can poison humans or livestock. A number of cyanobacteria species also fix nitrogen, but are almost always phosphorus-limited. In these tests, Dugouts ***A*** and ***C*** had conspicuous spikes of total nitrite + nitrate nitrogen in the fall suggesting rapid blue-green growth that might lead to toxin formation and release. Such pulses of readily available nitrogen often appear in waters with dense cyanobacteria populations, especially in late summer blooms.

No pesticides were detected in any samples from these five dugouts.

These observations and data suggest that a program to screen all Mackenzie County farm dugouts for available spring phosphorus, conductivity and a few key nutrients would be of great value to prevent inadvertent human and livestock exposures to either ionic concentrations that could be harmful (e.g. sodium, sulfates, etc.) or the potent bio toxins of cyanobacteria that thrive in chemically-enriched waters, especially when enriched by phosphorus. Farming operators should be especially vigilant to control and reduce the release of fertilizer phosphorus to their dugouts.

Honourable Verlyn Olson, Alberta's Minister of Agriculture and Rural Development and Bill Neufeld, Mackenzie County Reeve on MARA's Hege Plot Combine

The Old Bay House, Fort Vermilion-where Alberta started

Northern lights, Aurora borealis make the skies in Mackenzie County a beauty to watch.

Cover Photos: Jacob Marfo Photography