# MACKENZIE APPLIED RESEARCH ASSOCIATION [MARA]

## 2016 RESEARCH REPORT

**CONTACT**

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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, dissemination of 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 help producers increase production at reduced cost in environmentally sustainable manner.

## 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 and increase return on investment. 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 before the data can be used. 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

## Board of Directors - 2016

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## Board of Director's Chair Message

The MARA board once again welcomes the opportunity to share the success of our efforts over the past year. With the diversity of agriculture enterprises in the region we have tried to develop a program that will continue to benefit as many producers as possible.
The continuation of the RVT's, the fertility trials, the ongoing field scale fungicide testing, are a portion of our work that hopefully is a benefit to the traditional grain sector.
We continue to support the growing organic industry with the ongoing variety testing, the oat breeding, and cover crop trials. We have also started the agronomic hemp trials with support from REDI.
The livestock portion of the program is being addressed with grazing trials and work in forage production.
The extension side of our program continues to expand with crop -pasture walks and workshops covering numerous topics hosting knowledgeable speakers. We also continue to facilitate Environment Farm Plans within the County.

After the disappointing crop of 2015 the Mackenzie County returned to more normal rainfall and crop yields in the 2016 year. With ever-changing climatic conditions and the long-term vulnerability to rainfall shortage in the region, MARA is looking at ways to potentially address this. With heat units in the last five years being equal to or exceeding many areas in the southern prairies and with many potential local water supplies, MARA is moving forward with some small plot research trials to determine the agronomic and or economic benefits of irrigation here.
Any organization is only as good as its staff and we would like to thank all of them once again, for an exceptional job.

As an organization that continues to grow, we are proud to announce two significant projects that are moving forward.

- We have purchased a new small plot combine harvester that will be delivered for the 2017 crop year. This was made possible with significant contributions from Farm Credit Canada, the Fort Vermilion Ag Society, and the High Level Seed Cleaning Co-op.

- We are also in the process of moving the existing courthouse in Fort Vermilion to the research farm to serve as an office and meeting room for MARA. This was also made possible with significant contributions from the Mackenzie County.

With the support of many producers and local Ag businesses, our Innovative Farmers project was once again a success raising over 80,000 dollars. On behalf of the entire board, MARA extends its gratitude to the Mackenzie County, Alberta Government and the Agriculture Opportunity Fund management team, the Provincial Commodity Commissions, and all other groups and individuals that contributed to the operation and growth of MARA.

We would also like to acknowledge Fred Young (former Manager of the AOF) fund at this time. His support and belief in our organization the past years allowed us to survive and grow to what we are today. Thanks Fred. We take this opportunity to welcome Doug Macaulay, the new Manager for the AOF program.

MARA survives and grows only with the voluntary contributions from many individuals, groups, Ag business's, and different levels of government. To recognize this MARA has started an annual award to show our appreciation.

Thank you,

**Greg Newman**

**(Chair, MARA Board of Directors)**

On behalf of the MARA Board

## Manager's Report

The success enjoyed by MARA in 2016 was the result of the hard work and dedication put in by MARA Board of Directors, staff and volunteers, and the commitment from our Mackenzie County, Alberta government, Producer commodity groups, local producers, and local agriculture businesses. I am lucky to have a strong and knowledgeable board who work with us staff to make our research program relevant to the needs of local producers.

In 2016, MARA hosted several extension events including the Agriculture Fair, which attracted people and businesses all over the province. We had a busy growing season with the addition of an hundred corn plots, over two hundred new plots of silage and perennial forage trials, and we increased our nutrient management trial six fold. Experimenting with irrigation was also a new challenge that we embraced and expect will pay off with some important results for producers in the county. We also extended MARA's reach across the county this year by collaborating with producers on projects located from High Level to Tompkins Landing. This valuable research would not have been possible to conduct without the hard work of our summer staff Laura Simpson and William Hall, our senior technician Neil Simpson, and our assistant research coordinator Sabrina Westra. I am extremely grateful to the local producers who helped seed and harvest the wheat crop on the experimental farm grounds this year, the proceeds of which go towards keeping MARA viable. As always I am very much appreciative of the support from Mackenzie County and Provincial Government, as well as Alberta Canola Producers Commission, Alberta Barley, Alberta Wheat Commission and Alberta Pulse Growers.

Finally, thank you to all of our members and those who participate in our events. It is satisfying to see the turnout to our events increase over the years, and it makes all the work we do worthwhile. *And if you are still reading this, thank you for supporting MARA and agriculture development in Mackenzie County*.

**Jacob Marfo (PhD, PAg)**
**(Manager and Research Coordinator)**

**Sabrina Westra**

**Neil Simpson**

**Laura Simpson**

**William Hall**

## ARECA 2016 Report

*Ian Murray, Chair*

2016 was a good year for ARECA. We worked with our 9 members associations to deliver programs across the province.

RVTs: 5 of our member associations delivered pea, wheat, barley, oats and flax Regional Variety Trials on 22 sites across the province. Yield data is collected and distributed in the Alberta Seed Guide.

Pest Monitoring: As in the past, 6 of our associations worked with AAF to monitor insect infestations across the province. We monitored 8 insect pests in 260 field visits over the summer and submitted the data for inclusion in the Alberta Insect Pest Monitoring Network releases.

We launched a new website in 2016. It is cleaner, leaner, and is full of information about programs delivered by our member associations (www.areca.ab.ca).

Connections Newsletter: We created and distributed 9 newsletters with the intent of increasing the connection between our member association Boards. Each edition featured one member association. The newsletter is distributed internally to all association Board members.

*Janette McDonald, Executive Director*

Environmental Farm Plan: In 2016, we introduced the Web 3.0 edition of the EFP. As well, ARECA was instrumental in leading a movement to a national EFP. We hope to move this plan further in 2017. Late in 2016, we started preparing the Alberta EFP 5-year Business Plan for 2018-2023.

Sustainable Sourcing: ARECA was awarded Green Intern funding in 2016 and our intern has completed an excellent summary of potential global sustainability requirements and how those requirements will impact Alberta farmers.

Governance: In 2016, the ARECA Board spent time developing sound processes around how projects are approved and managed within ARECA and between ARECA and our members. Our new processes have resulted in successful programs and co-operation between our members.

Sainfoin Pasture: All associations are collaborating with ARECA and Alberta Agriculture and Forestry (AAF) on a province-wide sainfoin pasture project. We established 10 sites and will be measuring plant health and grazing yield in 2017.

Blackleg Surveillance: ARECA and 7 associations co-operated with AAF to collect and submit samples from 171 canola fields across the province. This project is a significant benefit to canola producers and we have the opportunity to expand it in 2017 and beyond.

Project Management Training: All ARECA associations and their staff manage projects. Project Management is a valued skill. Late in 2016, ARECA paid for training of 10 staff from 7 associations. This was an excellent course. If we work at what we learned, our projects will get better and better. Some staff comments:

> "We will be more organized and take less time to complete events or projects….Great course!"
>
> "Projects will be better understood and support more buy –in."
> "This was one of the best training workshops I have ever been to. "

***Strategic Planning Conference: In November, ARECA hosted 35 association Board members at a conference in Lacombe. It was an excellent session and will lead to greater collaboration between our associations, government and industry in 2017.***

**Thank you**

Mackenzie County

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PRODUCERS

ARECA

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COMMISSION

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Futures

Alberta
Government

ALBERTA PULSE
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organic
ALBERTA

MONSANTO
BioAg

Cargill

Growing Forward 2
A federal-provincial-territorial initiative

REGIONAL ECONOMIC
DEVELOPMENT INITIATIVE
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# Regional Variety Trials (RVTs)-2016

## Summary

The Regional Variety Trials (RVTs) are conducted throughout Alberta and in northern parts of British Columbia. The program is coordinated by the Alberta Regional Advisory Committee (ARVAC) and Alberta Agriculture and Forestry. Data from the different geographical sites are compiled by ARVAC for publication, including in the Alberta Seed Guide (**www.seed.ab.ca**). At the local level, the objectives of the trials 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

## Materials and Methods

The soil at the Fort Vermilion trial location was sandy loam (Table 1). Based on a target plant density (Table 2), thousand seed weight (TSW) and germination rate were used to determine seeding rate for each cultivar. A 6 row 8-inch spaced Fabro plot seeder was used for all the seeding. The seeder is modified to have separate control mechanism for seed and fertilizer. Each plot was 20 feet (6.1 m) in length. Fertilizer was banded 1-2 inches from the seed row. The trials followed a randomised block design. All cereal plots were replicated three times while flax and peas were replicated 4 times.

With the exception of field peas, Pardner, a group 6 herbicide was used for pre-seeding weed control. No in-crop herbicide application was done in any of the plots except the field pea plots which were sprayed with Poast Ultra + Merge. The few weeds in the cereal and flax plots were hand-picked. Headline fungicide was sprayed on all the crops (at different times). Following harvest. the seeds were cleaned and moisture content was measured using Labtronics 919 moisture tester. Yield data is adjusted for moisture. FOSS Infratec Sofia was used to measure the protein content in wheat.

## Statistical analyses

Data were analysed statistically using the analysis of variance (ANOVA). If a specific variable was statistically different, the means were compared using the Least Significant Difference (LSD)

approach to determine which means are different. Cultivars are different in performance only if the numerical difference between them is greater than the LSD. For example, if Plant A has yield of 80 bushels per acre and B has 69 bu/ac and the LSD is 30, there is no statistical difference between Plant A & B because the difference between the two is less than the LSD. The co-efficient of variation (CV), represents the ratio of standard deviation to mean (it measures the level of variability of the results). A lower CV indicates greater reliability of results. For example, a data with CV of 2.5 % is more reliable than data with CV of 15.9 %.

**Table 1: 2016 RVT site soil information**

| | Sampling depth (inches) | |
|---|---|---|
| | 0 - 6 | 6-12 |
| Organic matter (%) | 2.8 | 1.5 |
| Cation exchange capacity (meg/100g) | 8.5 | 8.5 |
| pH | 5.9 | 6.5 |
| Nitrate (lbs/ac) | 38 | 28 |
| Phosphorus (Bray P1)- (lbs/ac) | 60 | 30 |
| Phosphorus Sodium bicarbonate- (lbs/ac) | 30 | 22 |
| Potassium-(lbs/ac) | 142 | 114 |
| Calcium (lbs/ac) | 2360 | 2100 |
| Magnesium (lbs/ac) | 290 | 450 |
| Sulphur (lbs/ac) | 10 | 8 |
| Sodium (lbs/ac) | 22 | 28 |
| Zinc (lbs/ac) | 6.6 | 4.2 |
| Manganese (lbs/ac) | 90 | 58 |
| Iron (lbs/ac) | 162 | 136 |
| Copper (lbs/ac) | 1 | 0.8 |
| Boron (lbs/ac) | 1.4 | 1.4 |
| Aluminium (lbs/ac) | 708 | 856 |
| Estimated Nitrogen Release (lbs/ac) | 80 | 54 |
| Soil type: Sandy loam | | |

Table 2: Regional Variety Trial-2016 Materials and methods

| Crop | Previous Crop | Seeding date | Plant density (plants/m2) | Harvest date | Fertilizer (N-P-K, lbs/ac |
|---|---|---|---|---|---|
| Barley | Yellow peas | May 13 | 280 | August 18 | 80-32-10 |
| CWRS Wheat | Yellow peas | May 13 | 280 | August 18 | 80-32-10 |
| CPSR | Yellow peas | May 13 | 280 | August 22 | 80-32-10 |
| CWPS & SWS | Yellow peas | May 13 | 280 | August 23 | 80-32-10 |
| Flax | Yellow peas | May 17 | 900 | August 30 | 80-30-40 |
| Green Peas | fallow | May 13 | 88 | August 24 | 9-40-20 |
| Yellow peas | fallow | May 13 | 88 | August 24 | 9-40-20 |
| Oats | Yellow peas | May 13 | 250 | August 23 | 80-32-10 |
| Triticale | Yellow peas | May 13 | 310 | August 29 | 80-32-10 |
| | | | | | |
| Sources of fertilizer: N= 0-46-0 & 11-52-0 (peas received only 11-52-0), P = 11-52-0, K =0-0-60 | | | | | |
| Desiccant (Reglone) application on: field peas, flax and triticale | | | | | |
| 5.4 lbs/ac granular CellTech inoculant was applied to the pea seeds | | | | | |
| | | | | | |
| Wheat classes: Canada Western Soft White Spring (CWSWS)<br>Canada Western Red Spring (CWRS)<br>Canada Western Hard White Spring (CWHWS)<br>Canada Prairie Spring Red (CPSR)<br>Canada Western Special Purpose (CWSP) | | | | | |

## Results

### Trial Summary: Canada Western Red Spring (CWRS) and Canada Western Hard White Spring (CWHWS) wheat

Nineteen cultivars were tested. The check, AC Barrie yielded 69.38 bu/ac. AAC Cameron and AAC Viewfield yielded the highest (~84 bu/ac). Carberry, AC Barrie, CDC Hughes (formerly called PT588) and AAC Redberry yielded the least (~69 bu/ac). SY637 had the highest protein content (16 %). AAC Prevail recorded the least protein content of 13.24 %. CWRS and CWHWS at local level yielded higher than the overall Alberta average. Further results are provided Table 3.

Table 3: Canada Western Red Spring and Canada Western Hard White Spring wheat performance data. Data in last column is 2016 Alberta wide RVT yield

| Cultivar | Height (cm) | Days to maturity | Yield (bu/ac) | Protein (%) | TSW (g) | Test weight (lb/bu) | Yield (bu/ac) AB |
|---|---|---|---|---|---|---|---|
| **AC BARRIE** | **85.00** | **84** | **69.38** | **14.70** | **38.47** | **61.72** | 60 |
| AAC Cameron | 91.67 | 85 | 84.50 | 14.17 | 42.27 | 62.52 | 69 |
| AAC Concord | 90.67 | 84 | 73.69 | 13.48 | 39.13 | 61.77 | ND |
| AAC Connery | 79.67 | 84 | 70.91 | 15.50 | 39.57 | 59.90 | 63 |
| AAC Prevail | 84.67 | 85 | 74.69 | 13.24 | 38.77 | 62.58 | 63 |
| AAC Redberry | 83.33 | 85 | 68.70 | 14.50 | 40.20 | 62.47 | 64 |
| AAC Viewfield | 82.00 | 86 | 83.90 | 14.57 | 41.17 | 60.52 | 70 |
| BW1011 | 75.00 | 84 | 74.38 | 14.62 | 39.57 | 61.40 | ND |
| BW488 | 77.00 | 84 | 78.83 | 13.82 | 33.00 | 62.95 | ND |
| SY Slate (BW496) | 84.33 | 85 | 71.36 | 14.98 | 39.73 | 61.94 | 63 |
| BW968 | 73.67 | 84 | 79.43 | 13.48 | 38.03 | 63.00 | ND |
| BW971 VB | 76.67 | 85 | 70.04 | 14.44 | 40.17 | 63.62 | ND |
| Carberry | 75.67 | 85 | 69.43 | 14.28 | 43.10 | 61.88 | 67 |
| CDC Bradwell | 82.67 | 84 | 82.23 | 13.99 | 36.50 | 62.68 | 64 |
| GO Early | 86.33 | 84 | 71.81 | 14.35 | 38.73 | 60.92 | 62 |
| PT250 | 81.67 | 85 | 70.79 | 15.61 | 38.97 | 62.47 | |
| CDC Hughes (VB PT588) | 75.67 | 85 | 69.22 | 14.14 | 43.63 | 62.58 | ND |
| SY479 VB | 92.00 | 85 | 73.37 | 14.99 | 38.53 | 61.08 | ND |
| SY637 | 93.67 | 85 | 71.15 | 16.00 | 40.87 | 62.52 | 61 |
| | | | | | | | |
| **Significant (p<0.05)** | **s** | **ns** | **s** | **s** | **s** | **ns** | |
| **LSD** | **9.29** | **1.33** | **8.87** | **0.75** | **3.43** | **2.16** | |
| **CV %** | **6.8** | **0.9** | **7.2** | **3.1** | **5.2** | **2.1** | |
| **S = significant, ns = not significant. Check is AC Barrie. ND = No data** | | | | | | | |

**Trial Summary: Canada Prairie Spring Red wheat (CPSR)**

Eight CPSR cultivars were grown locally at the Fort Vermilion research facility. All the cultivars yielded more than the check (AC Barrie). AAC Crossfield and AAC Crusader yielded the highest. Carberry and AC Barrie had the lowest yield. Protein was highest in AC Barrie and least in AAC Crossfield. All the cultivars yielded higher than the provincial overall average. Further results in Table 4 and Fig. 1.

Table 4: Canada Prairie Spring Red wheat performance data. Yield data in last column is average Alberta yield

| **Cultivar** | **Height (cm)** | **Days to maturity** | **Yield (bu/ac)** | **Protein (%)** | **TSW (g)** | **Test weight (lb/bu)** | **Yield (bu/ac) AB** |
|---|---|---|---|---|---|---|---|
| **AC BARRIE** | **96.33** | **86** | **71.18** | **15.15** | **38.80** | **62.74** | **60** |
| AAC Crossfield | 88.00 | 86 | 95.54 | 11.77 | 40.37 | 62.36 | **71** |
| AAC Crusader | 95.00 | 86 | 93.61 | 12.25 | 39.23 | 61.61 | **69** |
| AAC Tenacious | 97.00 | 87 | 77.97 | 12.56 | 39.93 | 62.31 | **63** |
| Carberry | 87.00 | 86 | 77.05 | 14.62 | 44.20 | 62.79 | **63** |
| Elgin ND | 88.33 | 87 | 84.69 | 13.91 | 39.73 | 62.90 | ND |
| SY Rowyn (HY2013) | 84.67 | 86 | 80.05 | 12.83 | 35.63 | 62.58 | ND |
| CDC Terrain (HY537) | 89.67 | 86 | 89.17 | 11.98 | 39.13 | 61.51 | ND |
| | | | | | | | |
| **Significant (p<0.05)** | **ns** | **ns** | **s** | **s** | **ns** | **s** | |
| **LSD** | **18.73** | | **9.77** | **0.70** | **6.32** | **0.81** | |
| **CV %** | **11.8** | | **6.7** | **3.1** | **9.1** | **0.7** | |
| **S = significant, ns = not significant. Check is AC Barrie. ND = No data** | | | | | | | |

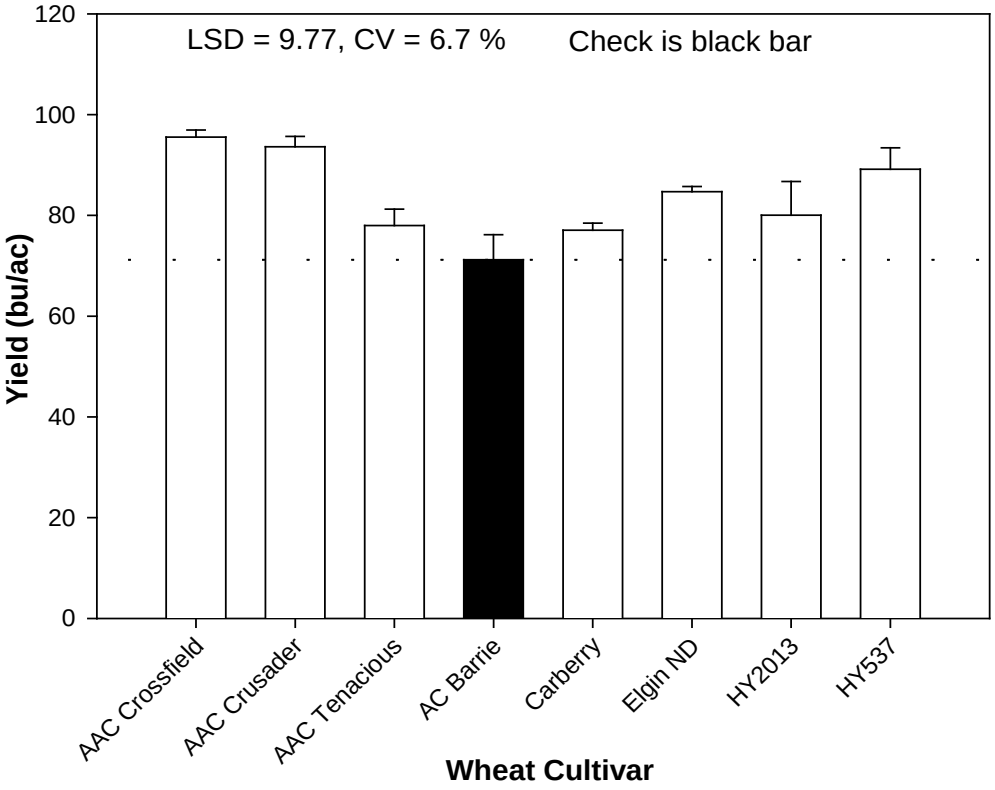



Figure 1: Canada Prairie Spring Red wheat (CPSR) yield-2016. Each bar is the average of 3 replications

**Trial Summary: Canada Western Special Purpose (CWSP) and Canada Western Soft White Spring Wheat (CWSWS)**

The 2016 CWSP and CWSWS had 10 entries. AC Barrie and AC Andrew were the check cultivars. KWS Charing had the highest yield (111.52 bu/ac). Yield was lowest in AC Barrie and Carberry (~73 bu/ac). Further results in Table 5 and Fig. 2.

Table 5: Canada Western Special Purpose and Canada Western Soft White Spring wheat trial data

| Cultivar | Height (cm) | Days to maturity | Yield (bu/ac) | Protein (%) | TSW (g) | Test wt (lb/bu) |
|---|---|---|---|---|---|---|
| **AC BARRIE** | **78.33** | **87** | **73.39** | **14.99** | **39.80** | **62.47** |
| AAC Indus | 86.33 | 87 | 104.22 | 10.52 | 46.23 | 57.55 |
| AAC Innova | 92.67 | 87 | 92.54 | 11.01 | 41.13 | 57.50 |
| AC Andrew | **91.33** | **87** | **89.78** | **11.13** | **40.20** | **60.17** |
| Belvoir | 92.00 | 87 | 104.56 | 10.25 | 41.60 | 55.41 |
| Carberry | 81.33 | 87 | 72.98 | 15.39 | 42.20 | 62.42 |
| AAC Awesome (GP151) | 89.33 | 87 | 105.08 | 10.68 | 46.70 | 58.73 |
| KWS Alderon | 88.00 | 88 | 105.73 | 10.31 | 45.97 | 54.61 |
| KWS Charing | 93.67 | 88 | 111.52 | 10.81 | 43.50 | 56.54 |
| KWS Sparrow | 81.67 | 88 | 100.83 | 10.86 | 43.33 | 57.07 |
| | | | | | | |
| **Significant (p<0.05)** | **s** | | **s** | **s** | **s** | **s** |
| **LSD** | **10.2** | | **11.04** | **1.13** | **4.87** | **1.84** |
| **CV %** | **6.8** | | **6.7** | **5.7** | **6.6** | **1.8** |
| **S = significant, ns = not significant** | | | | | | |
| **Check is AC Barrie and AC Andrew** | | | | | | |

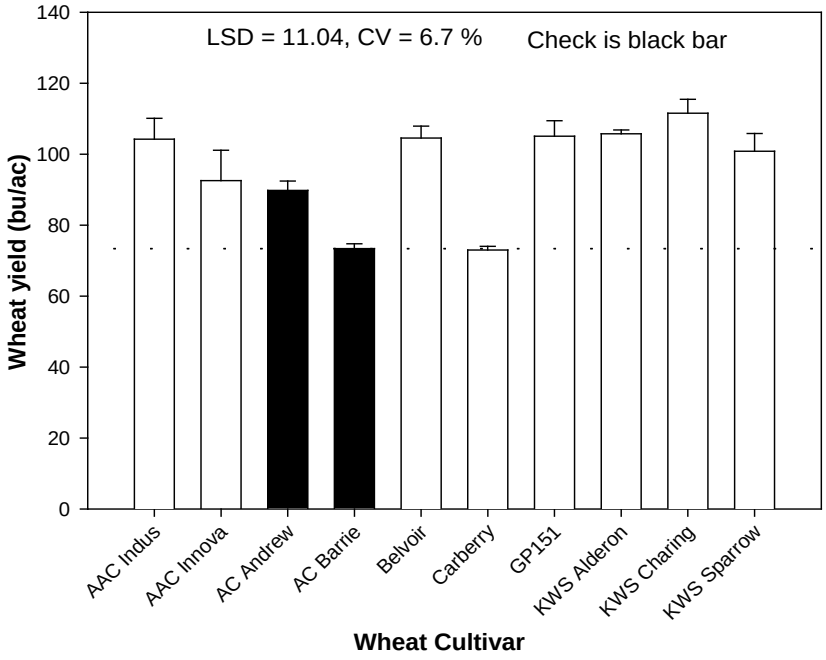



Figure 2: Canada Western Special Purpose and Canada Western Soft White Spring Wheat yield 2016. Each bar is the average of 3replications

**Trial Summary:** Triticale

Only two cultivars were entered into the 2016 RVT program (grain): AAC Delight and Brevis. The results of the trial are summarized in Table 5.

Table 5: Triticale RVT performance data

| Cultivars | **Height (cm)** | **Days to maturity** | **Yield (bu/ac)** | **TSW (g)** | **Test wt (lb/bu)** |
|---|---|---|---|---|---|
| AAC Delight | 101.2 | 86 | 101.0 | 64.2 | 53.1 |
| Brevis | 91.10 | 85 | 97.70 | 53.9 | 57.7 |

**Trial Summary: Barley**

Yield of the 14 feed, food and malt barley cultivars did not differ statistically. When varieties or cultivars have the same yield, it is important to consider other factors such as disease rating, maturity date, among other variables. Claymore was severely affected by Loose smut. The results of the trial are summarized in Table 6.

Table 6: RVT Barley trial data-2016

| Cultivar | Height (cm) | Days to maturity | Yield (bu/ac) | TSW (g) | Test weight (lb/bu) |
|---|---|---|---|---|---|
| **AC METCALFE** | **81.67** | **82** | **115.01** | **49.10** | **53.62** |
| *CDC Bow* | 85.33 | 81 | 121.78 | 51.83 | 52.53 |
| *CDC Platinum Star* | 88.67 | 82 | 120.60 | 47.67 | 51.54 |
| Champion | 74.33 | 82 | 128.35 | 53.90 | 53.43 |
| Claymore | 77.67 | 82 | 113.66 | 50.40 | 51.94 |
| HB13324 | 83.33 | 82 | 101.61 | 45.00 | 60.60 |
| Oreana | 67.67 | 81 | 131.22 | 48.47 | 53.25 |
| *CDC Fraser (TR12135)* | 76.00 | 81 | 105.43 | 55.23 | 51.51 |
| *TR12225* | 74.67 | 81 | 103.93 | 48.10 | 50.95 |
| *TR13606* | 81.33 | 81 | 119.85 | 46.13 | 55.07 |
| *TR13609* | 80.33 | 82 | 115.19 | 56.93 | 52.58 |
| TR13740 | 70.67 | 83 | 113.60 | 49.10 | 52.07 |
| *TR14928* | 66.33 | 81 | 118.99 | 47.07 | 52.07 |
| Vivar | 72.67 | 81 | 110.03 | 46.43 | 47.26 |
| | | | | | |
| **Significant (p<0.05)** | **s** | | ns | **s** | **s** |
| **LSD** | **7.16** | | 19.21 | **7.18** | **3.67** |
| **CV %** | **5.5** | | 9.9 | **8.6** | **4.1** |
| **S = significant, ns = not significant** | | | | | |
| **Check is AC Metcalfe** | | | | | |
| **Malt barley italicised. Name in bracket is previous cultivar name** | | | | | |

**Trial summary: Oats**

MARA tested 8 RVT oats cultivars in 2016. CFA1207 yielded 196 bu/ac with CS Camden recording 161 bu/ac. Statistically however, all the cultivars had similar yield. CFA 1207 had the highest test weight (bushel weight), with no difference in the other cultivars. Further results are summarized in Table 7.

Table 7: RVT Oats trial data-2016

| Cultivar | Height (cm) | Days to maturity | Yield (bu/ac) | TSW (g) | Test wt (lb/bu) |
|---|---|---|---|---|---|
| **CDC DANCER** | **112.67** | **80** | **167.85** | **42.67** | **43.73** |
| Akina | 103.33 | 80 | 188.76 | 45.27 | 42.50 |
| CDC Norseman | 117.00 | 79 | 175.84 | 43.30 | 42.13 |
| CFA1207 | 110.00 | 80 | 195.61 | 44.07 | 42.98 |
| CFA1220 | 119.67 | 82 | 173.98 | 44.87 | 46.06 |
| CS Camden | 106.67 | 82 | 160.85 | 44.90 | 43.68 |
| Kara | 100.00 | 81 | 169.50 | 47.63 | 44.21 |
| OT6011 | 113.67 | 81 | 187.90 | 42.47 | 43.04 |
| | | | | | |
| **Significant (p<0.05)** | **s** | | **ns** | **ns** | **s** |
| **LSD** | **12.28** | | **26.51** | **5.60** | **1.47** |
| **CV %** | **6.4** | | **8.5** | **7.2** | **1.9** |
| **S = significant, ns = not significant** | | | | | |
| **Check is CDC Dancer** | | | | | |

RVT Oats Plots- 2016. Insert is close up of oats

**Trial Summary: Flax**

Of the 11 flax cultivars, CDC Buryu, previously called FP2316, had the highest yield (36 bu/ac). Westlin 72 had the least yield (~27 bu/ac). Prairie Sunshine, Nulin 50 (VT50) and Westlin 72 matured very late. Further results in Table 8 and Fig. 3.

Table 8: RVT Flax trial data-2016

| Cultivar | Height (cm) | Days to maturity | Yield (bu/ac) | TSW (g) | Test wt (lb/bu) |
|---|---|---|---|---|---|
| **CDC BETHUNE** | **63.05** | **81** | **33.71** | **6.10** | **57.42** |
| CDC Neela | 67.83 | 82 | 35.42 | 6.20 | 57.22 |
| CDC Plava | 56.40 | 79 | 29.01 | 5.80 | 56.82 |
| CDC Buryu (FP2316) | 65.38 | 81 | 35.97 | 6.03 | 57.38 |
| Westlin 60 (FP2388) | 59.88 | 79 | 28.90 | 5.35 | 57.02 |
| Westlin 61 (FP2454) | 59.03 | 81 | 31.64 | 5.60 | 57.42 |
| Topaz (FP2457) | 65.70 | 80 | 34.16 | 5.95 | 57.18 |
| Nulin50/VT 50 | 58.90 | 83 | 30.47 | 5.30 | 57.26 |
| Prairie Grande | 61.80 | 79 | 27.54 | 5.63 | 57.46 |
| Prairie Sunshine | 61.10 | 83 | 31.86 | 6.13 | 56.68 |
| Westlin 72 | 60.23 | 83 | 27.28 | 5.80 | 56.17 |
| | | | | | |
| **Significant (p<0.05)** | **s** | **s** | **s** | **s** | **ns** |
| **LSD** | **3.38** | **1.81** | **4.13** | **0.47** | **0.89** |
| **CV %** | **3.8** | **1.5** | **9.1** | **5.6** | **1.1** |
| **S = significant, ns = not significant** | | | | | |
| **Check is CDC Bethune** | | | | | |

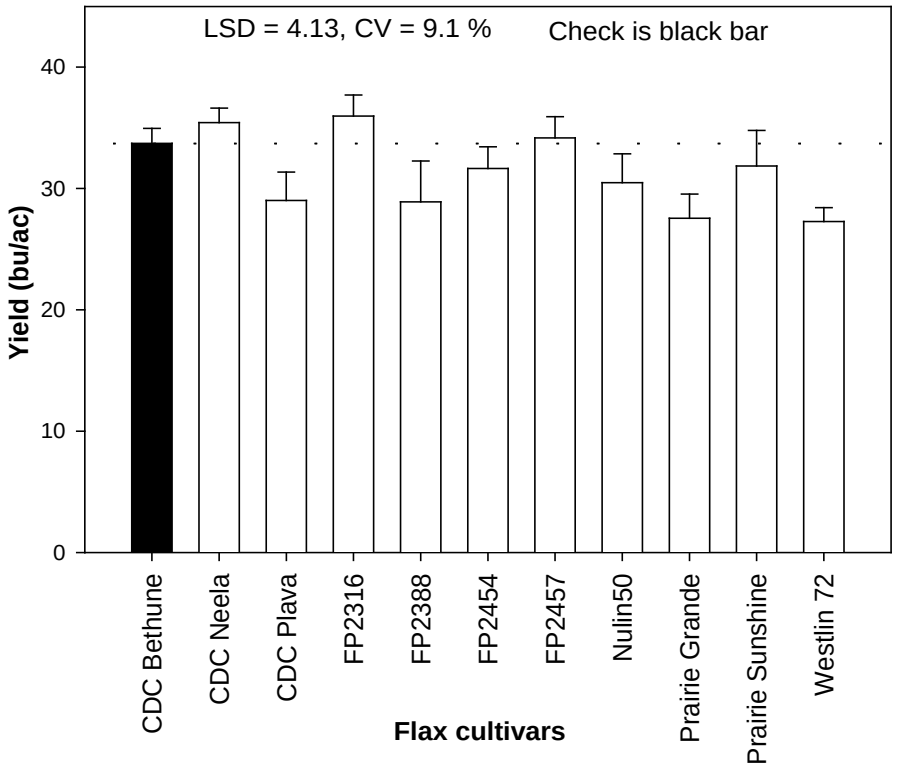


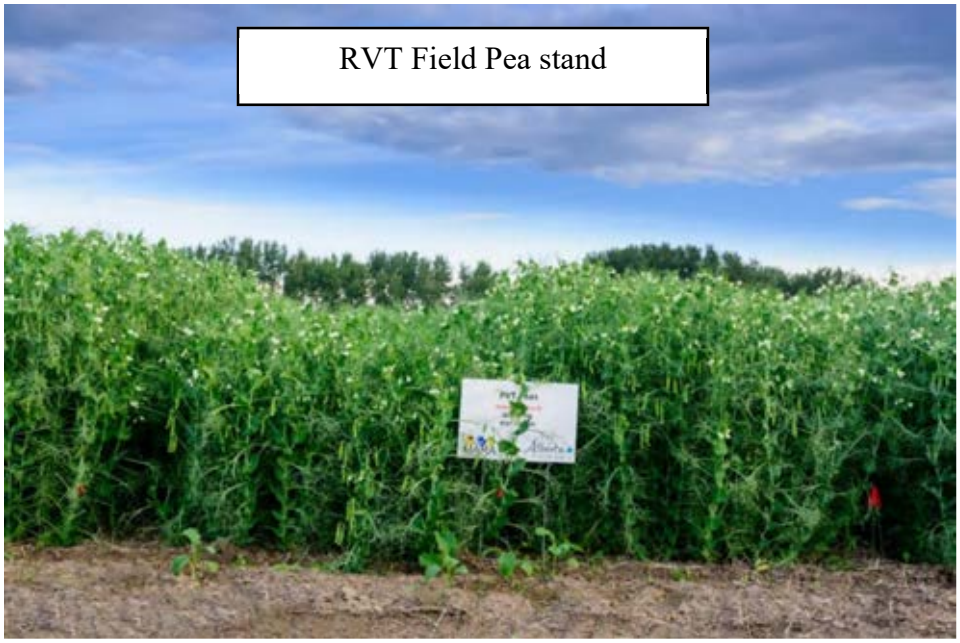

Figure 3: RVT Flax yield-2016. Each bar is the average of 4 replications

**Trial summary: Green Peas**

Yield of the 4 green pea cultivars tested in 2016 did not differ statistically. AAC Royce had the highest thousand seed weight (TSW) with the check, CDC Limerick recoding the least TSW. Further results in Table 9.

Table 9: RVT Green Peas trial data-2016

| Cultivar | Height (cm) | Days to maturity | Lodging | Yield (bu/ac) | TSW (g) |
|---|---|---|---|---|---|
| **CDC LIMERICK** | **102.15** | **92** | **3** | **86.34** | **229.78** |
| AAC Radius | 106.63 | 91 | 4 | 75.58 | 239.65 |
| AAC Royce | 93.58 | 91 | 2 | 80.75 | 259.98 |
| CDC Greenwater | 115.13 | 93 | 4 | 89.71 | 251.35 |
| | | | | | |
| **Significant (p<0.05)** | **s** | | | **ns** | **s** |
| **LSD** | **14.49** | | | **11.45** | **21.22** |
| **CV %** | **8.7** | | | **8.6** | **5.4** |
| **S = significant, ns = not significant** | | | | | |
| **Lodging: 1= upright, 10 = flat on the ground** | | | | | |
| **Check is Limerick** | | | | | |




**Trial summary: Yellow Peas**

Yield of the 6 yellow pea cultivars tested in 2016 were statistically similar. LN4228 had the highest weight per 1000 seeds, with CDC Meadow having the least TSW. Further results in Table 10.

Table 10: RVT Yellow Peas trial data-2016

| Cultivar | Height (cm) | Days to maturity | Lodging | Yield (bu/ac) | TSW (g) |
|---|---|---|---|---|---|
| **CDC MEADOW** | **111.40** | **91** | **3** | **93.77** | **233.65** |
| **AAC Barrhead** | 114.55 | 91 | 2 | 100.54 | 257.73 |
| **AAC Carver** | 116.65 | 91 | 3 | 101.02 | 273.55 |
| **CDC Amarillo** | 119.88 | 92 | 3 | 93.81 | 262.63 |
| **CDC Inca** | 125.40 | 92 | 4 | 99.76 | 256.28 |
| **LN4228** | 111.88 | 92 | 3 | 91.76 | 293.03 |
| | | | | | |
| **Significant (p<0.05)** | **ns** | | | **ns** | **s** |
| **LSD** | 10.56 | | | 12.88 | 13.38 |
| **CV %** | 6.0 | | | 8.8 | 3.4 |
| **S = significant, ns = not significant** | | | | | |
| **Lodging: 1= upright, 10 = flat on the ground** | | | | | |
| **Check is CDC Meadow** | | | | | |

## Effects of drip irrigation on silage and grain corn in Mackenzie County


### Summary

Five Roundup Ready corn varieties were grown at MARA's Fort Vermilion Research Facility from May 19 2016 to October 11 2016**.** The varieties were DKC26-26 RR, E47A17 R, P7213 R, PS Exleafy RR and Yukon R. The crops were grown with and without supplemental irrigation. Grain and silage yield was significantly increased by supplemental irrigation. Irrigation however, led to reduction in silage crude protein and grain protein content. The application of irrigation also led to Pythium stalk rot in some of the varieties.


### Introduction

Corn (*Zea mays* L.) production in Mackenzie County has been expanding in the last few years. The expansion is due to the availability of low corn heat unit varieties and the rapidly increasing heat unit in the County. Another reason for the increase in corn acreage in the County may be the relatively higher tonnage per acre yield, compared to other forage crops. However, the production is limited by precipitation. According to Alberta Agriculture & Forestry (2016, Agdex 111/561-1), corn requires about 500-550 mm (20-22 inches) of water to reach optimum maturity and productivity. Water is the limitation to corn production in Mackenzie County.

A field trial was conducted at MARA's Fort Vermilion Research Facility to test the effect of supplemental irrigation on corn grain and silage performance. The original plan was to apply enough water to make up for the difference between 20 inches and growing season rainfall. However, the irrigation was cut short due to disease incidence.

### Materials and Methods

Five Roundup Ready corn varieties (DKC26-26 RR, E47A17 R, P7213 R, PS Exleafy RR and Yukon R) were grown with and without supplemental irrigation at Fort Vermilion, Alberta. The cultivars were selected because they performed relatively better in a variety trial the previous two years (under no irrigation). Surface drip irrigation was used to apply 4.5 inches of water mainly in

July and August. Details of the materials and methods are summarized in Table 1 and schematic presentation of the irrigation design is presented as Figure 1.

Table 1: Materials and methods-Fort Vermilion corn irrigation trial 2016

| Trial location | Fort Vermilion, AB (58.3875813,-116.066707) |
|---|---|
| Previous crops | Canola (2015), field peas (2014) HRS wheat (2013) |
| Soil data at 0-6 inch | OM = 4.4%, N=16ppm, P=25ppm, K=67ppm, S = 13ppm, pH= 6.1, CEC= 11.6 meg/100g, Sandy loam: 53% sand |
| Pre-seeding treatment | Pardner with Roundup Weathermax |
| Seeding date | May 19 2016 |
| Harvest date & method | October 11 2016, by hand |
| Experimental design | Split-plot design, Irrigation (whole plot) varieties (sub-plot). Plot length 30 ft. |
| Seeding method | Direct seeding with 36-inch spaced John Deere 7000 4-row corn planter (2 inches seeding depth) |
| Target plant population | 24,900 plants per acre |
| Fertilizer applied | 100 N, 30 P, 30 K, 10 S, 2.5 Zn (actual lbs/ac). |
| In crop weed control | Buctril M. The few wild oats in the plots were hand picked |
| Source of irrigation water | Dugout |
| Irrigation method | Surface drip with pressure regulated drip lines |
| Corn Heat Units | DKC26-26 = 2125, E47A17 = 2200, P7213 =2050, PS ExLeafy = 2600 and Yukon = 2150 |

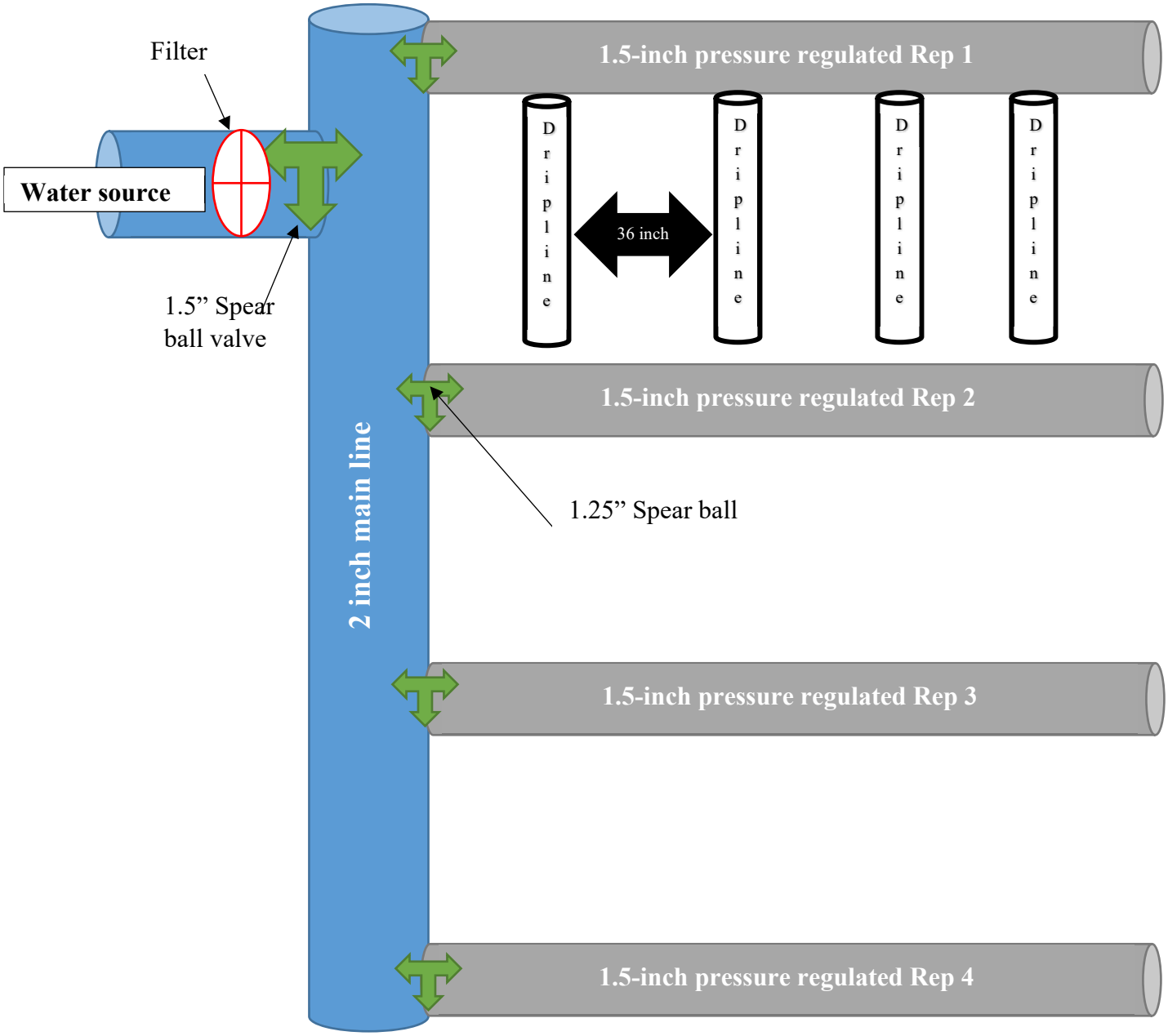



Figure 1: Schematic diagram of MARA’s 2016 corn drip irrigation

**Results**

Precipitation, mainly rainfall, from date of seeding to harvest was 206.8 mm (8.14 inches, Fig. 2).

Corn heat unit (CHU) reached 2482.80 units at time of harvest (Fig. 3).

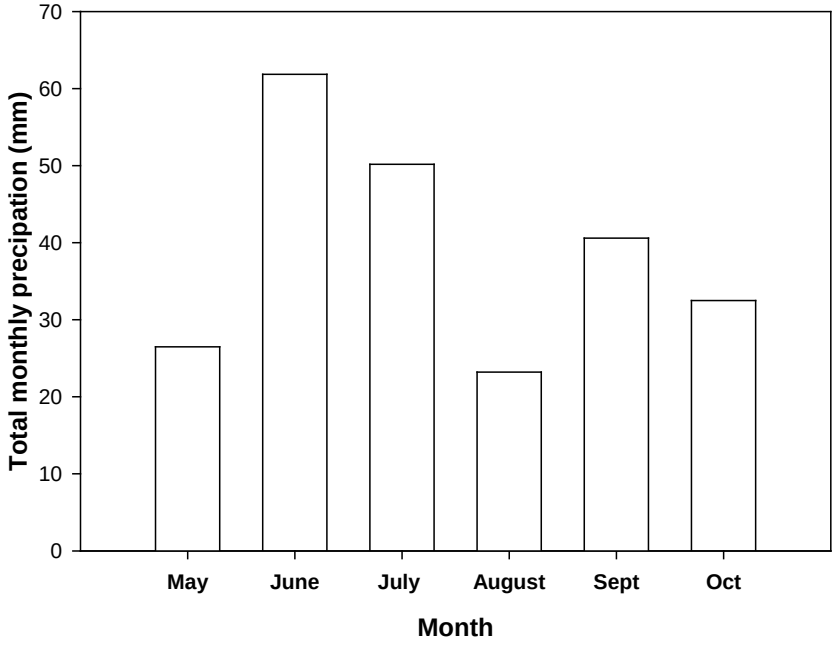



Figure 2: Monthly precipitation data at the MARA's Fort Vermilion Research station

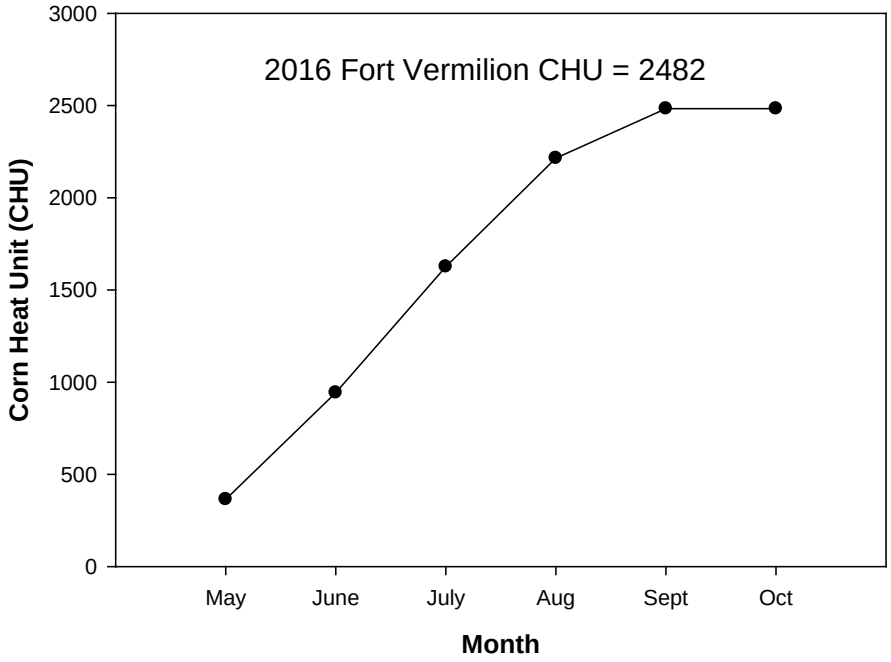



Figure 3: Corn heat unit, Fort Vermilion 2016

The application of 4.5 inches of irrigation increased plant height by 6.8% across varieties (Table 2, Fig. 4). Yukon R was significantly taller than the other varieties while DKC26-25 was the shortest variety.

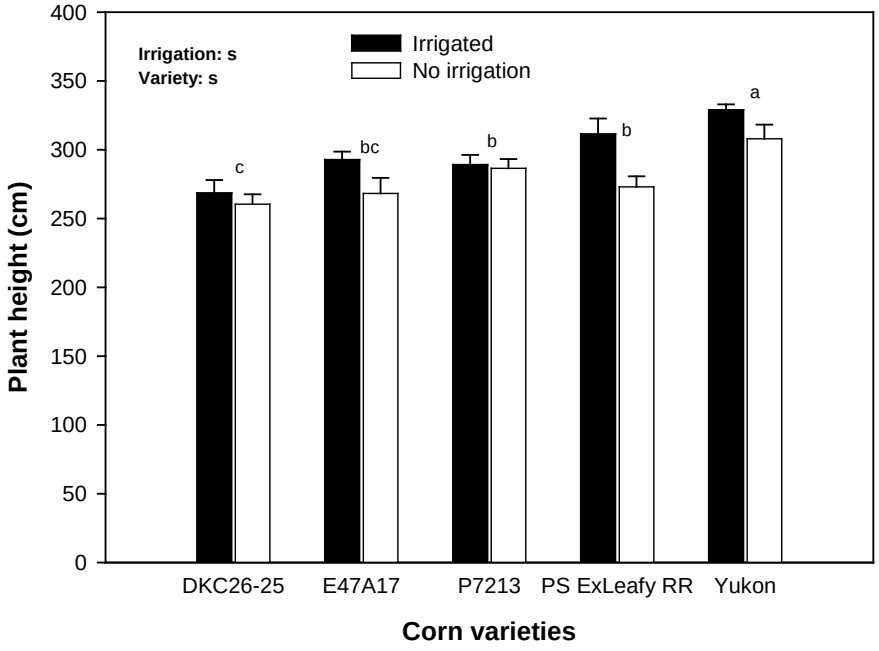



Figure 4: Effects of irrigation on height of 5 corn

In the analysis of grain yield, Yukon and PS ExLeafy were excluded from the analysis because with no irrigation, kernels of the two varieties did not fill or mature (Table 1, Fig 5). Excluding the two varieties, irrigation significantly increased grain yield in P7213R but not in the other varieties (Fig. 6). Considering only the crops in the irrigation treatment, Yukon RR had the highest grain yield (156.8 bu/ac vs 134.3 for P7213). Overall, the 4.5-inch supplemental irrigation increased grain yield by 18% on average. Protein content of the grains did not differ with varieties but was reduced by irrigation (Table 1). Irrigation reduced grain protein content by 7.2%. Overall, grain protein content averaged 11.0 %, which is higher than the 10.3 % average documented by Alberta Agriculture & Forestry (Alberta Feedlot Management Guide: Nutrition and Management, 2000). Contrary to grain protein being reduced by irrigation, the supplemental irrigation increased grain starch content by a marginal 2.2%. E47A17 had the least grain starch content but the highest grain oil content. The average starch content of the grains was 68.8% and this was lower than the average reported for

corn by Alberta Agriculture & Forestry. The oil content of the harvested grains was least in DKC26-25 (could not be determined for Yukon & PS ExLeafy).

**Matured corn stands at MARA's Fort Vermilion research site, 2016**

Table 2: Effects of irrigation on height, yield and dry matter of 5 corn varieties

| **Variety** | **Irrigation** | **Height** | **Days to tassel** | **Kernels /ear** | **Grain yield** | **Grain Protein** | **Grain Oil** | **Grain Starch** | **Wet Silage** | **Dry silage** |
|---|---|---|---|---|---|---|---|---|---|---|
| | | **(cm)** | | **#** | **Bu/ac** | **(%)** | | | **Tons/ac** | |
| DKC26-25 | Irrigated | 268.50 | 69 | 499 | 110.62 | 10.68 | 3.58 | 70.87 | 14.14 | 5.40 |
| E47A17 | | 292.69 | 75 | 553 | 118.96 | 11.25 | 4.05 | 68.65 | 19.92 | 7.69 |
| P7213 | | 289.06 | 70 | 567 | 134.32 | 10.48 | 3.92 | 70.17 | 14.47 | 6.49 |
| PS ExLeafy | | 311.38 | 80 | *515* | *122.55* | *10.52* | *4.72* | *66.39* | 24.88 | 6.63 |
| Yukon | | 328.88 | 72 | *461* | *156.77* | *10.57* | *3.96* | *70.60* | 20.72 | 8.31 |
| | | | | | | | | | | |
| DKC26-26 | No-irrigation | 260.44 | 71 | 522 | 110.89 | 11.50 | 3.49 | 69.96 | 13.45 | 5.38 |
| E47A17 | | 268.19 | 79 | 510 | 104.68 | 11.69 | 4.90 | 66.60 | 16.42 | 5.68 |
| P7213 | | 286.50 | 71 | 523 | 111.64 | 11.41 | 3.96 | 69.08 | 13.23 | 5.41 |
| PS ExLeafy | | 272.94 | 84 | Kernels not fully formed | | | | | 20.48 | 6.28 |
| Yukon | | 307.96 | 78 | | | | | | 14.58 | 5.38 |
| | | | | | | | | | | |
| ***LSD*** *Irrigation* | | **17.10**$_{S}$ | **2.17**$_{S}$ | 39.9$_{ns}$ | 12.16$_{ns}$ | **0.75**$_{S}$ | 0.36$_{ns}$ | **0.63**$_{S}$ | **1.48**$_{S}$ | **0.78**$_{S}$ |
| ***LSD*** *variety* | | **16.60**$_{S}$ | **1.99**$_{S}$ | 58.85$_{S}$ | 25.86$_{ns}$ | 0.62$_{ns}$ | 0.56$_{S}$ | 0.94$_{S}$ | 2.82$_{S}$ | 1.30$_{ns}$ |
| ***LSD*** *Irr x Variety* | | 23.7$_{ns}$ | 2.82$_{ns}$ | 75.90$_{S}$ | 10.52$_{S}$ | 0.91$_{ns}$ | 0.72$_{ns}$ | 1.22$_{ns}$ | 3.68$_{ns}$ | 1.71$_{ns}$ |
| ***CV %*** | | 5.60 | | 11.0 | 20.5 | 5.3 | 13.3 | 1.3 | 15.9 | 20.1 |

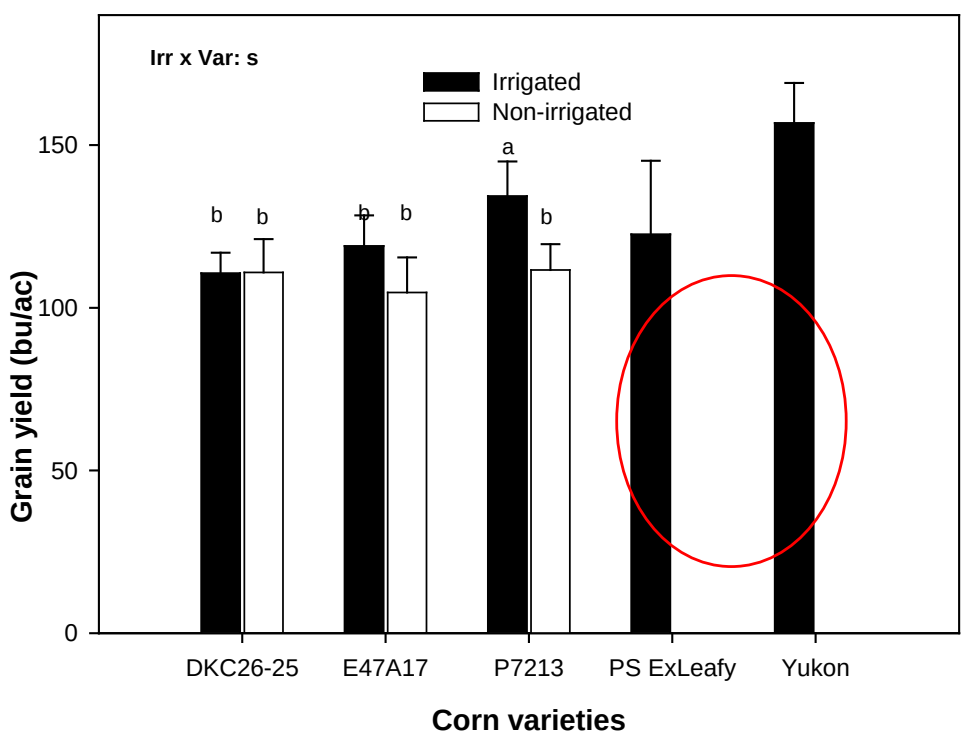



Figure 5: Effects of irrigation on grain yield of 5 corn varieties. PS ExLeafy and Yukon did not produce matured grains without irrigation (Circled)

Wet silage yield (tons per acre) differed among the varieties and irrigation treatment (Table 1). Irrigation increased the wet tonnage by 20.5 %. Averaged for both irrigation and no irrigation, PS ExLeafy produced the highest wet tonnage of 22.7 tons per acre, with P7213R and DKC26-25 recording the least wet tonnage of 12.8 tons per acre. On dry matter basis however, there was no significant difference in the five varieties (Table 1). Irrigation increased dry matter tonnage per acre by 22.6 % independent of varieties.

The application of supplemental irrigation significantly reduced metabolizable energy, net energy for lactation, gain and maintenance in PS ExLeafy but not in the other varieties (Fig. 6).

Table 2: Effects of irrigation on some nutritional qualities and feed energy of 5 corn varieties

| **Variety** | **Irrigation** | **ADF** | **NDF** | **TDN** | **Starch** | **NFC** | **DE** | **ME** | **$NE_L$** | **$NE_G$** | **$NE_M$** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | **%** | | | | | **(Mcal/kg)** | | | | |
| DKC26-25 | Irrigated | 30.15 | 52.85 | 66.78 | 22.77 | 32.46 | 2.94 | 2.41 | 1.49 | 0.89 | 1.61 |
| E47A17 | | 27.77 | 47.83 | 69.61 | 26.47 | 37.56 | 3.06 | 2.51 | 1.53 | 0.94 | 1.66 |
| P7213 | | 28.37 | 50.21 | 67.84 | 27.57 | 35.85 | 2.99 | 2.45 | 1.52 | 0.93 | 1.65 |
| PS ExLeafy | | 36.36 | 65.58 | 57.66 | 9.64 | 17.78 | 2.54 | 2.08 | 1.37 | 0.75 | 1.47 |
| Yukon | | 28.95 | 49.60 | 69.56 | 27.64 | 36.73 | 3.06 | 2.51 | 1.51 | 0.92 | 1.64 |
| | | | | | | | | | | | |
| DKC26-26 | No-irrigation | 27.31 | 47.72 | 70.28 | 14.29 | 36.06 | 3.09 | 2.54 | 1.54 | 0.95 | 1.67 |
| E47A17 | | 27.50 | 49.82 | 68.93 | 16.71 | 32.93 | 3.03 | 2.49 | 1.47 | 0.87 | 1.59 |
| P7213 | | 25.98 | 46.46 | 69.26 | 27.09 | 37.59 | 3.05 | 2.50 | 1.58 | 1.00 | 1.72 |
| PS ExLeafy | | 32.06 | 55.14 | 66.35 | 26.68 | 28.72 | 2.92 | 2.39 | 1.58 | 0.99 | 1.71 |
| Yukon | | 28.24 | 49.95 | 70.08 | 19.31 | 34.06 | 3.08 | 2.53 | 1.45 | 0.84 | 1.56 |
| | | | | | | | | | | | |
| ***LSD*** *Irrigation* | | $4.26_{ns}$ | $6.87_{ns}$ | $3.07_{ns}$ | $1031_{ns}$ | $6.46_{ns}$ | $0.14_{ns}$ | $0.11_{ns}$ | $0.12_{ns}$ | $0.15_{ns}$ | $0.14_{ns}$ |
| ***LSD*** *variety* | | **$3.32_S$** | **$5.31_S$** | **$32.22_S$** | **$3.77_S$** | **$4.78_S$** | **$0.10_S$** | **$0.08_S$** | **$0.05_S$** | **$0.06_S$** | **$0.06_S$** |
| ***LSD*** *Irr x Variety* | | $5.08_{ns}$ | $8.16_{ns}$ | **$3.50_S$** | **$9.52_S$** | **$7.49_S$** | **$0.15_S$** | **$0.11_S$** | **$0.11_S$** | **$0.14_S$** | **$0.13_S$** |
| ***CV %*** | | 11.0 | 10.0 | 3.20 | 16.7 | 14.1 | 3.2 | 3.2 | 3.1 | 6.0 | 3.3 |
| ***NS= not significant (p>0.05), S = Significant (p≤0.05). Number of replications = 4*** | | | | | | | | | | | |

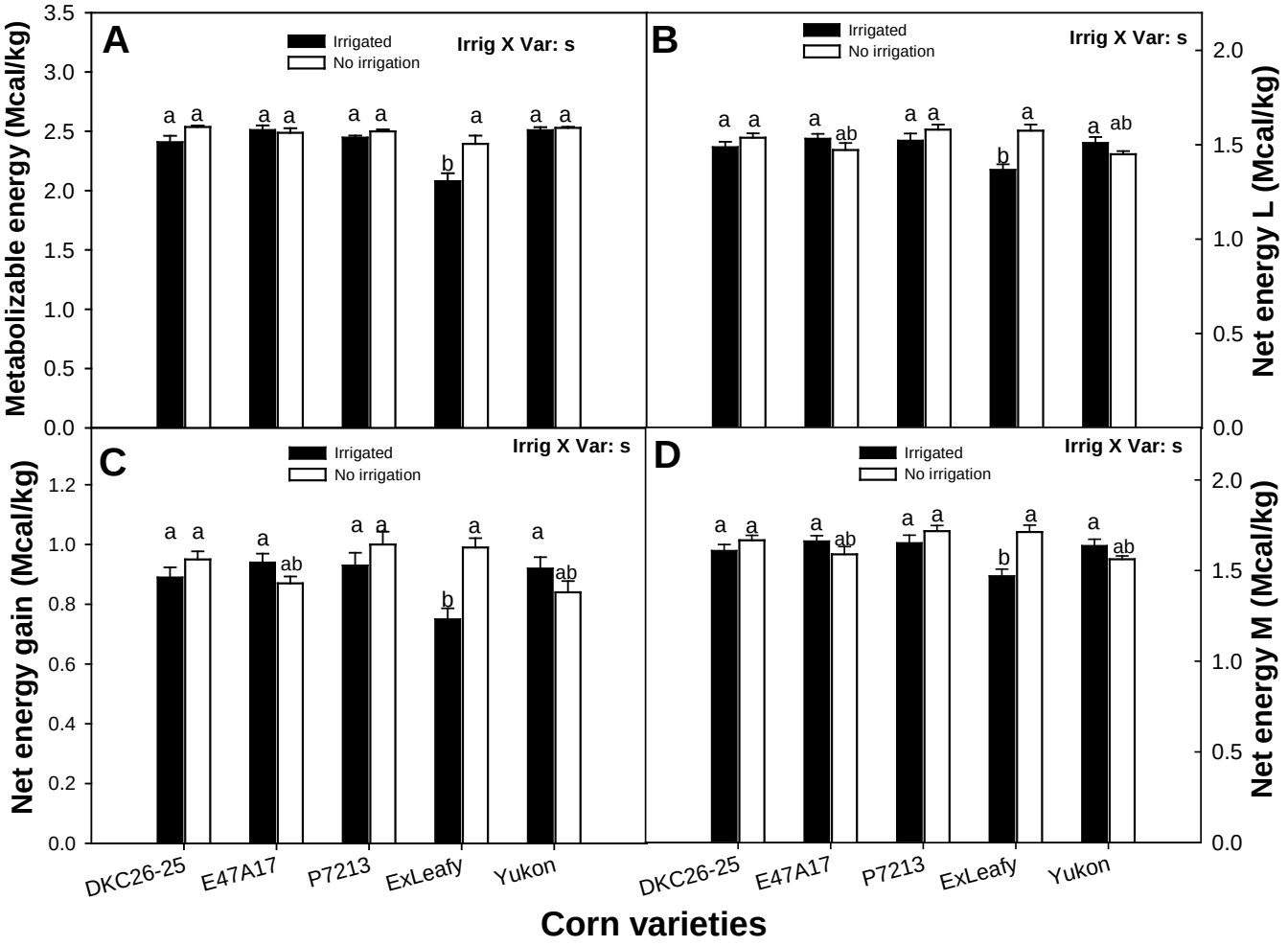



Figure 6: Effects of irrigation on metabolizable energy (A), net energy for lactation (B), gain (C) and maintenance (D) of five corn varieties grown at Fort Vermilion Research Station

Crude protein did not differ among the varieties (Table 3). CP averaged 8.4% for all the corn varieties. The application of supplemental irrigation significantly reduced CP in all the varieties (Fig. 7). The reduction was about 12%. Potassium content of the silage did not vary with irrigation or varieties (Table 3). However, the calcium content of the silage of the different varieties differed with supplemental irrigation (Table 3).

Table 3: Effects of irrigation on crude protein (CP), total fat, Relative Feed Value (RFV) and mineral content of 5 corn varieties

| Variety | Irrigation | CP | Fat | Ca | P | K | Mg | Cu | Fe | Zn | RFV |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | % | | | | | | ug/g | | | |
| DKC26-25 | Irrigated | 8.28 | 1.76 | 0.15 | 0.21 | 1.08 | 0.12 | 3.29 | 103.95 | 26.06 | 116.64 |
| E47A17 | | 8.04 | 2.18 | 0.12 | 0.25 | 1.12 | 0.12 | 3.03 | 86.22 | 23.07 | 132.07 |
| P7213 | | 7.68 | 1.99 | 0.12 | 0.23 | 1.10 | 0.12 | 2.78 | 141.99 | 21.67 | 125.58 |
| PS ExLeafy | | 8.36 | 1.54 | 0.22 | 0.19 | 1.15 | 0.17 | 3.78 | 101.19 | 31.17 | 86.22 |
| Yukon | | 7.33 | 2.17 | 0.10 | 0.19 | 0.94 | 0.12 | 2.79 | 92.84 | 25.55 | 126.03 |
| DKC26-26 | No-irrigation | 8.85 | 1.30 | 0.24 | 0.14 | 0.97 | 0.21 | 2.29 | 178.77 | 38.28 | 133.11 |
| E47A17 | | 9.51 | 2.06 | 0.20 | 0.16 | 1.06 | 0.22 | 4.47 | 104.94 | 23.42 | 111.87 |
| P7213 | | 9.04 | 2.24 | 0.16 | 0.20 | 1.02 | 0.19 | 3.48 | 72.41 | 34.88 | 138.29 |
| PS ExLeafy | | 8.67 | 2.23 | 0.20 | 0.18 | 1.04 | 0.15 | 3.05 | 86.99 | 39.48 | 142.18 |
| Yukon | | 8.33 | 1.96 | 0.26 | 0.16 | 1.08 | 0.18 | 3.15 | 88.43 | 32.85 | 106.22 |
| | | | | | | | | | | | |
| ***LSD*** *Irrigation* | | $0.41_{S}$ | $0.49_{ns}$ | $0.05_{S}$ | $0.02_{S}$ | $0.17_{ns}$ | $0.03_{S}$ | $1.03_{ns}$ | $88.03_{ns}$ | $8.22_{S}$ | $31.0_{ns}$ |
| ***LSD*** *variety* | | $0.82_{ns}$ | $0.34_{S}$ | $0.04_{S}$ | $0.03_{ns}$ | $0.13_{ns}$ | $0.02_{ns}$ | $0.73_{ns}$ | $41.91_{ns}$ | $7.01_{S}$ | $14.13_{ns}$ |
| ***LSD*** *Irr x Variety* | | $1.10_{ns}$ | $0.54_{S}$ | $0.06_{S}$ | $0.04_{ns}$ | $0.20_{ns}$ | $0.04_{S}$ | $1.17_{S}$ | $84.69_{S}$ | $10.40_{ns}$ | $29.53_{S}$ |
| ***CV %*** | | 9.4 | 16.9 | 21.7 | 17.1 | 11.6 | 15.0 | 22.1 | 38.4 | 22.9 | 11.20 |
| ***NS= not significant (p>0.05), S = Significant (p≤0.05). Number of replications = 4*** | | | | | | | | | | | |

Supplemental irrigation significantly reduced Ca in all the varieties except in P7213R and PS Exleafy. Supplemental irrigation increased the Phosphorus content of the varieties by 28%. No significant difference in the phosphorus content of the different varieties was observed. Irrigation reduced silage magnesium content in all the varieties except in PS Exleafy, where silage Mg content was marginally increased. The co-efficient of variation (CV), which measures dispersion or variability within a group was very high for the analysed calcium, crude fat, phosphorus, magnesium, copper, iron and zinc, making such results less reliable than those with lower percent CVs.

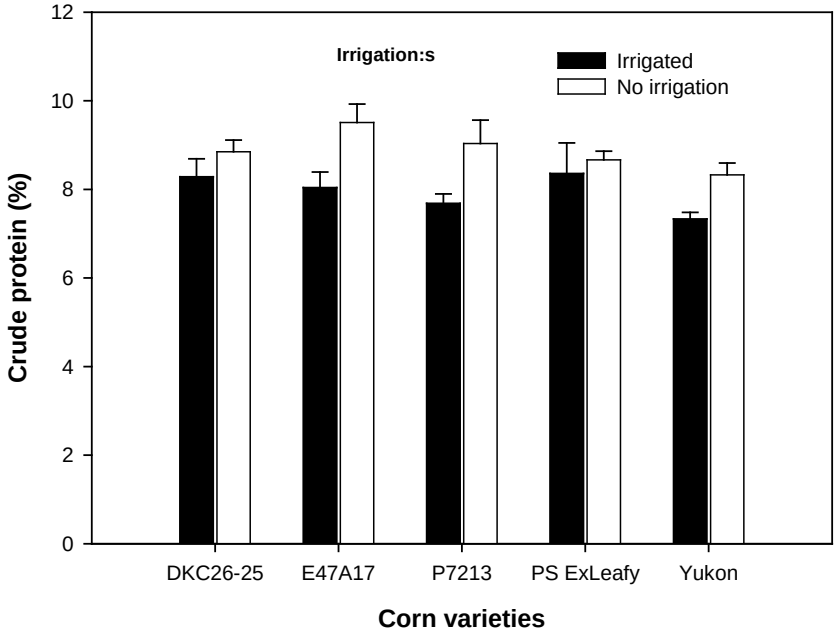



Figure 7: Effects of irrigation treatment on the crude protein content of five corn varieties

PS ExLeafy grown under irrigation had reduced relative feed value (RFV) compared to the other treatments (Table 3, Fig. 8). RFV as an index estimates feed digestibility and dry matter intake potential. RFV relates more to crude fibre than crude protein and cannot be used in the formulation of feed (because CP is not used). However, it is still relevant in determining the quality of the same type of forage. For example, RFV may be used to compare the relative value of different corn or alfalfa varieties but not cross-comparison of both corn & alfalfa feed simultaneously. A higher RFV value generally indicates higher feed quality.

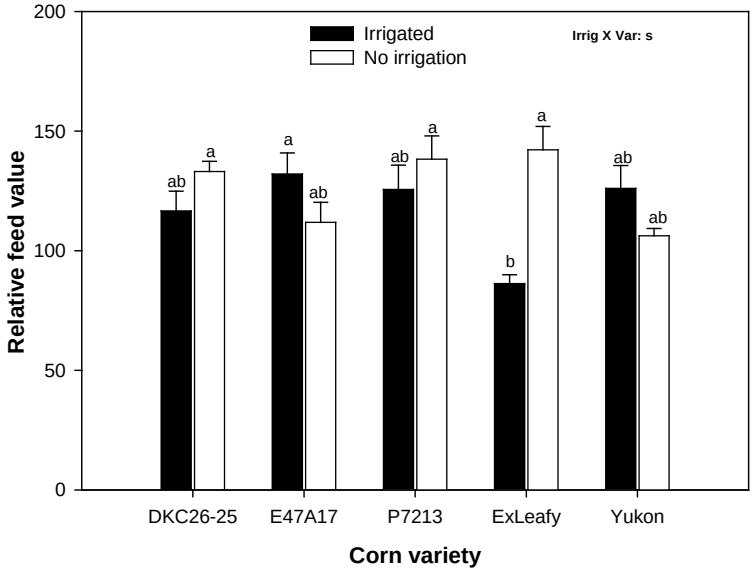
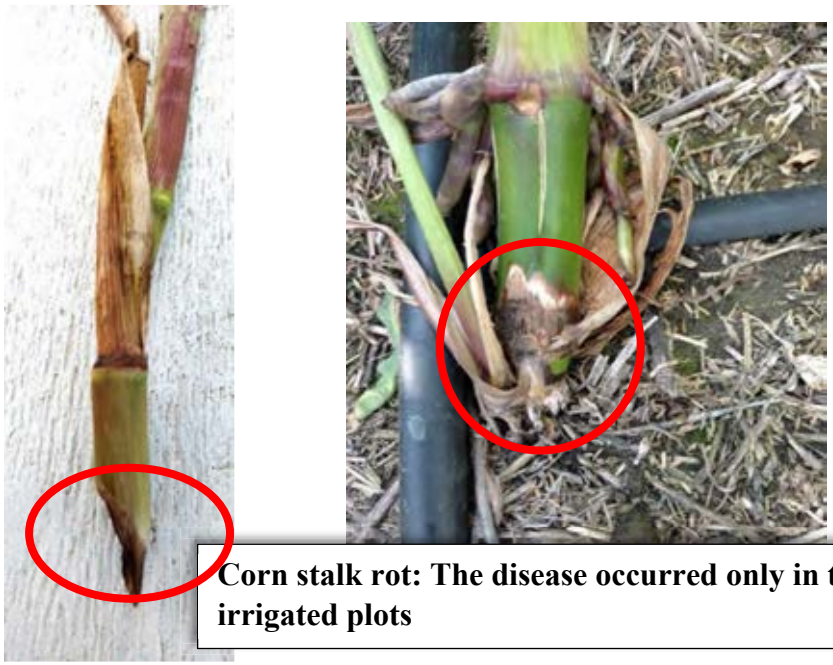



Figure 8: Effects of irrigation treatment on the relative feed value of five corn varieties

## Conclusion

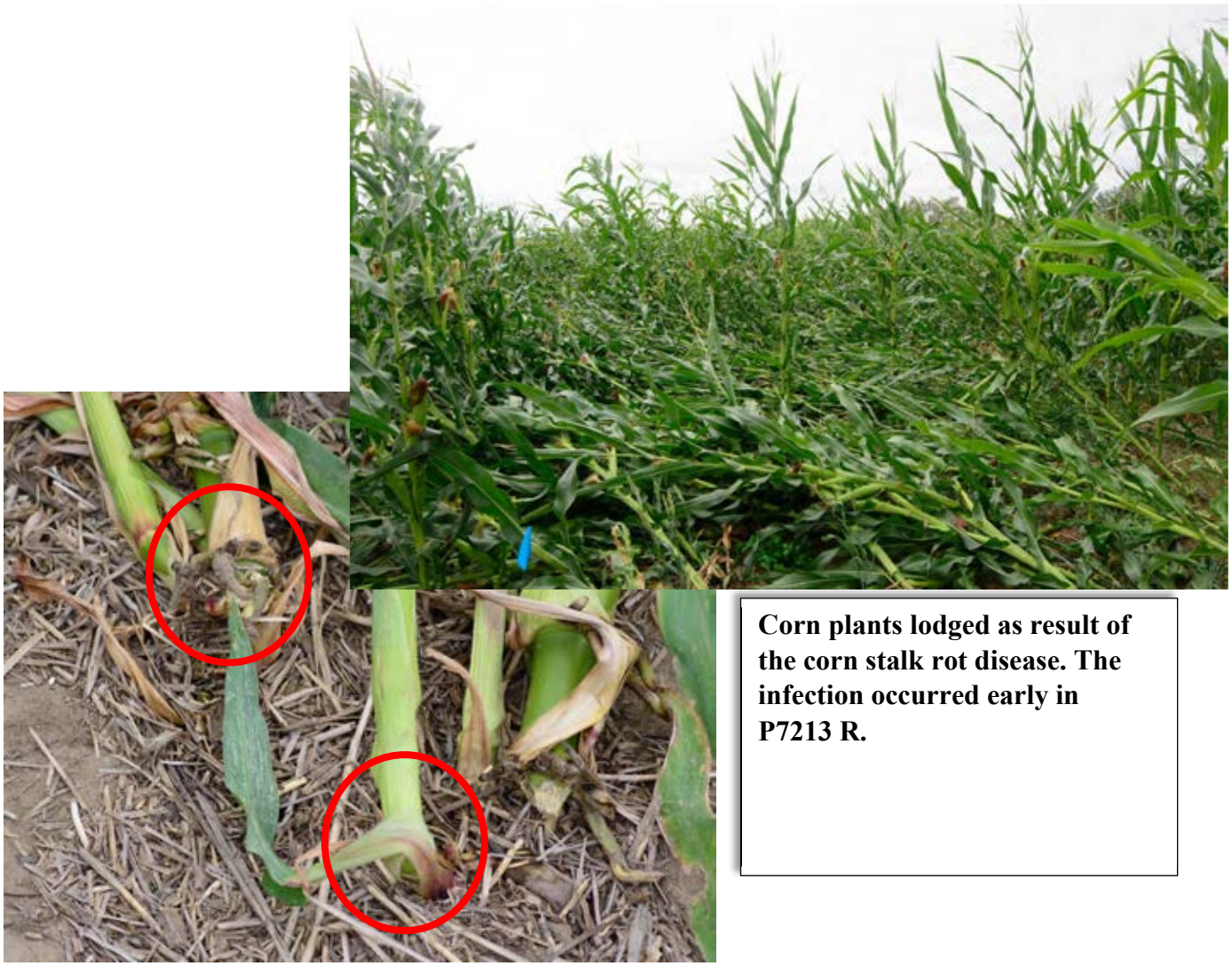
The irrigated plots received a total of 12.6 inches (320 mm) while the non-irrigated plots received about 8.1 inches (206 mm) of rainfall during the growing season. The supplemental irrigation of the five corn varieties (DKC26-26 RR2, E47A17 R, P7213, PS Exleafy RR and Yukon R) resulted in taller plants and increased grain and silage yield. It also enabled varieties like Yukon RR and PS ExLeafy to produce fully matured grains, which was not possible under the no irrigation treatment. It must be noted that PS ExLeafy is marketed as silage corn and not grain corn, hence, its inability to produce fully matured grains without irrigation is not surprising. Afterall, it is the only variety with heat unit higher than the CHU recorded during the growing season (requires 2600 CHU, 2482 recorded).

The application of irrigation through surface drip decreased grain and silage protein contents. Protein is essential in feed formulation and its reduction with supplemental irrigation may impact feed ration balance. Combining corn silage with protein-rich crops such as alfalfa can easily fix this issue. Alternatively, since irrigation crops generally have higher nutrient demand than non-irrigated ones under the same condition, the additional application of fertilizer to irrigated sites may address the low grain and silage protein issues. A major problem with the irrigation was the high prevalence of Pythium stalk rot caused by *Pythium aphanidermatum*, a fungus.



**Corn stalk rot: The disease occurred only in the irrigated plots**

The rot occurred mainly at the first internode and appeared as brown water soaked area. With the exception of the first and sometimes second internodes, the entire plant remained green until it completely topples over. The occurrence was observed more in P7213 R and E47A17 R. The infection resulted in about 40% of the plants lodging. Because the disease occurred at the late stage (except in P7213 R where it occurred even before flowering), most of the lodged plants still went to produce matured grains. It appears grains from the heavily infected plants had more kernels per ear than the least infected ones.



**Corn plants lodged as result of the corn stalk rot disease. The infection occurred early in P7213 R.**

The occurrence of the disease was a surprise as the site had not previously had corn and it is on a 3-4 year cereal rotation. The soil was sandy loam, which is better for drainage. The warmer temperatures coupled with the extra moisture probably facilitated the spread of the disease. It is now also known that the pathogen infects a host of peas and over winters in the soil as oospores. The irrigation scheduling may be different and more dependent on general weather conditions in future trials. Depending on funding, this project will be continued in the 2017 growing season.

**Acknowledgements**

Ron Wieler: Dupont Pioneer Rep (Mackenzie County-seed and extension support), Jerry Wilner (Brett Young Regional Account Manager, Alberta and BC Peace Region-seed and extension support), Southern Irrigation Ltd (provided technical support and discounted irrigation equipment), Alberta Government (funding through Agriculture Opportunity Fund).

## Field evaluation of twenty corn varieties in Northern Alberta

### Summary

The performance of twenty-five corn varieties was tested at MARA's Fort Vermilion Research Facility. This is a continuation of the 2014 and 2015 trials. Most of the varieties tested were Round-Up Ready. The crops were evaluated for silage and yield, nutritional information and feed energy values.

### Materials and methods

This trial was parallel to the corn irrigation trial in the earlier chapter. Hence, with the exception of supplemental irrigation, all the other conditions such as seeding date, harvest date, fertilizer are the same. Most of the varieties had corn heat unit of 2400 or less (Table 1).

Planting corn at MARA's Fort Vermilion Research site

Table 1: Corn varieties and heat units

| Variety | Company | CHUs |
|---|---|---|
| E44A02 R | Brett Young | 2150 |
| E46J77 R | Brett Young | 2150 |
| E47A12 R | Brett Young | 2225 |
| E47A17 R | Brett Young | 2200 |
| E48A27 R | Brett Young | 2250 |
| E50G27 R | Brett Young | 2350 |
| E50P52R | Brett Young | 2300 |
| E53B22 | Brett Young | 2350 |
| E61P12 | Brett Young | 2525 |
| Fusion RR | Brett Young | 2200 |
| Tundra RR | Brett Young | 2300 |
| Venza R | Brett Young | 2500 |
| X13-8084 | Brett Young | 2400 |
| Yukon RR | Brett Young | 2150 |
| DKC26-25 | Dekalb | 2125 |
| Hyland 3093 | Dow | 2300 |
| PS 2210VT2P | Pickseed | 2175 |
| PS 2262 RR | Pickseed | 2075 |
| PS2501 | Pickseed | 2300 |
| PS ExLeafy RR | Pickseed | 2600 |
| 39D97 | Pioneer Seeds | 2250 |
| P7213 R | Pioneer Seeds | 2050 |
| P7332 R | Pioneer Seeds | 2000 |
| P7443R | Pioneer Seeds | 2100 |
| P8906AM | Pioneer Seeds | 2650 |

**Results**

The tallest corn varieties were Venza R and Fusion RR while the shortest variety was DKC26-25. Mean plant height was 280 cm (~110 inches). On wet basis (direct field grazing), the corn silage yield ranged from 13.20 to 20.48 tons per acre. PS ExLeafy, a 2600 heat unit corn and Venza R (2500 CHU) yielded the highest. For varieties with CHU of less than 2400, E50G27 R (2350 CHU) had the highest wet yield of 18.77 tons/ac. The yield of EG0G27 R was statistically same as that of PS ExLeafy R and Venza R. The wet yield typically resembles what is available to livestock if field grazing (green feed) is done rather than silaging.

On dry matter basis, silage yield of the 25 varieties did not differ statistically from each other (Table 2). Dry matter silage yield range from 3.86 tons/ac in P8906AM to 6.17 tons/ac in Venza. The dry matter yield is generally low for corn. The Alberta Corn Committee -2014 reported an average silage corn yield of 7.4 tons/ac, dry. It must be noted though that all the data in the Alberta Corn Committee report is from outside the Peace Region and different varieties were used.

Crude protein was less than 10% and did not differ among the varieties (Table 2). This crude protein is not adequate for growing and finishing cattle or for yearlings. However, at pre-calving stage, matured cows and heifers require about 8.6 - 9.0 % crude protein. Also, at the gestation stage, cows typically require about less than 10% crude protein, making this feed suitable.

**Corn plants at Fort Vermilion, Alberta**

Table 2: Height, yield, crude protein (CP), starch, total fat and relative feed value (RFV) of 25 corn varieties grown at Fort Vermilion, Alberta

| Variety | Height | Wet yield | Dry yield | CP | Starch | Fat | RFV |
|---|---|---|---|---|---|---|---|
| | cm | tons/ac | | % | | | |
| 39D97 | 276.44 | 14.91 | 6.03 | 9.10 | 15.28 | 1.89 | 100.51 |
| DKC26-25 | 260.44 | 13.45 | 5.38 | 8.85 | 14.29 | 1.30 | 133.11 |
| E44A02 | 285.25 | 16.07 | 5.50 | 8.70 | 16.78 | 1.87 | 112.36 |
| E46J77R | 282.06 | 13.75 | 4.84 | 9.10 | 17.89 | 1.71 | 116.62 |
| E47A12 | 277.81 | 16.89 | 5.31 | 9.15 | 21.46 | 2.30 | 130.85 |
| E47A17 | 268.19 | 16.42 | 5.68 | 9.51 | 16.71 | 2.06 | 111.87 |
| E48A27 | 268.31 | 15.32 | 4.62 | 9.38 | 19.91 | 2.03 | 119.93 |
| E50G27 | 273.88 | 18.77 | 5.61 | 9.43 | 22.31 | 2.52 | 128.14 |
| E50P52R | 264.56 | 17.11 | 5.26 | 8.95 | 18.31 | 2.26 | 113.70 |
| E53B22 | 286.63 | 14.66 | 4.80 | 8.91 | 17.36 | 1.99 | 121.69 |
| E61P12 | 300.38 | 19.37 | 5.66 | 8.41 | **29.83** | 2.31 | **148.14** |
| Fusion | 286.44 | 13.78 | 5.16 | 8.99 | 16.62 | 2.01 | 111.99 |
| Hyland 3093 | 267.19 | 13.20 | 4.05 | 9.88 | 24.41 | 2.06 | 131.24 |
| P3222 | 262.06 | 14.00 | 5.08 | 9.06 | 23.92 | 2.00 | 127.56 |
| P7213 | 286.50 | 13.23 | 5.41 | 9.04 | 27.09 | 2.24 | 138.29 |
| P7443R | 280.38 | 13.34 | 5.32 | 9.11 | 25.38 | 2.11 | 132.18 |
| P8906AM | 276.44 | 14.14 | 3.86 | 8.94 | 23.81 | 2.05 | 140.85 |
| PS 2210VT2P | 276.69 | 16.73 | 5.09 | 8.67 | 26.68 | 2.23 | 142.18 |
| PS 2262 RR | 271.25 | 14.52 | 5.67 | 8.69 | 21.54 | 2.00 | 127.62 |
| PS 2501 | 281.31 | 14.44 | 4.77 | 9.72 | 22.86 | 2.14 | 127.35 |
| PS ExLeafy | 272.94 | **20.48** | 4.91 | 8.92 | 21.99 | 2.26 | 120.48 |
| Tundra | 279.06 | 15.90 | 5.14 | 8.71 | 22.59 | 2.05 | 121.24 |
| Venza R | **308.81** | **20.17** | 6.17 | 8.07 | 19.96 | 2.16 | 123.46 |
| X13-8084 | 273.75 | 17.44 | 5.92 | 8.65 | 20.25 | 2.19 | 120.18 |
| Yukon RR | **307.96** | 14.58 | 5.38 | 8.33 | 19.31 | 1.96 | 106.22 |
| | | | | | | | |
| **Mean** | **278.99** | **15.71** | **5.23** | **8.97** | **21.06** | **2.07** | **124.31** |
| **p<0.05** | **s** | **s** | **ns** | **ns** | **s** | **s** | **s** |
| **LSD** | **20.6** | **3.26** | **1.44** | **10.8** | **7.52** | **0.35** | **20.86** |
| **CV %** | **5.2** | **14.7** | **19.5** | **8.5** | **25.3** | **12.1** | **11.9** |

Table 3: Fibre, digestibility and energy characteristics of 25 corn varieties grown at Fort Vermilion, Alberta

| Variety | ADF | NDF | TDN | DE | ME | $NE_L$ | $NE_G$ | $NE_M$ |
|---|---|---|---|---|---|---|---|---|
| | % | | | Mcal/kg | | | | |
| 39D97 | 26.37 | 47.11 | **70.25** | **3.09** | **2.53** | 1.42 | 0.81 | 1.53 |
| DKC26-25 | 27.31 | 47.72 | **70.28** | **3.09** | **2.54** | 1.54 | 0.95 | 1.67 |
| E44A02 | 27.68 | 48.46 | 69.47 | 3.06 | 2.51 | 1.48 | 0.87 | 1.60 |
| E46J77 R | 28.94 | 51.41 | 69.80 | **3.07** | 2.**52** | 1.49 | 0.90 | 1.62 |
| E47A12 | 29.31 | 52.19 | 67.93 | 2.99 | 2.45 | 1.54 | 0.94 | 1.67 |
| E47A17 | 27.50 | 49.82 | 68.93 | 3.03 | 2.49 | 1.47 | 0.87 | 1.59 |
| E48A27 | 30.74 | 54.02 | 68.29 | 3.00 | 2.46 | 1.51 | 0.91 | 1.63 |
| E50G27 | 27.48 | 49.84 | 67.98 | 2.99 | 2.45 | 1.54 | 0.94 | 1.66 |
| E50P52R | 29.27 | 51.96 | 69.99 | **3.08** | **2.53** | 1.47 | 0.87 | 1.59 |
| E53B22 | 28.59 | 51.10 | **70.20** | 3.09 | **2.53** | 1.52 | 0.93 | 1.65 |
| E61P12 | 30.50 | 52.62 | 66.12 | 2.91 | 2.39 | **1.60** | **1.02** | **1.75** |
| Fusion | 27.28 | 48.43 | 68.72 | 3.02 | 2.48 | 1.47 | 0.87 | 1.59 |
| Hyland 3093 | 29.25 | 51.78 | 69.22 | 3.05 | 2.50 | 1.55 | 0.96 | 1.68 |
| P3222 | 26.65 | 47.53 | 68.53 | 3.02 | 2.47 | 1.53 | 0.94 | 1.66 |
| P7213 | 25.98 | 46.46 | 69.26 | 3.05 | 2.50 | 1.58 | 1.00 | 1.72 |
| P7443R | 26.34 | 46.76 | 69.71 | **3.07** | 2.52 | 1.55 | 0.96 | 1.68 |
| P8906AM | **33.81** | **58.51** | 63.54 | 2.80 | 2.29 | 1.58 | 1.00 | 1.72 |
| PS 2210VT2P | 32.06 | 55.14 | 66.35 | 2.92 | 2.39 | 1.58 | 0.99 | 1.71 |
| PS2262 RR | 27.36 | 47.68 | 69.52 | 3.06 | 2.51 | 1.54 | 0.95 | 1.67 |
| PS 2501 | 27.10 | 46.86 | **70.20** | **3.09** | **2.53** | 1.52 | 0.93 | 1.65 |
| PS ExLeafy | 28.87 | 51.14 | 64.60 | 2.84 | 2.33 | 1.49 | 0.89 | 1.62 |
| Tundra | 28.38 | 48.99 | 67.34 | 2.96 | 2.43 | 1.49 | 0.89 | 1.61 |
| Venza R | 31.23 | 54.17 | 69.21 | 3.05 | 2.50 | 1.53 | 0.93 | 1.65 |
| X13-8084 | 30.56 | 53.41 | 65.77 | 2.89 | 2.37 | 1.50 | 0.90 | 1.62 |
| Yukon RR | 28.24 | 49.95 | **70.08** | **3.08** | **2.53** | 1.45 | 0.84 | 1.56 |
| | | | | | | | | |
| **Mean** | **28.67** | **50.52** | **68.45** | **3.01** | **2.47** | **1.52** | **0.92** | **1.64** |
| **p<0.05** | **s** | **s** | **s** | **s** | **s** | **s** | **s** | **s** |
| **LSD** | **3.88** | **6.32** | **3.39** | **0.15** | **0.12** | **0.08** | **0.09** | **0.9** |
| **CV %** | **9.6** | **8.9** | **3.5** | **3.5** | **3.5** | **3.5** | **6.8** | **3.8** |

Table 4: Mineral content of 25 corn varieties grown at Fort Vermilion, Alberta

| Variety | Ca | P | K | Mg | S | Cu | Zn | Mn |
|---|---|---|---|---|---|---|---|---|
| | % | | | | | ug/g | | |
| 39D97 | 0.25 | 0.12 | 1.02 | 0.25 | 0.11 | 2.92 | 26.85 | 41.59 |
| DKC26-25 | 0.24 | 0.14 | 0.97 | 0.21 | 0.10 | 2.29 | 38.28 | 37.18 |
| E44A02 | 0.24 | 0.14 | 1.05 | 0.21 | 0.10 | 3.22 | 37.38 | 35.99 |
| E46J77R | 0.22 | 0.13 | 0.91 | **0.26** | 0.09 | 4.13 | 33.14 | 37.21 |
| E47A12 | 0.17 | 0.16 | 1.04 | 0.24 | 0.10 | **4.36** | 29.09 | 29.75 |
| E47A17 | 0.20 | 0.16 | 1.06 | 0.22 | 0.10 | **4.47** | 23.42 | 28.38 |
| E48A27 | 0.17 | 0.15 | 0.95 | 0.16 | 0.09 | 2.69 | 26.69 | 26.96 |
| E50G27 | 0.24 | 0.16 | 0.97 | 0.23 | 0.11 | 2.17 | 38.07 | 46.43 |
| E50P52R | 0.23 | 0.14 | 1.05 | 0.18 | 0.09 | 2.19 | 33.37 | 39.46 |
| E53B22 | 0.25 | 0.16 | 0.97 | 0.22 | 0.11 | 3.03 | 36.26 | 33.89 |
| E61P12 | 0.16 | **0.22** | 0.99 | 0.15 | 0.11 | 3.23 | 36.48 | 25.69 |
| Fusion | 0.24 | 0.20 | **1.35** | 0.16 | 0.11 | 3.00 | 32.31 | 39.33 |
| Hyland 3093 | 0.18 | 0.17 | 1.11 | 0.17 | 0.11 | 3.52 | 31.01 | 28.34 |
| P3222 | 0.20 | 0.17 | 0.99 | 0.18 | 0.11 | 3.86 | 37.52 | 33.40 |
| P7213 | 0.16 | 0.20 | 1.02 | 0.19 | 0.11 | 3.48 | 34.88 | 31.08 |
| P7443R | 0.19 | 0.17 | 0.92 | 0.19 | 0.11 | 3.19 | 34.50 | 31.06 |
| P8906AM | 0.24 | 0.18 | 0.97 | 0.23 | **0.12** | 3.62 | 47.77 | **52.82** |
| PS 2210VT2P | 0.20 | 0.18 | 1.04 | 0.15 | **0.12** | 3.05 | 39.48 | 39.07 |
| PS2262 RR | 0.20 | 0.17 | 1.00 | 0.21 | 0.11 | 3.95 | 33.30 | 42.83 |
| PS2501 | 0.22 | 0.15 | 0.91 | 0.22 | 0.11 | 3.52 | 33.11 | 32.15 |
| ExLeafy | 0.20 | 0.14 | 1.04 | 0.20 | 0.10 | 2.86 | 28.33 | 26.97 |
| Tundra | 0.19 | 0.17 | 0.86 | 0.20 | 0.10 | 3.05 | 37.29 | 34.12 |
| Venza R | 0.21 | 0.14 | 0.89 | 0.24 | 0.11 | 3.39 | 31.00 | 30.70 |
| X13-8084 | 0.22 | 0.16 | 0.85 | 0.23 | 0.11 | 3.08 | 34.46 | 28.80 |
| Yukon RR | 0.26 | 0.16 | 1.08 | 0.18 | 0.10 | 3.15 | 32.85 | 43.49 |
| | | | | | | | | |
| **Mean** | **0.21** | **0.16** | **1.00** | **0.20** | **0.10** | **3.26** | **98.52** | **33.87** |
| **p<0.05** | **ns** | **s** | **s** | **s** | **s** | **s** | **ns** | **ns** |
| **LSD** | **0.08** | **0.03** | **0.19** | **0.05** | **0.02** | **0.99** | **11.10** | **13.71** |
| **CV %** | **25.3** | **14.8** | **13.2** | **17.3** | **9.9** | **21.5** | **23.2** | **27.7** |

Acid detergent fibre (ADF) and Neutral detergent fibre (NDF) were both highest in P8906AM and lowest in 39D97, P7443R and P7213 R (Table 3). Feeds with high fibre content have low digestibility. In other words, the higher the fibre content of feed, the less digestible the feed is.

Total digestible nutrients (TDN) as a percent of dry matter ranged from a low of 63.54% in P8906AM to a high of 70.28% in DKC26-25. Growing and finishing cattle require about 68% TDN daily, with yearlings, gestating cows and lactating cattle requiring a daily TDN of 55-60 %. Therefore, TDN from most of the 25 varieties will meet the daily requirement of cattle at different growth stages.

Matured corn at Fort Vermilion, Alberta

In terms of energy for growth (gain), maintenance and lactation, EP1P12 corn variety had the highest values. Overall, the average net energy from all the varieties meet the daily energy requirements of cattle at different stages of life.

Mineral requirements of beef cattle vary depending on the class of the animal, the age and current condition. Calcium (Ca) requirements range from a low of 0.31% for pregnant cows to a high of 0.53% for 500 pounds steer and heifers. The average phosphorus (P) requirement for beef cattle is about 0.23% while 0.6 to 0.8 % potassium (K) is adequate for most cattle. About 0.15 % sulphur (S) is the daily requirement for most cattle except cows with superior milking abilities which require 0.20 %. Comparing these requirements with data from this trial (Table 4), Ca, P and S in the 25 varieties are generally not adequate to meet daily requirements of most beef cattle. However, the levels of K and Mg are significantly above the levels required. To achieve proper ration balance, corn with nutritional values similar to the ones obtained in this study should be combined with other feed.

Of the 25 corn varieties grown in 2016, 18 of them were previously grown in 2015 and 10 were grown in 2014, 2015 and 2016. The crops in 2016 were much taller than the same cultivars in 2015. Similarly, the 2016 silage yield was 118% higher than the 2015 average (Table 5). While both yield and height were higher in 2016 than in 2015, crude protein was higher in 2015 than in 2016. This could be explained by the different rainfall regimes in the two years. There was significant drought in 2015 which reduced growth and yield of different crops in Mackenzie County. Under dry conditions however, more of the nitrogen taken up by plants are stored in tissues as photosynthetic demand of plants are lower, leading to the higher crude protein in 2015.

Table 5: Comparison of 2015 and 2016 silage corn height, yield and crude protein content

| Variety | Height (cm) | | Yield (tons/ac, dry) | | Crude protein % | |
|---|---|---|---|---|---|---|
| | **2016** | **2015** | **2016** | **2015** | **2016** | **2015** |
| 39D97 | 276.44 | 129 | 6.03 | 1.76 | 9.10 | 11.16 |
| DKC26-25 | 260.44 | 135 | 5.38 | 3.36 | 8.85 | 10.74 |
| E44A02 R | 285.25 | 153 | 5.50 | 2.2 | 8.70 | 11.06 |
| E47A17 R | 268.19 | 143 | 5.68 | 3.18 | 9.51 | 10.44 |
| E48A27 R | 268.31 | 135 | 4.62 | 1.8 | 9.38 | 11.32 |
| E50G27 R | 273.88 | 154 | 5.61 | 2.12 | 9.43 | 11.53 |
| E53B22 | 286.63 | 125 | 4.80 | 1.7 | 8.91 | 11.44 |
| Fusion RR | 286.44 | 153 | 5.16 | 3.15 | 8.99 | 10.29 |
| Hyland 3093 | 267.19 | 125 | 4.05 | 2.53 | 9.88 | 11.29 |
| P7213 R | 262.06 | 121 | 5.08 | 2.01 | 9.06 | 9.97 |
| P7332 R | 286.50 | 145 | 5.41 | 2.66 | 9.04 | 9.39 |
| P7443R | 280.38 | 146 | 5.32 | 2.17 | 9.11 | 11 |
| PS 2262 RR | 271.25 | 126 | 5.67 | 2.3 | 8.69 | 10.44 |
| PS2501 | 272.94 | 84 | 4.91 | 1.95 | 8.92 | 11.13 |
| Tundra RR | 279.06 | 137 | 5.14 | 2.69 | 8.71 | 10.15 |
| Venza R | 308.81 | 133 | 6.17 | 2.86 | 8.07 | 9.94 |
| X13-8084 R | 273.75 | 133 | 5.92 | 2.8 | 8.65 | 10.78 |
| Yukon RR | 307.96 | 121 | 5.38 | 2.63 | 8.33 | 10.15 |
| | | | | | | |
| **Mean** | **278.64** | **133.22** | **5.32** | **2.44** | **8.96** | **10.68** |

While plant height, yield and protein content of the 2016 corn appeared different from that of the previous year, total digestible nutrients, digestible energy and net energy for growth, maintenance and lactation did not appear to differ much between the two years.

Table 6: Comparison of 2015 and 2016 ADF, TDN and energy values of silage corn

| **Variety** | **ADF** | | **TDN** | | **DE** | | **ME** | | **NEG** | | **NEM** | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2016** | **2015** | **2016** | **2015** | **2016** | **2015** | **2016** | **2015** | **2016** | **2015** | **2016** | **2015** |
| 39D97 | 26.37 | 29.3 | 70.25 | 67.34 | 3.09 | 2.97 | 2.53 | 2.46 | 0.81 | 0.97 | 1.53 | 1.57 |
| DKC26-25 | 27.31 | 26.03 | 70.28 | 70.83 | 3.09 | 3.13 | 2.54 | 2.59 | 0.95 | 1.08 | 1.67 | 1.69 |
| E44A02 R | 27.68 | 28.93 | 69.47 | 67.74 | 3.06 | 2.99 | 2.51 | 2.48 | 0.87 | 0.99 | 1.60 | 1.59 |
| E47A17 R | 27.50 | 27.25 | 68.93 | 69.53 | 3.03 | 3.07 | 2.49 | 2.54 | 0.87 | 1.04 | 1.59 | 1.64 |
| E48A27 R | 30.74 | 29.23 | 68.29 | 67.42 | 3.00 | 2.97 | 2.46 | 2.47 | 0.91 | 0.98 | 1.63 | 1.58 |
| E50G27 R | 27.48 | 28.64 | 67.98 | 68.04 | 2.99 | 3.00 | 2.45 | 2.49 | 0.94 | 0.99 | 1.66 | 1.6 |
| E53B22 | 28.59 | 26.8 | 70.20 | 70.01 | 3.09 | 3.09 | 2.53 | 2.56 | 0.93 | 1.05 | 1.65 | 1.66 |
| Fusion RR | 27.28 | 28.8 | 68.72 | 67.88 | 3.02 | 2.99 | 2.48 | 2.48 | 0.87 | 0.99 | 1.59 | 1.59 |
| Hyland 3093 | 29.25 | 27.37 | 69.22 | 69.41 | 3.05 | 3.06 | 2.50 | 2.54 | 0.96 | 1.03 | 1.68 | 1.64 |
| P7213 R | 26.65 | 27.64 | 68.53 | 69.12 | 3.02 | 3.05 | 2.47 | 2.53 | 0.94 | 1.03 | 1.66 | 1.64 |
| P7332 R | 25.98 | 28.37 | 69.26 | 68.33 | 3.05 | 3.02 | 2.50 | 2.5 | 1.00 | 1 | 1.72 | 1.61 |
| P7443R | 26.34 | 32.26 | 69.71 | 64.18 | 3.07 | 2.83 | 2.52 | 2.35 | 0.96 | 0.89 | 1.68 | 1.48 |
| PS 2262 RR | 27.36 | 22.87 | 69.52 | 74.21 | 3.06 | 3.27 | 2.51 | 2.72 | 0.95 | 1.17 | 1.67 | 1.8 |
| PS2501 | 28.87 | 28.06 | 64.60 | 68.66 | 2.84 | 3.03 | 2.33 | 2.51 | 0.89 | 1.01 | 1.62 | 1.62 |
| Tundra RR | 28.38 | 27.34 | 67.34 | 69.44 | 2.96 | 3.06 | 2.43 | 2.54 | 0.89 | 1.04 | 1.61 | 1.65 |
| Venza R | 31.23 | 28.35 | 69.21 | 68.35 | 3.05 | 3.01 | 2.50 | 2.5 | 0.93 | 1 | 1.65 | 1.61 |
| X13-8084 R | 30.56 | 28.18 | 65.77 | 68.53 | 2.89 | 3.02 | 2.37 | 2.51 | 0.90 | 1.01 | 1.62 | 1.62 |
| Yukon RR | 28.24 | 29.86 | 70.08 | 66.74 | 3.08 | 2.94 | 2.53 | 2.44 | 0.84 | 0.96 | 1.56 | 1.56 |
| | | | | | | | | | | | | |
| **Mean** | **28.10** | **28.07** | **68.74** | **68.65** | **3.02** | **3.03** | **2.48** | **2.51** | **0.91** | **1.01** | **1.63** | **1.62** |

With the exception of potassium (K) which was reduced in 2015 compared to the 2016, the mineral content of the varieties were generally higher in 2015 than in 2016 (Table 7). Under drought conditions, K is needed by plants probably more than other nutrient elements to control water loss and plant stress. K does this by regulating the opening and closing of the stomates to minimize further water loss. Hence, more of the K in the plants were used in the 2015 crops than was replenished from soil source. In the case of the 2016 plants though, soil moisture was not a major limiting factor and even if the higher plant growth and yield required higher K uptake, it's uptake from the soil was relatively not limited.

Table 7: Comparison of mineral content of silage corn grown in 2015 and 2016

| Variety | % Ca | | % P | | % K | | %Mg | |
|---|---|---|---|---|---|---|---|---|
| | **2016** | **2015** | **2016** | **2015** | **2016** | **2015** | **2016** | **2015** |
| 39D97 | 0.25 | 0.43 | 0.12 | 0.2 | 1.02 | 0.9 | 0.25 | 0.32 |
| DKC26-25 | 0.24 | 0.37 | 0.14 | 0.21 | 0.97 | 0.77 | 0.21 | 0.4 |
| E44A02 R | 0.24 | 0.41 | 0.14 | 0.23 | 1.05 | 0.81 | 0.21 | 0.37 |
| E47A17 R | 0.20 | 0.31 | 0.16 | 0.2 | 1.06 | 1.07 | 0.22 | 0.28 |
| E48A27 R | 0.17 | 0.41 | 0.15 | 0.22 | 0.95 | 0.99 | 0.16 | 0.3 |
| E50G27 R | 0.24 | 0.39 | 0.16 | 0.21 | 0.97 | 0.86 | 0.23 | 0.34 |
| E53B22 | 0.25 | 0.44 | 0.16 | 0.19 | 0.97 | 0.85 | 0.22 | 0.42 |
| Fusion RR | 0.24 | 0.36 | 0.20 | 0.2 | 1.35 | 0.83 | 0.16 | 0.28 |
| Hyland 3093 | 0.18 | 0.44 | 0.17 | 0.22 | 1.11 | 0.91 | 0.17 | 0.3 |
| P7213 R | 0.20 | 0.37 | 0.17 | 0.19 | 0.99 | 0.85 | 0.18 | 0.34 |
| P7332 R | 0.16 | 0.26 | 0.20 | 0.22 | 1.02 | 0.85 | 0.19 | 0.28 |
| P7443R | 0.19 | 0.38 | 0.17 | 0.19 | 0.92 | 1.04 | 0.19 | 0.29 |
| PS 2262 RR | 0.20 | 0.32 | 0.17 | 0.21 | 1.00 | 0.76 | 0.21 | 0.34 |
| PS2501 | 0.20 | 0.36 | 0.14 | 0.2 | 1.04 | 0.78 | 0.20 | 0.35 |
| Tundra RR | 0.19 | 0.42 | 0.17 | 0.21 | 0.86 | 0.79 | 0.20 | 0.33 |
| Venza R | 0.21 | 0.31 | 0.14 | 0.18 | 0.89 | 1.09 | 0.24 | 0.29 |
| X13-8084 R | 0.22 | 0.4 | 0.16 | 0.19 | 0.85 | 0.79 | 0.23 | 0.4 |
| Yukon RR | 0.26 | 0.31 | 0.16 | 0.2 | 1.08 | 0.86 | 0.18 | 0.31 |
| | | | | | | | | |
| **Mean** | **0.21** | **0.37** | **0.16** | **0.20** | **1.01** | **0.88** | **0.20** | **0.33** |

The three average height of the 10 varieties which were grown from 2014-2016 ranged from a low of 198 cm (P7213) to a high of 231 cm (Venza). Silage yield over the three-year period ranged from 3.27 tons/ac to 4.43 tons/ac. Yield and height for the three years trended growing season precipitation: yield increased with total growing season precipitation. For comparative purposes, data from the 2014-2016 trials are summarized in Tables 8 and 9.

Table 8: Comparison of height, yield, crude protein, total digestible nutrients and digestible energy of corn varieties grown in 2014, 2015 and 2016 at MARA's Fort Vermilion site

| Variety | | 39D97 | E44A02 | E47A17 | E48A27 | Fusion | P7213 | P7332 | P7443 | Venza | X13-8084 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Height (cm)** | **2016** | 276 | 285 | 268 | 268 | 286 | 262 | 287 | 280 | 309 | 274 |
| | **2015** | 129 | 153 | 143 | 135 | 153 | 121 | 145 | 146 | 133 | 133 |
| | **2014** | 212 | 233 | 216 | 215 | 229 | 210 | 229 | 223 | 251 | 243 |
| | **Mean** | **206** | **224** | **209** | **206** | **223** | **198** | **220** | **216** | **231** | **217** |
| | | | | | | | | | | | |
| **Yield (tons/ac)** | **2016** | 6.03 | 5.50 | 5.68 | 4.62 | 5.16 | 5.08 | 5.41 | 5.32 | 6.17 | 5.92 |
| | **2015** | 1.76 | 2.2 | 3.18 | 1.8 | 3.15 | 2.01 | 2.66 | 2.17 | 2.86 | 2.8 |
| | **2014** | 3.9 | 4.68 | 3.7 | 3.4 | 3.32 | 3.68 | 4.96 | 3.98 | 3.88 | 4.58 |
| | **Mean** | **3.90** | **4.13** | **4.19** | **3.27** | **3.88** | **3.59** | **4.34** | **3.82** | **4.30** | **4.43** |
| | | | | | | | | | | | |
| **CP %** | **2016** | 9.10 | 8.70 | 9.51 | 9.38 | 8.99 | 9.06 | 9.04 | 9.11 | 8.07 | 8.65 |
| | **2015** | 11.16 | 11.06 | 10.44 | 11.32 | 10.29 | 9.97 | 9.39 | 11 | 9.94 | 10.78 |
| | **2014** | 9.06 | 9.23 | 9.07 | 9.07 | 9.98 | 8.51 | 8.37 | 8.05 | 9.33 | 8.54 |
| | **Mean** | **9.77** | **9.66** | **9.67** | **9.92** | **9.75** | **9.18** | **8.93** | **9.39** | **9.11** | **9.32** |
| | | | | | | | | | | | |
| **TDN %** | **2016** | 70.25 | 69.47 | 68.93 | 68.29 | 68.72 | 68.53 | 69.26 | 69.71 | 69.21 | 65.77 |
| | **2015** | 67.34 | 67.74 | 69.53 | 67.42 | 67.88 | 69.12 | 68.33 | 64.18 | 68.35 | 68.53 |
| | **2014** | 66.34 | 69.77 | 64.45 | 68.4 | 63.93 | 66.16 | 65.22 | 61.5 | 63.78 | 67.19 |
| | **Mean** | **67.98** | **68.99** | **67.64** | **68.04** | **66.84** | **67.94** | **67.60** | **65.13** | **67.11** | **67.16** |
| | | | | | | | | | | | |
| **DE Mcal/kg** | **2016** | 3.09 | 3.06 | 3.03 | 3.00 | 3.02 | 3.02 | 3.05 | 3.07 | 3.05 | 2.89 |
| | **2015** | 2.97 | 2.99 | 3.07 | 2.97 | 2.99 | 3.05 | 3.02 | 2.83 | 3.01 | 3.02 |
| | **2014** | 2.93 | 3.08 | 2.84 | 3.01 | 2.82 | 2.92 | 2.87 | 2.71 | 2.81 | 2.96 |
| | **Mean** | **3.00** | **3.04** | **2.98** | **2.99** | **2.94** | **3.00** | **2.98** | **2.87** | **2.96** | **2.96** |

Table 9: Comparison of mineral contents of 10 corn varieties grown in 2014, 2015 and 2016 at MARA's Fort Vermilion site

| Variety | | 39D97 | E44A02 | E47A17 | E48A27 | Fusion | P7213 | P7332 | P7443 | Venza | X13-8084 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Ca %** | **2016** | 0.25 | 0.24 | 0.20 | 0.17 | 0.24 | 0.20 | 0.16 | 0.19 | 0.21 | 0.22 |
| | **2015** | 0.43 | 0.41 | 0.31 | 0.41 | 0.36 | 0.37 | 0.26 | 0.38 | 0.31 | 0.4 |
| | **2014** | 0.35 | 0.3 | 0.32 | 0.29 | 0.39 | 0.33 | 0.28 | 0.28 | 0.29 | 0.24 |
| | **Mean** | **0.34** | **0.32** | **0.28** | **0.29** | **0.33** | **0.30** | **0.23** | **0.28** | **0.27** | **0.29** |
| | | | | | | | | | | | |
| **P %** | **2016** | 0.12 | 0.14 | 0.16 | 0.15 | 0.20 | 0.17 | 0.20 | 0.17 | 0.14 | 0.16 |
| | **2015** | 0.2 | 0.23 | 0.2 | 0.22 | 0.2 | 0.19 | 0.22 | 0.19 | 0.18 | 0.19 |
| | **2014** | 0.15 | 0.13 | 0.13 | 0.16 | 0.16 | 0.12 | 0.13 | 0.13 | 0.13 | 0.15 |
| | **Mean** | **0.16** | **0.17** | **0.16** | **0.18** | **0.19** | **0.16** | **0.18** | **0.16** | **0.15** | **0.17** |
| | | | | | | | | | | | |
| **K %** | **2016** | 1.02 | 1.05 | 1.06 | 0.95 | 1.35 | 0.99 | 1.02 | 0.92 | 0.89 | 0.85 |
| | **2015** | 0.9 | 0.81 | 1.07 | 0.99 | 0.83 | 0.85 | 0.85 | 1.04 | 1.09 | 0.79 |
| | **2014** | 1.22 | 0.97 | 0.85 | 1.1 | 1.21 | 0.95 | 0.81 | 0.99 | 0.96 | 1.03 |
| | **Mean** | **1.05** | **0.94** | **0.99** | **1.01** | **1.13** | **0.93** | **0.89** | **0.98** | **0.98** | **0.89** |
| | | | | | | | | | | | |
| **Mg %** | **2016** | 0.25 | 0.21 | 0.22 | 0.16 | 0.16 | 0.18 | 0.19 | 0.19 | 0.24 | 0.23 |
| | **2015** | 0.32 | 0.37 | 0.28 | 0.3 | 0.28 | 0.34 | 0.28 | 0.29 | 0.29 | 0.4 |
| | **2014** | 0.15 | 0.2 | 0.29 | 0.22 | 0.23 | 0.23 | 0.18 | 0.17 | 0.27 | 0.18 |
| | **Mean** | **0.24** | **0.26** | **0.26** | **0.23** | **0.22** | **0.25** | **0.22** | **0.22** | **0.27** | **0.27** |

## Conclusion

The yield of the corn varieties tested depended much on growing season precipitation. The higher the volume of rainfall, the greater the yield. On the contrary, the higher the precipitation, the generally lower the feed's mineral nutritional content. MARA will continue to test the same varieties in 2017 and 2018. After 5 years a bigger and clearer picture may emerge of the most suitable corn varieties for this region.

**Special thanks to Ron Wieler (Pioneer Seeds), Jerrry Wilnner (Brett Young Seeds) and Bill Letondre (Pickseeds) for providing MARA with seeds for the trials.**

**Canola yield, grain quality and nitrogen use efficiency in Northern Alberta as affected by different nitrogen fertilizers**


## Funded by

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# Canola yield, grain quality and nitrogen use efficiency in Northern Alberta as affected by different nitrogen fertilizers


## Summary

Nitrogen is needed by plants in largest quantities and it costs the most per unit weight, in relation to other nutrient elements. A split-plot field trial with four replications was conducted in 2016 to evaluate yield and nutrient use efficiencies of hybrid canola to Agrotain, ESN, SuperU and urea with and without irrigation. The application of 3.2 inches of irrigation had no significant effect on yield but delayed maturity by 4 days. Days to maturity averaged 96 and was not affected by the type of N fertilizer applied. Yield was reduced when SuperU was broadcasted but not with broadcast Agrotain. Nitrogen uptake was highest in broadcast Agrotain but nutrient use efficiency was least when Agrotain was broadcasted.


## Introduction

Improved nitrogen use efficiency can minimize the amount of nitrogen fertilizer required for optimal crop production, thereby reducing nitrous oxide and other greenhouse emissions (Rochester 2011; David, Xin et al. 2016). Of the major nutrients required by plants, nitrogen is the one required in largest amounts and the cost of nitrogen per unit weight is also the highest. Therefore, improved nitrogen use efficiency is not only beneficial for the environment but can also result in reduced cost of production and higher returns on investment. One way to improve nitrogen use efficiency in canola is the use of cultivars with higher nutrient use efficiencies-NUE (Svcnjak and Rengel 2006). Alternatively, or in combination with cultivars with high NUE, the use of slow release or urease inhibitors products can increase NUE by decreasing nitrogen loss. With funding from the Alberta Canola Producers Commission, MARA started a five-year trial in 2014 to investigate the effects of different nitrogen fertilizers on canola. The fertilizers being evaluated are Agrotain (urea treated with ammonia inhibitors), ESN (urea with polymer coatings), SuperU (urea treated with ammonia and nitrate inhibitors) and untreated urea.

In the absence of adequate soil moisture, uptake of fertilizer applied is reduced. For example, in the trial conducted in 2015, where Mackenzie County recorded severe drought, nitrogen uptake averaged only 37% of the applied N. As a result, irrigation was added to the trial to examine the combined effects of supplemental irrigation and nitrogen fertilizer on canola yield, oil content and nutrient use efficiencies.

**Materials and Methods**

In a split plot study, Invigor L252 hybrid canola was direct seeded at a rate of 5 lbs/ac. The two factors were irrigation (irrigation vs dryland) and 7 fertilizer treatments. The fertilizer treatments were banded Agrotain, broadcasted Agrotain (Agrotain B), banded ESN, banded SuperU and broadcasted SuperU (SuperU B), Urea and a Control (no nitrogen fertilizer). The control treatment was fertilized with phosphorus, potassium, sulphur and zinc, at the same levels as the N fertilized plots but had no N fertilizer (Table1). Fertilizer application was based on soil test conducted in early May for each plot (Table 2).

Headline EC fungicide was applied to all the plots at a rate of 0.16 litres per acre at the early bloom stage. Using sub-surface drip lines, 3.2 inches of supplementary irrigation was supplied to the plots in the irrigation treatment. The irrigation was stopped before the end of the scheduled times because the crops started falling. At the flowering stage, topmost portions of 3 randomly selected plants were sent to A & L Lab for tissue analysis. Seed oil content (100 grams) was determined using FOSS Infratec Sofia, a whole grain near infrared spectroscopy analyzer. Simultaneous measurement of soil moisture (SM) and soil temperature (ST) was accomplished with 5TE sensor connected to Decagon Procheck meter. The measurement was done on July 21 and a month later.

The following were calculated based on tissue N content, yield and N applied:

Agronomic nitrogen use efficiency (ANUE) was calculated as

$$\frac{\textbf{\textit{Yield of fertilized plots} - \textit{Yield of Control plots}}}{\textbf{\textit{N fertilizer applied}}}$$

Grain nitrogen uptake (GNU) was calculated as

$$\frac{\textbf{\textit{Percent Nitrogen in grain x Grain yield}}}{\textbf{100}}$$

Internal nitrogen utilization efficiency (INUE) was determined as

$$\frac{\textbf{\textit{Grain yield}}}{\textbf{\textit{Nutrient uptake}}}$$

Apparent nitrogen recovery (ANR) was calculated as

$$\frac{\textbf{\textit{Nitrogen uptake in Nfertilized plots} - \textit{Nitrogen uptake of control plots}}}{\textbf{\textit{Nitrogen applied}}}$$

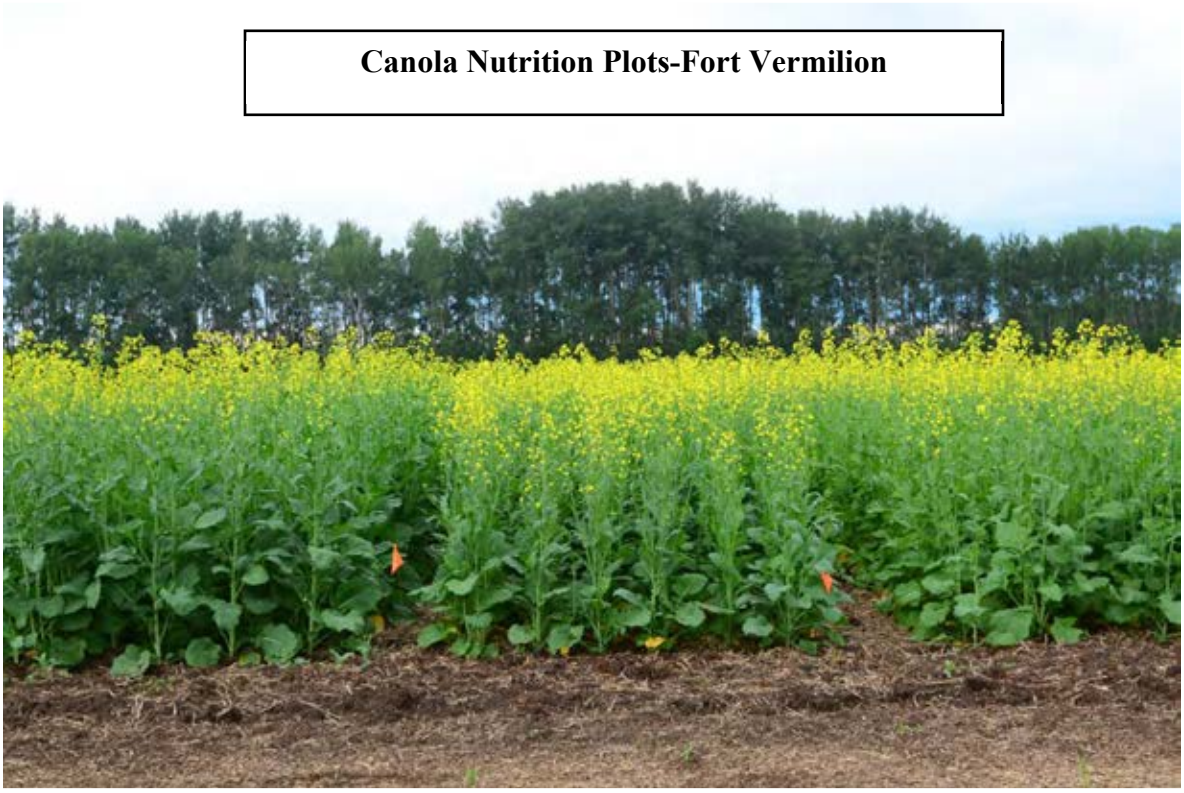
Table 1: Materials and methods-Canola nutrition-irrigation trial 2016

| | |
|---|---|
| Trial location | Fort Vermilion, Alberta (58.3875813,-116.066707) |
| Previous crops | Field peas (2015) |
| Pre-seeding weed control | Pardner (0.48 litre/ac) + Roundup Weathermax (0.33 l/ac) |
| Seeding date | May 18 2016 |
| Harvest date | August 29 2016 |
| Experimental design | Split-plot design, Irrigation (whole plot) and Nitrogen fertilizer (sub-sub plot). Each plot area 7.5 $m^2$ or 80 $ft^2$ |
| Number of replications | 4 |
| Seeding method | Direct seeding with 6 row 8-inch spaced Fabro seeder |
| Fertilizer applied | 30 P, 20 K, 20 S, 5 Zn (actual lbs/ac). For N, refer to Table 2 |
| In crop weed control | Lontrel 360 (0.25 l/ac) + Poast Ultra (0.18 l/ac) + Merge (0.4 l/ac) |
| Source of irrigation water | Snow melt and run-off water in dugout |
| Irrigation method | Surface drip with pressure regulated drip lines |

Table 2: Nitrogen fertilizer applied based on target actual N of 140 lbs/ac

| Irrigation | N Fertilizer | N in soil before seeding (lbs/ac) | Actual N applied (lbs/ac) |
|---|---|---|---|
| Irrigated | Agrotain | 15.33 | 124.67 |
| Irrigated | Agrotain B | 17.33 | 122.67 |
| Irrigated | Control | 14.00 | |
| Irrigated | ESN | 14.00 | 126.00 |
| Irrigated | SuperU | 16.67 | 123.33 |
| Irrigated | SuperU B | 14.00 | 126.00 |
| Irrigated | Urea | 12.67 | 127.33 |
| | | | |
| No-irrigation | Agrotain | 18.00 | 122.00 |
| No-irrigation | Agrotain B | 22.67 | 117.33 |
| No-irrigation | Control | 20.00 | |
| No-irrigation | ESN | 20.67 | 119.33 |
| No-irrigation | SuperU | 18.67 | 121.33 |
| No-irrigation | SuperU B | 22.00 | 118.00 |
| No-irrigation | Urea | 24.00 | 116.00 |

**Canola Nutrition Plots-Fort Vermilion**



**Results and Discussion**

Rainfall from May 1 to September 30th was 202 mm (7.95 inches). The 2016 rainfall was 24 % higher than the 2014 rainfall for the same period and more than doubled that of 2015 (Fig. 1).

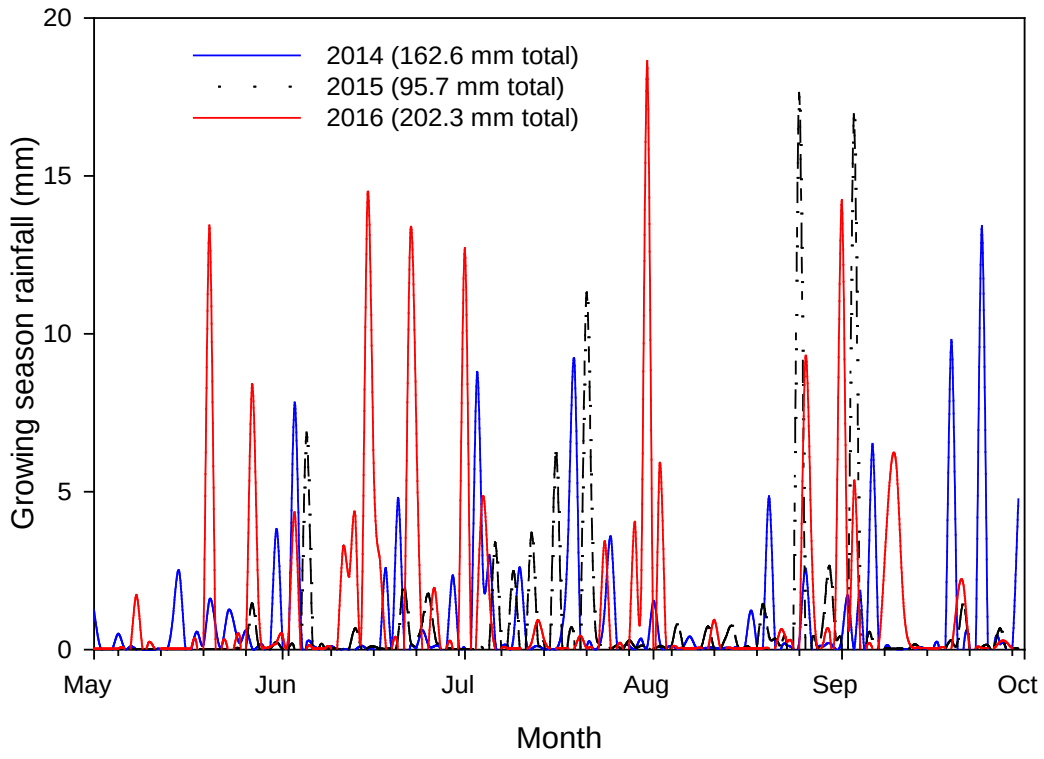



Figure 1: Growing season precipitation from May to September 2014, 2015 and 2016

Volumetric soil moisture measured 4 days after irrigation in July averaged 20 % in the irrigated plots and 5% in the dryland plots (Fig. 2, black bars). Soil temperature at the same time averaged 18 $^{o}$C for the irrigated plots and 23 $^{o}$C for the dryland plots. Soil moisture and temperature measured on August 21 averaged 6 % and 13 $^{o}$C for the irrigated plots. This was approximately the same for the dryland plots (Fig. 2, red bars).

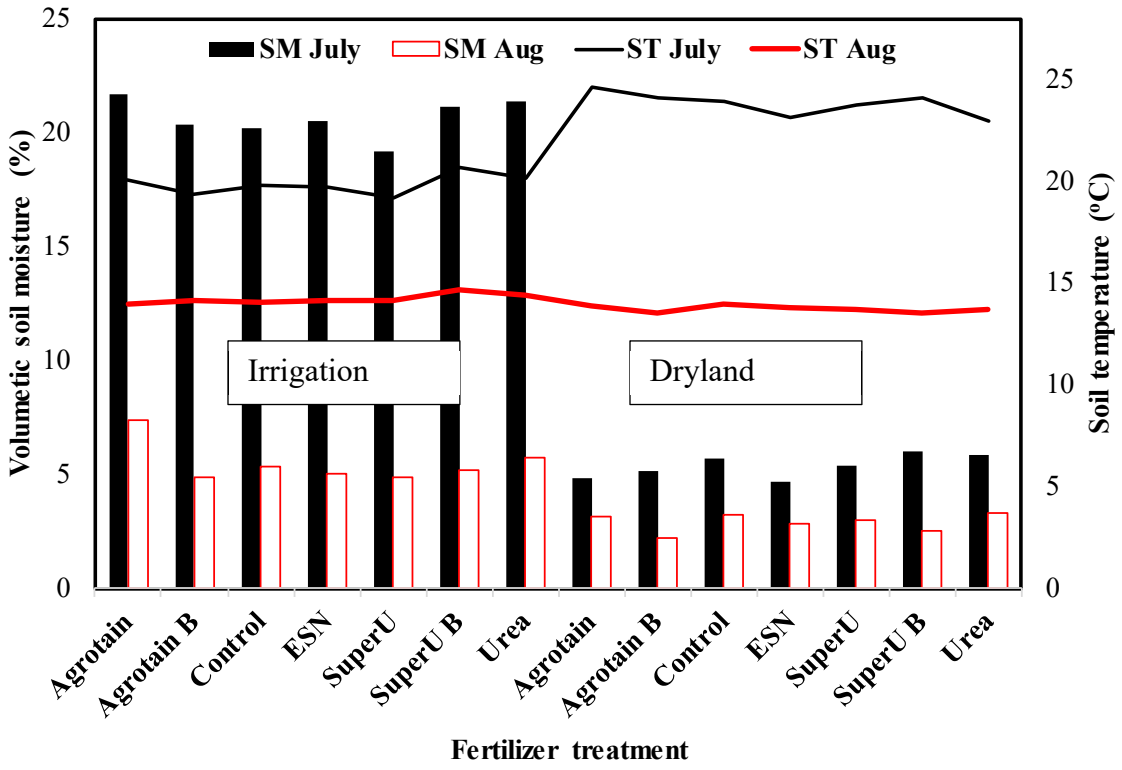



Figure 2: Volumetric soil moisture (SM) and soil temperature (ST) measured in July

Irrigation alone had no effect on height of the canola plants. The interactive effect of irrigation and N fertilizer on height was however, significant (Fig. 3). Banding Agrotain under irrigation resulted in significant height growth (Fig. 3). Mean plant height was 135 cm (~53 inches).

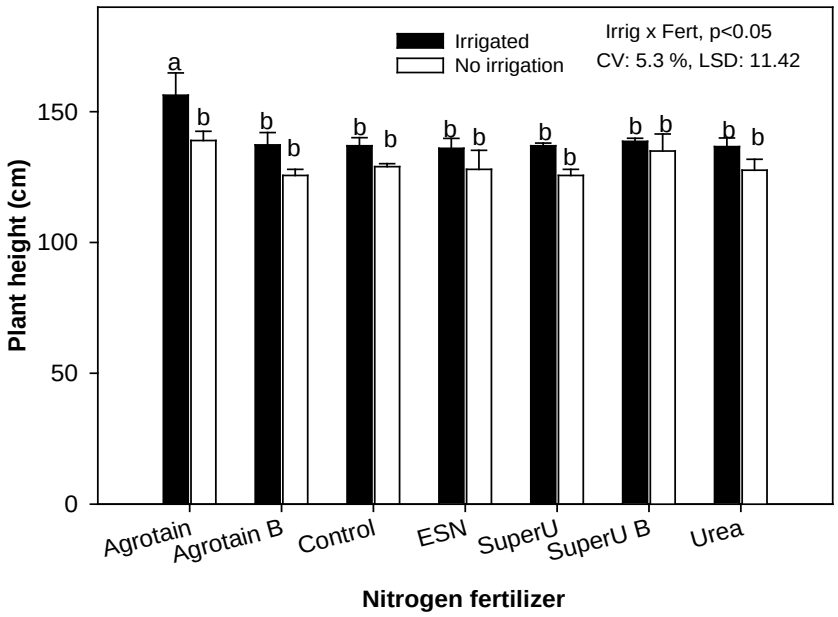



Figure 3: Height response of Invigor L252 canola to different nitrogen fertilizer types and irrigation. Each bar represents the mean of four replications.

Days to maturity averaged 96 and was not affected by the type of N fertilizer applied. However, irrigation delayed maturity by 4 days (98 vs 94 days).

Irrigation increased yield by 4 bushels per acre but that was not statistically different from non-irrigated crops. Yield statistically differed with the type of N fertilizer applied (Fig. 4). Of the fertilized plots, broadcasted Agrotain produced the highest yield, though the mean was not statistically different from plots fertilized with banded Agrotain, urea and banded SuperU (Fig. 4). Within the fertilized plots, yield was lowest in broadcasted SuperU and ESN (Fig. 4). Overall, the non-N fertilized control plots had the least yield.

Comparing yield from the previous years, the 2016 crops yielded the highest (55 bu/ac), compared to the 42 and 37 bu/ac in 2014 (two locations) and 31 bu/ac in 2015 (Table 3). Several reasons might have accounted for this: growing season rainfall was highest in 2016 and least in 2015. Secondly, the cultivar used in 2016 differed from what was used in the previous two years and different canola cultivars are known to respond differently to fertilizer treatments (Svcnjak and Rengel 2006). Because the irrigation component of the project only started in 2016, all the comparisons are with data from the non-irrigated crops only (Table 3).

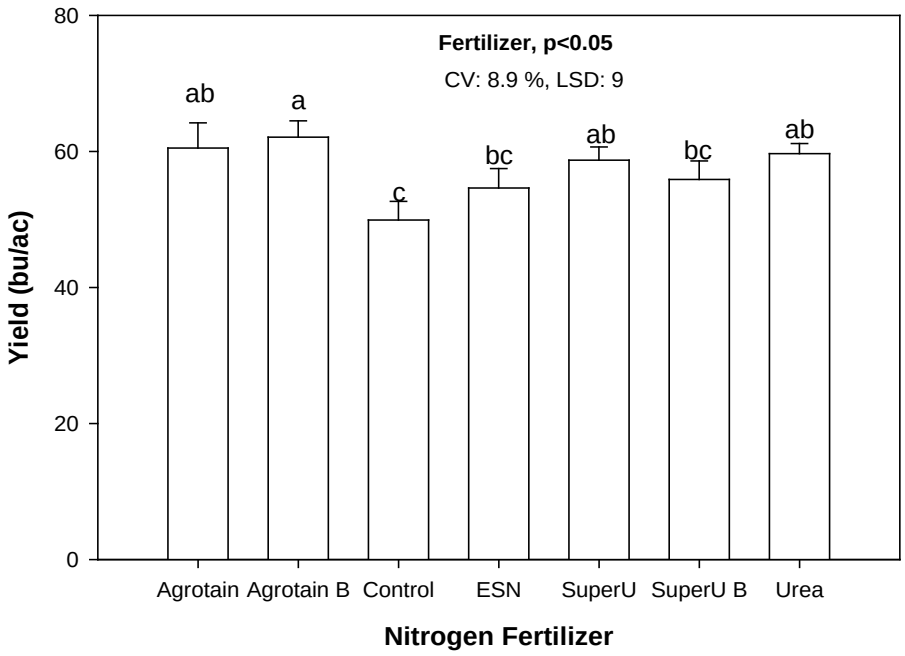



Figure 4: Effects of different nitrogen fertilizers on canola yield (n=6)

Table 3: Comparison of yield, seed oil content and height of hybrid canola fertilized with different nitrogen fertilizers in 2014, 2015 and 2016

| | Year | Agrotain | Agrotain Broadcast | Control | ESN | SuperU | SuperU Broadcast | Urea |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | |
| **Yield (bu/ac)** | 2014-A | 45.58 | 43.74 | 19.78 | 53.84 | 48.58 | 45.96 | 38.41 |
| | 2014-B | 41.9 | 35.99 | 22.28 | 41.15 | 47.88 | 35.25 | 35.25 |
| | 2015 | 45.91 | 15.42 | 15.54 | 60.30 | 34.34 | 23.56 | 22.81 |
| | 2016 | 54.72 | 63.62 | 48.14 | 49.21 | 57.73 | 54.73 | 58.91 |
| ***Mean*** | | ***47.03*** | ***39.69*** | ***26.43*** | ***51.13*** | ***47.13*** | ***39.87*** | ***38.85*** |
| | | | | | | | | |
| **Oil content (%)** | 2014ws | 47.14 | 47.56 | 47.65 | 47.01 | 48.08 | 47.09 | 46.87 |
| | 2014b | 47.93 | 47.61 | 48.31 | 47.99 | 48.25 | 47.47 | 48.55 |
| | 2015 | 42.42 | 40.40 | 41.48 | 43.69 | 40.80 | 41.24 | 40.90 |
| | 2016 | 48.66 | 48.47 | 49.08 | 47.33 | 48.64 | 47.95 | 48.03 |
| **Mean** | | ***46.54*** | ***46.01*** | ***46.63*** | ***46.51*** | ***46.44*** | ***45.94*** | ***46.09*** |
| | | | | | | | | |
| **Height (cm)** | 2014b | 90.0 | 85.3 | 90.0 | 90.9 | 91.8 | 85.1 | 89.7 |
| | 2015 | 65.8 | 62.0 | 66.3 | 62.0 | 69.3 | 65.8 | 62.0 |
| | 2016 | 139 | 125.67 | 129 | 128 | 125.67 | 135 | 127.67 |
| ***Mean*** | | ***98.3*** | ***91.0*** | ***95.1*** | ***93.6*** | ***95.6*** | ***95.3*** | ***93.1*** |

Seed oil content was significantly influenced by N fertilizer and irrigation interaction. Irrigation significantly reduced seed oil content in the control treatment and marginally in banded Agrotain and SuperU (Fig. 5). Overall, seed oil content averaged 48%, similar to 2014 levels but higher than the 2015 levels (Table 3). The 48% seed oil content observed in this study is higher than the 2016 Western Canada average reported by Canada Grains Commission.

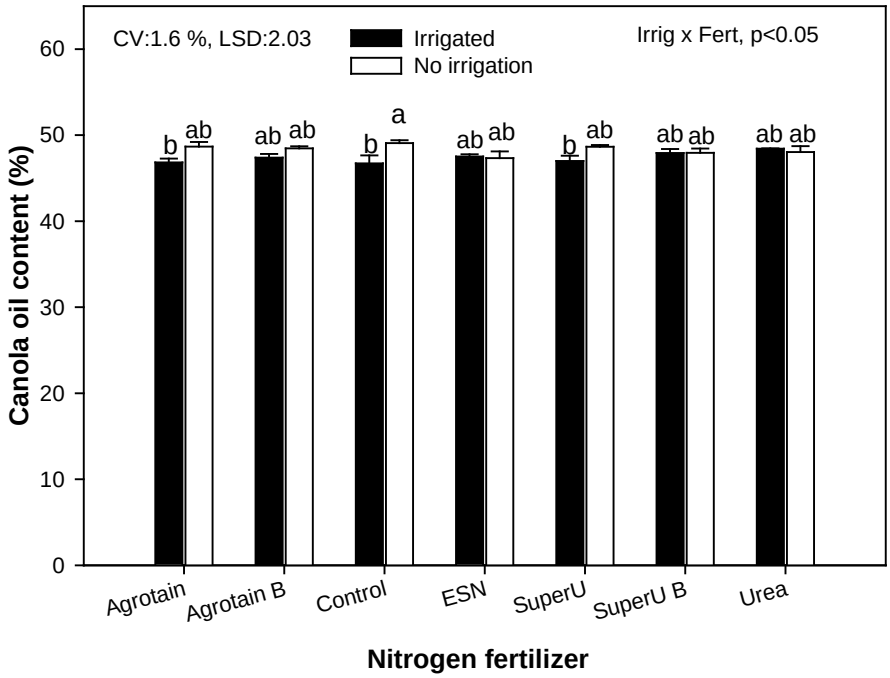



Figure 5: Seed oil content of canola in response to different nitrogen fertilizer types and irrigation. Each bar represents the mean of three replications

Tissue nitrogen content measured at flowering was above 3%, even for the control treatment, which had no application of N fertilizer. Of the N fertilized plots, tissue N content was highest in broadcasted Agrotain and not statistically different in the other treatment combinations. The higher N of plots treated with broadcasted Agrotain is surprising as N uptake and efficiency of broadcasted fertilizer is generally low. Seeding was done when the soil was moist but not wet and few days following seeding, was “perfect rainfall”-not too heavy to cause nitrification or N immobilization but enough to enhance uptake within the top two inches of the soil. That is probably the reason for the higher N content in plants treated with broadcasted Agrotain. Of all the treatments however, tissue N was lowest in control plots, which had no N applied (Fig. 6). According to the Canola

Council, healthy canola plants usually have tissue N content of 2.5% or higher at flowering. Therefore, all the plants in this trial were considered healthy at the tissue sampling time. Irrigation had no significant effect on tissue N concentration.

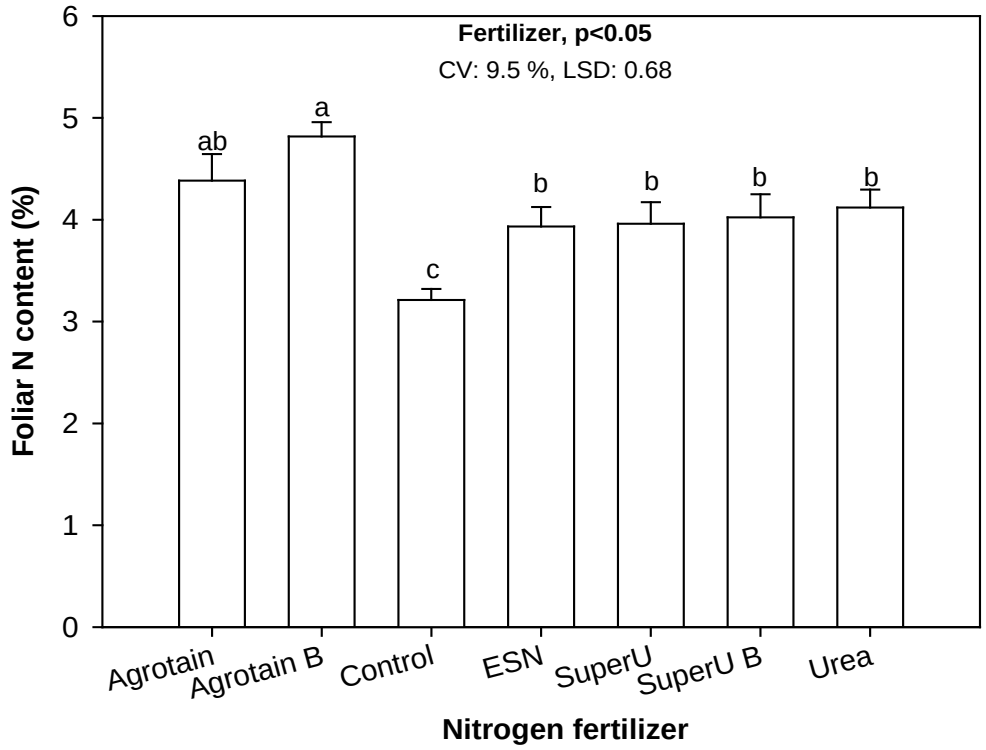



Figure 6: Effects of different nitrogen fertilizers on tissue nitrogen concentration of canola (n = 3)

Nitrogen uptake significantly varied among the different N fertilizer types and with irrigation. N uptake was highest in broadcasted Agrotain, whether irrigated or not. However, without irrigation, banded Agrotain uptake was significantly reduced to the same level as that of the control plots (Fig. 7). Generally, N uptake was higher with irrigation than on dryland. The control treatment had the least N uptake, under both irrigation regimes, but that was not statistically different from dryland ESN, banded Agrotain, SuperU or urea (Fig. 7). N uptake in 2016 averaged 107 lbs/ac compared to 2015's 37 lbs/ac (Table 4).

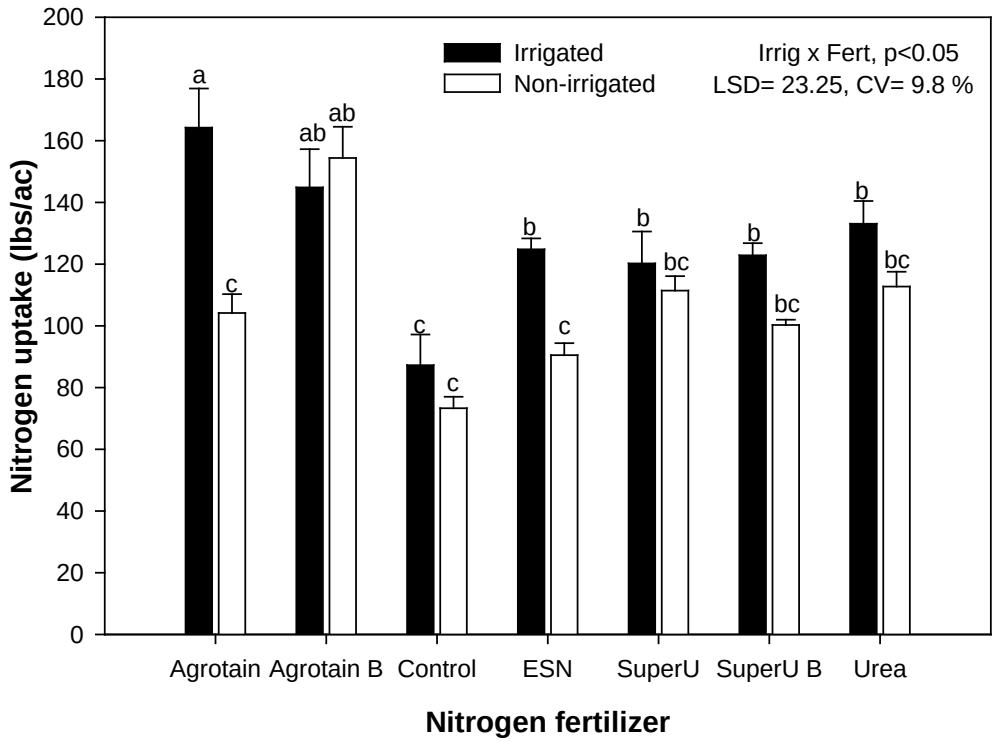



Figure 7: Canola nitrogen uptake in response to different nitrogen fertilizer types and irrigation. Each bar represents the mean of three replications.

According to the Canadian Fertilizer Institute (2001), a bushel of canola seed requires about 2.9-3.5 lbs of N per acre. This was based on data obtained in late 1990s. The International Plant Nutrition Institute in 2014 reported that a bushel of canola removes a total of 2.2 lbs/acre N. In this trial, each bushel of canola removed about 2.1 lb/ac N. The lower N requirement may be due to differences in cultivars and the fact that modern canola hybrids have higher nutrient use efficiencies than cultivars in the 1990s. Further, the variation may be due to the fact that the N uptake data in this trial is from N content at flowering stage and not at harvest while the IPNI and CFI data are based on harvest. The relationship between nutrient uptake and yield was highly positive (Fig. 8). For every 2.1 lb/ac N uptake, yield increased by a bushel until after 140 lbs/ac N. At that point, 2.5 lbs/a N was required for every bushel of grain.

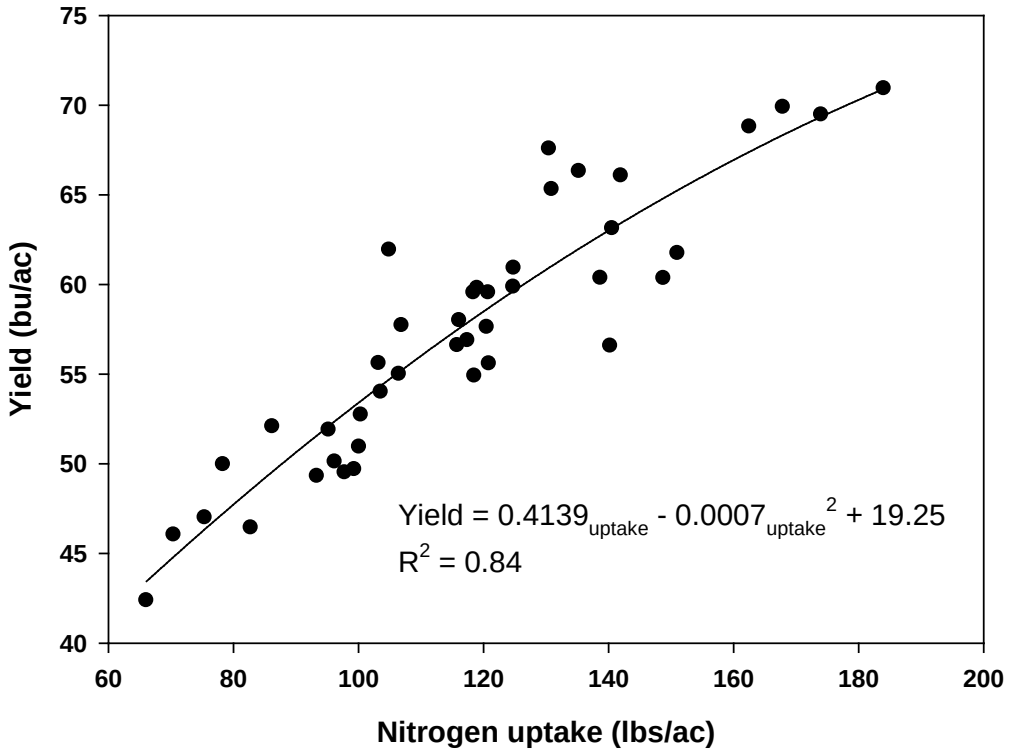



Figure 8: Relationship between canola nutrient uptake and yield

Table 4: Comparison of canola nitrogen uptake and recovery in 2015 and 2016 in response to different nitrogen fertilizers

| **Fertilizer** | **N uptake (lbs/ac)** | | **N recovery (%)** | |
|---|---|---|---|---|
| | **2015** | **2016** | **2015** | **2016** |
| **Agrotain** | 53.88 | 104.17 | 26.73 | 25.26 |
| **Agrotain Broadcast** | 21.65 | 154.38 | 1.94 | 68.94 |
| **Control** | 19.12 | 73.31 | | |
| **ESN** | 62.51 | 90.48 | 33.37 | 14.46 |
| **Super U** | 49.60 | 111.4 | 23.44 | 31.36 |
| **Super U Broadcast** | 26.61 | 100.26 | 5.76 | 22.88 |
| **Urea** | 23.79 | 112.7 | 3.59 | 34.31 |

Apparent nitrogen recovery, which reflects the ability of the plants to acquire nitrogen from the soil was much higher in broadcasted Agrotain (dryland) and banded Agrotain (irrigated) than in the other treatment combinations (Table 4, Fig. 9). We cannot fully explain why irrigation increased N recovery with banded Agrotain but reduced it in broadcasted Agrotain. N recovery depends on the amount of N available and the need of the plant. The fact that the recovery was lower in banded Agrotain (non-irrigated) but higher in broadcast Agrotain (non-irrigated) suggests that plants in the two treatments had different N needs at the time of sampling. Low N rates of recovery suggest that N supply or availability exceeds the plant needs. N application in excess of plant needs can lead to N inefficiencies and that was the case in this study. While agronomic nitrogen use efficiency (ANUE) did not statistically differ among the different N treatments, it was lowest in broadcast Agrotain (10, 18, 5, 18 and 7 % lower than banded Agrotain, ESN, broadcast SuperU, banded SuperU and urea, respectively). Moreover, the ability of the plants to transform acquired nitrogen (internal nitrogen use efficiency) was significantly lower in broadcast Agrotain (Fig. 10). This indicates that though yield and nutrient uptake was highest in broadcast Agrotain, it had the least efficiency in utilizing the nutrients.

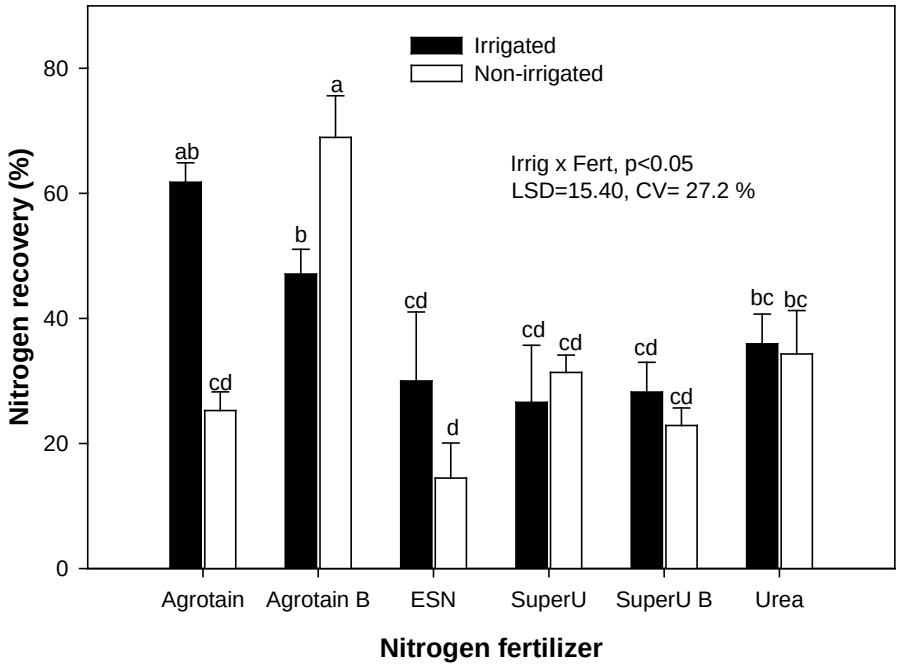



Figure 9: Effects of nitrogen fertilizer types and irrigation on canola apparent nitrogen recovery in (n=3)

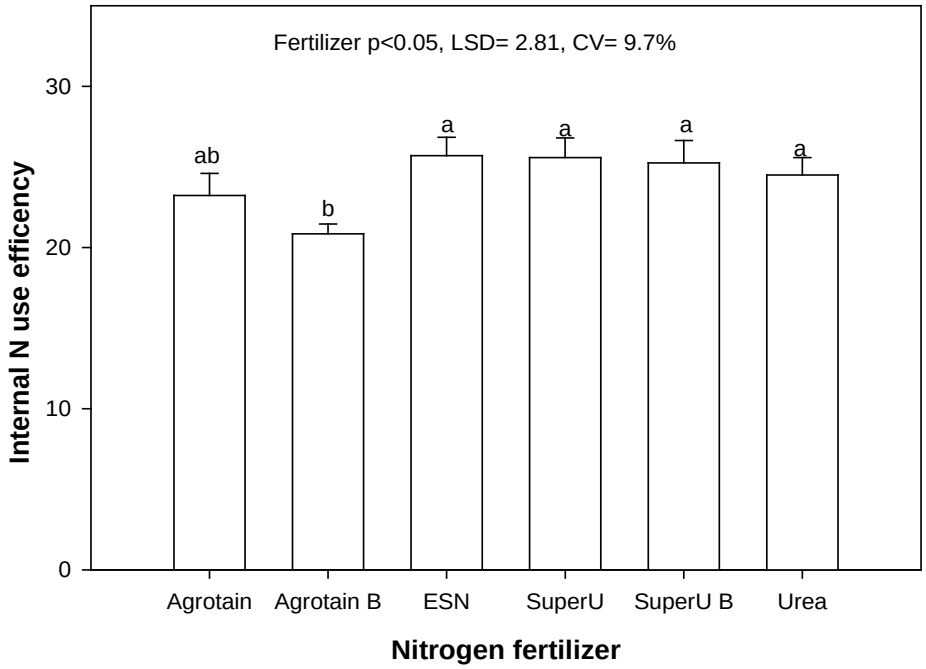



Figure 10: Effects of different nitrogen fertilizers on internal nitrogen use efficiency of canola (n = 6)

**Conclusion**

This trial is the third year of a five-year study. In the first two years, yield was higher in ESN and banded SuperU than in the other treatments. Nitrogen use efficiency during the same period was least when either Agrotain or SuperU fertilizer was broadcasted. In 2015, rainfall during the entire growing season was only 95 mm, resulting in a very low nutrient uptake and nitrogen recovery rates. In 2016, total rainfall and its distribution during the growing season was relatively better than the previous years of the trial and that resulted in significant yield gains. Despite the much higher yield with Agrotain broadcast in 2016, it still had the least nutrient use efficiency. Based on data from 2014-2016, it can be concluded that yield response of Agrotain, ESN, SuperU and Urea is highly dependent on soil moisture availability while the efficiency of those fertilizers depend on both moisture and method of application. The three-year average yield is highest in ESN, followed by banded SuperU and Agrotain, with untreated urea and broadcast Agrotain and SuperU recording almost the same yield. In all the trials, the non-fertilized plots recorded the least yield.

The effect of irrigation was very marginal in this trial, other than delaying maturity. For instance, irrigation alone had no effect on yield and marginally reduced nutrient use efficiency and seed oil content. These might have occurred because rainfall and its timing was almost perfect during the 2016 growing season. In a dry year, the effect of irrigation might have been positively well pronounced. A major change to this study in 2017 will be the use of dosimeter tubes to quantify the amount of N lost following the application of each fertilizer. The tubes were to be used in 2016 but early seeding and delay in receiving them made their use impossible.

**Acknowledgements**

Alberta Canola Producers provided the funds for this project. MARA is very grateful to Mr. Ward Toma of ACPC. MARA received in-kind support from Agrium Incorporated and Koch Agronomic Inc.

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**Effects of irrigation, fungicide and different nitrogen fertilizers on wheat's yield and nutrient use efficiency**

## Funded by

Alberta Wheat COMMISSION

## Additional support from

Alberta Government

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KOCH FERTILIZER CANADA, ULC

**Summary**

Wheat is a major crop in Alberta. The cultivation of wheat requires high amount of nitrogen and water for optimal production. A field study was conducted in Spring-summer of 2016 to assess the effects fungicide application and, six nitrogen fertilizers plus a control treatment on irrigated and dryland CDC Stanley wheat. The application of 4.21 inches of irrigated water resulted in taller crops though this did not translate into higher yield or higher nutrient use efficiency. However, irrigation interacted with nitrogen fertilizer to influence yield: plots without irrigation and treated with urea had reduced yield while the banded Agrotain and the control plots did not respond to irrigation treatment. Plots treated with Agrotain had significantly lower agronomic nutrient use efficiency irrespective of whether irrigated or not. Fungicide has no effect on yield or nutrient use efficiency. Irrigation delayed maturity by 5 days and the use of fungicide slowed maturity by 2 days.

**Introduction**

Wheat is one of the most important grain crops grown in the world for human, livestock consumption and industrial uses. About 30 million tonnes of wheat is produced every year in Canada. Between 2005 and 2015, an average of 8.4 million tonnes of wheat was produced in Alberta, with spring wheat accounting for over 87% of the total. Water and nutrients are two key factors limiting crop production in Alberta, particularly the North Peace region. According to Alberta Agriculture & Forestry, spring wheat requires 420 to 480 mm (17-19 inches) of water per growing season to produce optimally. The 10-year average precipitation in Mackenzie County is significantly less than the amount of water wheat requires. While supplemental irrigation is not a common feature in Mackenzie County's agriculture, recent droughts have prompted its consideration and adoption. Supplemental irrigation can boost wheat production by increasing the amount of water available to the crop at the specific time needed. Nitrogen applied to crops can be lost through ammonia volatilization, resulting in higher N cost to farmers. The use of speciality and slow release efficient nitrogen fertilizers can reduce N loss. With financial support from Alberta Wheat Commission, MARA conducted a field trial to assess the effects of

irrigation and different nitrogen fertilizers on wheat. Because high soil moisture and moist crop environments favour fungi growth, another factor in the trial was the use of fungicides.

**Materials and Methods**

A split-split plot trial was conducted at MARA's Fort Vermilion site from May 17 to August 29 2016. Half of the plots were irrigated while the other half had no irrigation. Within each irrigation treatment, half of the plots received fungicide while the remaining 50% had no fungicide applied. Headline EC, a group 11 fungicide was applied after the flag leaf had fully unrolled. It was applied at a rate of 120 ml/ac. Seven nitrogen treatments were applied to all the plots: Agrotain, ESN, Super U, Urea and a Control (See Fig. 1). Agrotain and Super U were both banded and broadcasted. Agrotain and Super U are from Koch Agronomic Inc while Agrium Inc. manufactures ESN. ESN is urea coated with proprietary polymer to slowly release nitrogen to the plant roots. Agrotain and Super U are chemically treated urea. Agrotain is treated with [(N-n-butyl)-thiophosphoric triamid], a urease inhibitor that minimizes the breakdown of urea molecule into ammonia gas on the soil surface. In addition to having the urease inhibitor, Super U also has nitrification inhibitors (Dicyandiamide). All the plots received the same amount of phosphorus, potassium and sulphur, including the control plots. Fertilizer was banded an inch from the seed row at a depth of 2 inches.

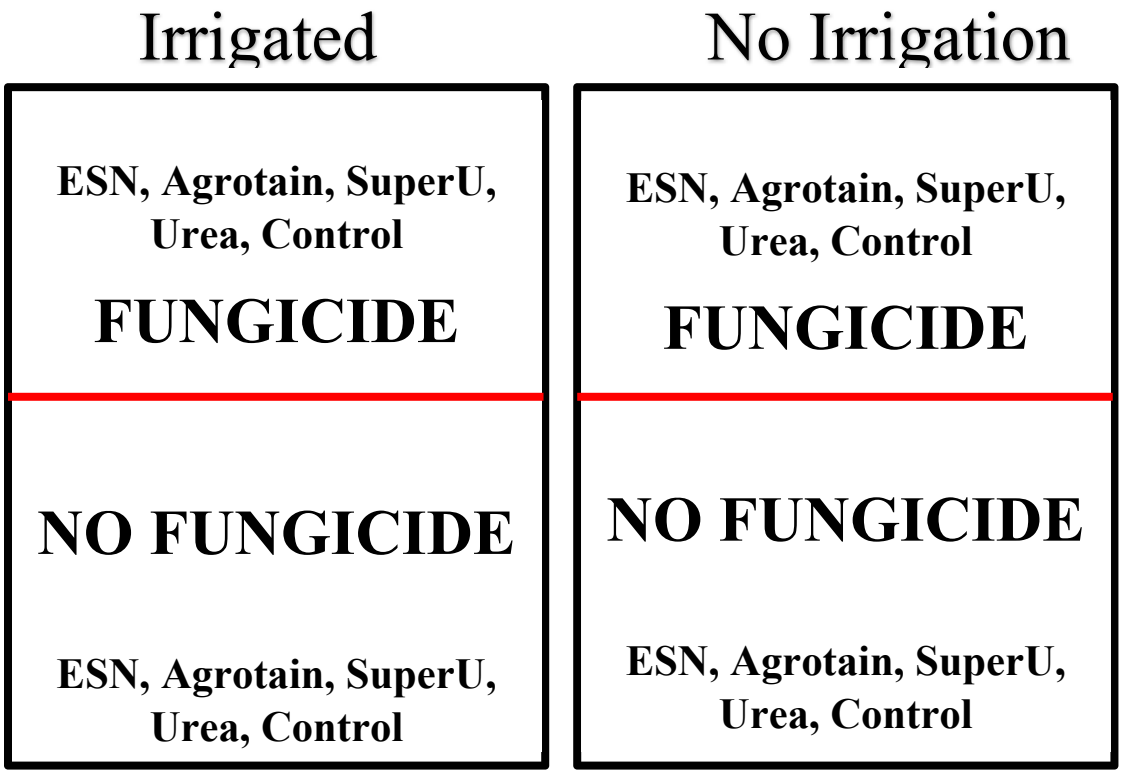


Figure 1: Diagram of the experimental design

Surface drip irrigation was used to supply 4.21 inches (107 mm) of water to the crops. The water supply was dugout water pumped into tanks and then through a series of irrigation lines. Water flow was monitored manually with Netafim 'M' water meters.

CDC Stanley, a hard red spring wheat, was seeded into canola stubble at a rate of 125 lbs per acre. Other materials and methods are summarized in Table 1. Precipitation and temperature data is summarized as Figure 2.

For each treatment combination, 5-10 leaf samples were randomly selected for tissue nutrient analysis. Grain protein content was measured with Foss Infratec Sofia NIR.

For how agronomic nitrogen use efficiency (ANUE), Plant nitrogen uptake, internal nitrogen utilization efficiency (INUE), apparent nitrogen recovery (ANR) were calculated, refer to the canola nutrition chapter.

Table 1: Summary of materials and methods

| | |
|---|---|
| Trial location | Fort Vermilion, Alberta (58.3875813,-116.066707) |
| Previous crops | Field peas (2015), canola (2014), HRS wheat (2013) |
| Pre-seeding weed control | Pardner (0.48 litre/ac) |
| Seeding date | May 17 2016 |
| Harvest date | August 29 2016 |
| Experimental design | Split-split-plot design, Irrigation (whole plot) Fungicide (sub-plot) and Nitrogen fertilizer (sub-sub plot). Each plot area 7.5 $m^2$ or 80 $ft^2$ |
| Number of replications | 4 |
| Seeding method | Direct seeding with 6 row 8-inch spaced Fabro seeder |
| Fertilizer applied | 100 N, 30 P, 20 K, 20 S, 5 Zn (actual lbs/ac). |
| In crop weed control | Infinity FX (0.32 l/ac) + Liquid Achieve (0.20 l/ac) |
| Source of irrigation water | Snow melt and run-off water in dugout |
| Irrigation method | Surface drip with pressure regulated drip lines |

**Results**

Fungicide application had no effect on plant height. The irrigated crops were 5% taller than crops in the dryland treatments and this was statistically significant ($p<0.05$). The control plots which had no nitrogen fertilizer produced the shortest crops, though that was not statistically different from plots that had banded Super U (Fig. 2). The average height of 103 cm observed in this study is higher than the 87 cm provincial average reported by Alberta Agriculture (Agdex 100-32).

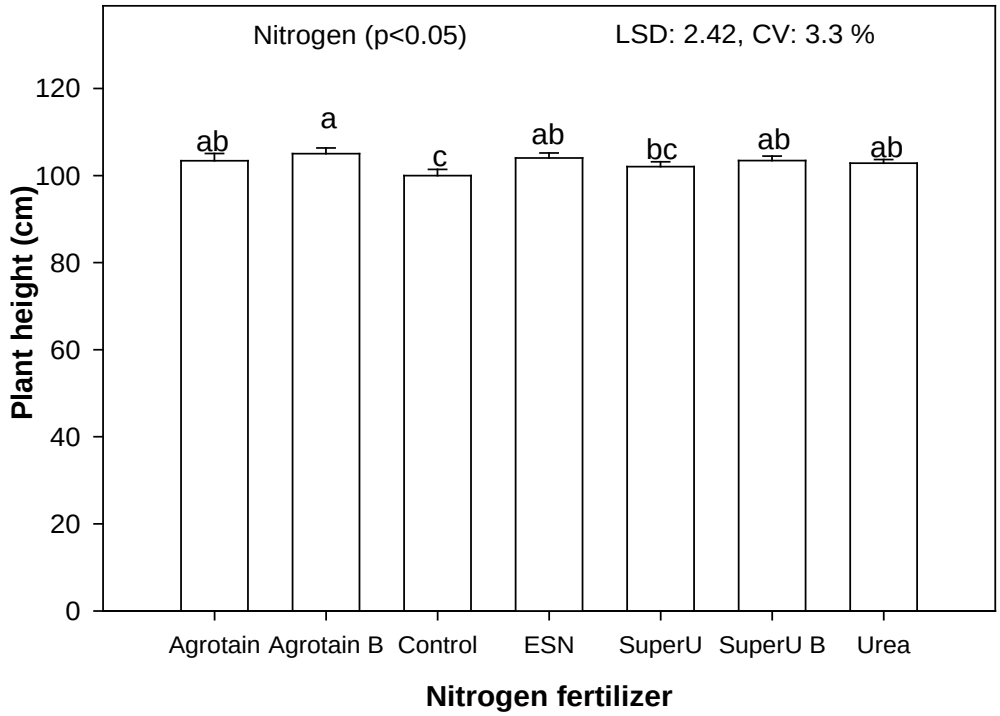


Figure 2: Different nitrogen fertilizer effects on CDC Stanley wheat height. Different letters on the bars indicate statistically significant differences ($p<0.05$). Each bar represents the average of 16 plot data.

Days to maturity averaged 82 days and was influenced by irrigation, fungicide and nitrogen treatments (Table 2). Irrigation delayed maturity by 5 days and the application of fungicide delayed maturity by 2 days. Plots in the control treatments matured the fastest, with no significant difference among the other nitrogen treatments. The combined effect of no irrigation and no fungicide resulted in the earliest maturing crops (78 days). However, not applying fungicide under irrigation resulted in the nitrogen fertilized plots maturing late (85 days).

Table 2: Irrigation, fungicide (F) and nitrogen fertilizer effects on bushel weight and days to maturity of CDC Stanley

| | **Bushel weight (lb/bu)** | | | | **Days to maturity** | | | |
|---|---|---|---|---|---|---|---|---|
| | **Irrigated** | | **No Irrigation** | | **Irrigated** | | **No Irrigation** | |
| | **F** | **No F** | **F** | **No F** | **F** | **No F** | **F** | **No F** |
| **Agrotain** | 57.58 | 56.74 | 59.38 | 59.02 | 85 | 85 | 81 | 78 |
| **Agrotain B** | 58.62 | 57.70 | 59.90 | 59.30 | 83 | 85 | 81 | 78 |
| **Control** | 59.62 | 57.34 | 59.86 | 59.10 | 83 | 85 | 81 | 78 |
| **ESN** | 59.14 | 57.42 | 59.82 | 58.94 | 84 | 85 | 81 | 78 |
| **SuperU** | 58.38 | 58.02 | 60.10 | 59.22 | 85 | 85 | 81 | 78 |
| **SuperU B** | 59.78 | 57.22 | 59.90 | 59.58 | 83 | 86 | 81 | 78 |
| **Urea** | 59.66 | 56.90 | 59.42 | 58.94 | 84 | 86 | 81 | 78 |
| **p<0.05, LSD= 0.966, CV= 1.2 %** | | | | | **p<0.05, LSD= 1.027, CV= 0.8 %** | | | |

Fungicide had no effect on yield (Fig. 3). Irrigation and the form of nitrogen fertilizer interacted to influence yield (Fig. 3). The absence of irrigation reduced yield in plots treated with urea while the banded Agrotain and the control plots did not respond to irrigation treatment. Plots without nitrogen treatment had the lowest yield, though these were not statistically different from banded Agrotain plots (Fig.3). Irrigation alone increased yield by a marginal 3.6 bushels per acre. Under non-irrigated conditions, the average yield of CDC Stanley wheat as reported by Alberta Agriculture is 68 bu/ac. That is less than the 75 bu/ac average observed in this trial. However, it is within the range of 36-81 bu/ac reported across the province.

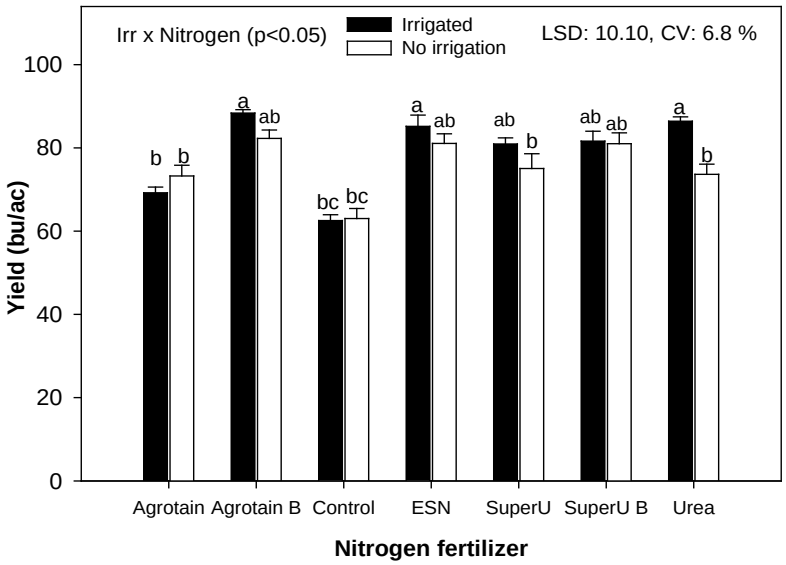


Figure 3: Effects of irrigation and nitrogen fertilizer treatment on yield of CDC Stanley wheat. Each bar represents the average of 6 plots.

Grain protein content, which attracts a premium, averaged 12.2% for the N fertilized plots and 9.5% for the treatments that had no nitrogen application. The type of N fertilizer applied did not influence grain protein content (Fig. 4). The average reported in this study is generally lower than what is previously reported for the variety.

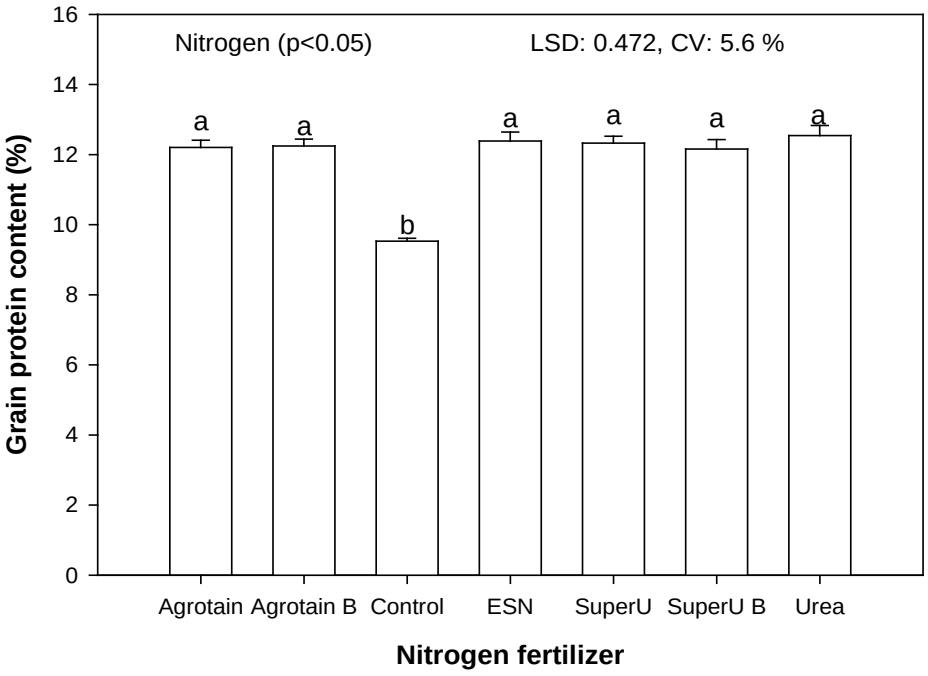


Figure 4: Effects of nitrogen fertilizer treatment on CDC Stanley wheat grain protein content. Each bar represents the average of 16 plots.

Bushel weight (test weight) was influenced by the irrigation, fungicide and nitrogen treatments (Table 2). Averagely, bushel weight was lowest when irrigation was applied without fungicide and the reduction was highest in banded Agrotain and urea (Table 2). The average bushel weight was 59 lb/bu.

The use of supplemental irrigation significantly increased thousand seed weight (TSW) by 4.39 g, the equivalent of 11% over plots not irrigated (44.19 vs 39.8 g). TSW responded differently to the type of nitrogen fertilizer (Fig. 5). Plots treated with broadcasted Agrotain recorded the heaviest TSW, though that was not statically different from plots treated with ESN, urea and broadcasted SuperU (Fig. 5). Banded Agrotain, Super U and control plots had the least TSW (Fig. 5). Fungicide application had no effect on TSW.

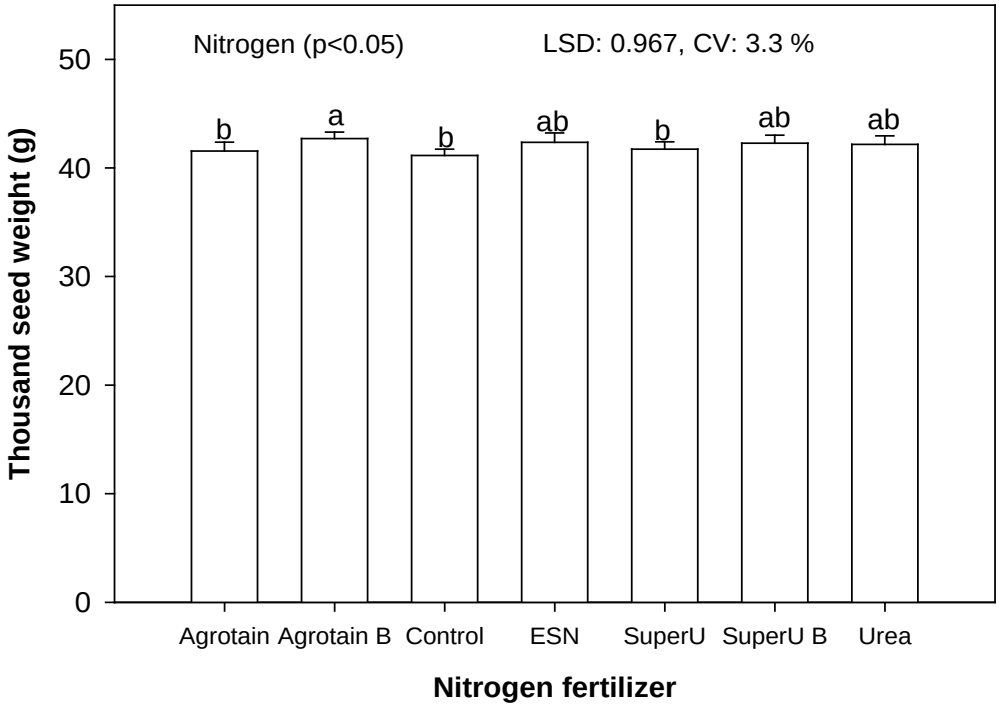


Figure 5: Effects of nitrogen fertilizer treatment on CDC Stanley wheat grain protein content. Each bar represents the average of 16 plots.

Grain nitrogen uptake (GNU) which is the product of grain nitrogen content and grain yield, divided by the amount of nitrogen applied was not affected by the application of fungicide. While irrigation alone had no effect on GNU, the combined effect of nitrogen and irrigation on GNU was statistically significant (Fig. 6). Banded Agrotain under irrigation had statistically lower GNU than the other treatments, though the means were generally similar to treatment combinations except ESN and Urea treated plots under irrigation (Fig. 7). Nutrient uptake in the control plots (not shown in the Fig. 6) was 60 and 62 lbs/ac for the irrigated and non-irrigated plots, respectively.

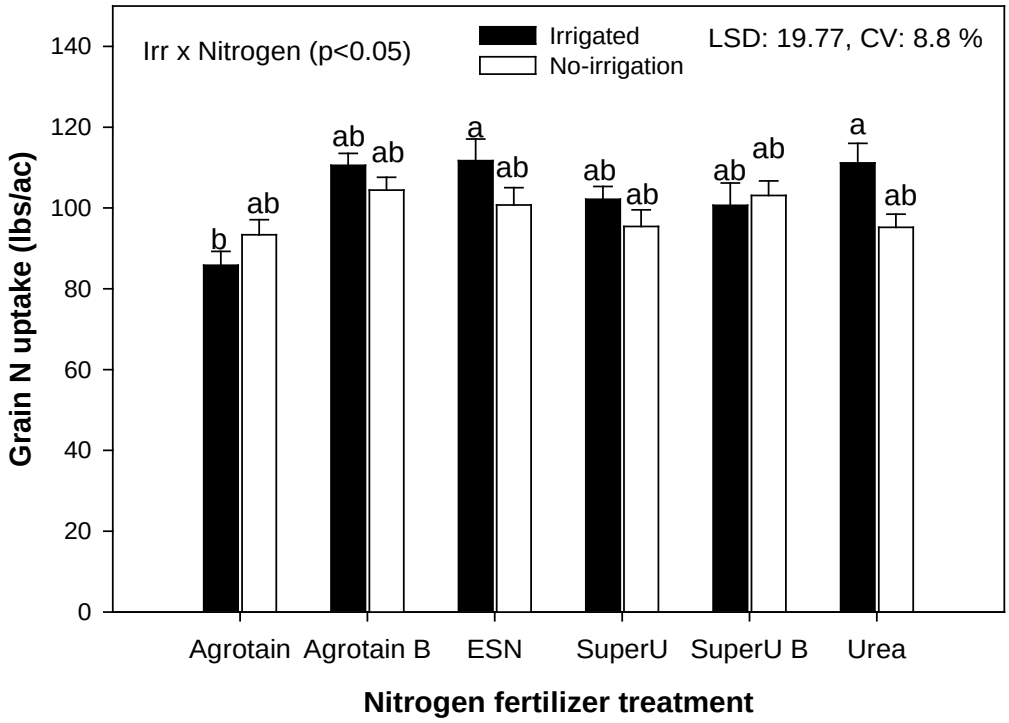


Figure 6: Effects of irrigation and nitrogen fertilizer on grain nitrogen uptake of CDC Stanley wheat. Each bar represents the average of 8 plots.

Agronomic nitrogen use efficiency (ANUE) measures how much productivity is gained per unit nitrogen applied. ANUE was significantly affected by the combined effects of irrigation and nitrogen fertilizer (Table 3). Plots treated with Agrotain had significantly lower ANUE, irrespective of whether irrigated or not. Dryland urea treated crops had significantly reduced ANUE. Overall, Agrotain has the least ANUE and that may be explained by the low apparent nitrogen recovery (ANR) of plots treated with banded Agrotain under irrigation (Table 3). ANR (the amount of applied nutrients taken up by plants) was lowest in Agrotain treated plots, especially when it was banded. In other words, more of the Agrotain applied was not taken up by the plants and either lost or left in the soil unused. Internal nitrogen utilization efficiency (INUE), measures the ability of plants to transform the absorbed nitrogen into economic yield, in this case, wheat grain. INUE did not differ with nitrogen or irrigation. In other words, all the plants, irrespective of the type of the nitrogen applied or level of irrigation had the same ability to transform the absorbed nutrients into grains. The fact that INUE was similar for all the plots suggest that more of the banded Agrotain was lost or remained in the soil rather than being used luxuriously. Fungicide had no effect on ANUE, ANR or INU.

Table 3: Irrigation and nitrogen fertilizer effects on CDC Stanley wheat agronomic nitrogen use efficiency (ANUE), apparent nitrogen recovery (ANR) and internal nitrogen utilization efficiency (INU)

| | **ANUE (lb yield/lb N)** | | **ANR (%)** | | **INUE** | |
|---|---|---|---|---|---|---|
| | ***Irrigated*** | ***No Irrigation*** | ***Irrigated*** | ***No Irrigation*** | ***Irrigated*** | ***No Irrigation*** |
| **Agrotain** | 4.01 c | 6.13 bc | 25.26 c | 30.68 bc | 48.78 | 47.21 |
| **Agrotain B** | 15.5 a | 11.45 ab | 50.03 a | 41.73 ab | 48.21 | 47.38 |
| **ESN** | 13.59 ab | 10.83 ab | 51.16 a | 38.07ab | 46.19 | 48.63 |
| **SuperU** | 11.04 ab | 7.21 b | 41.62 ab | 32.76 bc | 47.76 | 47.20 |
| **SuperU B** | 11.46 ab | 10.78 ab | 40.10 ab | 40.42 ab | 49.42 | 47.25 |
| **Urea** | 14.32 a | 6.37 bc | 50.62 a | 32.54 bc | 47.22 | 46.55 |
| | LSD= 6.90, CV= 29.9% | | LSD= 14.56, CV = 22.2 % | | LSD =6.83, CV= 5.6, (not significant) | |

## General discussion and conclusion

The supplemental application of 4.21 inches of irrigated water to CDC Stanley wheat was less pronounced than the effects of nitrogen fertilizer. In most cases, the effect of irrigation alone was not statistically significant. For example, irrigation alone did not significantly influence yield, change tissue N concentration, N uptake or nitrogen use efficiency, except in combination with nitrogen fertilizer. Nutrient demand of irrigated crops are higher than non-irrigated crops. However, in this trial, the amount of nutrients applied to both irrigated and non-irrigated crops were the same. The effects of irrigation might have been more pronounced if the irrigated crops had received higher nutrients supply. Also the total growing season precipitation of 8 inches and its almost perfect distribution alleviated the effects of moisture stress.

In related studies with canola, banded Agrotain and banded Super U performed significantly better than when broadcasted. However, in this trial with wheat, the reverse occurred. That is because in the previous study with canola, the soil was relatively dried and most of the roots were in the 2 to 4-inch zone in search of moisture. The wheat roots in this study were however, mostly within the moist top 2 inches. Nutrient use efficiency of Super U and urea improved significantly with irrigation and this may indicate that under favourable soil moisture conditions, nitrogen uptake and utilization may increase in some N forms but not all. Depending on funding availability, this trial will be continued in 2017. A major change to the trial would be the use of dosimeter tubes to measure nitrogen loss and varied levels of nitrogen.

## Acknowledgements

Funding for this project was provided by Alberta Wheat Commission. Special thanks to Brian Kennedy of AWC for facilitating this project. Both Agrium Inc and Koch Agronomic Inc provided free fertilizer products.

## Evaluating yield and yield qualities of five wheat varieties commonly grown in Mackenzie County

### Summary

About 8.4 million tonnes of wheat is produced annually in Alberta, with spring wheat accounting for over 87% of the total. In Mackenzie County, almost every conventional producer grows wheat, with hard red spring accounting for the majority. The top five varieties grown in the County are AC Intrepid, CDC Go, CDC Stanley, Stettler and Superb. We conducted a trial with these varieties and compared their yield and maturity data with that of the 2016 RVT Canada Western Hard Red Spring (CWRS) trial.

### Materials and methods

The soil information, seeding conditions and fertilizer treatments are the same as previously described in the Regional Variety Trial section of this report. This trial was technically not part of the RVTs but was set up on one side of the RVTs to allow for comparison. Target seeding density was the same as the RVTs. The 5 varieties: AC Intrepid, CDC Go, CDC Stanley, Stettler and Superb were randomized in 3 replications. A major difference between this trial and the RVTs is that: only certified seeds were used for the RVTs while in this trial, seeds from local producers were used (bin-run seeds). Another difference is the seeding and harvest dates: the 5 varieties were seeded on May 18 and harvested on August 29, 2016 while the CWRS plots were seeded on May 13 and harvested on August 18, 2016.

**Results**

Days to maturity, yield, grain protein content and test weight (bushel weight) of the 5 varieties were statically not different. Average days to maturity was 83 (Table 1). Yield ranged from 80.49 bushels per acre in Stettler to 84.79 bu/ac in Superb. Grain protein content averaged 13.25 %. Height and thousand seed weight (TSW) of the 5 varieties however, differed. AC Intrepid was the tallest variety, followed by Stettler. The difference in height of CDC Go, CDC Stanley and Superb were not statistically different. The weight of thousand seeds of CDC Go and Superb were significantly higher than the other three varieties, though the heavier seeds did not translate into significantly greater yield. This means that the grains on a typical head of CDC Go and Superb were fewer but heavier while the other three varieties had more grains per head but relatively lighter. Because the three most important wheat variables: days to maturity, yield and seed protein content, did not differ among the varieties, producers can select any of them and not see significant yield or quality difference. However, it must be noted that other factors such as resistance to different diseases may vary with the varieties. The degree of resistance to diseases and full grading was not done in this study and those may play a role in varietal selection.

Table 1: Height, yield and grain qualities of 5 hard red spring wheat commonly grown in Mackenzie County

| **Variety** | **Height cm** | **Days to maturity** | **Yield bu/ac** | **Protein %** | **TSW g** | **Test weight lb/bu** |
|---|---|---|---|---|---|---|
| AC Intrepid | **109.00 a** | 83.33 | 84.61 | 13.01 | 40.10 b | 61.19 |
| CDC Go | 96.00 c | 83.00 | 85.20 | 13.70 | **52.27 a** | 61.77 |
| CDC Stanley | 100.67 bc | 83.33 | 86.26 | 13.25 | 41.57 b | 61.35 |
| Stettler | 102.33 b | 83.67 | 80.49 | 13.29 | 43.30 b | 62.31 |
| Superb | 96.33 c | 83.33 | 85.78 | 12.99 | **51.17 a** | 60.92 |
| | | | | | | |
| **Mean** | **100.87** | **83.33** | **84.47** | **13.25** | **45.68** | **61.51** |
| **p<0.05** | **s** | **ns** | **ns** | **ns** | **s** | **ns** |
| **LSD** | **5.17** | **1.06** | **9.11** | **1.35** | **5.86** | **1.04** |
| **CV %** | **2.7** | **0.7** | **5.7** | **5.4** | **6.8** | **0.9** |

Table 2: Comparison of the five local varieties and RVT 2016 entries

| Variety | Height (cm) | Days to maturity | Yield bu/ac | Protein % | TSW g | Test wt lb/bu |
|---|---|---|---|---|---|---|
| AAC Cameron | 91.67 | 84.67 | **84.50** | 14.17 | 42.27 | 62.52 |
| AAC Concord | 90.67 | 84.33 | 73.69 | 13.48 | 39.13 | 61.77 |
| AAC Connery | 79.67 | 84.33 | 70.91 | 15.50 | 39.57 | 59.90 |
| AAC Prevail | 84.67 | 84.67 | 74.69 | 13.24 | 38.77 | 62.58 |
| AAC Redberry | 83.33 | 84.67 | 68.70 | 14.50 | 40.20 | 62.47 |
| AAC Viewfield | 82.00 | 86.00 | 83.90 | 14.57 | 41.17 | 60.52 |
| AC Barrie | 85.00 | 84.00 | 69.38 | 14.70 | 38.47 | 61.72 |
| BW488 | 77.00 | 84.33 | 78.83 | 13.82 | 33.00 | 62.95 |
| BW968 | 73.67 | 84.33 | 79.43 | 13.48 | 38.03 | 63.00 |
| BW971 VB | 76.67 | 84.67 | 70.04 | 14.44 | 40.17 | 63.62 |
| Carberry | 75.67 | 84.67 | 69.43 | 14.28 | 43.10 | 61.88 |
| CDC Bradwell | 82.67 | 84.33 | 82.23 | 13.99 | 36.50 | 62.68 |
| CDC Go | 96.00 | **83.00** | **85.20** | 13.70 | **52.27** | 61.77 |
| Go Early | 86.33 | **83.67** | 71.81 | 14.35 | 38.73 | 60.92 |
| Intrepid | **109.00** | **83.33** | **84.61** | 13.01 | 40.10 | 61.19 |
| PT250 | 81.67 | 84.67 | 70.79 | **15.61** | 38.97 | 62.47 |
| PT588 | 75.67 | 85.00 | 69.22 | 14.14 | 43.63 | 62.58 |
| Stanley | **100.67** | **83.33** | **86.26** | 13.25 | 41.57 | 61.35 |
| Stettler | **102.33** | **83.67** | 80.49 | 13.29 | 43.30 | 62.31 |
| Superb | 96.33 | **83.33** | **85.78** | 12.99 | **51.17** | 60.92 |
| SY Slate | 84.33 | 84.67 | 71.36 | 14.98 | 39.73 | 61.94 |
| SY Sovite | 75.00 | 84.00 | 74.38 | 14.62 | 39.57 | 61.40 |
| SY479 | 92.00 | 85.33 | 73.37 | 14.99 | 38.53 | 61.08 |
| SY637 | 93.67 | 85.00 | 71.15 | **16.00** | 40.87 | 62.52 |
| | | | | | | |
| **Mean** | **86.49** | **84.33** | **76.26** | **14.21** | **40.78** | **61.92** |
| **p<0.05** | **s** | **s** | **s** | **s** | **s** | **ns** |
| **LSD** | **9.75** | **1.51** | **9.44** | **0.91** | **4.04** | **2.06** |
| **CV %** | **6.9** | **1.1** | **7.5** | **3.9** | **6.0** | **2.0** |

When the five “local” varieties were compared with the 2016 CWRS wheat entries, there were significant differences in all the comparisons except test weight (Table 2). AC Intrepid and CDC Stanley and Stettler were the tallest while the shortest cultivar was BW968 (yet to be fully registered). Generally, the local 5 varieties matured earlier than most of the 2016 CWRS entries. Similarly, yields were generally higher in the local 5 varieties than most of the 2016 RVT CWRS entries. However, grain protein content of the 5 local varieties ranked low when compared with the 2016 CWRS RVT entries. Several factors might have accounted for these differences. One of them being inherent varietal differences making most of the 5 local varieties achieve higher yield and relatively lower protein. The chances of all 5 having higher yield with low protein content, and maturing early is highly impossible. The 5 local varieties were in the field for 104 days (seeding to harvest) while the RVT CWRS entries were in the field for 98 days (seeding to harvest). During this period, the 5 local varieties received 157.41 mm of precipitation while the RVT plots had 143.81 mm. Further, between May 13 2016 when the RVT plots were seeded to May 18 when the 5 “local varieties” were seeded, there was no precipitation. However, from the time the RVTs were harvested to the harvesting of the “local varieties” there was 13.6 mm of precipitation. The late August precipitation, which delayed harvesting of the local varieties, might have also contributed to reducing the protein content of these varieties.

We will continue to test the same 5 varieties for the next couple of years to fully evaluate their performance in relation to the RVTs.

***Special thanks to Bill Boese, John Simpson, Greg Newman and Tony Batt for providing the seeds for the trial.***

# Performance of six oats cultivars in Mackenzie County under certified organic conditions

## Introduction

Mackenzie County is home to the largest percentage of Organic producers in Alberta. Most organic producers in the county grow oats, in addition to other crops such as wheat and field peas. Because the use of some external inputs such as chemical fertilizers, which enhance yield, are not allowed in organic production, it is important organic for producers select crop varieties highly suited for their location. With funds from Grain Millers, through the Prairie Organic Grain Initiative (POGI), MARA conducted a field trial in 5 locations within the County. The objective of the trial was to evaluate growth, yield and milling qualities of 6 oats cultivars.

## Materials and Methods

Six oats cultivars: AAC Oravena, CDC Ruffian, CDC Seabiscuit, AC Morgan, OT6007 and Tractor, were grown at five sites within Mackenzie County. These cultivars were selected after stakeholder consultations: local organic farmers, Grain Millers, Organic Alberta and MARA staff. The location and site information are summarized in Tables 1 and 2. All the sites used for the trial are certified for organic production. The area of each plot was 120 $ft^2$ (11.15 $m^2$). Each cultivar was replicated 4 times at every location. Seeding was accomplished with 6 row 8-inch Fabro seeder. Soil tests were conducted on each site prior to seeding and no fertilizer was applied to the crops. Only certified organic seeds were used for the trial. Height was measured at maturity for all the locations except the High Level location where the height was measured at harvest. All the data were analyzed statistically using ANOVA. The data were analyzed two ways: first for all the locations and then individually for each location. For more information on the statistics, please refer to the Regional Variety Trial chapter.

Only growth and yield results are presented here. The milling quality data will be published online when completed.

Table 1: Trial location and site history

| Locations | Seeded on | Harvested on | Site history |
|---|---|---|---|
| Fort Vermilion East (FV East) | 30-May-16 | 13-Sep-16 | Fababean |
| MARA (Research Station) | 30-May-16 | 13-Sep-16 | Fallowed |
| Tompkins | 26-May-16 | 14-Sep-16 | Newly cleared |
| Blue Hills | 26-May-16 | 14-Sep-16 | Oats on oats |
| High Level | 1-Jun-16 | 29-Sep-16 | Field peas |

Table 2: Soil information prior to seeding

| | Blue Hills | | Tompkins | | High Level | | FV East | | MARA | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Depth (inches)** | 0-6 | 6-12 | 0-6 | 6-12 | 0-6 | 6-12 | 0-6 | 6-12 | 0-6 | 6-12 |
| | | | | | | | | | | |
| OM (%) | 4.4 | 1.9 | 12 | 7.6 | 2.8 | 2.1 | 3.2 | 2.5 | 3.2 | 1.7 |
| pH | 7.1 | 7.7 | 7.7 | 8 | 7.6 | 7.9 | 6.7 | 5.3 | 6.3 | 6.9 |
| Cation exchange capacity (meg/100g) | 13.2 | 10.6 | 14.1 | 31.2 | 14.7 | 29.6 | 11.6 | 12.4 | 10.7 | 8.5 |
| Nitrate (lb/ac) | 6 | 4 | 34 | 36 | 24 | 36 | 56 | 48 | 72 | 84 |
| Phosphorus (lb/ac) | 78 | 48 | 24 | 4 | 16 | 8 | 36 | 22 | 62 | 32 |
| Potassium (lb/ac) | 292 | 160 | 136 | 54 | 200 | 166 | 138 | 92 | 220 | 116 |
| Calcium (lb/ac) | 3840 | 3100 | 4320 | 10420 | 4620 | 9660 | 2680 | 1660 | 3060 | 2100 |
| Magnesium (lb/ac) | 480 | 630 | 730 | 1180 | 690 | 1240 | 800 | 1300 | 370 | 450 |
| Sulphur (lb/ac) | 14 | 22 | 38 | 172 | 24 | 46 | 106 | 86 | 18 | 12 |
| Sodium (lb/ac) | 24 | 22 | 38 | 98 | 32 | 72 | 86 | 166 | 24 | 30 |
| Zinc (lb/ac) | 12.4 | 8 | 5.4 | 2.4 | 3.8 | 2.6 | 3 | 2.4 | 10.8 | 6.4 |
| Manganese (lb/ac) | 40 | 26 | 48 | 22 | 44 | 28 | 26 | 20 | 90 | 66 |
| Iron (lb/ac) | 214 | 200 | 156 | 98 | 128 | 100 | 146 | 140 | 160 | 154 |
| Copper (lb/ac) | 0.8 | 1 | 1 | 1 | 1.2 | 1.8 | 0.6 | 0.6 | 1 | 0.8 |
| Boron (lb/ac) | 2.2 | 2.2 | 2 | 1.6 | 1.8 | 1.8 | 1.6 | 1.4 | 1.8 | 1.6 |
| ENR (lb/ac) | 43 | 28 | 112 | 54 | 40 | 33 | 44 | 37 | 44 | 29 |

**Results**

The High Level site received the highest amount of rainfall from May-September 2016. The site had 304.50 mm of precipitation while the Blue Hills site (La Crete data is used) and Tompkins site recorded identical precipitation of ~ 196 mm (Fig.1).

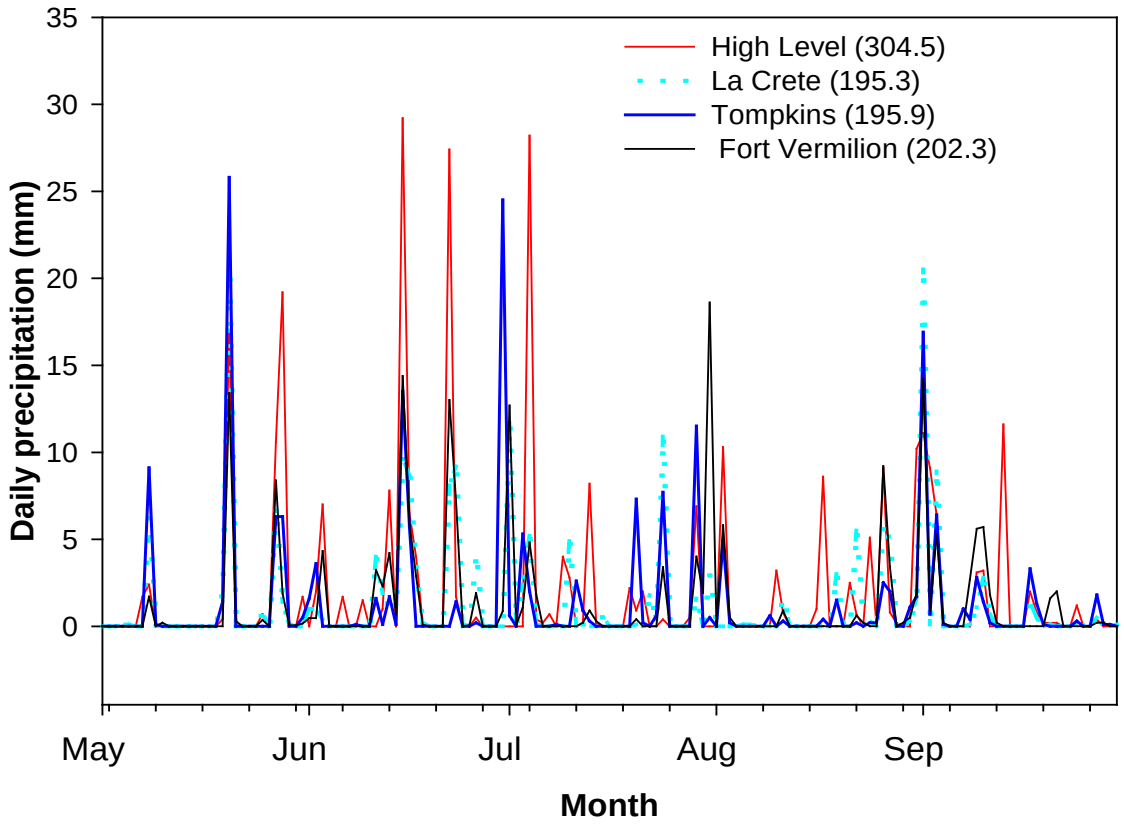


Figure 1: May-September 2016 precipitation data for Fort Vermilion, La Crete, Tompkins and High Level Alberta

**Plant Height**: When data from all the locations were analyzed together, there was no difference among the cultivars. However, there was significant difference with location (Fig. 2). Plants at the High Level site were tallest, followed by the MARA and Tompkins sites. Plants at the Blue Hills site were the shortest

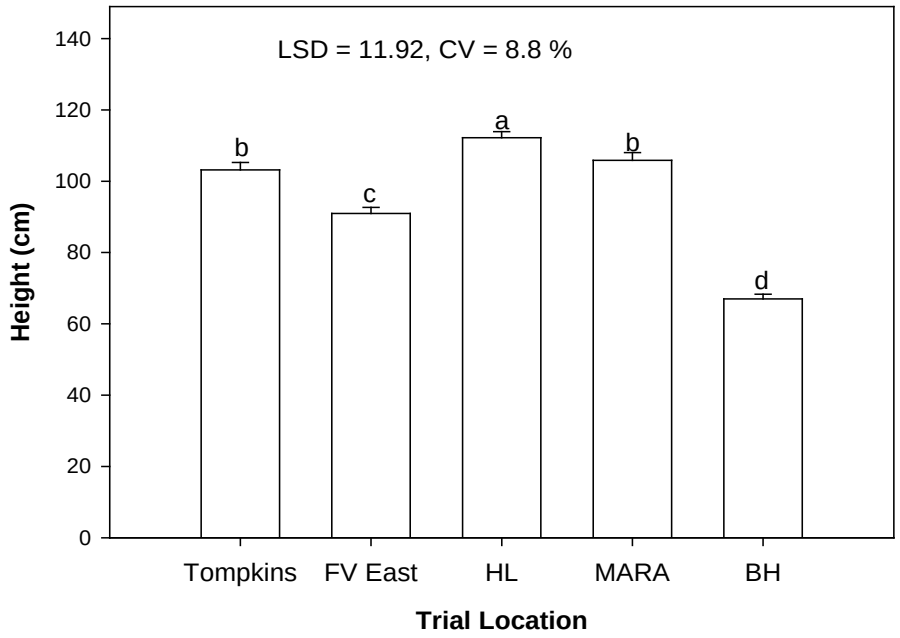


Fig. 2: Height response of organic oats grown at 5 locations in Mackenzie County (n = 24)

Table 3: Height of six oats cultivars grown under certified organic conditions in Mackenzie County

| **Cultivar** | **Height (cm)** | | | | |
|---|---|---|---|---|---|
| | **Tompkins** | **FV East** | **High Level** | **MARA** | **Blue Hills** |
| AAC Oravena | 112.75 **a** | 98.25 | 112.83 | 102.75 | 67.00 |
| CDC Ruffian | 97.92 b | 85.50 | 109.33 | 100.50 | 65.00 |
| CDC Seabiscuit | 106.25 **ab** | 95.75 | 112.00 | 109.00 | 66.00 |
| AC Morgan | 103.00 b | 89.25 | 114.00 | 105.00 | 70.00 |
| OT6007 | 99.58 b | 87.25 | 111.83 | 117.75 | 67.25 |
| Triactor | 99.58 b | 89.75 | 113.25 | 100.00 | 66.75 |
| ***Mean*** | **103.18** | **90.96** | **112.21** | **105.83** | **67.00** |
| ***p<0.05*** | **s** | **ns** | **ns** | **ns** | **ns** |
| ***LSD*** | **9.60** | **11.43** | **12.50** | **13.00** | **10.35** |
| ***CV %*** | **6.2** | **8.3** | **7.4** | **8.2** | **10.2** |
| | *FV East = Fort Vermilion East, MARA = MARA Research Station* | | | | |

When the height data were analyzed for each location, there were cultivar variations but only at the Tompkins site (Table 3). At the Tompkins site, AAC Oravena and CDC Seabiscuit were statistically the tallest plants. Height of plants at the other locations did not differ statistically (Table 3).

**Days to Maturity**: In the County wide combined analysis, OT6007 was the earliest maturing cultivar, followed by AAC Oravena. AC Morgan had the longest maturity date. Overall, plants at the two Fort Vermilion locations matured first (except AC Morgan at MARA's site). Maturity was generally late in the Blue Hills site. No maturity data was collected at the High Level site.

At three of the four locations where maturity date varied with cultivar, OT6007 matured first (Table 4).

Table 4: Days to maturity of six oats cultivars at 4 locations in Mackenzie County

| **Cultivar** | **Days to maturity** | | | |
|---|---|---|---|---|
| | **Tompkins** | **FV East** | **MARA** | **Blue Hills** |
| AAC Oravena | 71.50 **ab** | 63.00 **ab** | 63.25 b | 69.50 |
| CDC Ruffian | 72.25 **b** | 65.00 bc | 70.50 c | 68.50 |
| CDC Seabiscuit | 72.75 **b** | **66.25 c** | 70.75 c | 66.50 |
| AC Morgan | 73.50 b | **67.00 c** | 71.25 c | 68.75 |
| OT6007 | **69.75 a** | **61.00 a** | **58.00 a** | 69.25 |
| Triactor | 72.50 b | 65.75 c | 71.75 c | 69.25 |
| ***Mean*** | **72.04** | **64.67** | **67.58** | **68.63** |
| ***p<0.05*** | **s** | **s** | **s** | **ns** |
| ***LSD*** | **2.03** | **2.37** | **2.50** | **3.04** |
| ***CV %*** | **1.9** | **2.4** | **2.5** | **2.9** |
| | | | | |

Mean yield of the plants ranged from 77.29 bu/ac at the Blue Hills site to 220.27 bu/ac at the Tomkins site (Table 5, Fig. 3). Plots at the Tompkins site had the highest yield, followed by plots at the High Level site. Yield of plants at the two Fort Vermilion sites did not differ statistically (Fig. 3). The Blue Hills site statistically recorded the lowest yield.

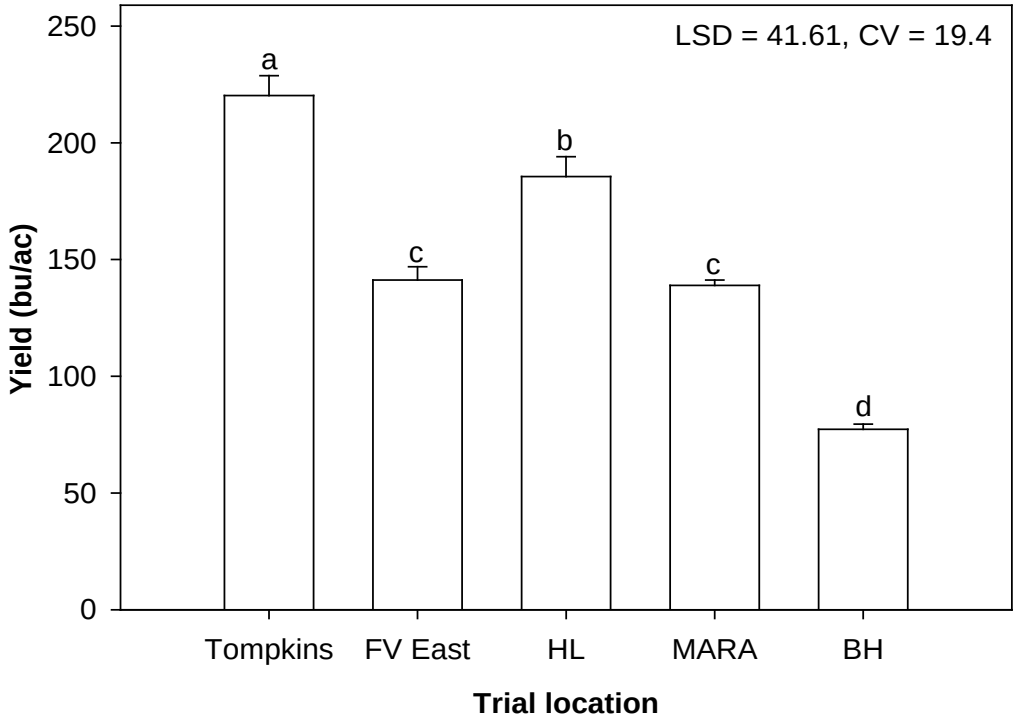


Figure 3: Yield of oats grown at 5 locations in Mackenzie County under certified organic conditions. Each bar represents the mean of 24 plots

For the location specific analysis on yield, the only site where the cultivars had different yield response was at Tompkins (Table 5). At the Tompkins site, AC Morgan, Triactor and CDC Ruffian jointly had the highest yield (Table 5). OT6007 had the least yield.

Table 5: Yield of six oats cultivars grown under certified organic conditions in Mackenzie County

| Cultivar | Yield (bu/ac) | | | | |
|---|---|---|---|---|---|
| | **Tompkins** | **FV East** | **High Level** | **MARA** | **Blue Hills** |
| AAC Oravena | 193.04 bc | 135.96 | 176.85 | 140.00 | 73.08 |
| CDC Ruffian | **240.74 a** | 139.78 | 179.47 | 144.66 | 77.77 |
| CDC Seabiscuit | **229.36 ab** | 149.59 | 162.33 | 136.20 | 66.51 |
| AC Morgan | **233.62 a** | 137.29 | 185.29 | 137.35 | 79.11 |
| OT6007 | 188.92 c | 122.71 | 193.35 | 132.45 | 80.32 |
| Triactor | **235.96 a** | 162.13 | 215.93 | 143.01 | 86.93 |
| ***Mean*** | **220.27** | **141.24** | **185.53** | **138.94** | **77.29** |
| ***P<0.05*** | **s** | **ns** | **ns** | **ns** | **ns** |
| ***LSD*** | **37.61** | **32.06** | **50.22** | **15.93** | **14.94** |
| ***CV %*** | **11.3** | **15.1** | **18.0** | **7.6** | **12.8** |

**Bushel weight:** Of the five locations, the cultivars had varied test weight (bushel weight) only at the Tompkins and MARA sites (Table 6). At the Tompkins site, CDC Ruffian, AC Morgan and OT6007 had the highest test weight with Triactor recorded the least test weight. At the MARA site in Fort Vermilion, test weight was highest in CDC Ruffian and OT6007, with Triactor having the least test weight (Table 6).

Table 6: Test weight of six oats cultivars grown under certified organic conditions in Mackenzie County

| Cultivar | Test weight (lb/bu) | | | | |
|---|---|---|---|---|---|
| | **Tompkins** | **FV East** | **High Level** | **MARA** | **Blue Hills** |
| AAC Oravena | 38.09 bc | 39.94 | 40.68 | 40.02 bc | 38.53 |
| CDC Ruffian | 39.70 **a** | 39.86 | 40.54 | **41.94 a** | 39.49 |
| CDC Seabiscuit | 38.37 **b** | 39.09 | 41.06 | 39.57 cd | 39.62 |
| AC Morgan | **39.82 a** | 39.21 | 40.38 | 39.98 bc | 38.41 |
| OT6007 | **39.78 a** | 41.02 | 40.14 | 40.90 **ab** | 38.17 |
| Triactor | 37.45 c | 38.81 | 39.13 | 38.77 d | 38.17 |
| **Mean** | **38.87** | **39.66** | **40.32** | **40.20** | **38.73** |
| ***p<0.05*** | **s** | **ns** | **ns** | **s** | **ns** |
| ***LSD*** | **0.91** | **1.47** | **1.83** | **1.08** | **1.50** |
| ***CV %*** | **1.5** | **2.5** | **3.0** | **1.8** | **2.6** |

Oats plots- Tompkins, Alberta

## General Discussion and conclusion

The sites used for this trial ranged from newly cleared land to a site which had back to back oats production. Plants at the Tompkins site, which were on newly cleared land were tallest and also produced the highest yield. Though the site had only 34 lbs N/ac, more N might have been released during the growing season because of the site's high organic matter and Estimated Nitrogen Release-ENR). Yield was also higher at sites where management practices have been put in place to restore or improve nutrient status. For example, the two sites in Fort Vermilion were either fallowed or had a faba bean plough down to improve soil nutrient status. Likewise, at the High Level site, field peas were planted the year prior to the trial to help improve soil N levels. These fertility management strategies coupled with the relatively high precipitation (compared to 5 years prior to the trial) contributed to the higher yields. On the site which had continuous oats production for the last couple of years, the yield was less than half of was recorded by the top yielding site.

Yield response of the six cultivars did not vary much throughout the County, varying only at one site. This means organic producers in this region can use any of the six cultivars and not be severely penalized by low yield as long as other conditions are favourable. However, variety selection should not only be limited to yield. In this region where the growing season is short, days to maturity is important. And at most of the locations, OT6007 matured the earliest.

Depending on funding availability, this trial will be continued in 2017. Caution is required in using this data on commercial production basis.

## Acknowledgements

MARA acknowledges the significant support provided by Grain Millers, Organic Alberta, Prairie Organic Grain Initiatives, Sendziak Seeds Farm. Special thanks to Edwin Wieler, Colin Wolfe, John & George Zacharias, Henry and James Thiessen for supporting this project.

# Monitoring Changes in Soil and Crop Yields on Newly Broken Land

## Background

Mackenzie County is one of the few regions in Western Canada where forested land is available for conversion to agricultural use. Many producers opt to manage newly cleared land organically, since the land does not require a multi-year transition period required for organic certification and organic products typically fetch higher prices than conventional. There is interest amongst producers and researchers in understanding how best to manage newly cleared land, and how agriculture changes the soil landscape with time.

A producer in Mackenzie County teamed with MARA to track these changes and monitor the yields of flax, oats, fababeans, field peas, and soybeans. These crops would be rotated in a 4-year cycle. The goal of the project is to track yields and changes in soil nutrient and chemical properties in this newly broken land over multiple years of agricultural use under organic conditions.

## Materials and Methods

As of May 2016, the study site had been recently cleared of predominantly aspen poplar trees and black spruce trees. At each depth (0-6 ad 6-12 inches), a composite soil sample was taken from the area where the plots were to be located two weeks before seeding. Five different crops were seeded in small plots (11.1 $m^2$) in random order with three replications (details in Table 1). Post-harvest soil sampling was conducted approximately at the same location as the initial sampling, two weeks after harvest on October 15$^{th}$ 2016.

Table 1: Seeding information

| | |
|---|---|
| Replications | 3 |
| Crops seeded | Prairie Grand flax, AAC Oravena oats, Snowdrop fababean, CDC Meadow Peas, Pekko R2 soybean |
| Site preparations | Tillage and root picking |
| Soil type | Clayey loam |
| Management type | Organic |
| Seeding information | Seeded on May 31st, 2016 with a Fabro plot seeder, 6 seed openers at 8" apart. |
| Harvest | Sept. 13th, 2016 with a Hege 140 plot combine |

**Results and discussion**

Plots were harvested on September 13th 2016, but only oats and peas were harvested, as flax, soybeans, and fababeans were still green and did not mature in time. Moisture and test weight was measured for oats, but there was not enough sample to measure moisture or test weight for peas.

Oat yield averaged 47 bushels per acre, which is 22 bushels lower than the Peace Region average for 2016 (Alberta Agriculture, 2016). The pea yield was extremely low at only 7 bu/ac whereas the Peace Region average for 2016 was 45 bu/ac (Alberta Agriculture, 2016, Table 2). Low yields in these plots were likely due to the late seeding date, and possibly to low nutrient availability.

Table 2: Crop measurements and yield information

| | **Plant height (cm)** | **Yield (bu/ac)** | **Test weight lb/bu)** |
|---|---|---|---|
| Fababeans | 20.0 | n/a | n/a |
| Flax | 25.4 | n/a | n/a |
| Oats | 36.0 | 47.5 | 38.56 |
| Peas | 30.5 | 7.3 | n/a |
| Soybeans | 13.5 | n/a | n/a |

Based on nutrient removal estimates for the four nutrients required in greatest quantities (N, P, K, and S) by field crops in Western Canada (Canadian Fertilizer Institute, 2001), the soil at the start of the 2016 growing season was severely deficient in nitrogen. Using the lower end of the estimated range of nutrient removal, crops grown in this study required anywhere from 62 to 257 lbs/acre of nitrogen (Table 3) but the soil only had about 10 lbs/acre N in the top six inches. While legumes can fix most of their own nitrogen, they still require an initial amount to grow their root systems and first leaves before beginning nodulation. Flax and oats are entirely dependent on N in the soil and therefore, were likely severely limited in growth (Table 4). All other macro and micro nutrients appeared to be non-limiting (Table 4 and 5).

Table 3: Nutrient uptake estimates for field crops in Western Canada (Canadian Fertilizer Institute, 2001)

| **Crop** | **Yield (bu/ac)** | **Uptake (pounds per acre)** | | | |
|---|---|---|---|---|---|
| | | **N** | **P** | **K** | **S** |
| Oats | 100 | 100 - 120 | 16 - 20 | 108 - 133 | 12 - 14 |
| Peas | 50 | 138 - 168 | 16 - 20 | 102 - 125 | 11 - 14 |
| Fababeans | 24 | 257 - 314 | 39 - 47 | 190 - 232 | 12 - 15 |
| Flax | 50 | 62 - 76 | 8 - 10 | 33 - 40 | 12 - 15 |

*Note: Information was not available for soybean.*

Almost all soil nutrient levels increased in both the 0 to 6” layer and at the 6” to 12” depth over the season (Tables 4 and 5). Organic matter was observed to increase in the 0 to 6” layer from 1.7% to anywhere from 2.4 % to 3.8%, and in the 6” to 12” layer from 1.5% to between 1.7% and 4.1% (Table 4). An increase in organic matter between the beginning and end of season was expected, but was not likely due entirely to the growth of agricultural crops. Soil sampling at the beginning of the season had occurred before root picking was finished; the process of root picking may have brought up fine root material to the upper layers of the soil, which increased organic matter content.

Between the beginning and end of the growing season, phosphorus (P) appeared to double or triple for most crops in both the 0 to 6” layer and 6 to 12” layer of the soil. The potassium

content also almost doubled for most crops. All other nutrient levels except for nitrogen, sulphur, and boron increased or remained the same as the initial amount. The increase in nutrient levels could have been due to nutrient release from the breakdown of organic matter residues rather than nutrient uptake by the agricultural crops. Soil pH remained between 6.1 and 6.5 compared to 6.1 at the beginning of the season, in both the top 6 inches and the lower 6 to 12-inch layers indicating no major chemical changes (Table 4).

Table 4: Changes in soil properties between newly broken land, and the same land after one season of growing crops

| | OM | **CEC** | **pH** | **$NO_3$-N** | **P** | **K** | **S** |
|---|---|---|---|---|---|---|---|
| | **%** | **(meq/100g)** | | **Pounds per acre** | | | |
| **Top Soil (0 – 6 inches)** | | | | | | | |
| *Newly broken* | *1.7* | *6.9* | *6.1* | *10* | *46* | *136* | *14* |
| Peas | 3 | 9.7 | 6.3 | 8 | 76 | 238 | 18 |
| Flax | 2.4 | 8.1 | 6.5 | 2 | 84 | 226 | 16 |
| Oats | 3.8 | 9.3 | 6.4 | 8 | 110 | 244 | 12 |
| Fababean | 2.8 | 7.5 | 6.1 | 16 | 80 | 188 | 12 |
| Soybean | 2.4 | 9.2 | 6.0 | 16 | 68 | 248 | 16 |
| | | | | | | | |
| **Sub Soil (6 – 12 inches)** | | | | | | | |
| *Newly broken* | *1.5* | *10.3* | *6.1* | *2* | *16* | *116* | *12* |
| Peas | 3.3 | 9.3 | 6.4 | 4 | 84 | 220 | 16 |
| Flax | 2.2 | 10.3 | 6.0 | 4 | 58 | 260 | 28 |
| Oats | 3.4 | 10.4 | 6.4 | 10 | 58 | 290 | 14 |
| Fababean | 1.7 | 10.5 | 6.1 | 2 | 30 | 222 | 10 |
| Soybean | 4.1 | 9.6 | 6.2 | 12 | 82 | 228 | 14 |

Soil nitrate-N ($NO_3$-N) decreased from 10 lbs/acre to 2- 8 lbs/acre in peas, flax, and oats while $NO_3$-N increased in both fababean and soybean plots to 16 lbs/acre. It is possible that fababean

and soybean plants release more N back into the soil during the season than peas do. Sulfur decreased slightly in the top six inches of the soil with oats and fababeans, and boron also decreased in the top twelve inches of the soil in all crops.

Table 5: Changes in soil micronutrient levels between newly broken and land after the same land after one season of growing crops.

| | **Ca** | **Mg** | **Na** | **Zn** | **Mn** | **Fe** | **Cu** | **B** |
|---|---|---|---|---|---|---|---|---|
| | **Pounds per acre** | | | | | | | |
| **Top Soil (0 – 6** inches) | | | | | | | | |
| *Newly broken* | *1400* | *480* | *16* | *3* | *58* | *184* | *0.6* | *1.4* |
| Peas | 2200 | 640 | 20 | 10.4 | 56 | 198 | 0.6 | 0.4 |
| Flax | 1820 | 480 | 18 | 5.4 | 58 | 228 | 0.6 | 0.4 |
| Oats | 2300 | 490 | 16 | 6.4 | 66 | 234 | 0.6 | 0.4 |
| Fababean | 1660 | 460 | 14 | 5.2 | 68 | 204 | 0.6 | 0.4 |
| Soybean | 2080 | 600 | 22 | 6.2 | 68 | 218 | 0.6 | 0.4 |
| | | | | | | | | |
| **Sub Soil (6 – 12 inches)** | | | | | | | | |
| *Newly broken* | *1760* | *1090* | *26* | *2.6* | *30* | *132* | *0.8* | *1.2* |
| Peas | 2260 | 520 | 16 | 6.4 | 70 | 212 | 0.6 | 0.4 |
| Flax | 2100 | 550 | 22 | 5.4 | 44 | 206 | 0.6 | 0.4 |
| Oats | 2400 | 680 | 18 | 6.8 | 44 | 182 | 0.6 | 0.4 |
| Fababean | 1900 | 1020 | 24 | 3.8 | 66 | 168 | 1 | 0.2 |
| Soybean | 2220 | 610 | 18 | 9.4 | 64 | 194 | 0.6 | 0.4 |

As the soil continues to breakdown the large amount of residue from the new clearing, it is expected that soil nutrient levels will continue to increase. Results from the first year of this study highlight the importance of growing legumes to increase the N levels, which can stimulate microbial activity and increase breakdown of organic residues left over from clearing the land.

## References

Alberta Agriculture and Forestry, Economics and Competitiveness Branch (2016) Alberta Crop Report – Final Report of 2016.

Canadian Fertilizer Institute (2001). Nutrient Uptake and Removal by Field Crops – Western Canada.

## Acknowledgement

**Thank you to the Simpson Family Farm for hosting this trial and to Dr. Tom Jensen at the International Plant Nutrition Institute for guiding us on this project.**

**Matured plots at the research site**

# MARA Participatory Wheat and Oat Breeding Project

**What is the Producer Participatory Breeding (PPB) Program all about?**

The Participatory Breeding Program is run out of the Natural Systems Agriculture Lab at the University of Manitoba. The program is about developing better crop varieties suited to the needs of organic producers. Organic producers have extra vulnerabilities when it comes to soil nutrient deficiencies, weed pressure, insect pests, and disease pressure. Past research indicates varietal performance increases in organic systems if the variety was actually bred in an organic system. The participatory breeding program was started to develop crop varieties better suited to the conditions of organic farmers.

In traditional breeding programs, the breeders select the parent varieties, cross those varieties, and then select the offspring plants. Next, breeders test those new lines for agronomic performance before registering the lines as new varieties.

In the participatory breeding program, the farmers and researchers decide on the parent lines, then the researchers cross the parent lines (F1 generation) and increase seed from that cross (F2 generation). The seed is sent to producers and grown at their farms under their local conditions. The producers make the selections (about 300-500 plants from each cross), and send the selected plant seeds back to the researchers who thresh the seed. The researchers send back the threshed seed to the farmers who grow and make selections on the next generation (F3-F6). After several years of this process, the researchers compare plants grown from the final selection by the producers with registered varieties.

**MARA's Role**

For the past three years, MARA has been an active participant in both the wheat and the oat breeding program. MARA grows three oat crosses and three wheat crosses at our experimental farm, and has been coordinating the delivery of oat crosses to other producers in the area. In 2016, MARA facilitated the participation of 5 other producers participating in this program from High Level, Fort Vermilion, La Crete area, and Blue Hills. MARA staff seeded three plots each 120 $ft^2$ of oat crosses at each participating location using our small plot seeder, and in some cases, assisted producers in making selections.

**Selection Criteria**

In 2016, MARA selected wheat plants based on spike size, early maturity, and resistance to loose smut. Oat plants were selected based on panicle size, maturity, and straw strength. The participating producers primarily made their selections for oat crops based on panicle size, some also selected based on maturity, height, and disease pressure.

**Results**

So far, University of Manitoba researchers have only conducted a comparison between producer-selected lines and registered varieties for wheat, but they are working on a similar study for oats. From the wheat trials, researchers compared early season vigor, days to maturity, plant height, lodging, yield, disease resistance, and thousand kernel weight between producer selected and registered varieties. Researchers discovered the producer selected plants took on average 4 days longer to mature and were on average 7 cm taller than the registered check varieties. The producer selected lines were also higher yielding at 107% of the registered check varieties, and had better rated early season vigor. The only negative of producer selected varieties was that they tended to lodge more than the conventional varieties (Kirk et. al, 2015).

**What's Next?**

MARA will continue to work with the PPB Program in 2017, facilitating the participation of local producers and the next generations of our own lines.

**References**

Kirk, A., Vaisman, I., Martens, G., Entz, M. (2015) Field performance of farmer-selected wheat populations in Western Canada, University of Manitoba.

**Acknowledgements**: Thank you to our participating producers, John and George Zacharias, Henry and James Thiessen, Colin Wolfe, Edwin Wieler, and Frank Bueckert. We are grateful to Iris Vaisman (Organic Alberta & Prairie Organic Grain Initiative) and Michelle Carkner (University of Manitoba) for facilitating this project.

## Organic Wheat and Oats performance following Tillage Radish cover crop

### Background

Tillage radishes (*Raphanus sativus* L.) are popular cover crop plants, known for their large taproots and vigorous biomass production. Tillage radishes have been found to be effective in alleviating soil compaction and in weed control. However, research on tillage radish performance in Northern Alberta is still limited. The objective of this study was to evaluate if a measurable effect on soil compaction, moisture content, and yield of grain crops could be observed the year following a season of tillage radish cover crops in Mackenzie County, and if this yield effect differed with the length of time the tillage radish grew the previous growing season.

### Materials and Methods

In 2015, MARA conducted a trial with tillage radish seeded on three separate dates and evaluated the feed quality of tillage radish at three different stages of growth (Table 1). This trial took place on MARA's organic-designated land, and for this reason did not receive any fertilizer or chemical pesticide treatments. In 2016, each tillage radish plot from 2015 was divided in half with one side seeded to wheat and the other side seeded to oats (Table 2, Figure 1). Control plots were seeded on land adjacent to the 2015 tillage radish trial which had been left fallow that year.

Table 1: Study design and agronomic details of the 2015 Tillage Radish Trial

| | |
|---|---|
| **Trial location** | Fort Vermilion, Alberta |
| **Previous crop** | Fallow |
| **Experimental design** | Split plot |
| **Treatments** | Seeding Date |
| **Reps** | 3 |
| **Seeding dates:** | June 1$^{st}$, June 22$^{nd}$, July 7$^{th}$, 2015 |
| **Variety:** | Tillage Radish |
| **Seeding rate:** | 11.2 kg/ha (10 lbs/ac) |
| **Terminated:** | October 27$^{th}$, 2015 |

Table 2: Study design and agronomic details of the 2016 Tillage Radish Trial

| | |
|---|---|
| **Experimental design** | Split-split plot |
| **Factors** | Crop type, Tillage Radish Seeding Date |
| **Reps** | 3 |
| **Soil type** | Sandy loam |
| **Soil test** | OM = 3.2%, CEC= 10.7, pH = 6.3, N = 72 lbs/ac, P = 62 lbs/ac, K= 220 lbs/acre, S = 18 lbs/ac, Ca = 3060 lbs/ac, Mg = 370 lbs/ac |
| **Site prep.** | Light cultivation for weed control |
| **Seeding date** | May 31st, 2016 |
| **Variety** | AC Stettler (wheat), AC Morgan (oats) |
| **Seeding rate** | 124 kg/ha (110 lbs/ac wheat), 128 kg/ha ( 114 lbs/ac oats) |
| **Seeding depth** | 1” |
| **Measurement dates** | June 17th (Moisture and Compaction), August 19th (Compaction) |
| **Harvest date** | September 19th, 2016 |

| No TR in 2015 | | | TR in 2015 | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Control - Oats | Control - Wheat | | June 1 TR - Oats | June 1 TR - Wheat | | June 22 TR - Oats | June 22 TR - Wheat | | July 7 TR - Oats | July 7TR - Wheat |

Figure 1: Plot layout for one replicate of the oats and wheat plots grown in 2016

Compaction and soil moisture were measured on June 17th, 2016 and compaction was measured again on August 19th, 2016. Compaction was measured with a Spectrum Soil compaction meter and recorded as the depth (in inches) at which the soil resistance pressure read 300 psi. Soil volumetric moisture was measured with a Procheck soil moisture meter (Decagon Devices, Pullman WA).

Plant height was measured at time of harvest, and plots were harvested with a Hege 140 plot combine harvester. Test weight and 1000 kernel weight were measured post-harvest. Yields were corrected for actual plot length and moisture.

**Results and discussion**

Table 3: Comparison of oat plots following 148 days, 127 days, and 112 days of tillage radish cover crop grown the previous season

| Trt. | VMC (%) | Compaction June (inches to 300 psi) | Compaction August (inches to 300 psi) | DTM | Plant height (cm) | Yield (bu/ac) | Test weight (lb/bu) | TSW (g) |
|---|---|---|---|---|---|---|---|---|
| Control | 14.70 | 3.0 | 12.0 | 73.3 | 104.0 | 122.5 | 39.29 | 35.0 |
| 112 days | 14.80 | 3.4 | 11.1 | 73.3 | 104.0 | 90.4 | 39.05 | 36.9 |
| 127 days | 14.37 | 3.9 | 8.0 | 72.0 | 103.3 | 110.8 | 45.71 | 35.6 |
| 148 days | 13.50 | 3.2 | 8.3 | 72.7 | 102.0 | 99.4 | 44.43 | 43.9 |
| | | | | | | | | |
| **Mean** | 14.34 | 3.4 | 9.8 | 72.8 | 103.3 | 105.8 | 42.10 | 37.9 |
| **Sign.** | ns | ns | ns | ns | ns | ns | ns | ns |
| **LSD** | 1.29 | 1.41 | 6.63 | 2.21 | 5.50 | 51.49 | 12.35 | 16.26 |
| **CV** | 4.5 | 20.8 | 33.7 | 1.5 | 2.1 | 24.4 | 14.7 | 21.5 |
| | | | | | | | | |

*Volumetric water content (VMC), Days to maturity (DTM), Thousand seed weight (TSW)*

Table 4: Comparison of wheat plots following 148 days, 127 days, and 112 days of tillage radish cover crop grown the previous season

| Trt | VMC (%) | Compaction June (inches to 300 psi) | Compaction August (inches to 300 psi) | DTM | Plant height (cm) | Yield (bu/ac) | Test weight (lb/bu) | TSW (g) |
|---|---|---|---|---|---|---|---|---|
| Control | 15.40 | 4.3 | 13.3 | 68.0 | 86.0 | **50.21 a** | 61.59 | 41.7 |
| 148 days | 15.23 | 3.8 | 12.3 | 68.0 | 89.0 | 31.5 c | 52.77 | 37.7 |
| 127 days | 14.30 | 3.6 | 9.7 | 68.7 | 93.0 | 31.7 c | 52.77 | 39.8 |
| 112 days | 14.17 | 4.2 | 11.0 | 67.7 | 91.3 | 40.4 b | 59.74 | 38.2 |
| | | | | | | | | |
| **Mean** | 14.77 | 4.0 | 11.6 | 68.0 | 89.8 | 38.5 | 56.70 | 39.4 |
| **Sign.** | ns | ns | ns | ns | ns | **s** | ns | ns |
| **LSD** | 1.89 | 1.46 | 5.28 | 1.20 | 6.70 | 6.12 | 12.03 | 8.07 |
| **CV (%)** | 6.4 | 19 | 23 | 0.9 | 3.7 | 8.0 | 10.9 | 10.3 |
| | | | | | | | | |

*Volumetric water content (VMC), Days to maturity (DTM), Thousand seed weight (TSW)*

No differences in compaction, moisture, maturity, plant height, or grain quality were observed in both the wheat and oat crops (Table 3, Table 4). The only significant difference between the treatments was for wheat yield, where the highest yield was actually observed for the control treatment which did not have tillage radish the year before. There was an almost 19 bushel yield difference between the control plots and the two treatments which had previously had tillage radish for 148 days, and for 112 days in 2015 (Table 4).

The large yield difference between these treatments is likely explained by the plots in the 148 day TR and 127 day TR which were heavily lodged at the time of harvest. Although plant height was not statistically different between treatments, the 148 day and 127 day treatments did have higher mean heights and a higher observed lodging than the control.

The soil where this research took place (MARA's organic research site) has high organic matter (3.2%) relative to the average for dark gray soils in the area (where organic matter is usually

between 1% and 2%) and was fallow for several years before the tillage radish experiment. Generally soils with high organic matter tend to have better moisture holding capacity, and better soil aggregate structure (Lickacz & Penny, 2000).

It is possible that no positive yield effect was observed from the tillage radish both because problems with soil structure at the study site were minimal. For higher quality soils, the effect of a tillage radish cover crop may not be as pronounced as for a problem compact soil. MARA intends to keep working with tillage radish in the upcoming season the see if tillage radish can improve soil structure for some of the Experimental Farm's more compact soils.

**References**

Lickacz, J., Penny, D., (2000). Soil Organic Matter, Alberta Agriculture. Agdex 536-1

## Regional Silage Variety Trials (RSVT)

### Summary

MARA for the first time participated in the Regional Silage Variety Trials (RSVT) in 2016. Similar to the grain version, (RVTs), the RSVTs are conducted throughout Alberta. The project is coordinated by Alberta Agriculture and Forestry. RSVTs are mainly funded by Alberta Agriculture. At the provincial level, the aim of the RSVTs is to provide livestock producers, particularly cattle producers, with feed and silage varietal information for comparative analysis. Locally, the specific objectives are

- To provide livestock producers with agronomic data relevant to Mackenzie County
- To familiarize local producers with newly registered annual feed and forage varieties available to them, and
- To contribute local agronomic data to the provincial feed and silage database

In the 2016 RSVTs, MARA participated in the annual barley, triticale and cereal-pea mix components of the larger project.

### Materials and Methods

The site conditions and seeding information is same as previously described in this report for the Regional Variety Trial, with one exception. The cereal-pea mixture received only 50 lb/ac 11-52-0 unlike in the monoculture. Target seeding densities were: Barley: 300 plants/m², Triticale: 370 plants/m². Cereal-pea mixtures were seeded at 50% the cereal rate and 75% the pea rate. Seeded depth and equipment is same as in the RVTs. Each treatment was replicated 4 times and the area of each plot was 11.25 $m^2$ (121 $ft^2$). All the plots were seeded on May 25 2016. No in-crop herbicide was used. Barley was harvested at the soft dough stage while the triticale plots were harvested at the late milk stage. The cereal-pea mixtures were harvested based on the cereal maturity stage. Following harvesting, the samples were to A & L Labs Canada for analysis. Data analysis was done using ANOVA. For further information, please refer to the chapter on RVTs.

## Results

### Trial summary: Silage Barley

Thirteen silage barley varieties were tested as part of the RSVTs. Tonnage ranged from ~5 to 7 tons/ac. Yield did not differ statistically. CDC Austenson had the highest crude protein of 10.43%. Overall, CDC Meredith had the highest relative feed value. Further results are in Tables 1-3.

Table 1: Yield, moisture, crude protein (CP), fibre and relative feed value (RFV) of different silage barley varieties

| **Cultivar** | **Moisture** | **Yield** | **CP** | **ADF** | **NDF** | **TDN** | **RFV** |
|---|---|---|---|---|---|---|---|
| | % | Tons/ac | % | | | | |
| **CDC Austenson** | 67.05 | 5.98 | 10.43 | 23.31 | 38.89 | 70.44 | 169.56 |
| Amisk | 56.50 | 5.56 | 8.36 | 25.14 | 42.98 | 68.92 | 150.40 |
| Canmore | 65.81 | 5.48 | 9.69 | 22.37 | 40.55 | 71.26 | 164.41 |
| CDC Coalition | 59.05 | 6.03 | 7.48 | 24.30 | 40.78 | 68.37 | 159.69 |
| CDC Cowboy | 62.64 | 6.37 | 9.24 | 25.27 | 43.68 | 68.73 | 147.92 |
| CDC Maverick | 63.86 | 6.20 | 7.27 | 27.17 | 44.04 | 67.08 | 143.90 |
| CDC Meredith | 61.77 | 6.55 | 9.06 | 19.60 | 34.94 | 73.68 | 197.08 |
| Champion | 63.07 | 6.87 | 8.93 | 24.11 | 41.90 | 69.75 | 156.68 |
| Claymore | 65.32 | 4.98 | 8.34 | 27.83 | 47.38 | 66.50 | 133.37 |
| Conlon | 56.83 | 5.41 | 7.98 | 24.17 | 42.67 | 69.69 | 153.82 |
| Gadsby | 62.14 | 5.32 | 8.56 | 22.65 | 38.58 | 71.02 | 173.57 |
| Sundre | 64.26 | 6.15 | 9.31 | 23.12 | 39.56 | 70.60 | 167.14 |
| TR13740 | 61.68 | 5.81 | 8.33 | 26.07 | 41.47 | 68.04 | 154.88 |
| | | | | | | | |
| **Significant p<0.05** | | **NS** | **S** | **S** | **S** | **S** | **S** |
| **LSD** | | **1.37** | **1.27** | **3.46** | **3.95** | **2.91** | **19.39** |
| **CV %** | | **16.2** | **10.2** | **9.9** | **6.7** | **2.9** | **8.5** |
| *Check: CDC Austenson. S= Significant, NS = Not significant* | | | | | | | |

Table 2: Mineral content of different silage barley varieties

| Variety | Ca | P | K | Mg | S | Cu | Fe | Mn |
|---|---|---|---|---|---|---|---|---|
| | % | | | | | | | |
| **CDC Austenson** | 0.44 | 0.18 | 1.48 | 0.22 | 0.15 | 2.43 | 117.08 | 38.76 |
| Amisk | 0.47 | 0.20 | 1.71 | 0.14 | 0.13 | 2.13 | 114.43 | 31.76 |
| Canmore | 0.29 | 0.18 | 1.29 | 0.16 | 0.14 | 2.75 | 123.96 | 27.54 |
| CDC Coalition | 0.33 | 0.18 | 1.48 | 0.16 | 0.13 | 2.45 | 140.63 | 32.20 |
| CDC Cowboy | 0.42 | 0.16 | 1.48 | 0.18 | 0.16 | 2.23 | 129.66 | 30.95 |
| CDC Maverick | 0.34 | 0.18 | 1.42 | 0.12 | 0.10 | 1.96 | 107.10 | 28.59 |
| CDC Meredith | 0.28 | 0.20 | 1.15 | 0.15 | 0.13 | 2.80 | 123.10 | 25.23 |
| Champion | 0.39 | 0.16 | 1.50 | 0.17 | 0.15 | 2.14 | 118.02 | 28.92 |
| Claymore | 0.39 | 0.17 | 1.49 | 0.18 | 0.14 | 2.56 | 133.15 | 32.52 |
| Conlon | 0.36 | 0.20 | 1.32 | 0.14 | 0.12 | 2.05 | 155.87 | 30.66 |
| Gadsby | 0.32 | 0.17 | 1.28 | 0.14 | 0.12 | 2.61 | 161.58 | 24.51 |
| Sundre | 0.33 | 0.16 | 1.46 | 0.18 | 0.16 | 2.63 | 103.83 | 27.53 |
| TR13740 | 0.40 | 0.17 | 1.49 | 0.12 | 0.13 | 2.30 | 153.24 | 30.60 |
| | | | | | | | | |
| **Significant p<0.05** | **S** | **NS** | **S** | **S** | **S** | **NS** | **S** | **S** |
| **LSD** | **0.09** | **0.03** | **0.26** | **0.06** | **0.03** | **0.65** | **31.31** | **7.29** |
| **CV %** | **17.4** | **12.1** | **12.6** | **24.3** | **15.5** | **18.9** | **16.9** | **17** |
| *Check: CDC Austenson. S= Significant, NS = Not significant* | | | | | | | | |

Table 3: Energy (digestible energy, metabolizable energy, net energy for lactation, gain and maintenance) values of different silage barley varieties

| Variety | DE | ME | $NE_L$ | $NE_G$ | $NE_M$ |
|---|---|---|---|---|---|
| | Mcal/kg | | | | |
| **CDC Austenson** | 3.10 | 2.54 | 1.62 | 1.04 | 1.76 |
| **Amisk** | 3.03 | 2.49 | 1.59 | 1.00 | 1.72 |
| **Canmore** | 3.14 | 2.57 | 1.64 | 1.07 | 1.79 |
| **CDC Coalition** | 3.01 | 2.47 | 1.60 | 1.02 | 1.74 |
| **CDC Cowboy** | 3.02 | 2.48 | 1.58 | 1.00 | 1.72 |
| **CDC Maverick** | 2.95 | 2.42 | 1.55 | 0.96 | 1.68 |
| **CDC Meredith** | 3.24 | 2.66 | 1.70 | 1.13 | 1.85 |
| **Champion** | 3.07 | 2.52 | 1.60 | 1.02 | 1.74 |
| **Claymore** | 2.93 | 2.40 | 1.53 | 0.94 | 1.66 |
| **Conlon** | 3.07 | 2.51 | 1.60 | 1.03 | 1.75 |
| **Gadsby** | 3.12 | 2.56 | 1.64 | 1.06 | 1.78 |
| **Sundre** | 3.11 | 2.55 | 1.62 | 1.05 | 1.77 |
| **TR13740** | 2.99 | 2.45 | 1.57 | 0.98 | 1.70 |
| | | | | | |
| **Significant p<0.05** | **S** | **S** | **S** | **S** | **S** |
| **LSD** | **0.13** | **0.11** | **0.07** | **0.08** | **0.08** |
| **CV %** | **2.9** | **2.9** | **2.9** | **5.3** | **3.2** |
| *Check: CDC Austenson. S= Significant, NS = Not significant* | | | | | |

**Trial Summary: Cereal-Pea Mix silage**

Nine cereal-pea mixtures were trialed. The cereals were barley (CDC Austenson), oats (CDC Baler) and triticale (Taza). Combining the cereals with peas resulted in generally higher tonnage than in monoculture and mostly higher crude protein but reduced energy values. Details are in Tables 4-6.

Table 4: Yield, moisture, crude protein (CP), fibre and relative feed value (RFV) of different cereal-pea silage varieties

| **Variety** | **Moist** | **Yield** | **CP** | **ADF** | **NDF** | **TDN** | **RFV** |
|---|---|---|---|---|---|---|---|
| | **%** | **tons/ac** | **%** | | | | |
| **CDC Austenson** | 60.81 | 6.63 | 7.90 | 19.89 | 32.55 | 59.79 | 160.94 |
| CDC Austenson/CDC Horizon | 61.33 | 7.12 | 7.52 | 21.70 | 33.51 | 51.42 | 129.61 |
| CDC Austenson/CDC Meadow | 51.70 | 8.52 | 8.26 | 17.13 | 26.43 | 49.96 | 158.06 |
| CDC Baler | 63.09 | 8.85 | 5.88 | 22.11 | 34.81 | 47.13 | 111.65 |
| CDC Baler/CDC Horizon | 64.04 | 8.17 | 7.40 | 20.54 | 30.66 | 44.85 | 118.00 |
| CDC Baler/CDC Meadow | 61.76 | 7.43 | 7.46 | 19.93 | 27.48 | 46.64 | 142.86 |
| Taza | 59.25 | 7.39 | 7.73 | 31.56 | 49.01 | 64.23 | 122.19 |
| Taza/CDC Horizon | 56.83 | 7.61 | 9.05 | 18.76 | 25.74 | 47.47 | 156.98 |
| Taza/CDC Meadow | 60.72 | 7.50 | 8.77 | 19.57 | 29.42 | 52.55 | 149.94 |
| | | | | | | | |
| **Significant p<0.05** | | **NS** | **NS** | **S** | **NS** | **S** | **S** |
| **LSD** | | **2.91** | **2.03** | **4.80** | **2.03** | **7.15** | **22.64** |
| **CV %** | | **26.0** | **17.9** | **15.5** | **17.9** | **15.2** | **11.2** |
| *Check: CDC Austenson. S= Significant, NS = Not significant* | | | | | | | |

Table 5: Mineral content of different cereal-pea silage varieties

| Variety | Ca | P | K | Mg | S | Cu | Fe | Mn |
|---|---|---|---|---|---|---|---|---|
| | % | | | | | | | |
| **CDC Austenson** | 0.28 | 0.16 | 1.36 | 0.13 | 0.11 | 2.21 | 149.09 | 21.00 |
| CDC Austenson/CDC Horizon | 0.44 | 0.13 | 1.63 | 0.14 | 0.11 | 1.88 | 254.68 | 32.45 |
| CDC Austenson/CDC Meadow | 0.50 | 0.11 | 1.23 | 0.14 | 0.09 | 1.55 | 155.90 | 27.44 |
| CDC Baler | 0.30 | 0.15 | 2.12 | 0.12 | 0.11 | 1.68 | 134.41 | 64.39 |
| CDC Baler/CDC Horizon | 0.43 | 0.14 | 1.68 | 0.14 | 0.10 | 2.04 | 173.85 | 48.09 |
| CDC Baler/CDC Meadow | 0.55 | 0.13 | 1.68 | 0.16 | 0.10 | 1.79 | 250.56 | 48.03 |
| Taza | 0.26 | 0.21 | 2.31 | 0.08 | 0.11 | 1.86 | 192.41 | 56.90 |
| Taza/CDC Horizon | 0.73 | 0.14 | 1.35 | 0.15 | 0.09 | 1.70 | 230.86 | 42.39 |
| Taza/CDC Meadow | 0.59 | 0.17 | 1.26 | 0.15 | 0.10 | 2.25 | 178.02 | 42.88 |
| | | | | | | | | |
| **Significant p<0.05** | **S** | **S** | **S** | **NS** | **NS** | **NS** | **NS** | **S** |
| **LSD** | **0.19** | **0.04** | **0.44** | **0.06** | **0.04** | **0.63** | **97.91** | **17.19** |
| **CV %** | **28.9** | **18.3** | **18.4** | **28.9** | **24.5** | **23.0** | **35.0** | **27.6** |
| *Check: CDC Austenson. S= Significant, NS = Not significant* | | | | | | | | |

Table 6: Energy values of different cereal-pea silage varieties

| **Variety** | **DE** | **ME** | **$NE_L$** | **$NE_G$** | **$NE_M$** |
|---|---|---|---|---|---|
| | | | | | |
| **CDC Austenson** | 2.63 | 2.16 | 1.29 | 0.82 | 1.41 |
| CDC Austenson/CDC Horizon | 2.26 | 1.86 | 1.06 | 0.63 | 1.15 |
| CDC Austenson/CDC Meadow | 2.20 | 1.80 | 1.00 | 0.62 | 1.09 |
| CDC Baler | 2.07 | 1.70 | 0.95 | 0.55 | 1.02 |
| CDC Baler/CDC Horizon | 1.97 | 1.62 | 0.88 | 0.50 | 0.95 |
| CDC Baler/CDC Meadow | 2.05 | 1.68 | 0.92 | 0.54 | 1.00 |
| Taza | 2.83 | 2.32 | 1.46 | 0.86 | 1.58 |
| Taza/CDC Horizon | 2.09 | 1.71 | 0.98 | 0.59 | 1.06 |
| Taza/CDC Meadow | 2.31 | 1.90 | 1.07 | 0.66 | 1.17 |
| | | | | | |
| **Significant p<0.05** | **S** | **S** | **S** | **S** | **S** |
| **LSD** | **0.51** | **0.41** | **0.23** | **0.15** | **0.41** |
| **CV %** | **15.3** | **15.3** | **14.7** | **15.9** | **15.3** |
| *Check: CDC Austenson. S= Significant, NS = Not significant* | | | | | |

**Trial summary: Silage triticale**

Of the 5 triticale varieties tested in monoculture, Sunray had the largest yield. Digestible energy, metabolizable energy and total digestible nutrients were highest in 94L043057. Overall, 94L043057 had the highest relative feed value. More details can be found in Tables 7-10.

Table 7: Yield, moisture, crude protein (CP), fibre and relative feed value (RFV) of different triticale varieties

| **Variety** | **Moisture** | **Yield** | **CP** | **ADF** | **NDF** | **TDN** | **RFV** |
|---|---|---|---|---|---|---|---|
| | % | tons/ac | % | | | | |
| **Taza** | 61.78 | 6.42 | 7.09 | 31.56 | 49.01 | 63.84 | 122.19 |
| 94L043057 | 63.74 | 6.22 | 8.12 | 29.00 | 47.74 | 66.31 | 129.24 |
| Bunker | 60.79 | 6.21 | 5.96 | 34.00 | 52.44 | 62.42 | 110.77 |
| Sunray | 61.99 | 7.32 | 7.78 | 30.81 | 48.58 | 64.90 | 124.51 |
| Tyndal | 60.00 | 6.44 | 8.61 | 30.34 | 48.99 | 65.26 | 124.63 |
| | | | | | | | |
| **Significant p<0.05** | | **S** | **S** | **S** | **S** | **S** | **S** |
| **LSD** | | **0.77** | **1.58** | **1.53** | **2.78** | **1.36** | **9.13** |
| **CV %** | | **7.7** | **13.6** | **3.2** | **3.7** | **1.4** | **4.8** |
| *Check: Taza. S= Significant* | | | | | | | |

Table 8: Mineral content of different triticale varieties

| **Variety** | **Ca** | **P** | **K** | **Mg** | **S** | **Cu** | **Fe** | **Mn** |
|---|---|---|---|---|---|---|---|---|
| | **%** | | | | | | | |
| **Taza** | 0.27 | 0.20 | 2.28 | 0.08 | 0.11 | 1.86 | 192.41 | 56.90 |
| 94L043057 | 0.20 | 0.24 | 1.61 | 0.08 | 0.11 | 2.50 | 119.28 | 52.02 |
| Bunker | 0.25 | 0.16 | 1.66 | 0.08 | 0.09 | 1.90 | 155.46 | 53.96 |
| Sunray | 0.25 | 0.24 | 1.92 | 0.08 | 0.12 | 2.17 | 149.27 | 65.30 |
| Tyndal | 0.24 | 0.24 | 1.70 | 0.10 | 0.12 | 2.90 | 131.08 | 60.12 |
| | | | | | | | | |
| **Significant p<0.05** | **S** | **S** | **S** | **NS** | **NS** | **S** | **NS** | **S** |
| **LSD** | **0.029** | **0.035** | **0.26** | **0.022** | **0.025** | **0.65** | **49.42** | **7.89** |
| **CV %** | **7.9** | **10.5** | **9.1** | **16.6** | **14.8** | **18.7** | **21.5** | **8.9** |
| *Check: Taza. S= Significant, NS = Not significant* | | | | | | | | |

Table 9: Energy values of different triticale varieties

| Variety | DE | ME | $NE_L$ | $NE_G$ | $NE_M$ |
|---|---|---|---|---|---|
| | Mcal/kg | | | | |
| **Taza** | 2.81 | 2.30 | 16.70 | 16.25 | 16.79 |
| 94L043057 | 2.92 | 2.39 | 17.71 | 17.26 | 17.81 |
| Bunker | 2.75 | 2.25 | 16.66 | 16.21 | 16.75 |
| Sunray | 2.86 | 2.34 | 17.33 | 16.88 | 17.42 |
| Tyndal | 2.87 | 2.35 | 17.43 | 16.98 | 17.52 |
| | | | | | |
| **Significant p<0.05** | **S** | **S** | **NS** | **NS** | **NS** |
| **LSD** | **0.06** | **0.049** | **1.34** | **1.33** | **1.33** |
| **CV %** | **1.4** | **1.4** | **5** | **5.2** | **5.0** |
| *Check: Taza. S= Significant, NS = Not significant* | | | | | |

# Perennial Forage Project at Fort Vermilion Alberta

## Background

The perennial forage variety trials were initiated by applied research associations in Alberta as a response to the lack of regional information available to producers on perennial forages. The project is replicated at eight different sites across the province, and aims to provide information on tonnage and nutrient quality of several key forage varieties.

The project is split into three components, an alfalfa variety trial, a grass variety trial, and a mixed variety trial where 3 alfalfa varieties and 3 grasses varieties were combined to form 9 different mixes. In the first year, establishment of the plants was monitored, and feed quality will be tested in years 2 and 3 of the project.

## Materials and Methods

Table 1: Details on design and seeding of the Perennial Forages Variety Trial at MARA

| | |
|---|---|
| **Study Design** | Randomized Complete Block Design |
| **Treatments** | Varieties: 14 legumes, 11 grasses, 9 legume/grass combinations. |
| **Replications** | 4 |
| **Plot size** | 10 $m^2$ |
| **Soil type** | Sandy loam |
| **Soil information (top 6")** | OM=2.4%, pH=6.4, $NO_3$-N= 36 lb/ac, P (bray) = 124 lb/ac, P (bicarb) = 66 lb/ac, K = 238 lb/ac, S = 14 lb/ac, Na = 24 lb/ac, Ca = 2720 lb/ac, Mg= 240 lb/ac |
| **Seeding date** | First seeding date: May 31$^{st}$, 2016, Second seeding date: June 17$^{th}$, 2016 |
| **Seeding information** | Fabro 6-row small plot seeder. First pass was seeded to 0.5", the next pass seeds were placed barely under the surface |
| **Fertilizer** | Grasses only: 100 lb/acre 46-0-0 , Legumes only: 40 lbs/ac of 11-52-0, Grass and legume mix: 40 lbs/acre of 11-52-0, 60 lbs/acre of 46-0-0 |

| | |
|---|---|
| **Weed management** | Pre-seeding glyphosate burndown (1.67 l/acre) |

Note: Plots were seeded twice, as there was very poor establishment the first time even though moisture was adequate. The second time plots were seeded at the shallowest setting on the seeder and better emergence was observed.

**Results and Discussion**

Plants were very slow to establish, with very little establishment was seen in June and midway through July. Establishment was stronger in August after receiving more rain. One set of plant counts was taken which involved counting plants in three ¼ $m^2$ areas per plot. Plant counts were taken over the period of September 8$^{th}$ to 15$^{th}$, which is approximately 30-40 days after plants had likely germinated.

According to Alberta Agriculture's Guide on Perennial Forage Establishment, a productive grass or alfalfa stand in the Grey Wooded Soil zone should have a minimum of 40-50 plants per square meter (3.8 to 4.6 plants per square foot) established. A grass/legume mixed pasture should have a minimum of 30-40 plants per square meter, or about 2.8 to 3.8 plants per square foot (Agdex 120/22-3). This stand was still within the first few months of establishment, but these guidelines can be used to evaluate if the plots are at least meeting the guidelines early on. The following results are an average of plant counts across all four reps of each treatment.

Table 2: Mean first year plant counts per $ft^2$ of each grass variety averaged across 4 reps

| **Variety** | **Mean plants per $ft^2$ (n=4)** |
|---|---|
| AC Admiral Hybrid Brome (HB) | 6.0 |
| AC Saltlander Green Wheatgrass | 7.4 |
| Courtney Tall Fescue | 6.7 |
| Fleet Meadow Brome | 6.3 |
| Fojtan Festulolium | 8.4 |
| Greenleaf Pubescent Wheatgrass | 2.1 |
| Grinstat Timothy | 2.3 |
| Killarney Orchard Grass | 4.5 |
| Kirk Crested Wheatgrass | 5.4 |
| Knowles Hybrid Brome (HB) | 5.4 |
| Success Hybrid Brome (HB) | 5.0 |

Table 3: Mean first year plant counts per $ft^2$ for each legume variety averaged across 4 reps

| **Variety** | **Plants per $ft^2$ (n=4)** |
|---|---|
| 20-10 Alfalfa | 3.6 |
| 44—44 Alfalfa | 5.9 |
| AC Mountainview Sainfoin | 4.5 |
| Assalt ST Alfalfa | 2.9 |
| Dalton Alfalfa | 4.2 |
| Halo Alfalfa | 5.9 |
| Nova Sainfoin | 2.8 |
| Oxley 2 Cicer Milk Vetch | 2.5 |
| PV Ultima Alfalfa | 4.4 |
| Rugged Alfalfa | 4.8 |
| Spredor 4 Alfalfa | 5.9 |
| Spredor 5 Alfalfa | 5.3 |
| Veldt Cicer Milk Vetch | 2.5 |
| Yellowhead Alfalfa | 3.6 |

Table 4: Mean number of legume and grass plants counted per $ft^2$ in the legume/grass mix plots averaged over 4 reps

| **Variety** | **Legumes** | **Grasses** |
|---|---|---|
| | **Plants per $ft^2$** | **Plants per $ft^2$** |
| AC Mountainview/AC Knowles | 0.4 | 5.2 |
| Spredor 5/AC Knowles | 2.1 | 4.9 |
| Yellowhead/AC Knowles | 3.6 | 5.0 |
| Spredor 5/Fleet MB | 2.3 | 5.3 |
| Yellowhead/Fleet MB | 1.4 | 5.0 |
| AC Mountainview/Fleet MB | 0.7 | 5.8 |
| Yellowhead/Success HB | 1.6 | 3.5 |
| AC Mountainview/Success HB | 0.4 | 3.8 |
| Spredor 5/Success HB | 2.3 | 3.5 |

Establishment was extremely variable across the site, but most varieties met or exceeded the goal of 3.8 plants / square foot in a pure grass or alfalfa stand. Fojtan Festulolium, which is a cross between Tall Fescue and Italian Ryegrass, was one of the varieties with very strong establishment in some of the reps, averaging 8.4 plants per square foot. Saltlander Wheatgrass and Courtney Tall Fescue were also some of the better establishing grasses of the season (Table 2). Greenleaf pubescent wheatgrass and Grinstat Timothy did not meet the guideline of 3.8 plants/$ft^2$ within the first few months of seeding and will likely require reseeding in the spring.

As for legumes, alfalfa typically had higher establishment numbers than the sainfoin or vetch varieties, with Halo, Spredor 4, and 44-44 as the varieties with the highest plant numbers (Table 3). Some of the legume varieties were not successful in achieving adequate plant counts, these include Assalt ST, 20-10, and Yellowhead Alfalfa. Furthermore, both cicer milk vetch varieties the Nova sainfoin did not achieve the desired plant densities (Table 3).

On its own, AC Mountainview sainfoin had a healthy stand count at 4.5 plants per $ft^2$, however in the mixes AC Mountain view struggled to achieve on average 1 plant per $ft^2$, meaning there were plots where no sainfoin was established in these mixes. Alfalfa varieties Spredor 5 and Yellowhead in the mixes were more successful with 1.4 to 3.6 plants per $ft^2$ (Table 4).

**Figure 2: Fojtan Festulolium plot photo taken in September, 2016**

In 2017, MARA plans to conduct emergence counts in these same plots in the spring and apply any seeding touch-ups deemed necessary. Measurements taken in 2017 will be plant height at harvest, stage of maturity at harvest, tonnage, and feed quality tests for all varieties.

## High Legume Grazing Project in Mackenzie County

### Background

Cattle producers in Alberta are always seeking to increase their productivity while keeping costs low. One strategy in line with this goal may be for producers to increase their use of legumes in their pastures.

Findings from economic analysis work conducted through Alberta Agriculture's Agriprofit program (2008-2015) have highlighted the potential of large profit margins for beef producers who graze their cows on legume/grass pastures compared to producers who graze their cattle on tame grass pastures. While the analysis did not reveal higher margins for all producers who grazed their cattle on legume/grass pastures, it identified that within the top 1/3$^{rd}$ of producers (defined as producers with the lowest management costs), the highest margins were found amongst producers grazing on legume/grass pastures. In other words, for producers who know how to manage legume/grass pastures, the profit potential could be very large (Table 1).

Table 1: Economic benefits of higher legume pastures in Northern Alberta (2013-2015 average)

| | **Animal Unit Days /Acre** | | **Gross margin/ac ($)** | | **Gross margin/AUM ($)** | |
|---|---|---|---|---|---|---|
| Pasture types | All | Top 1/3$^{rd}$ ** | All | Top 1/3$^{rd}$ | All | Top 1/3$^{rd}$ |
| Legume / Grass | 35 | 126 | 7 | 27 | 6 | 7 |
| Tame Grass | 35 | 56 | 8 | 9 | 7 | 5 |
| Tame Native Grass | 37 | 90 | 7 | 43 | 5 | 15 |

** Top 1/3$^{rd}$ represents a group of producers with the lowest management cost, based on total production cost per unit of output (Source. Alberta Agriculture 2016)

Agriprofit data exists for each of Southern, Central, and Northern Alberta, and does vary by region. It is also important to note that the results from Northern Alberta are to be taken with caution because of a low number of producers surveyed. Still, with results finding legume/grass

pastures to be 2 or 3 times more profitable than tame grass pastures, incorporating legumes may be a worthwhile strategy for producers to test on their farms.

Legumes have several benefits in a pasture. They have higher feed quality than grasses, tending to have higher crude protein values and lower acid digestible fibre contents (Aasen & Bjorge, 2009). Legumes also fix atmospheric nitrogen and can lower the future nitrogen fertilizer requirements. For example, the Alberta Forage Manuel states that a stand of alfalfa is estimated to contribute between 70 and 198 lbs of N/acre (Aasen & Bjorge, 2009).

Maintaining a high legume stand proportion can be a challenge and producers need to manage their pastures carefully. Legumes do not recover as well as grasses from overgrazing, and are sensitive to high nitrogen rates which may cause grasses to quickly outgrow legumes and take over the stand (Aasen & Bjorge, 2009). Producers are also wary of grazing legumes because of the risk of bloat. Given the many benefits however of grazing legumes, researchers have focused on finding ways to help producers face some of the challenges.

One way to minimize the risk of bloat is to grow sainfoin or another bloat-supressing legume, together with alfalfa. In the past this strategy has been challenging since alfalfa tends to grow more vigorously than other legumes, but Dr. Surya Acharya from Agriculture and Agrifoods Canada (Lethbridge), has been developing a line of sainfoin called AAC Mountainview which persists better than older varieties alongside alfalfa.

In 2016, MARA worked together with Alberta Agriculture & Forestry and other applied research associations in the province to initiate a province-wide demonstration project of grazing high legume sainfoin-alfalfa pastures. The objective of this project is to educate producers that high-legume pastures can be safe to graze with proper management. A key component of this project though is for producers and researchers to learn how to better establish and maintain a high stand percentage of legumes in these pastures in their local areas.
There are 14 locations for this project across the province, two of which are in Mackenzie County. One location is in Blue Hills and the other location is located approximately 15 km east of Fort Vermilion.

**Materials and Methods**

Table 2: Establishment and weed control information of sainfoin-alfalfa pastures in Mackenzie County

| | **Blue Hills Location** | **Fort Vermilion Location** |
|---|---|---|
| **Date of seeding** | May 26, 2016 | June 10, 2016 |
| **Site preparation** | Site was harrowed and packed before seeding. | Harrow packer before and after seeding |
| **Soil type** | Clay loam | Sandy loam |
| **Seeding rates** | Mix of AAC Mountainview Sainfoin (30%) and Hay Grazer Alfalfa (70%) at 35 lbs/acre | Mix of AAC Mountainview Sainfoin (30%) and Hay Grazer Alfalfa (70%) at 35 lbs/acre |
| **Seeder type** | Concord double shoot dutch-opener seeder | John Deere Air Drill with 4 |
| **Fertilizer rates** | 11-0-0-10 at 100 lbs/acre | None (residual fertilizer from previous year still in the soil) |
| **Seeding depth** | 0.5” | Between 0.5” - 1.0” |
| **Grass mixes** | 2.5 lbs/acre of Meadow Brome | None |
| **Weed control** | Pre-seeding burndown of glyphosate and heat (1/2 L/acre), used the cutter and baler to bale up tall weeds in Mid-July. | Pre-seeding burndown of glyphosate 0.67 L/acre, mowing in August. |

**Photo 1:** Sainfoin and alfalfa seedlings reaching the first trifoliate stage.

**Results and discussion**

Table 3: Sainfoin and alfalfa establishment measurements at the Blue Hills location in August, 2016

| | Target # of plants per $ft^2$ | Actual # plants per $ft^2$ | Min # per $ft^2$ | Max # per $ft^2$ |
|---|---|---|---|---|
| Sainfoin | 1-2 | 0.7 | 0 | 2 |
| Alfalfa | 2-3 | 1.4 | 0 | 4 |
| Weeds | 0 | 1.9 | 0 | 5 |

The goal for the project is to have 3-5 plants established per square foot, preferably 2 alfalfa plants per every sainfoin plant. Establishment numbers were collected on August 31st, 2016 at 10 points across the pasture establishment site (1 point per acre) at the Blue Hills Location. On average there were 0.7 sainfoin plants and 1.3 alfalfa plants per square foot making an average of 2 plants per square foot, which is less than what is needed for the stand to be economically viable (Table 3). There was very high variation in establishment across the field (CV for both sainfoin and alfalfa > 75%). Some areas of the field had no plant establishment, other areas had up to 4 alfalfa plants and 2 sainfoin plants per $ft^2$ establish. One of the goals for the upcoming year will be for the producer and researchers to study how to achieve better establishment in those problem areas with the lowest plant count numbers.

Sites will have seeding touch-ups in the spring, plant counts and tonnage will be evaluated on both sites and sites will be grazed in the summer of 2017.

**References:**

Aasen, A. & Bjorge, M (2009) Alberta Forage Manuel 2nd edition, Alberta Agriculture and Rural Development, Edmonton, Alberta

Oginskyy, A. (2016). Agriprofit$ Benchmarks. Alberta Agriculture

**Acknowledgements**

**Thank you to local collaborators, Dicky Driedger and Raymond Friesen, as well as Grant Lastiwka, Lorna Baird, and Andrea Hanson from Alberta Agriculture.**

Photo 2: A healthy mix of first year sainfoin and alfalfa plants at full bloom.

## Tillage Radish Grazing Trial

### Background

Brassica plants, such as kale, turnips, forage rape, and forage radish are high-protein options for livestock producers to use as feed. They are especially popular in northern climates because they are fast-growing and cold tolerant.

Tillage radish, which was originally bred from a forage radish variety, is gaining popularity as a cover crop, however there exists little information on the forage quality and yield of tillage radish in climates as far north as Mackenzie County. MARA has undergone a multi-year project to assess if tillage radish may be a useful feed source for livestock producers in Mackenzie County.

In 2015, MARA analyzed the forage quality of tillage radish at three different stages (vegetative, flowering, and seed pod formation). Crude protein and digestibility was high for plants in the vegetative stage (CP>30% and TDN>78%) and at the flowering stage (CP=24%, TDN=70%) relative to cereal feed sources. If cattle were grazed only on tillage radish at these stages, they may run the risk of bloat or nitrate poisoning, therefore it was recommended that if a farmer were grazing their cattle on tillage radish, they should also supply a more fibrous feed alongside.

In 2016 MARA again grew tillage radish, and harvested the above ground biomass at three different stages. The intention was to have yield information supplement the forage quality data from 2015.

### Materials and Methods

Table 1: Tillage radish trial 2016 information

| | |
|---|---|
| Variety | Tillage Radish |
| Seeding information | 6 lbs/ac at 0.5” seeding depth, seeded with a 6 row Fabro plot seeder at 8” spacing between rows |
| Seeding Date | June 17th, 2016 |
| Site Preparations | Shallow cultivation for weed control |
| Soil Type | Sandy Loam |
| Harvest dates | July 28 (vegetative), August 9 (flowering), August 19 (seed pod formation) |

**Results and Discussion**

In this study, tillage radish was harvested approximately six weeks after seeding. Harvesting tillage radish two weeks later could have drastically increased the yield. Tonnage increased by 70% from approximately 6 weeks after seeding to the flowering stage. Tonnage did not change much after the flowering stage (Table 2).

Table 2: Height, and yield information of tillage radish at three different stages grown in 2016

| **Plant Stage** | **Plant height (cm)** | **Wet weight (lbs/acre)** | **Dry weight (lbs/acre)** |
|---|---|---|---|
| Vegetative | 75 a | 25173 a | 2642 a |
| Flowering | 120 b | 39947 b | 4513 b |
| Podding | 118 b | 46993 b | 5750 b |
| | | | |
| Significant ($p<0.05$) | s | s | S |
| LSD | 11.34 | 9993.16 | 1351.21 |
| CV% | 8.4 | 20.8 | 24.4 |

**Photo 1:** Tillage radish plants was an excellent source of nectar for pollinators.

Table 3: Feed quality information of tillage radish at three different stages (grown in 2015)

| Plant Stage | DE | ME | CP | ADF | TDN | NE main | NE gain |
|---|---|---|---|---|---|---|---|
| | Mcal/kg | | % | | | | |
| Vegetative | 3.457 a | 2.867 a | 30.92 a | 18.96 c | 78.38 a | 1.920 a | 1.2767 a |
| | | | | | | | |
| Flowering | 3.003 b | 2.493 b | 24.35 b | 28.52 b | 68.17 b | 1.600 b | 0.9967 b |
| | | | | | | | |
| Podding | 2.307 c | 1.913 c | 13.31 c | 43.33 a | 52.35 c | 1.067 c | 0.5100 c |
| | | | | | | | |
| p<0.05 | s | s | s | s | s | s | s |
| LSD | 0.2328 | 0.19 | 2.748 | 4.902 | 5.242 | 0.1764 | 0.1611 |
| CV % | 4.4 | 4.3 | 7.1 | 8.9 | 4.3 | 6.3 | 9.5 |

Table 4: Feed nutritional information of tillage radish at three different growth stages (grown in 2015)

| **Plant Stage** | **P** | **Ca** | **Mg** | **K** | **Na** |
|---|---|---|---|---|---|
| | **%** | | | | |
| **Vegetative** | 0.3167 a | 2.94 a | 0.4967 a | 5.013 a | 0.34 |
| | | | | | |
| **Flowering** | 0.3033 a | 2.00 b | 0.4333 a | 3.793 b | 0.65 |
| | | | | | |
| **Podding** | 0.1533 b | 1.943 b | 0.330 b | 2.857 c | 0.69 |
| | | | | | |
| **p<0.05** | s | s | s | s | ns |
| **LSD** | 0.04622 | 0.5989 | 0.0779 | 0.6522 | N/A |
| **CV %** | 9.4 | 21.5 | 12.3 | 8.7 | 28.8 |
| **S = significant, ns = not significant** | | | | | |

While quality generally decreased from the vegetative stage to the flowering stage, the amount of total digestible nutrients (% TDN multiplied by dry weight) increased because of the large gain in total dry matter (Table 3). The proportion of certain nutrients such as phosphorus (P) and Magnesium (Mg) also did not significantly decrease from the vegetative to the flowering stage (Table 4).

Based on these results, it appears that for a producer only grazing tillage radish once in a season, grazing at an early flowering stage would provide the highest amount of nutrients to the animal. If a producer intends to graze tillage radish twice in a season, it is important to leave enough leafy biomass for the plant to continue to photosynthesize and regenerate. The original suppliers of Tillage Radish (Cover Crop Solutions) recommend about 4 inches of green leafy height to ensure the plants grow back.

## Mackenzie Applied Research Association
## Summary of Events - 2016

MARA staff strive to provide high-quality events with a diverse set of topics to fit the needs of the producers in this county. We have worked to bring in the top speakers in their respective fields so that producers can have their questions answered and stay on top of the latest agronomic research and technology. The following is a brief summary of some events MARA hosted in 2016.

**Livestock Health Workshop – January 23rd, 2016 at the Rocky Lane Ag. Hall.**

This workshop was aimed at helping livestock producers of all ages improve the health and wellness of both their pastures and animals. Colin Stone (P.Ag), a Rangeland Management Specialist with Alberta Environment and Parks presented on both how to assess and improve pasture health. Dr. Wendy Quist, our regional veterinarian from Frontier Veterinary Service gave a clinic on livestock reproduction, including calving, and key elements of livestock nutrition.

**Cover Crops for Northern Alberta's Climate (hosted with UFA La Crete) – February 22nd, 2016 at the La Crete Heritage Center.**

Kevin Elmy. (P.Ag) from Friendly Acre Farms identified cover crop solutions which could fit Mackenzie County's unique climate. His presentation covered cover crop types, establishment methods, and benefits drawing from both research and his own extensive experience from his farm.

**Weed Management Workshop - February 24th, 2016 at the Fort Vermilion Community Complex.**

Shafeek Ali (P.Ag), the 30-year author of Alberta's Crop Protection Guide (Blue Book) and former Provincial Weed Management Specialist, gave a full day presentation on weed management (weed identification, growth habits, prevention, and treatment) for both organic and conventional producers.

**MARA's Annual General Meeting (Co-hosted with Bluewave Energy) – March 9th, 2016 at the La Crete Heritage Center**

With the help of Bluewave Energy, MARA was able to host a special Annual General Meeting featuring three industry leaders as guest speakers. Dr. Tom Jensen, from the International Plant Nutrition Institute presented on Fertilizer types and sources, Ray Dowbenko, a Senior Agrologist with Agrium Inc. presented on the latest research in Plant Nutrition, and Nevin Rosaasen, a Program Specialist with Alberta Pulse Growers provided agronomic information on both traditional and new pulse crops.

**Organic Grain and Field Crops Conference (Co-hosted with Organic Alberta) - April 1st and 2nd, at the La Crete Heritage Center**.

As a joint initiative with Organic Alberta, this conference featured a tradeshow, presentations, and featured researchers, producers, and industry leaders who discussed topics such as transitioning to organic, fertility, weed management, organic crop insurance, etc.

**Northern Ag Update - April 13th, 2016 at the Fort Vermilion Community Complex.**

MARA's Northern Ag Update is an annual full day event, aimed at presenting high quality industry information to producers before the growing season begins. This year, Mike Hittinger, a Growing Forward 2 (GF2) specialist with Alberta Agriculture gave a thorough presentation on available GF2 programs and the application process. Neal Persson from Monsanto BioAg presented research results which emphasized the importance of inoculating seeds. In response to the expressed interest in irrigation from several producers in Mackenzie County, our event dedicated a whole afternoon to topics pertaining to irrigation, such as soil moisture levels, irrigation regulations, and irrigation equipment. Speakers included John Zylstra, a Land Specialist from Alberta Agriculture, Ted Harms, an Irrigation Specialist from Alberta Agriculture, and Kees van Beek of Southern Irrigation Ltd.

**June Field Day – June 25th, 2016 at the Fort Vermilion Experimental Farm**

Our June Field Day was a full day event, and began with a tour of MARA's 1000+ research plots. Our special guests were Roger Andreiuk from Reduced Tillage Linkages who led a practical demonstration on best soil practices for soil moisture capture and avoiding compaction issues, as well as Claus & Ilene Toerper who demonstrated their use of drone and imaging technology towards farm water management.

**Agriculture Field Tour (Co-hosted with Hemp Production Services and Organic Alberta) - July 5th, 2016 in Blue Hills and Buffalo Head Prairie**

Together with Hemp Production Services and Organic Alberta, we lead a packed bus tour to five fields including two hemp fields, two cover crop fields (faba bean and cocktail cover crop), as well as the site of MARA's organic oats variety trials. Along the way, the tour featured short presentations from Jeff Kostuik (P.Ag) of Hemp Production Services on hemp varieties and agronomy, and Iris Vaisman of Organic Alberta on using cover crops for soil fertility.

**August Field Day and Agriculture Fair - August 5th, 2016 at the Fort Vermilion Experimental Farm**

MARA's largest tour of the season hosted two busses full of guests to visit our on-site and off-site research plots followed by a barbecue lunch, trade show, and industry speakers. Tradeshow Speakers included Roger Andreiuk, who returned to talk about controlled traffic farming as a measure to improve soil health, and Rob Lawson from the Alberta Government Occupational Health & Safety department led a discussion on the latest developments with Bill 6.

**High Legume Pasture Workshop - August 13th, 2016 at the Fort Vermilion Experimental Farm**

The workshop began at a local pasture site seeded to an alfalfa sainfoin mix. Grant Lastiwka, Forage and Livestock Beef Specialist with Alberta Agriculture, and Nora Paulovich, Manager of the North Peace Applied Research Association (NPARA) discussed the best techniques for seeding, and target populations of plants required for healthy stands. Later back at the Experimental Farm, Grant presented on the soil health and the economic benefits of higher legume pastures, and Nora gave updates on the soil health initiatives undertaken in Manning at NPARA.

**EFP and Growing Forward 2 Workshop - November 11th, 2016 at the County M.D Building in Fort Vermilion**

MARA staff guided a group of local farmers to help them each complete the initial first chapters (which are also the longest and most detailed chapters) of the Alberta Environmental Farm Plan. MARA staff also went through available GF2 programs and helped producers find programs that would be relevant for their operations.

**Pasture establishment and grazing management workshop – December 5th, 2016 at the La Crete Heritage Center**

Graeme Finn of Southern Cross Livestock, one of Alberta's most respected graziers led a workshop where he shared his unique experience with pasture management and grazing techniques. Graeme discussed pasture varieties, especially legumes, weed management, and grazing strategies to minimize pests, improve animal health, and improve soil moisture retention and fertility.

**MARA's Participation in Other Events**

MARA's manager Dr. Jacob Marfo presented to the following groups in 2016:

- Mackenzie County council and producers – Topic: Soil Erosion
- Regional Economic Development Initiative (Northern Alberta) – Topic: Hemp Research
- Bayer Crop Science – Topic: Benefits of Seed Treatment

- Mackenzie County Agriculture Service Board – Topic: Status of Research and Extension at MARA

Dr. Marfo (P.Ag) also offered Professional Agrologist services to producers and residents at no cost.

## Event Sponsors

**Thank you again to all our generous event sponsors. The following groups helped us host our extension events this year:**

Government of Alberta
Mackenzie County
Alberta Wheat Commission
Alberta Canola Producers Commission
Alberta Pulse Growers
Alberta Barley Commission
Bayer Science
Bluewave Energy, La Crete
Agrium Inc.
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Brett Young Seeds
Pickseed Canada
International Plant Nutrition Institute
Monsanto BioAg
Southern Irrigation Ltd.
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Organic Alberta
Regional Economic Development Initiative Northwest
Toerper Tech and Precision Ltd.
Frontier Veterinary Clinic
UFA, La Crete
Prairie Coast La Crete
Cargill
Richardson Pioneer, High Level
Parkland Industries
Canola Council of Canada
ARECA
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Ag Societies: La Crete, Rocky Lane, High Level and Fort Vermilion Alberta