Parkland Crop Diversification Foundation

2022 ANNUAL REPORT

Table of Contents

Introduction

The Parkland Crop Diversification Foundation (PCDF) is located in Roblin, in the Parkland region of Manitoba and has a close liaison with Manitoba Agriculture. PCDF works alongside three other Diversification Centres in the province: Manitoba Horticulture Productivity Enhancement Centre (MHPEC) in Carberry, Prairies East Sustainability Agricultural Initiative (PESAI) in Arborg, and Westman Agricultural Diversification Organization (WADO) in Melita.

The Parkland Crop Diversification Foundation owes its success to excellent cooperation with ARD, the PCDF board of directors and staff, producers, industry and cooperating research institutions.

The 2022 season was full of hard work and dedication from the staff to execute all the research activities that came with an ambitious project list. A thank you goes out to James Frey and all the staff: Jessica Frey, Brooklyn Bartel, Sara Marzoff and Ella Marzoff. In addition to our regular staff, PCDF was able to host Adrien Huault, an intern from the *École superieure des agricultures* in Angers, France. Adrien worked with PCDF from early July through to mid-September. Merci beaucoup, Adrien!

Funding is essential for the Parkland Crop Diversification Foundation's everyday activities to occur. This year PCDF received core funding and support from the Canadian Agricultural Partnership (CAP) and Agriculture Sustainability Initiative (ASI) programs, as well as from trial cooperators, producers, and members of the local community. PCDF is always open to project ideas and learning about the production concerns of local producers, so please feel free to contact us with any project proposals. For project submissions or additional information, please refer to the Contact info supplied on this website.

Parkland Crop Diversification Foundation (PCDF)
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Manitoba Diversification Centres
Parkland Coop
Pepsi-co/Quaker Oats
Saskatchewan Pulse Growers
Saskatchewan Variety Performance Group
University of Alberta
University of Manitoba
University of Saskatchewan

Meteorological Data

Table 1: Roblin 2022 Season Report by Month (based on 30-year average)

Month	Precipitation		Corn Heat Units		Growing Degree Days	
	Actual	Normal	Actual	Normal	Actual	Normal
April	18	24	5	33	2	7
May	131	45	272	321	159	172
Jun	77	73	517	530	307	314
Jul	110	71	670	645	407	392
Aug	24	56	653	587	399	354
Sep	15	53	396	292	243	163
Oct	14	26	125	42	50	11

Information gathered from Manitoba Agriculture Growing Season Report website at https://web43.gov.mb.ca/climate/SeasonalReport.aspx

Table 2: Roblin 2022 Season Summary April 1 – October 31

	Actual	Normal	% of Normal
Number of Days	214	-	-
Growing Degree Days	1569	1415	111
Corn Heat Units	2641	2452	108
Total Precipitation	393	350	112

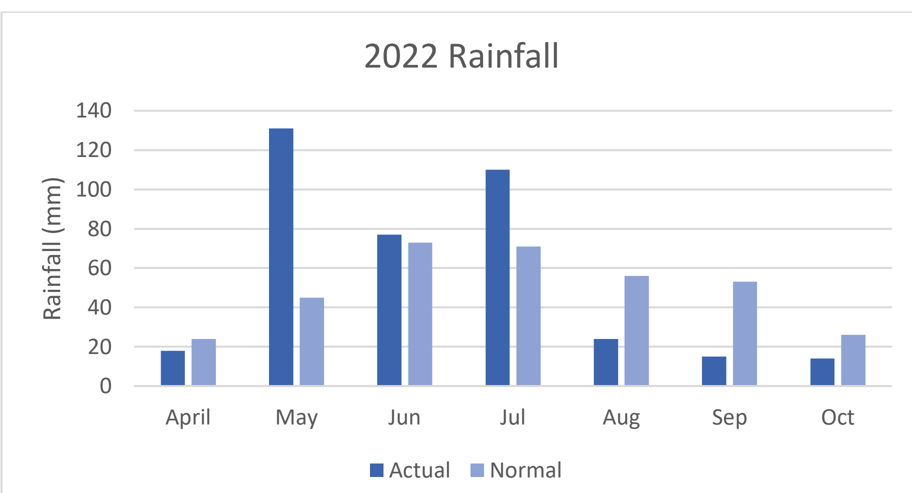


Figure 1: Roblin 2022 Precipitation by Month April – October

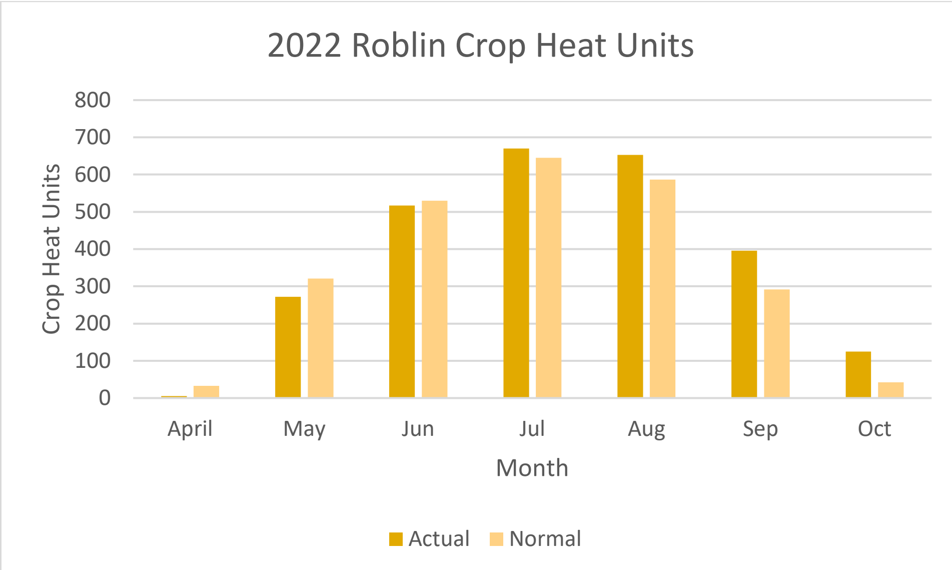


Figure 2: Roblin 2022 Crop Heat Units by Month April-October

Extension Activities

Ag Days and CropConnect, two of PCDF's major extension events, were cancelled due to COVID-19.

Table 1: PCDF 2022 Extension Activities

Name	Medium	Date	Location
Field Day	Tour	Jul 27	Roblin

PCDF Field Trials

Plot information

At seeding:	9m x 1.2m
Trimmed:	7m x 1.2m
Plot Area:	$10.8m^2$
Alleyways:	2m

Equipment

5-Row Fabro Disc Seeder
Plot Sprayer
Wintersteiger Plot Combine

Manitoba Crop Variety Evaluation (MCVET) Trials

Manitoba Crop Variety Evaluation Trials (MCVET) facilitates variety evaluations of many different crop types in this province. The purpose of MCVET trials is to grow both familiar (checks or reference) and new varieties side by side in a replicated manner in order to compare and contrast various variety characteristics such as yield, maturity, protein content, disease tolerance, and many others.

During 2022, PCDF did variety evaluations for winter wheat, fall rye, oat, barley, fababean, pea, forage, and flax. Yearly data is collected, combined, and summarized in the *Seed Manitoba Guide*. Hard copies are available at most Manitoba Agriculture and agriculture industry offices.

Table 1: 2022 MCVET Trials*

Crop type	Stubble	Seeding Date	Fertility Applied N-P-K in lb/ac	Weed/Insect Control (rate/acre)	Harvest Date	# of plots
Barley	Canola	May 11	36-15-0	Dicamba @ 110 ml/ac and Puma @ 270 ml/ac on June20	Sep 2	48
Oats	Canola	May 11	10-15-0	Dicamba @ 110 ml/ac on June 20	Sep 8	18
Flax and Linseed	Canola	May 24	34-10-0		Oct 24	48
Fababean	Canola	May 6	0-10-0	Bentazon @ 400 ml/ac and Quizalafop @ 200 ml/ac	Sep 29	57
Fall Rye	Canola	Sep 16	24-15-0	Bentazon @ 400 ml/ac on July 15	Aug 25	12
Forage	Canola	May 27	10-10-0	None	Aug 12 and Sep 18	36
Winter Wheat	Canola	Sep 16	24-15-0	Bentazon @ 400 ml/ac on July 15	Aug 25	15
Total plots						**234**

* See *Seed Manitoba Guide* or visit websites *www.seedinteractive.ca* or [*www.seedmb.ca*](http://www.seedmb.ca).

Table 2: 2022 PCDF Discontinued Trials

Crop Type	Collaborators	Purpose	Number of Plots
Intercrop	PCDF	Cereals intercropped with chicory (Year 2)*	36

*Note: The chicory established well in 2021, but the trial was discontinued in early 2022 due to excessive deer damage to the chicory crop.

Table 3: Summary of 2022 PCDF Trials

Crop Type	Collaborators	Purpose	# Plots
Barley	Saskatchewan Variety Performance Group	2-row barley variety trial	87
Corn	Agricultural and Agri-Food Canada	Variety trial	90
	Agricultural and Agri-Food Canada	Corn nursery	500
	University of Manitoba	Prairie-wide corn intercropping trial	35
Fababean	Saskatchewan Pulse Growers	White and coloured variety evaluation	21
	University of Saskatchewan	High and low tannin fababean variety evaluation	57
Flax and linseed	Linseed Coop	Variety trial	48
Forage	PCDF	Hemp-cereal silage intercrop	15
	PCDF	Pea-cereal silage intercrop	21
	PCDF	Blue lupin forage evaluation	15
	PCDF	Teff seeding rate evaluation	20

Fruit Demonstration	PCDF	Sour cherry and Haskap	10
Hemp	Canadian Hemp Trade Alliance	National Industrial Hemp Variety Evaluation Trials	52
Hops	PCDF	Year 4 of hopyard	24
Intercropping	PCDF	Large-scale Wheat Clover intercrop	16
	PCDF	Barley-clover intercrop (Year 1)	20
	PCDF	Barley stubble with clover cover (Year 2)	20
	PCDF	Canola-clover intercrop (Year 1)	20
	PCDF	Canola stubble with clover cover (Year 2)	20
	PCDF	Oat-clover intercrop (Year 1)	20
	PCDF	Oat stubble with clover cover (Year 2)	20
	PCDF	Wheat-clover intercrop (Year 1)	20
	PCDF	Wheat stubble with clover cover (Year 2)	20
	PCDF	Wheat-phacelia intercrop	20
Oats	Agriculture and Agri-Food Canada	Evaluation of new oat lines being developed for organic production	75
	University of Saskatchewan	Variety trial	142
Peas	University of Manitoba	Canola and wheat stubble establishment for pea trial (Year 1).	48
	University of Manitoba	Evaluation of impact of stubble, tillage, and phosphorus on pea production (Year 2)	48
	Manitoba Pulse and Soybean Growers	Comparative fungicide efficacy testing for managing mycosphaerella blight and white mould in peas	24
	Sask Pulse Growers	Variety trial	144
Soybean	Sask Pulse Growers	Assessment of long- and short-season varieties	168
Spring wheat	Parkland Coop	Variety trial	63
	Saskatchewan Variety Performance Group	Variety trial	144
	University of Manitoba	Participatory Plant Breeding program for organic wheat production	93
Winter wheat	Ducks Unlimited	Evaluate management practices for high yielding winter wheat	42

Table 4: 2022 PCDF Exclusive Trials

Crop Type	**Collaborators**	**Number of Plots**
Oat	Pepsi-Co/Quaker Oats	80
Oat	Murphy et al, Inc	237

Table 5: 2022 Field Scale Collaboration

Crop Type	Collaborator	
Spring Wheat	PCDF and Midge Busters	Assess wheat midge population in a producer’s field

Table 6: 2022 Demonstrations

Saltlander
Intermediate Wheatgrass
Grazing of sheep on fall rye

Agronomic Trials

Yellow Pea Response to Preceding Crop, Residue Management, and P Fertilizer Placement (Establishment Year)

Project duration: 2020 – 2023

Objectives: Determine the effect of preceding crop, residue management and P fertility strategy, and their interactions, on pea establishment, weed community, disease incidence, yield, and seed quality

Collaborators: Kristen MacMillan – Soybean and Pulse Agronomy and Cropping Systems Research Lab, University of Manitoba

Background (provided by Kristen MacMillan)

In Manitoba, 38% of pea acres are grown on wheat stubble and 20% on canola stubble [Manitoba Agricultural Services Corporation (MASC) 2010-2015]. The yield impact of preceding crop on pea yield is not currently known despite some obvious agronomic concerns. Crop rotation data from MASC (2010-2015) points to some of these risks by showing that the relative yield of pea grown on wheat stubble is 103% compared to 96% for peas grown on canola stubble. Canola is a non-mycorrhizal crop and a host to Sclerotinia white mould. Peas are also susceptible to white mould and are a mycorrhizal crop, therefore, may be negatively affected by reduced AMF populations and increased sclerotinia risk following canola stubble. Starter P is commonly recommended in fields with low soil test levels. We aim to investigate if there is an interaction between field pea response to P fertilizer and preceding stubble type arising from the mycorrhizal and non-mycorrhizal crops. Little research has been conducted on P fertilizer strategy in field pea and strategies vary widely among farmers. In an informal Twitter poll in August 2019, the majority of farmers apply P fertilizer as starter in the seed row (44%) followed by side band or mid placement (26%), seed row plus side band or mid row (14%) and none (16%). According to the 2015 fertilizer use survey, only 45% of western Canadian farmers are applying P, primarily in the seed row (44%) and at an average rate of 19 lbs P205/ac. Yield response to 25 kg ha-1 of starter P has been documented, but no work is currently available on P fertilizer placement. Overall, there are fewer agronomic risks associated with seeding peas into wheat stubble. Peas are also tolerant to early seeding into cool soil and present an opportunity for reduced or rotational no-till systems in regions of Manitoba where tillage is common practice.

Results

This year marks the final year of stubble establishment for the following year's pea trial. This report summarizes the results for three years of stubble establishment. The two years of pea trials are reported on separately.

Target spring wheat and canola seeding rates are shown in Table 1. Treatments for establishment are provided in Table 2.

Table 1: Targets

	Seeding Rate seeds/ft2	Live Plant Stand plants/ft2	Seed Survival %
Wheat	32	27	85
Canola	10	6	60

Table 2: Treatment Structure

Treatment No	Preceding crop	Residue Management	P Fertility Strategy
1	Wheat	Tilled	None
2	Wheat	Tilled	Seed row
3	Wheat	Tilled	Side band
4	Wheat	Direct Seed	None
5	Wheat	Direct Seed	Seed row
6	Wheat	Direct Seed	Side band
7	Canola	Tilled	None
8	Canola	Tilled	Seed row
9	Canola	Tilled	Side band
10	Canola	Direct Seed	None
11	Canola	Direct Seed	Seed row
12	Canola	Direct Seed	Side band

Table 3: Average yield comparison (bu/ac) for wheat and canola

Treatment	Site 1		Site 2
	(Year 1)	(Year 2)	(Year 1)
Canola	67.2	-	60.5
Wheat	88.3	-	49.0
Pea			
Canola, tilled – No added P	-	23.4	-
Canola, direct seed – No added P	-	23.9	-
Canola, tilled – Side band P	-	23.7	-
Canola, direct seed – Side band P	-	26.7	-
Canola, tilled – Seed row P	-	23.2	-
Canola, direct seed – Seed row P	-	22.9	-
Wheat, tilled – No added P	-	23.9	-
Wheat, direct seed – No added P	-	20.8	-
Wheat, tilled – Side band P	-	21.9	-
Wheat, direct seed – Side band P	-	25.0	-
Wheat, tilled – Seed row P	-	21.9	-
Wheat, direct seed – Seed row P	-	23.0	-

Materials and methods

Experimental Design: Rectangular Lattice
Treatments: 12
Varieties: Wheat – AAC Brandon; Canola – L233P

	Seeding date	Harvest date
Site 1 (Year 1)	May 19, 2020	Sept 22, 2020
Site 1 (Year 2)	May 10, 2021	Aug 31, 2021
Site 2 (Year 1)	May 19, 2021	Sept 20, 2021
Site 2 (Year 2)	May 16, 2022	Aug 31, 2022
Site 3 (Year 1)	May 27, 2022	Oct 5, 2022

Agronomic information

Previous year's crop:	Barley silage (2020); Oat Silage (2021), Canola (2022)
Soil Type:	Erickson Clay Loam
Landscape:	Rolling with trees to the east
Seedbed preparation:	Tilled or direct-seeded, depending on the treatment

Table 4: Data collection

Data collected	Date collected				
	Site 1 (Year 1)	Site 1 (Year 2)	Site 2 (Year 1)	Site2 (Year 2)	Site 3 (Year 1)
Plant density	Jun 16	Jun 16	Jun 16	Jun 13	Jun 23
Disease risk at wheat flag leaf	Jun 24	-	Jun 6-15	-	Jun 30
Pea Root Rot Rating	-	Jun 16	-	Jun 16	-
Pea Shoot Symptoms Rating	-	Jul 6	-	Jun 16	-
Mycosphaerella Blight Rating	-	Jun 16	-	Jul 20	-
Disease risk at canola anthesis (20-50% bloom)	Jul 8-15	-	Jul 2	-	Jul 15-18
Days to Maturity Rating	-	Beginning of August	-	Beginning of August	-
Height	Aug 15	-	early Aug	-	Early Aug
Lodging	Aug 15	Aug 18	Sep 20	Aug 29	-

Table 5: Site 1 (Year 1, 2020) fertility information

	Available	Wheat Added	Canola Added	Type
N	58 lb/ac	131 lb/ac	96 lb/ac	46-0-0
P	71 ppm	15 lb/ac	10 lb/ac	11-56-0-0
K	513 ppm	-	-	-

Table 6: Site 2 (Year 1, 2021) fertility information

	Available	Wheat Added	Canola Added	Type
N	120 lb/ac	69 lb/ac	55 lb/ac	46-0-0
P	48 ppm	20 lb/ac	20 lb/ac	11-56-0-0
K	674 ppm	-	-	-

Table 7: Site 3 (Year 1, 2022) Fertility Information

	Available	Wheat Added	Canola Added	Type
N	112 lb/ac	77 lb/ac	63 lb/ac	46-0-0
P	39 ppm	40 lb/ac	40 lb/ac	11-56-0-0
K	472 ppm	-	-	-

Table 8: Spring 2022 Soil Fertility Information

	Wheat Tilled	Wheat Direct Seed	Canola Tilled	Canola Direct Seed
N 0-6”	29.3 lb/ac	35.5 lb/ac	37.5 lb/ac	27 lb/ac
N 6-24”	198 lb/ac	141.3 lb/ac	123 lb/ac	113.3 lb/ac
P	37.3 ppm	38.8 ppm	36.8 ppm	39.25 ppm
K	575.7 ppm	522.8 ppm	488.8 ppm	621.8 ppm

Note: P was added according to treatments outlined in Table 1 (none, seed row starter, or side band starter) at 20 lbs actual P_20_5/ac as MAP

Table 9: Site 1 (Year 2) Pesticide Application

Crop stage	Date	Product	Rate
Pre-emerge	May 19	Authority	118 ml/ac
In-crop	Jun 14	Viper (ADV)	400 ml/ac
		UAN 28%	810 ml/ac

Table 10: Site 2 (Year 1) Pesticide Application

Crop stage	Date	Product	Rate
Pre-emerge	May 26	Liberty	0.54 ml/ac
In-crop	Jul 9	Decis	0.82 ml/ac

Table 11: Site 2 (Year 2) Pesticide Application

Crop stage	Date	Product	Rate
Pre-emerge	May 19	Authority	118 ml/ac
In-crop	Jun 14	Viper (ADV)	400 ml/ac
		UAN 28%	810 ml/ac

Table 12: Site 3 (Year 1) Pesticide Application

Crop stage	Date	Product	Rate
Pre-plant (pea)	May 11	Heat + Merge + Glyphosate	59 ml/ac; 400 ml/ac; 670 ml/ac
Pre-emerge (wheat/canola)	May 27	Glyphosate	0.9 ml/ac

Barley

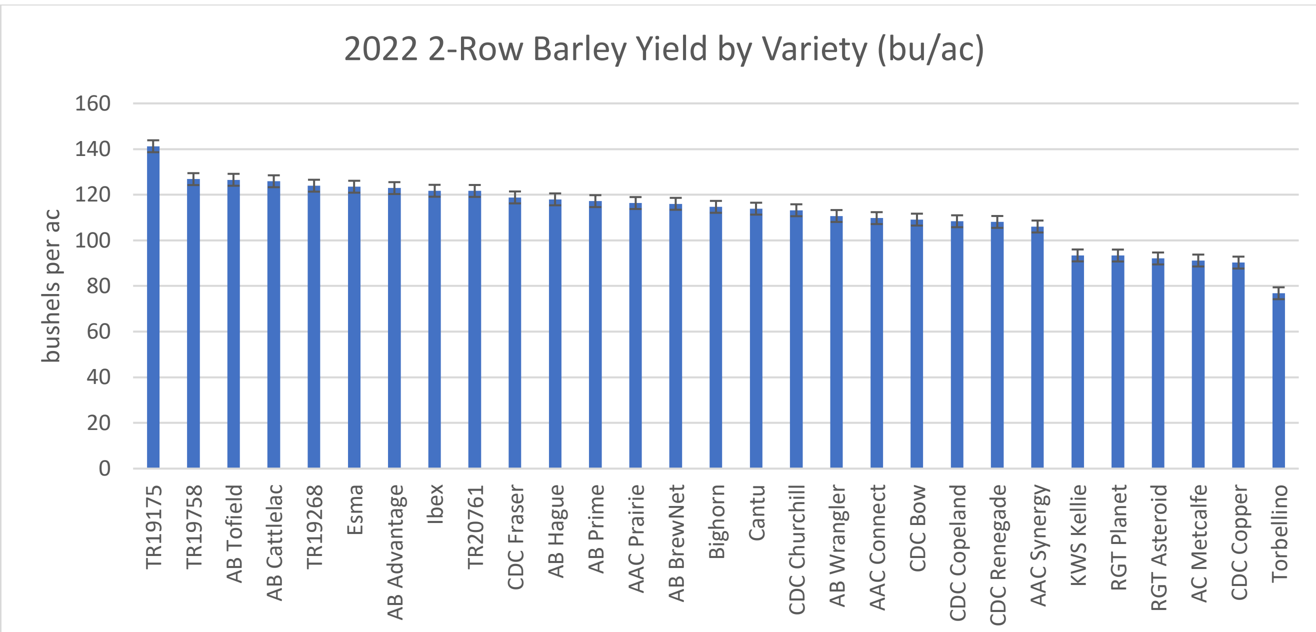
SVPG 2-Row Barley Variety Trial

Project duration: May 2022 – September 2022
Objectives: Evaluate 2-row barley varieties for the Saskatchewan Variety Performance Group
Collaborators: Steve Piche and Sara Tetland, Saskatchewan Agriculture

Background
The Saskatchewan Variety Performance Group (SVPG) conducts variety trials to evaluate important varieties. Find the 2022 Saskatchewan Seed Guide here.

Results
The yield results (bu/ac) for the Roblin site are shown in Figure 1.

Figure 1: 2-Row barley yields by entry (bu/ac)



Materials and methods

Experimental Design:	Random Complete Block Design
Entries:	29 varieties
Seeding:	May 11
Harvest:	Sep 2

Data collected	Date collected
Yield:	Sep 2
Moisture:	Sep 2

Agronomic info

Previous year’s crop:	Canola
Soil Type:	Erickson Clay Loam
Landscape:	Rolling with trees to the east
Seedbed preparation:	Direct seeded

Table 1: Malt barley varieties included in evaluation*

- CDC Churchill
- CDC Copper
- CDC Fraser
- CDC Copeland
- AAC Synergy
- AB BrewNet
- AAC Connect
- CDC Bow
- AC Metcalfe
- AAC Prairie

* Malt varieties were sent to the Canadian Malting Barley Technical Centre for analysis.

Table 2: Fertility Information

	Available	Added (actual)	Type
N	104 lb/ac	20 lb/ac	46-0-0
P	47 ppm	15 lb/ac	11-52-0-0

Table 3: Spraying Information

Crop stage	Date	Product	Rate
Pre-emerge	May 11	Heat 59	59 ml/ac
		Merge	400 ml/ac
		Glyphosate	670 ml/ac
In-crop	Jun 6	Dicamba	110 ml/ac
		Puma	270 ml/ac

Corn

Agriculture Agri-Food Canada Corn Variety Evaluation

Project duration: May 2017 – November 2022
Objectives: To develop and release early maturing cold tolerant corn inbreds with emphasis on the 1800-2000 CHU market.
Collaborators: Aida Kebede PhD – AAFC Research Scientist Ottawa Research and Development Centre; Manitoba Corn Growers Association

Background and findings

The trial is the final year of a five-year project, led by Dr. Aida Kebede, AAFC-Ottawa (following Dr. Lana Reid's retirement in 2021. The project's objective used conventional corn breeding methodology enhanced by double haploid inbred production and specialized screening techniques for cold tolerance and disease resistance. The trial was conducted at sites across five provinces. The anticipated impact of developing earlier maturing, cold tolerant corn will expand the acreage of corn production in Canada. AAFC will make research findings available at the conclusion of the project.

Materials and methods

Experimental Design:	Random Complete Block Design
Entries:	30 varieties
Seeding:	May 25
Harvest:	Nov 22
Data collected	Date collected
Yield:	Nov 22
Test Weight:	Nov 23
Moisture:	Nov 30
Agronomic info	
Previous year's crop:	Canola
Soil Type:	Erickson Clay Loam
Landscape:	Rolling with trees to the east
Seedbed preparation:	Direct Seeded

Table 1: Fertility Information

	Available	Added (actual)	Type
N	120 lb/ac	72 lb/ac	46-0-0
P	52 ppm	15 lb/ac	11-52-0-0
K	670 ppm	N/A	N/A

Table 2: Pesticide Application

Crop stage	Date	Product	Rate
Pre-emerge	May 12	Glyphosate	670 ml/ac
		Heat LQ	59 ml/ac
		Merge	400 ml/ac
		Sortan IS	30.4 g/ac
		Agral 90	200 ml/ac

Agriculture Agri-Food Canada Corn Nursery

Project duration: May 2017 – October 2022
Objectives: To develop and release early maturing cold tolerant corn inbreds with emphasis on the 1800-2000 CHU market.
Collaborators: Aida Kebede PhD – AAFC Research Scientist Ottawa Research and Development Centre; Manitoba Corn Growers

Background and project findings

The trial is the final year of a five-year project, led by Dr. Aida Kebede, AAFC-Ottawa (following Dr. Lana Reid's retirement in 2021. The project's objective used conventional corn breeding methodology enhanced by double haploid inbred production and specialized screening techniques for cold tolerance and disease resistance. The trial was conducted at sites across five provinces. The anticipated impact of developing earlier maturing, cold tolerant corn will expand the acreage of corn production in Canada. AAFC will make research findings available at the conclusion of the project.

Materials and methods

Experimental Design:	500 row observation nursery
Entries:	500
Seeding:	May 25
Harvest:	Nov 24
Data collected	Date collected
Tasseling Date:	Aug 5 – Aug 31
Silking Date:	Aug 8 – Sep 8
Ear Formation:	Aug 13 – Sep 12
Agronomic info	
Previous year's crop:	Canola
Soil Type:	Erickson Loam Clay
Landscape:	Rolling with trees to the east
Seedbed preparation:	Direct-seed

Table 1: Fertility Information

	Available	Added (actual)	Type
N	120 lb/ac	72 lb/ac	46-0-0
P	52 ppm	15 lb/ac	11-52-0-0
K	670 ppm	N/A	N/A

Table 2: Pesticide Application

Crop stage	Date	Product	Rate
Pre-emerge	May 12	Glyphosate	670 ml/ac
		Heat LQ	59 ml/ac
		Merge	400 ml/ac
		Sortan IS	30.4 g/ac
		Agral 90	200 ml/ac

Corn Intercropping Strategies for Fall and Winter Grazing of Beef Cattle

Project summary prepared by Dr. Emma Mcgeough, University of Manitoba

Project duration: May 2022 – November 2023
Objectives: Compare corn intercrop strategies for late fall and early winter grazing across a network of six sites in three Prairie Provinces.
Collaborators: Dr. Yvonne Lawley (U of M) and Dr. Emma Mcgeough (U of M)

Background

Finding innovative ways to extend the grazing season in western Canada continues to be at the forefront of winter feeding for many cow-calf producers, particularly when being faced with trying to "get more from less" when it comes to available land for cattle grazing and feed production.

As cattle typically graze on grass/legume forages in the summer that sharply decline in quality in fall/winter, a high quality stockpiled forage for extended grazing is crucial to maintaining animal productivity. Compared to perennial stockpile grazing for example, corn yields a large volume of feed per hectare, allowing more output from a smaller area. Corn also provides an effective wind break and abundant energy that helps cows through cold winter months; however, its low crude protein content results in unbalanced energy-to-protein ratio which restricts rate of liveweight gain. This feature limits the suitability of this winter grazing system for not only mature beef cows (when under extreme cold conditions) but also for growing cattle with high nutrient demands.

Corn on 60" spacing, intercropped with Italian ryegrass.

Partnering with the beef and forage industry, and using a range of agronomic, animal and economic analyses, this project will identify the potential feasibility for intercropping corn with high protein forages to increase the nutritive value of these mixed stands for beef cattle grazing in late fall/early winter under western Canadian winter conditions. Investigation of agronomic management practices for intercropping corn will provide flexible options to increase adoption across the Prairies. With growing interest in intercropping, crop-livestock integration, and regenerative agriculture, novel grazing strategies that will enhance the long-term resiliency, adaptability, competitiveness, and profitability of Canadian beef production are critical.

What did we do?

A two year, small plot study was initiated in 2022 at eight sites across western Canada. These sites were: Prairie Crop Diversification Foundation, Western Agricultural Diversification Organization, University of Manitoba (Glenlea & Carman), South East Research Farm (Redvers, SK), Olds College (Olds, AB), North Peace Applied Research Association (Manning, AB) and Farming Smarter (Lethbridge, AB).

Brooklyn Bartel in a plot at Roblin: corn on 60-inch row spacing, intercropped with crimson clover

Corn on 60-inch row spacing was intercropped with either Italian ryegrass, crimson clover, hairy vetch, grazing radish and compared to a corn only control seeded on 30 in row spacing. Corn was seeded in late May and intercrop seeded at V4. Establishment was determined by in season plant counts and in late September and early November, biomass yield of the corn and intercrop were determined. Additionally, the chemical composition of the corn and intercrops were also determined to evaluate their potential nutritive value for beef cattle. Data analysis is presently ongoing but early results from PCDF indicate that intercrop crude protein content ranged from 14 – 23%, showing promise to add supplemental feeding value to corn stands.

This Prairie wide evaluation will be repeated in 2023 and concurrently a large-scale grazing trial will be conducted at the University of Manitoba based on the most promising treatments selected from the regional, small plot evaluation.

Funding partners: NSERC Alliance Program, Alberta Beef Producers, Mitacs Accelerate, Union Forage (seed donation), University of Manitoba URGP Program.
Supporting partners: Manitoba Beef Producers, Manitoba Forage and Grassland Association, Saskatchewan Cattlemen's Association, Saskatchewan Forage Council

Project details at Roblin

(Prepared by Jessica Frey)

The trial at Roblin was initially planned as one experiment with five entries and four repetitions. However, a seeding error resulted in only three useable replications and shorter plot lengths. The trial was seeded again four weeks later, resulting in an opportunity to collect data on both trials, adjusting for their differences. In this report, the first seeding date is referred to as Exp 1 (shorter plots, 3 replications, earlier seeding date) and the second seeding date is Exp 2 (longer plots, 4 replications, later seeding date).

As part of a multi-site, multi-year project, the results will be compiled by the Principal Investigators and made available at the conclusion of the project. Agronomic data for Roblin is included here.

Table 1: Treatments

Treatment	Intercrop Treatment	Corn Row spacing (inches)	Intercrop Seeding Rate (lb/ac)
1	Italian Ryegrass	60	7
2	Hairy Vetch	60	10
3	Crimson Clover	60	3
4	Graza Forage Radish	60	3
5	Control (No intercrop)	30	none

Note: Intercrops were broadcast when the corn was at growth stage V4 (roughly three weeks after corn seeding)

Materials and methods

Experimental Design: Randomized Complete Block Design
Entries: 5
Replications: Exp 1 Three; Exp 2 Four
Seeding Date: Exp 1 May 25; Exp 2 June 20

Table 1: Data Collection

Data collected	Date collected	
	Experiment 1	Experiment 2
Corn Plant Counts	June 16	Sep 21
Corn Plants per 1m	At each biomass date	At each biomass date
Corn Cobs per 1m	At each biomass date	At each biomass date
Intercrop Plant Counts	Sep 21	Sep 28
Sep Corn Biomass	Sep 22	Sep 28
Sep Intercrop Biomass	Sep 26	Sep 27
Oct Corn Biomass	Oct 25	Oct 26
Oct Intercrop Biomass	Oct 18	Oct 18
Nov Corn Biomass	Nov 4	Nov 4
Nov Intercrop Biomass	Nov 4	Nov 4

Previous year's crop: Canola
Soil Type: Erickson Loam Clay
Landscape: Rolling with trees to the east
Seedbed preparation: Direct-seed

Table 2: Fertility Information

	Available	Added (actual)	Type
N	120 lb/ac	74 lb/ac	46-0-0
P	52 ppm	15 lb/ac	11-52-0-0
K	670 ppm	N/A	N/A

Table 3: Pesticide Application

Crop stage	Date	Product	Rate
Pre-emerge	May 12	Glyphosate	900 ml/ac
		Curtail M	810 ml/ac

Flax and Linseed

CDC Linseed Flax Coop Variety Evaluation

Project duration:	May 2022 – September 2022
Objectives:	To evaluate pre-registration varieties for the Linseed Coop.
Collaborators:	Helen Booker – University of Saskatchewan Plant Sciences Flax Breeder
	Ken Jackle – Crop Development Centre Flax Breeding Program

Background

The trial was conducted in partnership with Helen Booker and the Prairie Recommending Committee for Oilseeds (PRCO). For further information, contact Ken Jackle: ken.jackle@usask.ca.

Results

The mean yields by named and unnamed varieties are shown in Table 1. Statistical differences for yield are shown in Figure 1. Summary statistics for the test are shown in Table 2.

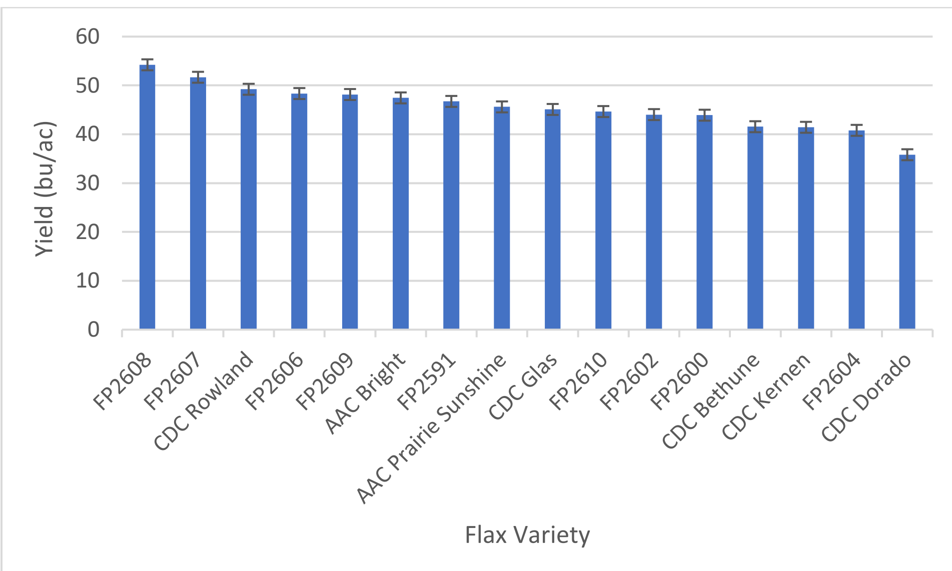


Figure 1: Flax yield by variety.

Table 2: Summary statistics for test

Mean (bu/ac)	45.35
CV (%)	12.1
LSD (.05)	9.48

Materials and methods

Experimental Design:	Random Complete Block Design
Entries:	16
Seeding:	May 24
Harvest:	Oct 6 and Oct 11

Data collected	Date collected
Height:	Aug 24

Determinate Habit:	Middle of September
Dry down Habit:	Middle of September
Maturity:	Middle of September
Lodging:	Aug 24
Yield:	Oct 24
Moisture:	Oct 24

Agronomic info

Previous year's crop:	Canola
Soil Type:	Erickson Clay Loam
Landscape:	Rolling with trees to the east
Seedbed preparation:	Direct seeded

Table 3: Fertility Information

	Available		Added	Type
N	84	lb/ac	36 lb/ac	46-0-0
P	29	ppm	10 lb/ac	11-52-0-0
K	463	ppm	-	

P banded with seed; N side-banded

Hemp

National Hemp Variety Field Trials – 5 Year Summary

Project duration: May 2018 – October 2022
Objectives: To evaluate industrial hemp varieties for the National Hemp Variety Field Trials coordinated by the Canadian Hemp Trade Alliance
Collaborators: Canadian Hemp Trade Alliance
PI, James Frey (Manitoba Agriculture and Resource Development)

Background
This report provides a summary of hemp variety trials conducted at the Manitoba Diversification Centres during the five-year project funded by CHTA. Established in 2003, the CHTA is a national organization that aims to develop the Canadian hemp industry. CHTA membership includes farmers, processors, suppliers, consultants, researchers, industry associations and government. The project aims to provide the hemp industry with third-party validated agronomic information for current or pending cultivars on the List of Approved Cultivars. Although this report focuses on the Diversification Centre sites, note that in 2022, the National Hemp Variety Field Trials were implemented at 13 sites across Canada (QC = 1, ON = 1, MB = 5, SK = 1 and AB = 5). The 2022 CHTA report for all sites can be accessed here.

One-Year Results (2022)
The evaluations tested entries for grain (Table 1) and fibre yield (Table 2), cannabinoids (Table 3), and agronomic variables (Table 4).

Table 1: Grain yield by variety (lb/ac)

	CMCDC		PCDF		PESAI		WADO		Mean (All Sites)
	Lb/ac	**% Check***	**Lb/ac**	**% Check***	**Lb/ac**	**% Check***	**Lb/ac**	**% Check***	**Lb/ac**
CRS-1	1112	100.0	1673	100.0	1882	100.0	1760	100.0	1607
Henola	†	72.1	1423	85.1	2079	110.5	1789	101.7	1523
Stalker	2216	199.2	928	55.4	1725	91.7	1360	77.3	1557
X59	945	85.0	1789	106.9	2105	111.8	1366	77.6	1551
Bountiful	2107	189.5	368	22.0	1416	75.2	790	44.9	1170
% CV	12.4	-	7.7	-	17.2	-	14.0	-	-
CRS-1	-	-	-	-	1715.5	100.0	1725.9	100.0	1720.7
Alyssa	-	-	-	-	1548.7	90.3	1624.4	94.1	1586.6
Bialobrzeskie	-	-	-	-	960.4	56.0	869.2	50.4	914.8
Canda	-	-	-	-	1416.3	82.6	1479.6	85.7	1448.0
Scarlett	-	-	-	-	1350.8	78.7	1508.8	87.4	1429.8
Silesia	-	-	-	-	1394.8	81.3	1408.8	81.6	1401.8
% CV	-	-	-	-	16.1	-	4.0	-	-

* Check = CRS-1, repeated for both Grain and Dual Purpose entries.
† Henola was removed from the results for Carberry due to extreme pest damage for that variety.
‡ Results were excluded for Dual Purpose entries at CMCDC and PCDF due to high % CVs, which reduce the reliability of the results.

Table 2: Fibre yield by variety (lb/ac)

	CMCDC		PCDF		PESAI		WADO		Mean (All Sites)
	Lb/ac	**% Check***	**Lb/ac**	**% Check***	**Lb/ac**	**% Check***	**Lb/ac**	**% Check***	**Lb/ac**
Dual Purpose entries†									
CRS-1	8853.4	100.0	-	-	-	-	3117.4	100.0	5985.4
Alyssa	7711.1	87.1	-	-	-	-	3919.0	125.7	5815.1
Bialobrzeskie	10477.4	118.3	-	-	-	-	3161.9	101.4	6819.7
Canda	8866.8	100.2	-	-	-	-	2850.2	91.4	5858.5
Scarlett	9572.0	108.1	-	-	-	-	3518.2	112.9	6545.1
Silesia	9790.9	110.6	-	-	-	-	3161.9	101.4	6476.4
% CV	15.3	-	-	-	-	-	15.2	-	-

* Check = CRS-1, repeated for both Grain and Dual Purpose entries

† Results were excluded for Fibre Yield at PCDF and PESAI due to high % CVs, which reduce the reliability of the results.

Table 3: Cannabidiol (CBD) and Cannabigerol (CBG) content by variety (%)*

	Cannabidiol (CBD)					Cannabigerol (CBG)			
	PCDF	PESAI	MCDC	WADO		PCDF	PESAI	MCDC	WADO
CRS-1	1.42	1.17	2.26	1.50		0.09	0.04	0.08	0.08
Alyssa	0.88	0.80	2.05	0.95		0.08	0.04	0.05	0.05
Bialobrzeskie	1.41	1.07	1.92	1.40		0.06	0.03	0.04	0.04
Bountiful	1.38	1.30	2.64	2.02		0.04	0.03	0.06	0.06
Canda	0.91	0.60	1.99	1.35		0.05	0.02	0.05	0.05
Henola	1.42	1.09	1.94	1.85		0.07	0.04	0.09	0.09
Marina	0.97	-	-	-		0.02	-	-	-
Stalker	1.84	1.62	3.03	2.11		0.07	0.04	0.09	0.09
Scarlett	1.51	1.14	1.97	1.44		0.07	0.03	0.06	0.06
Silesia	0.70	0.78	1.27	0.86		0.02	0.03	0.03	0.03
Visoka	0.84	-	-	-		0.02	-	-	-
X-59	1.25	0.86	1.95	1.72		0.03	0.01	0.04	0.04

* Derived from leaf and flower parts from upper 20 cm of plant (Source: InnoTech Alberta)

Table 4: Agronomic characteristics by variety

	CMCDC	PCDF	PESAI	WADO	Mean (All Sites)
	Lb/ac	**Lb/ac**	**Lb/ac**	**Lb/ac**	**Lb/ac**
Early vigor (at canopy closure, 1-10, 1=low)					
CRS-1 (grain)	7.3	5.8	10.0	8.8	7.9
Bountiful	7.5	4.8	10.0	8.8	7.8
Henola	7.8	5.3	10.0	7.3	7.6
Stalker	7.8	5.8	10.0	8.8	8.1
X-59	8.0	7.3	10.0	5.3	7.6
Alyssa	8.3	4.3	10.0	8.0	7.6
Bialobrzeskie	8.0	6.5	10.0	6.8	7.8
Canda	7.8	6.8	10.0	9.0	8.4
CRS-1 (dual)	7.8	5.3	10.0	8.3	7.8
Marina	-	6.5	-	-	6.5
Scarlett	8.0	5.3	10.0	8.5	7.9
Silesia	8.5	6.5	10.0	7.0	8.0
Visoka	-	5.5	-	-	5.5

Plant height (cm)					
CRS-1 (grain)	141	177	161	161	160
Bountiful	149	202	192	166	177
Henola	144	174	159	153	157
Stalker	141	191	184	178	174
X-59	145	161	151	152	152
Alyssa	146	202	193	178	179
Bialobrzeskie	148	234	206	214	200
Canda	144	192	180	163	170
CRS-1 (dual)	147	179	171	171	167
Marina	-	239	-	-	239
Scarlett	148	212	200	182	185
Silesia	147	218	194	197	189
Visoka	-	282	-	-	282
Days to maturity					
CRS-1 (grain)	-	-	-	100	-
Bountiful	-	-	-	105	-
Henola	-	-	-	103	-
Stalker	-	-	-	105	-
X-59	-	-	-	103	-
Alyssa	-	-	-	103	-
Bialobrzeskie	-	-	-	103	-
Canda	-	-	-	103	-
CRS-1 (dual)	-	-	-	100	-
Scarlett	-	-	-	103	-
Silesia	-	-	-	103	-
Emergence (number of days after sowing, 50% emergence)					
CRS-1 (grain)	20	10	12	9	13
Bountiful	20	10	12	9	13
Henola	20	10	12	9	13
Stalker	20	10	12	9	13
X-59	20	10	12	9	13
Alyssa	20	10	12	9	13
Bialobrzeskie	20	10	12	9	13
Canda	20	10	12	9	13
CRS-1 (dual)	20	10	12	9	13
Marina	-	10	-	-	10
Scarlett	20	10	12	9	13
Silesia	20	10	12	9	13
Visoka	-	10	-	-	10
Seedling mortality (%)					
CRS-1 (grain)	48.5	11.3	16.2	3.9	20
Bountiful	44.5	9.1	16.2	3.4	18
Henola	46.8	15.1	23.3	5.2	23
Stalker	44.6	9.1	12.4	1.1	17
X-59	46.8	12.5	22.2	22.8	26
Alyssa	40.1	16.3	14.4	2.5	18
Bialobrzeskie	40.1	5.2	33.8	49.1	32
Canda	41.0	9.5	21.8	1.0	18
CRS-1 (dual)	36.4	19.8	15.6	3.4	19
Marina	-	9.9	-	-	10
Scarlett	34.9	8.6	14.7	3.3	15
Silesia	42.8	8.7	24.9	23.7	25
Visoka	-	4.9	-	-	5

* Check = CRS-1, repeated for both Grain and Dual Purpose entries

Five-Year Results (2018-2022)

The five-year summary includes data for all varieties that were grown at the Diversification Centres over the lifetime of the project. Summaries are provided by variety for grain yield (Table 5), fibre yield (Table 6), and agronomic characteristics (Table 7). Note that yields for varieties are provided as a percentage, relative to the check, CRS-1. The yield for CRS-1 is provided in pounds-per-acre.

Table 5: Grain yield relative to CRS-1, 2018-2022*

				2022				2021	2020		2019	2018		
	(% CRS-1)	Years	Sites	PESAI	CMCDC	WADO	PCDF	PCDF	WADO	PCDF	PESAI	PESAI	WADO	PCDF
Grain Varieties														
CRS-1	100	5	12	100	100	100	100	100	100	100	100	100	100	100
Bountiful	80	1	5	75	189	45	22	-	-	-	-	-	-	-
CFX-2	100	3	4	-	-	-	-	-	-	-	92	95	119	93
Grandi	97	3	6	-	-	-	-	-	100	82	90	89	113	107
Henola	95	2	6	110	72	102	85	110	-	-	-	-	-	-
Judy	67	1	1	-	-	-	-	-	-	-	67	-	-	-
Katani	90	4	7	-	-	-	-	57	101	77	89	94	110	102
Picolo	78	2	2	-	-	-	-	-	89	68	-	-	-	-
S20	107	1	5	92	199	77	55	-	-	-	-	-	-	-
X59	99	5	11	112	85	78	107	-	82	117	112	89	87	100
Check Characteristics - CRS-1														
Grain Yield CRS-1 average : 1226 lb/ac				1882	1112	1760	1673	663	1339	1093	1107	1043	767	1047
CV%				17.2	12.4	14.0	7.7	14.6	6.8	18.1	9.0	5.3	11.4	12.9

				2022		2021	2020			2018			
	% CRS-1	Years Tested	Sites Tested	Arborg	Melita	Roblin	Arborg	Melita	Roblin	Arborg	Carberry	Melita	Roblin
Dual Purpose Varieties													
CRS-1	100	5	10	100	100	100	100	100	100	100	100	100	100
Altair	87	3	7	-	-		90	88	100	80	99	71	81
Alyssa	92	1	2	90	94		-	-	-	-	-	-	-
Angie	120	1	1	-	-	120	-	-	-	-	-	-	-
Anka	71	3	4	-	-		-	-	-	70	72	69	75
Bialobrzeskie	74	2	3	56	50	116	-	-	-	-	-	-	-
Canda	91	2	6	83	86		-	-	-	94	95	88	102
CFX-2	86	2	3	-	-	97	-	87	74	-	-	-	-
Joey	96	1	4	-	-		-	-	-	102	101	86	94
Judy	119	1	1	-	-	119	-	-	-	-	-	-	-
Maureen	121	1	1	-	-	121	-	-	-	-	-	-	-
Nadine	76	1	1	-	-		-	-	-	-	-	76	-
NWG 2730	41	1	2	-	-		-	36	46	-	-	-	-
Petera	58	2	3	-	-		50	70	54	-	-	-	-
Quida	136	1	1	-	-	136	-	-	-	-	-	-	-
Scarlett	83	1	2	79	87		-	-	-	-	-	-	-
Silesia	71	5	6	81	82		-	-	-	50	79	62	74
Vega	116	2	4	-	-	143	111	102	109	-	-	-	-
Check Characteristics - CRS-1													
Grain Yield CRS-1 avg: 891 lb/ac				1715	1726	417	1453	1203	745	1002	716	700	890
CV%*				16.1	4.0	13.0	14.4	7.9	16.1	7.6	12.9	10.3	9.3

*Adapted from a table prepared by Howard Love

Table 6: Fibre yield relative to CRS-1, 2018-2022*

				2022		2021	2020				2019	2018		
	% CRS-1	Years	Sites	CMCDC	WADO	PCDF	PESAI	CMCDC	WADO	PCDF	PESAI	PESAI	CMCDC	WADO
CRS-1	100	5	12	100	100	100	100	100	100	100	100	100	100	100
Altair	132	3	7	-	-	-	127	-	130	132	156	97	168	113
Alyssa	120	1	3	87	126	-	-	-	-	-	-	-	-	-
Angie	143	1	1	-	-	143	-	-	-	-	-	-	-	-
Anka	126	3	3	-	-	-	-	-	-	-	-	97	160	121
Bialobrzeskie	139	2	4	118	101	167	-	-	-	-	-	-	-	-
Canda	109	2	6	100	91	-	-	-	-	-	-	107	127	105
CFX-2	77	2	3	-	-	79	-	-	72	80	-	-	-	-
Joey	111	1	3	-	-	-	-	-	-	-	-	87	137	109
Judy	116	1	1	-	-	116	-	-	-	-	-	-	-	-
Marina	172	1	1	-	-	-	-	-	-	-	-	-	-	-
Maureen	119	1	1	-	-	119	-	-	-	-	-	-	-	-
Nadine	116	1	1	-	-	-	-	-	-	-	-	-	-	116
NWG 2730	133	1	3	-	-	-	-	146	131	121	-	-	-	-
Petera	165	2	4	-	-	-	199	-	156	153	151	-	-	-
Picolo	43	1	1	-	-	-	-	43	-	-	-	-	-	-
Quida	129	1	1	-	-	129	-	-	-	-	-	-	-	-
Scarlett	117	1	3	108	113	-	-	-	-	-	-	-	-	-
Silesia	136	5	7	111	101	-	-	-	-	-	158	158	179	118
Vega	120	2	4	-	-	129	119		122	108	-	-	-	-
Visoka	241	1	1	-	-	-	-	-	-	-	-	-	-	-
X59	82	1	1	-	-	-	-	82	-	-	-	-	-	-
Check Characteristics - CRS-1														
Fibre Yield CRS-1 avg: 4328 lb/ac				8853	3117	1793	5314	4364	4522	5985	4381	2685	2887	3447
CV%*				15.3	15.2	15.4	19.6	17.6	10.1	13.3	15.9	9.3	13.3	8.7

*Adapted from a table prepared by Howard Love

Figure 1: a) hemp plant, b) hemp plant nearing grain maturity, c) hemp plant with trichomes forming on flower and leaf parts, d) close-up of trichomes on a hemp leaf, e) hemp flowers.

Discussion

The data presented in this report provide information about varietal performance during a period of five years across four sites. The yields and other performance characteristics are related to climatic conditions for each site and year. A summary of climate information for each site during the period is in Table 7.

Table 7: Growing season report for Diversification Centres, 2018-2022

	CMCDC		PCDF		PESAI		WADO	
	Actual	% Normal	Actual	% Normal	Actual	% Normal	Actual	% Normal
Precipitation (mm)								
2018	337	111	554	146	282	86	268	77
2019	493	162	262	86	300	92	431	124
2020	254	84	261	86	213	65	182	52
2021	249	82	266	88	267	82	224	93
2022	358	118	323	106	495	152	185	53
Crop Heat Units								
2018	2642	104	2285	99	2523	99	2656	99
2019	2433	96	2215	96	2461	97	2566	95
2020	2693	106	2364	102	2642	104	2791	104
2021	1852	123	2692	117	2876	113	2996	111
2022	2743	108	2519	109	2786	109	2911	108
Growing Degree Days								
2018	1673	112	1389	102	1606	106	1692	105
2019	1503	100	1319	97	1498	98	1594	99
2020	1660	111	1439	106	1624	107	1736	107
2021	2884	114	1676	124	1850	122	1956	121
2022	1665	111	1503	111	1759	116	1797	111

*MB Agriculture Growing Season Report, https://web43.gov.mb.ca/climate/SeasonalReport.aspx

In general, the 2020-2021 seasons were dry and warm. In eastern and central Manitoba, the 2022 season began with large amounts of precipitation, which delayed seeding for CMCDC and PESAI. In general, hemp is vulnerable during the early growth stages to excessive soil moisture. Lack of moisture during seed development will access to soil nitrogen and reduce yield. Nevertheless, hemp is a resilient crop that generally performs well in a range of climates and growing conditions. For more general information on hemp production, see the CHTA e-guide.

The project completes a five-year funding arrangement between CHTA and the Diverse Field Crops Cluster. A new project agreement is in development to continue the projects for another five years.

Materials and methods

Experimental Design: Random Complete Block Design
Entries: 5 grain entries and 6 dual purpose entries, 4 replications

General information

Seed provided by variety owner or representative.
Seeding rate: 150 pl/m^2
Target seeding date: middle of May
Target fertility: 120-40 N-P; K and S followed local recommendations for wheat
Seeding depth: Up to 1.5 inches, into moisture
Herbicide: Pre-seed burn-off (non-residual); in-crop bromoxynil (if required)

Data collected
Emergence date: At 50% plot emergence
Plant density: 2 plant counts for 1m row/plot; (1) at 100% emergence and (2) at stem elongation
Early vigour: At canopy closure (1-10; 1=low)
Plant height: Average of 5 measurements/plot, 1 week before harvest
Lodging: At harvest (1-5; 1=no lodging)
Disease rating: Visual rating of disease symptoms such as sclerotinia (%)
Days to maturity: Emergence to physiological maturity (10-20% seed moisture)
Male to female ratio: Counted in 1m row/plot
Grain yield: All varieties, adjusted to 10% moisture
Fibre yield: All stems for 1m row/plot, dried and stripped of leaf material
Cannabinoids: 4 heads (top 20 cm) per plot, analysed at InnoTech Alberta

Table 5: Activities and dates

	PCDF	PESAI	MCDC	WADO
Seeding	May 28	May 25		May 24
Fibre harvest	Aug 27	Aug 17		Aug 3
CBD sampling	Aug 27	Sep 26		Aug 8
Grain harvest	Sep 29	Sep 26		Sept 6

Table 6: Fertility Information

	Available	Added	Type	Available	Added	Type
	PCDF			MCDC		
N	120 lb/ac	52 lb/ac	46-0-0			46-0-0
P	52 ppm	20 lb/ac	11-52-0-0			11-52-0-0
K	670 ppm					
	PESAI			**WADO**		
N	212lb/ac	30lb/ac	46-0-0	39 lbs/ac	130 lbs/ac	28-0-0 UAN
P	36lb/ac	20lb/ac	11-52-0-0	15 ppm	35 lb/ac	11-52-0-0
K				294 ppm	25 lb/ac K	0-0-60

Table 7: Herbicide Application

	Product	Crop Stage	Date	Rate
PCDF	Liberty	Pre-emerge (no in-crop)	May 26	540 ml/ac
PESAI	Pardner	In crop	June 22	0.4L/ac
MCDC				
WADO	Assure II, Koril	3”, 4”	June 8, 10	0.2L/ac, 0.4L/ac

PCDF In-House Trials

Cereal-Forage Intercrops – Grain Summary (2020-2022)

Note: This report focuses on the grain yield for the cereals component of the cereal-forage intercrop project. See the "Forage Summary (2020-2022)" report for the forage yield data.

Project duration: May 2020 – September 2022
Objectives: To evaluate intercropping potential for barley, oats and wheat with leguminous forage crops.
Collaborators: PCDF

Background
Leguminous species such as alfalfa and some clovers are important forage crops in Manitoba. In addition to producing large quantities of biomass, these crops contain high levels of crude protein for animal nutrition. Because alfalfa is not very competitive against weeds, producers frequently establish it by planting it with a nurse crop, such as oats. This practice effectively creates a cereal-forage intercrop in the year of establishment. This trial expands on the practice by examining the potential for intercropping barley, oats and wheat with alfalfa, red clover, white clover and yellow sweet clover.

In addition to the potential of using the leguminous species as a forage crop in the year after planting, they can also serve as cover crops. The Manitoba Agriculture website states that producers may plant cover crops to minimize wind and water erosion. Cover crops can play an important role after low-residue crops, or in spring during crop establishment. Another import function is to prevent losses of excess nutrients after harvest, especially nitrogen. Additionally, cover crops can help to trap snow, enhancing moisture conditions in spring. Depending on the growing period, leguminous cover crops can also fix substantial amounts of nitrogen for subsequent crops.

Despite the benefits identified above, the Parkland's limited growing season before or after other crops can make establishing cover crops a challenge. Establishing a leguminous species with a cereal crop may allow producers in the Parkland to adopt cover cropping successfully on their farms.

Results
Overview
The data presented here are for three years (2020-2022), and focus on the grain yield of the intercrop. Table 1 summarizes average yields for all cereal crops by treatment, shown as a percentage of the cereal-only treatment. Table 2 shows the statistical significance for grain yield.

Table 1: Summary of yield (% cereal-only) for cereals by treatment (2020-2022)

	Barley			Oats			Wheat		
	2020	**2021**	**2022**	**2020**	**2021**	**2022**	**2020**	**2021**	**2022**
Cereal-only	100	100	100	100	100	100	100	100	100
Cereal-Alfalfa	99	93	96	98	103	100	114	84	93
Cereal-Red Clover	99	97	102	98	96	97	108	95	98
Cereal-Sweet clover	95	100	91	111	84	100	110	94	96
Cereal-White Clover	100	110	99	110	108	98	124	112	97

Table 2: Statistical significance of grain yield for cereals by treatment (2020-2022)*

	Barley				Oats			Wheat				
	2020	2021		2022	2020	2021	2022	2020	2021			2022
Cereal only	A	A	B	A	A	A	A	A	A	B	C	A
Cereal-Alfalfa	A	A		A	A	A	A	A	A			A
Cereal-Red Clover	A	A	B	A	A	A	A	A	A	B		A
Cereal-Sweet clover	A	A	B	A	A	A	A	A		B		A
Cereal-White Clover	A		B	A	A	A	A	A			C	A
%CV**	5.6	10.1		7.7	10.7	27.9	5.2	13.9	13.3			5.4

* Yields for treatments marked by the same letter in the same column are not statistically significant.
** A lower %CV suggests that the data is more reliable.

<u>Results by cereal type</u>
Figures 1-3 show grain yields (bu/ac) for barley, oats and wheat, respectively, for 2020-2022.

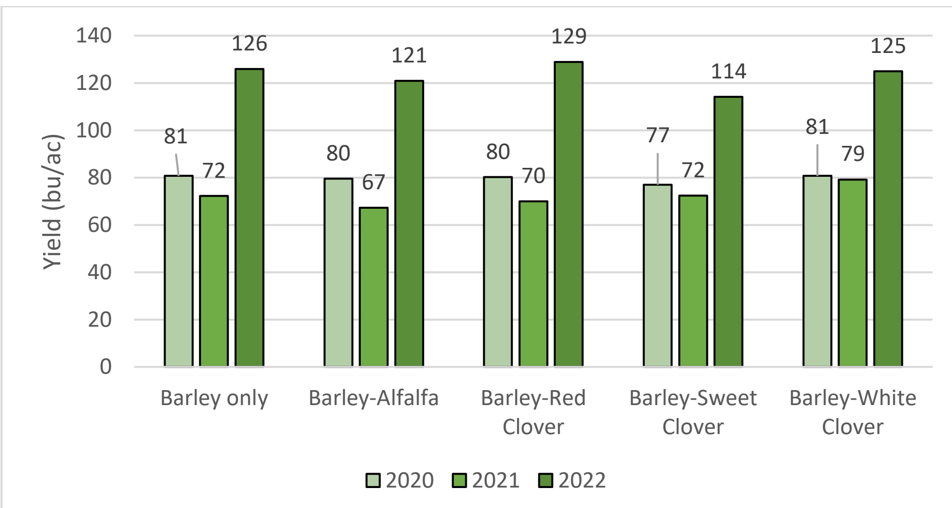


Figure 1: Barley grain yield (bu/ac) by treatment for 2020-2022.

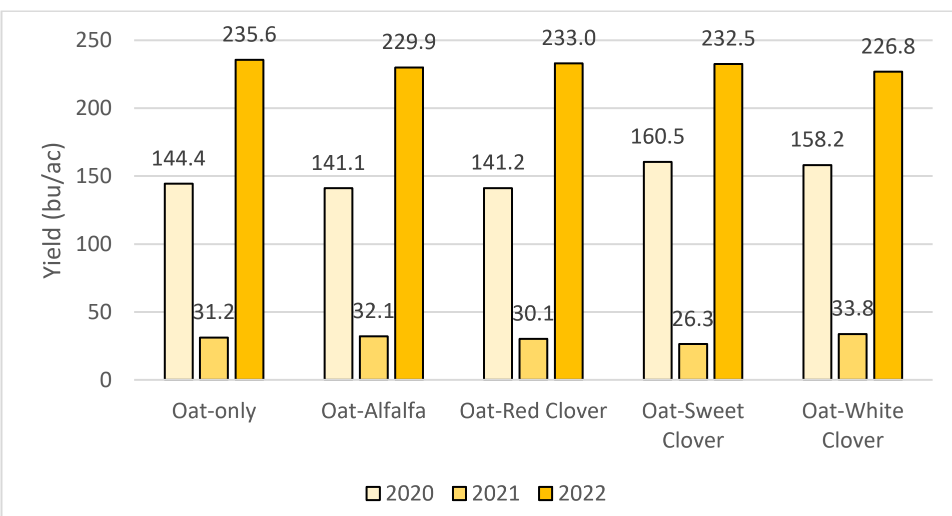


Figure 2: Oat grain yield (bu/ac) by treatment for 2020-2022.

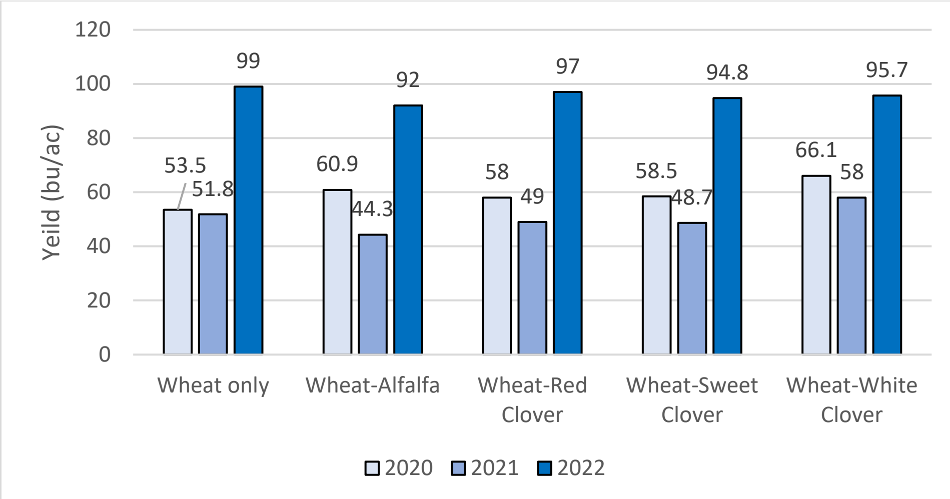


Figure 3: Wheat grain yield (bu/ac) by treatment for 2020-2022.

Discussion

The results highlight the large variations in yield for cereals for the years of the study, especially for oats. This variation can be explained, in part, as resulting from the growing conditions during each season. In 2020 and 2021, the springs were especially dry, although there was enough soil moisture for the cereal crops to establish. Timely rains allowed all the cereal types to produce good to average yields in 2020, but in 2021, the lack of moisture and excessive heat resulted in a crop failure for oats. Of particular explanatory importance for the poor oat yield in 2021 was the fact that high temperatures (>30◦C) coincided with anthesis (flowering), resulting in sterile florets that did not produce seed.

In contrast, the 2022 growing season provided nearly optimal growing conditions for cereals, with good spring soil moisture, warm days and cool nights, and relatively low levels of disease. This resulted in extremely good yields for all cereal types. It should be noted that in general, due to management and scale, small-plot yields are often higher than those observed in a field-scale setting.

Table 3 shows the total amount of precipitation, crop heat units and growing degree days for the period of 2020-2022. Note especially the lower precipitation and temperatures for 2021.

Table 3: Growing season report for PCDF, 2020-2022

	Actual	% Normal
Precipitation (mm)		
2020	261	86
2021	266	88
2022	323	106
Crop Heat Units		
2020	2364	102
2021	2692	117
2022	2519	109
Growing Degree Days		
2020	1439	106
2021	1676	124
2022	1503	111

Despite the effect of environmental factors on cereal yield, statistical differences for yields were only observed in 2021 for barley and wheat. Again, this was the driest year of the study, when yields for most crops in the Parkland region were low. This suggests that in years where moisture is sufficiently available, planting a legume crop with a cereal crop does not significantly affect yield. However, in years that moisture is severely limited, yield for cereals appears to be significantly affected by the presence of a legume intercrop. Further, the affect appears to differ between legume types, with cereal yields for wheat and barley with alfalfa performing the worst in 2021.

Interestingly, in 2021, opposite trend was observed for barley and wheat with white clover: in that very dry year, yields for barley with white clover were higher than for any other treatment, and equal to the wheat-only comparison. The reason for this observation is unknown. Speculatively, the cereal might benefit from the nitrogen fixed by the winter wheat crop. Alternatively, the winter wheat may create a favorable soil environment, allowing the cereal to better access moisture or nutrients. More research is required to gain a better understanding of intercrop dynamics. Additionally, it should be emphasized again that this difference disappears in years that soil moisture is sufficiently available.

No herbicides were applied to the treatments. Although some herbicide options are available for cereal-legume intercrops, the close proximity of the plots and danger of spray drift made it more feasible to hand-weed the plots. On a field-scale, careful field selection and a pre-emergence herbicide application would be crucial to the establishment of a successful intercrop. Consult a herbicide guide or dealer to determine the best herbicide option for each intercrop.

2022 Establishment Year Materials and methods

Experimental Design: Random Complete Block Design
Barley variety: CDC Austenson
Wheat variety: CDC Landmark
Oats: AC Summit
Treatments: 5
Replications: 4
Seeding: May 16
Harvest: Sep 6

Table 2: Treatments (crops by lb/ac)

	All Cereals	Red Clover	White Clover	Sweet Clover	Alfalfa
Treatment 1	105 lb/ac	-	-	-	-
Treatment 2	105 lb/ac	10lb/ac	-	-	-
Treatment 3	105 lb/ac	-	5lb/ac		
Treatment 4	105 lb/ac	-	-	5lb/ac	-
Treatment 5	105 lb/ac	-	-	-	18lb/ac

Data collected

Emergence:
Stand rating
Vigor Rating
Yield
Moisture

Agronomic info

Previous year's crop: Canola (2021), Oat Silage (2020), Barley Silage (2019)
Soil Type: Erickson Loam Clay
Landscape: Rolling with trees to the east
Seedbed preparation: Direct seeded

Table 3: Fertility Summary, 2020-2022

Nitrogen					
Target		Added to Achieve Target			Type
		2020	2021	2022	
N (lb/ac)	125	63	10	12	46-0-0

Phosphorous and Potassium					
Available				Added (All Years)	Type
	2020	2021	2022		
P (ppm)	47	41	39	15 lb/ac	11-52-0-0
K (ppm)	393	703	472	-	N/A
Cover crops inoculated; no herbicide applied (hand weeded)					

Cereal-Forage Intercrops – Forage Summary (2020-2022)

Note: This report focuses on the forage yield of the cereal-forage intercrop project. See the "Grain Summary (2020-2022)" report for the cereal yield data.

Project duration: May 2020 – September 2022
Objectives: To evaluate intercropping potential for barley, oats and wheat with leguminous forage crops
Collaborators: PCDF

Background

Leguminous species such as alfalfa and some clovers are important forage crops in Manitoba. In addition to producing large quantities of biomass, these crops contain high levels of crude protein for animal nutrition. Because alfalfa is not very competitive against weeds, producers frequently establish it by planting it with a nurse crop, such as oats. This practice effectively creates a cereal-forage intercrop in the year of establishment. This trial expands on the practice by examining the potential for intercropping barley, oats and wheat with alfalfa, red clover, white clover and yellow sweet clover.

In addition to the potential of using the leguminous species as a forage crop in the year after planting, they can also serve as cover crops. The Manitoba Agriculture website states that producers may plant cover crops to minimize wind and water erosion. Cover crops can play an important role after low-residue crops, or in spring during crop establishment. Another import function is to prevent losses of excess nutrients after harvest, especially nitrogen. Additionally, cover crops can help to trap snow, enhancing moisture conditions in spring. Depending on the growing period, leguminous cover crops can also fix substantial amounts of nitrogen for subsequent crops.

Despite the benefits identified above, the Parkland's limited growing season before or after other crops can make establishing cover crops a challenge. Establishing a leguminous species with a cereal crop may allow producers in the Parkland to adopt cover cropping successfully on their farms.

Results

The data presented here are for two years (2021-2022), and focus on the forage component of the intercrop. Note that the plots for the 2021 data were seeded in 2020; likewise, the 2022 data is from plots seeded in 2021. Table 1 summarizes average yields for all forages by treatment, shown as a percentage of the alfalfa treatment. Table 2 shows the statistical significance for forage yield.

Table 1: Average forage yields for forages by cereal type, 2021-2022 (show as % alfalfa yield)*

	Barley				Oats				Wheat			
	2021	2022			2021	2022			2021	2022		
		Cut 1	Cut 2	Cut 3		Cut 1	Cut 2	Cut 3		Cut 1	Cut 2	Cut 3
Alfalfa	100	100	100	100	100	100	100	100	100	100	100	100
Red Clover	103	12	40	66	114	42	76	67	118	68	133	61
Sweet Clover	212	13	49		132	31	75		202	51	120	
White Clover		9	26	55		19	46	56	56	40	73	92

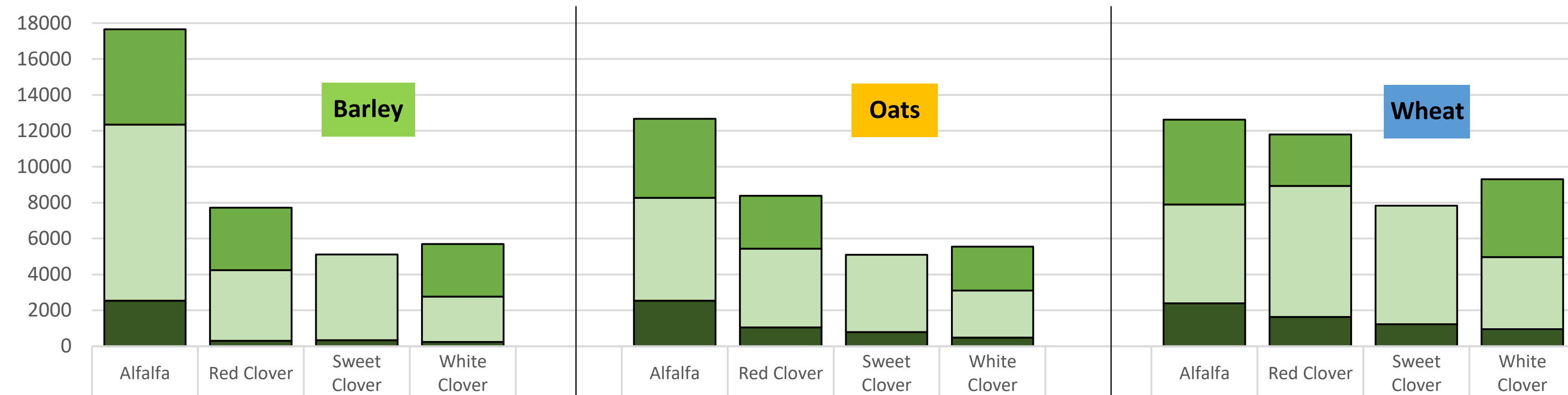
* In 2021, the only cut was July 15. In 2022, the 1st cut was June 7; the 2nd cut was July 12; the 3rd cut was August 17.

Table 2: Statistical significance of forage yield by treatment (2021-2022)*

	Barley							Oats								Wheat							
	2021	2022						2021	2022							2021	2022						
		Cut 1		Cut 2		Cut 3			Cut 1		Cut 2			Cut 3			Cut 1		Cut 2			Cut 3	
Alfalfa	A	A		A		A		A	A		A			A		A	A		A	B	C	A	
Red Clover	A		B	A	B	A	B	A		B	A	B		A		A		B	A	B			B
Sweet Clover	A		B	A	B			A		B		B	C			A		B	A	B			
White Clover			B		B		B			B		B	C		B	A		B	A		C	A	

* Yields for treatments marked by the same letter in the same column are not statistically significant.

Figure 1 shows average forage yields by treatment for 2022. The forages were seeded in 2021 with barley, oats and wheat, respectively.



	Barley: Alfalfa	Barley: Red Clover	Barley: Sweet Clover	Barley: White Clover	Oats: Alfalfa	Oats: Red Clover	Oats: Sweet Clover	Oats: White Clover	Wheat: Alfalfa	Wheat: Red Clover	Wheat: Sweet Clover	Wheat: White Clover
Total	17658	7722	5105	5700	12665	8384	5103	5546	12615	11796	7828	9309
3rd cut, August 17	5310	3482		2928	4394	2947		2442	4728	2869		4337
2nd cut, July 12	9807	3939	4775	2534	5739	4386	4307	2628	5496	7290	6602	4026
1st cut, June 7	2542	301	330	238	2533	1052	796	475	2392	1637	1227	946

Figure 1: Average forage yield by treatment for 2022 (lb/ac). Note the sweet clover did not regrow after the 2nd cut, resulting in no yield for the 3rd cut.

Table 2: % CV for forage yield by treatment. Note that a higher % CV indicates greater differences between plot yields for the same treatment only.

	Barley				Oats				Wheat			
	1st Cut	2nd Cut	3rd Cut	Total	1st Cut	2nd Cut	3rd Cut	Total	1st Cut	2nd Cut	3rd Cut	Total
Alfalfa	20.9	39.4	11.0	26.9	19.7	9.2	7.6	4.1	13.0	28.9	16.3	17.7
Red Clover	43.1	24.0	25.5	10.7	51.9	38.7	46.7	35.8	34.1	17.7	19.8	16.0
Sweet Clover	22.2	24.2		23.5	46.3	19.8		23.0	25.8	13.5		15.0
White Clover	86.0	70.7	13.4	38.5	37.7	11.2	7.2	9.3	35.4	20.5	8.1	4.3

Figure 2: Before 2nd cut, right to left, (a) alfalfa cut; (b) red clover; (c) sweet clover; and (d) white clover.

Figure 3: Before 3rd cut (left) alfalfa; (center) red clover; (c) minimal sweet clover regrowth

Figure 4: October 3, after hard frost, (left) alfalfa; (lower right) red clover; (upper right) white clover.

Table 3: Feed values for forages.

Stubble	Timing†	Forage Type‡	Crude Protein (%)	Ca (%)	P (%)	Mg (%)	K (%)	Na (%)	ADF (%)	NDF (%)	Non-Fibre Carbs (%)	TDN (%)	Relative Feed Value
Barley	June 7	AF	23.33	1.42	0.37	0.26	3.30	0.02	31.93	39.37	26.50	64.53	151
		RC	20.30	1.46	0.37	0.35	2.45	0.01	25.44	33.35	35.55	71.46	193
		SC	27.14	1.66	0.40	0.33	2.84	0.01	24.56	31.56	30.50	72.40	206
		WC	18.03	1.39	0.36	0.29	2.28	0.02	29.81	36.40	34.77	66.79	168
	July 12	AF	21.43	1.50	0.29	0.22	2.56	0.03	39.02	45.82	21.95	56.95	119
		RC	18.81	1.28	0.34	0.35	4.12	0.04	34.45	40.16	30.23	61.83	144
		SC	19.67	0.92	0.30	0.23	2.50	0.01	40.41	46.76	22.77	55.46	114
		WC	19.93	1.53	0.38	0.36	4.25	0.04	32.53	37.78	31.49	63.88	156
Oats	June 7	AF	24.38	1.49	0.36	0.24	3.26	0.02	29.72	38.51	26.31	66.89	159
		RC	21.79	1.49	0.42	0.36	3.44	0.01	28.85	37.44	29.97	67.82	165
		SC	28.96	1.77	0.44	0.40	3.34	0.01	23.32	31.82	28.42	73.73	207
		WC	16.81	1.81	0.36	0.34	3.11	0.04	26.88	36.72	35.67	69.92	172
	July 12	AF	20.32	1.51	0.28	0.24	2.67	0.04	40.73	48.40	20.48	55.12	110
		RC	15.81	1.24	0.30	0.33	3.69	0.03	39.78	46.26	27.13	56.14	116
		SC	21.83	1.03	0.37	0.28	2.63	0.02	38.42	44.69	22.68	57.59	123
		WC	20.62	1.49	0.40	0.34	3.84	0.06	38.10	38.82	29.76	57.93	142
Wheat	June 7	AF	21.69	1.29	0.30	0.20	2.82	0.01	36.20	44.95	22.56	59.96	126
		RC	21.41	1.52	0.37	0.34	3.49	0.01	29.91	35.78	32.01	66.68	171
		SC	30.99	1.69	0.45	0.35	3.59	0.01	23.29	26.40	31.81	73.76	249
		WC	16.06	1.20	0.29	0.23	2.39	0.02	33.54	43.82	29.32	62.81	133
	July 12	AF	20.07	1.21	0.29	0.19	2.74	0.02	40.91	48.11	21.02	54.93	110
		RC	18.02	1.06	0.33	0.30	3.85	0.01	35.92	41.96	29.22	60.26	135
		SC	20.82	0.92	0.32	0.24	2.41	0.01	39.21	47.54	20.84	56.75	114
		WC	19.13	1.24	0.38	0.27	3.77	0.04	36.11	43.09	26.98	60.06	131

† Note that feed values for the 3rd cut (August 17) are not available

‡ AF = Alfalfa; RC = Red Clover; SC = Sweet Clover; WC = White Clover

Nitrogen content for forages

The average nitrogen content for protein is 16%. This means that a forage containing 10% protein will contain 1.6% nitrogen by weight. Based on the crude protein content (show in Table 3) and the total dry matter yield per plot, the average nitrogen content for each treatment is shown in Table 4.

Table 4: Nitrogen content (lb/ac) for forages by treatment at June 7

	Barley	Oats	Wheat
Alfalfa	60	62	42
Red Clover	6	23	28
Sweet Clover	9	23	30
White Clover	4	8	12

Plot establishment and winter survival

The percent plot establishment for forages was determined after grain harvest in 2021. The percent winter survival of forages for each plot was determined in early June, after plots had broken dormancy and begun growing vigorously. The plot stand rating was presented for each plot, based on the percent establishment and winter survival, as shown in Table 4. A summary of climate data for May-October 2021-2022 is shown in Table 5.

Table 4: Establishment, Winter Survival and Stand Rating*

	2021 % Plot Establishment			% Winter Survival			2022 Plot Stand Rating (0-10)		
	Barley	Oats	Wheat	Barley	Oats	Wheat	Barley	Oats	Wheat
Alfalfa	75	68	63	88	95	98	6.56	6.46	6.14
Red Clover	80	63	68	43	65	93	3.40	4.10	6.29
Sweet Clover	80	63	68	14	43	58	1.10	2.68	3.91
White Clover	68	70	75	30	46	58	2.01	3.24	4.31

* Plot stand rating = % Plot Establishment x % Winter Survival x 10 (i.e., 10 = 100% establishment, 100% winter survival)

Table 5: Growing season report for PCDF, 2021-2022

	Actual	% Normal
Precipitation (mm)		
2021	266	88
2022	323	106
Crop Heat Units		
2021	2692	117
2022	2519	109
Growing Degree Days		
2021	1676	124
2022	1503	111

Discussion

Plot establishment and growing conditions

Much of the variation in plot yields can be explained as resulting from the growing conditions in 2021 and 2022. In 2021, despite minimal rainfall, there was enough soil moisture for the cereal intercrops crops to establish. Timely rains allowed good yields for barley and wheat grain, but the lack of moisture and excessive heat resulted in a crop failure for the oats. For the majority of forage intercrops, the establishment appeared to be moderately (80%) or strongly (63%) affected by the lack of moisture. Winter survival for forages ranged from as high as 98% (wheat-alfalfa) to as low as 14% (barley-sweet clover). The winter survival for barley was generally lower than for other cereal treatments, and highest for wheat. Sweet clover generally showed the lowest winter survival for all treatments, and alfalfa showed the highest.

The very dry weather and high temperatures experienced in 2021 (Table 5) help to explain challenges to establishment. The forages germinate and grow more slowly than the cereal intercrop, and therefore may be out-competed by the cereal crop. In 2021, competition appears to have had the most impact on forage establishment in the oat crop.

The winter of 2021-2022 saw high amounts of snowfall, resulting in thick snowdrifts that formed on the trial site. These drifts, which only melted in early May, combined with several hard frosts after the breaking of dormancy for the forages, may have been responsible for the low levels of winter survival that were observed in some plots.

In contrast to the extremely dry conditions in 2021, the 2022 growing season provided nearly optimal growing conditions for forages, resulting in good yields for most treatments. However, the late snow and cool growing conditions resulted in slightly different maturities across plots of the same treatment. These differences in maturity can be observed in the fact that, despite large differences in CV for some of the cuts (Table 2), the CV for total yield for most treatments is acceptably low. This suggests that the large variations between plots is influenced by the timing of the cut, and not the total amount of plant growth.

Statistical differences in yield

- In 2021, no statistical differences for forage yields were observed.
- In 2022, alfalfa yielded significantly more than other treatments for the first cut.
- For the second cut, white clover generally yielded lower than other treatments, except for after oats, where white clover yielded on par with sweet clover. (The lower yield can reasonably be attributed to the smaller stature of the white clover plant compared to the other legumes. Despite lower yields, white clover can provide excellent ground cover, preventing erosion or nutrient losses, and may work especially well in a situation where a producer intends to terminate the crop before seeding a subsequent crop.)
- For the third cut, yields differed by treatment:
    - Alfalfa and red clover yield were the same after both barley and oats, but red clover was lower than alfalfa after wheat.
    - Alfalfa and white clover yielded the same after wheat.

No herbicides were applied to the treatments. Although some herbicide options are available for cereal-legume intercrops, the close proximity of the plots and danger of spray drift made it more feasible to hand-weed the plots. On a field-scale, careful field selection and a pre-emergence herbicide application would be crucial to the establishment of a successful intercrop. Consult a herbicide guide or dealer to determine the best herbicide option for each intercrop.

Management options

Intercropping cereals and forage legumes provides producers with several management options. The first is to use the legume as a cover crop and green manure. Because forage production is minimal in the year of establishment, it is likely preferable to let the crop overwinter and terminate it before seeding in spring. In this case, the amount of nitrogen available to the next crop varies by forage type. In this study, alfalfa produced more nitrogen than any other treatment (Table 4), based on crude protein content and plot yields. Note that the nitrogen from the legume material is available to the subsequent crop at a slow rate, with some only available in the following year.

Another option is to keep the legume as a forage crop. In this case, sweet clover provided just one cut, whereas other forages provided two cuts. Another consideration is that spoiled sweet clover can cause hemorrhaging and death in livestock. A less serious issue can be sensitivity in light-coloured animals caused by the sun that can cause skin lesions. Consult a seed guide or dealer to identify the best variety of sweet clover for hay production.

Finally, a third option that is available to producers is to harvest the crops for seed. The clover varieties in this trial do not self-pollinate, so honeybees are essential for seed set. Alfalfa requires pollination from leafcutter bees.

2022 Year 2 Forage (seeded 2021)

Data Collected:	Date Collected
Dormancy broken:	May 9
Winter survival %:	Jun 3
1st cut:	Jun 7
2nd cut:	July 12
3rd cut:	Aug 17

Wheat-Phacelia Intercrop Evaluation

Project duration: May 2020 – September 2022
Objectives: To evaluate intercropping potential for wheat and phacelia
Collaborators: PCDF

Background
This trial evaluates intercropping wheat and phacelia, and the effect of different rates of phacelia on wheat yield. This report provides data for three years. The seeding rate for wheat for all treatments was 1.75 bu/ac, targeting 25 plants/ft^2. The seeding rate for phacelia ranged from 2 lb/ac to 5 lb/ac.

Phacelia is a broadleaf plant that produces abundant flowers throughout the growing season, making it attractive to pollinator species. Honey producers prize the crop for its long flowering period and light honey quality. Conversely, cereals crops such as wheat rely on wind for pollination, and do not provide attractive habitat for pollinators. Intercropping wheat and phacelia increases in-crop diversity, provides pollinator habitat in cereals crops, and may attract beneficial predators, such as wasps that predate wheat midge. For a detailed summary of phacelia cultivation, see this USDA Plant Guide.

Figure 1: (left) wheat-phacelia intercrop; (right) phacelia blossoms with a pollinator.

Results
The wheat yield for treatments is shown in Figure 1. Although observed wheat yields for each treatment appear to decrease slightly with higher seeding rates of phacelia, the differences are not statistically significant (Table 1). The markedly lower yields in 2021 were due to very dry growing conditions.

Phacelia establishment was good for all years, including during the dry conditions of 2021. The yield for phacelia was measured in 2020. The yields did not differ statistically between seeding rates of 4 lb/ac and 5 lb/ac; however, yields for lower seeding rates were significantly less.

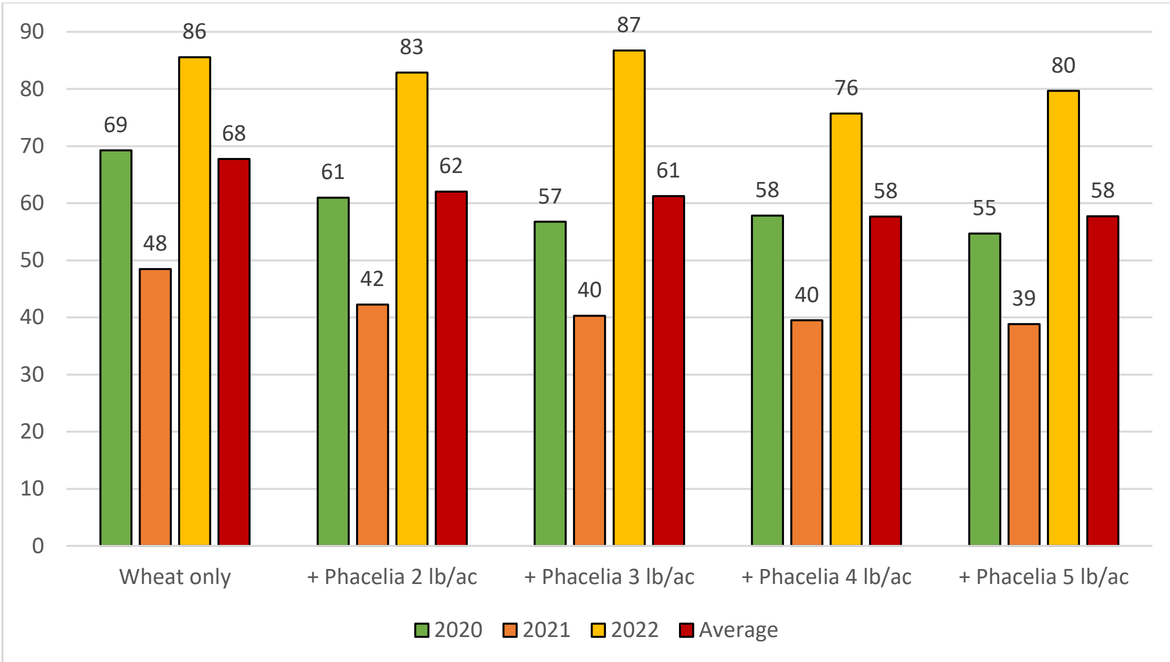


Figure 1: Wheat yield (bu/ac) by treatment

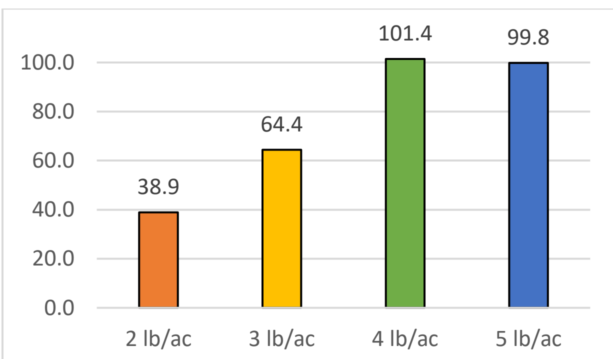


Figure 2: Phacelia yield (lb/ac) by treatment (2020 only)

Table 1: Summary of statistical information for wheat and phacelia yield

Entry (Crop, lb/ac)	Statistical significance: Wheat*			Statistical significance: Phacelia*		
	2020	2021	2022	2020†		
Wheat only**	A	A	A			
Wheat-Phacelia 2	A	A	A	A		
Wheat-Phacelia 3	A	A	A		B	
Wheat-Phacelia 4	A	A	A			C
Wheat-Phacelia 5	A	A	A			C
CV (%)	12.6	14.0	10.3	7.7		

† Yield for phacelia was calculated in 2020 only

* Treatments not marked with the same letter are statistically different from other treatments.

** Wheat seeding rate = 105 lb/ac

Table : Growing season report for PCDF, 2020-2022

	Actual	% Normal
Precipitation (mm)		
2020	261	86
2021	266	88
2022	323	106
Crop Heat Units		
2020	2364	102
2021	2692	117
2022	2519	109
Growing Degree Days		
2020	1439	106
2021	1676	124
2022	1503	111

There are no herbicides registered for phacelia, making intercropping with wheat a challenge. Good weed control prior to seeding is crucial. The trial was hand-weeded.

Discussion

The slight differences in wheat yield in treatments that included phacelia were not statistically significant. Further, it appears as increasing the seeding rate for phacelia creates the potential for harvesting some phacelia seed. However, three important considerations must be noted for phacelia seed production:

1. Because phacelia flowers continuously throughout the summer, the maturity of seeds varies. This means that harvest seed may not fully mature, reducing the germination rate. Further, some mature seed may fall to the ground before harvest.
2. Because phacelia seed is smaller and lighter in weight than wheat seed, harvesting both seeds together likely requires retaining more chaff in the harvest sample, and will require careful cleaning.
3. There are no registered herbicides for phacelia. Intercropping wheat (a grass) and phacelia (a broadleaf) will require careful site selection and a pre-emergent non-residual herbicide application.

Materials and methods

Previous year's crop:	Canola
Soil Type:	Erickson Loam Clay
Landscape:	Rolling with trees to the east
Seedbed preparation:	Direct Seeded

Table 3: Fertility Information

	Available		Added (actual)	Type
N	119	lb/ac	70 lb/ac	46-0-0
P	48	ppm	15 lb/ac	11-52-0-0
K	572	ppm		

No herbicide applied

Why Intercrop Wheat with Phacelia?

Intercropping wheat with phacelia can help to prevent leaching of nitrogen, suppress weeds due to its quick establishment, and attract pollinators and other beneficial insects that help to suppress wheat midge.

The Orange Blossom Wheat Midge fly emerged as a major pest of wheat on the Canadian prairies in the 1980's and quickly spread from there to also cause major wheat yield damage in Minnesota, North Dakota, Montana and pockets in Idaho and British Columbia. According to Montana State University Extension "spring wheat fields that normally would have yielded 80-90 bushels per acre instead produced less than 2 bushels".

The Parkland in particular has seen very high populations in Orange Blossom Wheat Midge. For the last six years PCDF has been cooperating with the Entomology Department at the University of Manitoba and the Parkland Coop Wheat Variety Evaluation trial (University of Alberta) to collect samples of wheat heads for analysis of midge populations. These numbers have consistently reported high populations.

In the spring of 2022, in addition to the usual wheat phacelia intercrop plot research, PCDF attempted a large scale (2 ac) intercrop of wheat and phacelia, this time with the expressed aim of observing the behaviour of the beneficial wasp, Macroglenes penetrans. This wasp is a known predator of wheat midge eggs, not for consumption, but rather for parasitism. While the wheat midge lays eggs inside the developing young heads of wheat in orange clusters, the Macroglenes wasp uses midge eggs as a consuming host for their own eggs. In other words, they lay their eggs inside the midge eggs, causing a reduction of up to 30-40% of the following year's midge population (Think Wheat Midge). The developing wasp feeds off of the unsuspecting midge larva with no observable outward change. The wasp will then overwinter dormant with the midge in their cocoon. Only when larval emergence occurs in the spring is it known whether a midge or a wasp will emerge from the egg.

Given that spraying for wheat midge is tricky to time and often unsuccessful even at the best of times these types of biological controls present an attractive alternative. In 1995 510,000 ha of land in Saskatchewan were sprayed but there was still an overall crop loss of $130 million. Manitoba Agriculture does not advise spraying unless midge populations are above the economic threshold. Proper use of varietal blends play a critical role in reducing overall midge population but biological controls are also listed as a main strategy for control of wheat midge by the governments of all three prairie provinces, and also by the states listed above where midge damage has been significant.

Since spraying can also harm the Macroglenes wasp, especially if it is a late season spray, then following timing guidelines (at splitting of the boot, when the adults are active at dawn or dusk) is a must. Because the wasps tend to emerge 5 days after the wheat midge, Dr. Tyler Wist at AAFC is Saskatoon identifies that a later spray can significantly harm the wasp population, while the midge themselves will have already completed their task. In addition to the wasp the Prairie Soils & Crops Journal published that as of 2011 there were up to 14 different ground beetles identified that feed on the midge cocoons that may also be killed by insecticides. Between the various predatory insects, up to 86 lavae/m2 may be consumed. Therefore spraying is not an optimal choice.

PCDF's research question has therefore turned to whether or not it is possible to attract even more of these wasps to our wheat fields by the use of phacelia, especially since it is a known attractor of various pollinators. Unfortunately, the phacelia in the large scale trial was killed by herbicide drift. However, the site still provided a learning and training opportunity for PCDF staff.

Throughout the season PCDF staff monitored midge populations via pheromone sticky traps.

Figures 1 and 2: Pheromone trap in the PCDF wheat field used a pheromone emitter to attract the bright orange wispy male midge to the trap where they became stuck on a grid of sticky paper for convenient counting.

In the middle of August, PCDF staff also had the opportunity to work with the University of Manitoba's Entomology Wheat Midge Lab to dissect the sampled wheat heads from the PCDF site. Midge larva were pulled out of the glumes, counted, and stored in soil containers for artificial "overwintering" at the University in order to observe how many midge and how many wasps emerge from the soil in controlled lab conditions. Damaged kernels were also counted.

This experiment will be repeated in 2023, hopefully with a successful crop of phacelia.

Hemp-Cereal Silage

Project duration: May 2020 – August 2022
Objectives: To evaluate intercrop mixes with hemp for silage production
Collaborators: PCDF, Manitoba Horticulture Productivity Enhancement Centre (MHPEC)

Background

Silage plays an important part in the Manitoba livestock industry. Corn silage provides high yields, relative to barley silage (14 t/ac, over 7.5 t/ac, 2021 Silage Cost of Production, MARD). In the Parkland area, the yield for corn silage is variable and many producers opt to produce a cereal silage, such as barley or oat. PCDF and MHPEC have worked together to explore intercropping options for cereals silage.

Hemp provides an interesting opportunity for silage production, due to its high production potential and good nutritional qualities. However, Canadian regulations currently prohibit the use of hemp products as a livestock feed ingredients in Canada. As such, this research is purely exploratory, and is not intended to provide recommendations to producers. The Manitoba Diversification Centres are working with the Canadian Hemp Trade Alliance to develop data in support of changes to regulations around the use of hemp in livestock feed.

Results

Figure 1: Clockwise from top-left: (1) hemp-only; (2) barley-hemp; (3) oat-hemp; (4) oat-only; (5) hemp-oat silage, chopped; (6) long fibres from over-ripe hemp plants.

The silage yields at PCDF (t/ac) for treatments is shown in Figure 2. Hay yields (1500-lb bales/ac, 15% moisture) are shown in Figure 3.

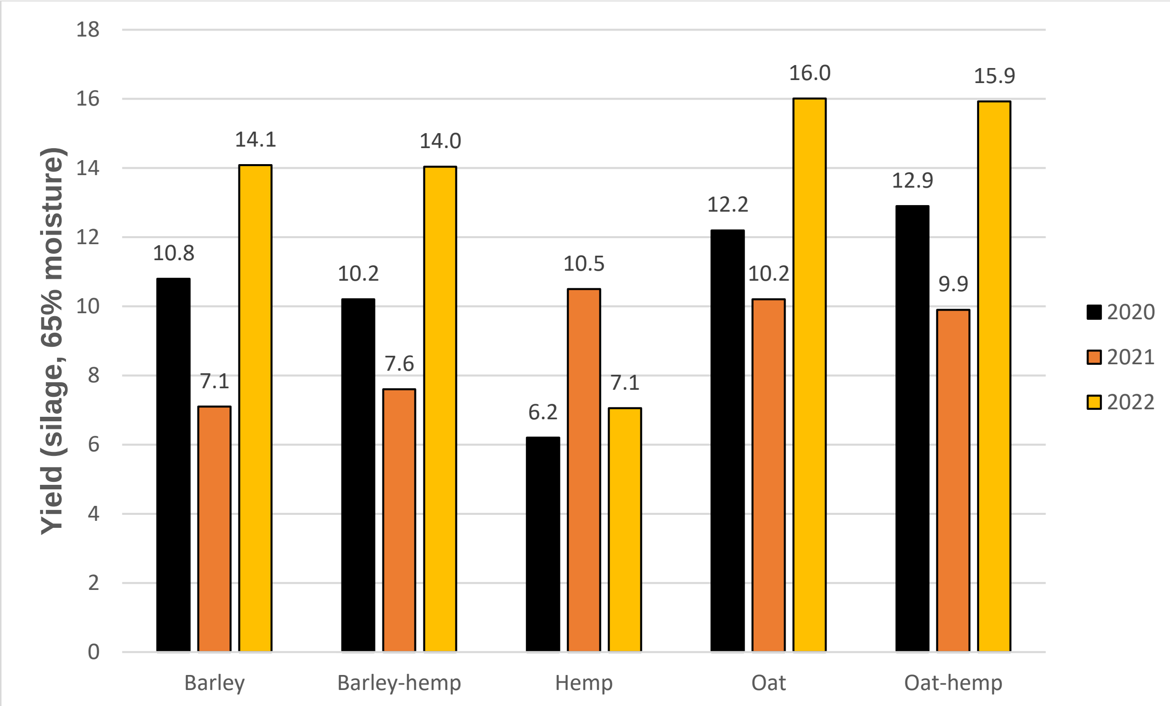


Figure 2: PCDF wet silage yield (t/ac) by treatment; all yields adjusted to 65% moisture.

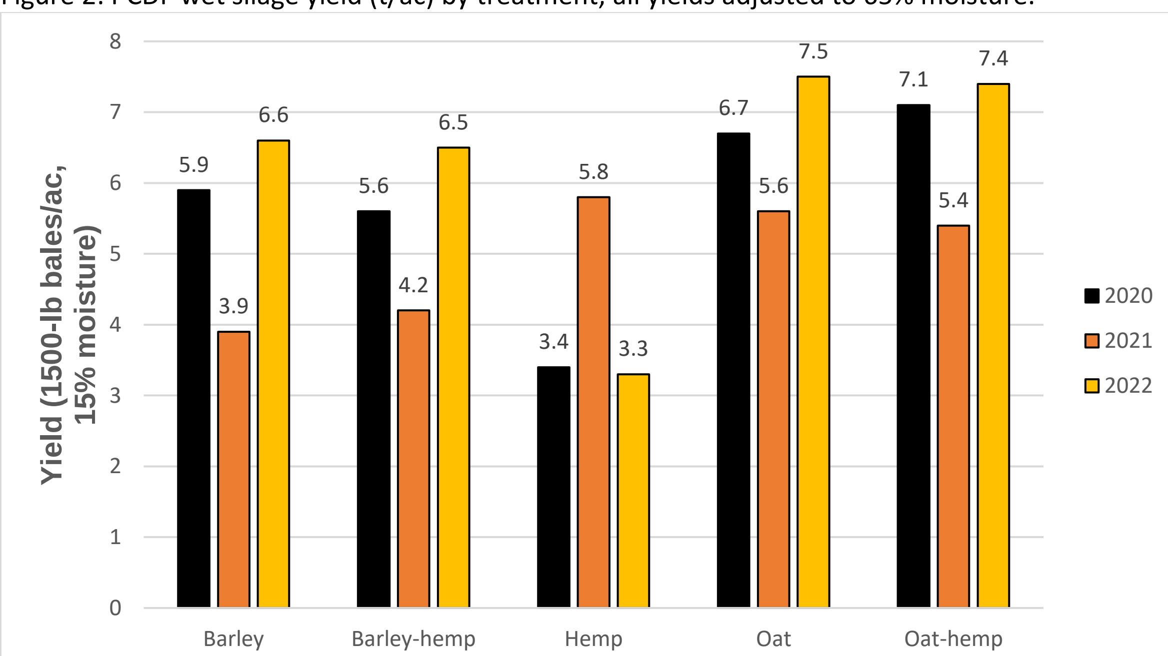


Figure 3: PCDF hay yield (1500-lb bales/ac, 15% moisture) by treatment.

The silage yields at MHPEC (t/ac) for treatments is shown in Figure 4. Hay yields (1500-lb bales/ac, 15% moisture) are shown in Figure 5.

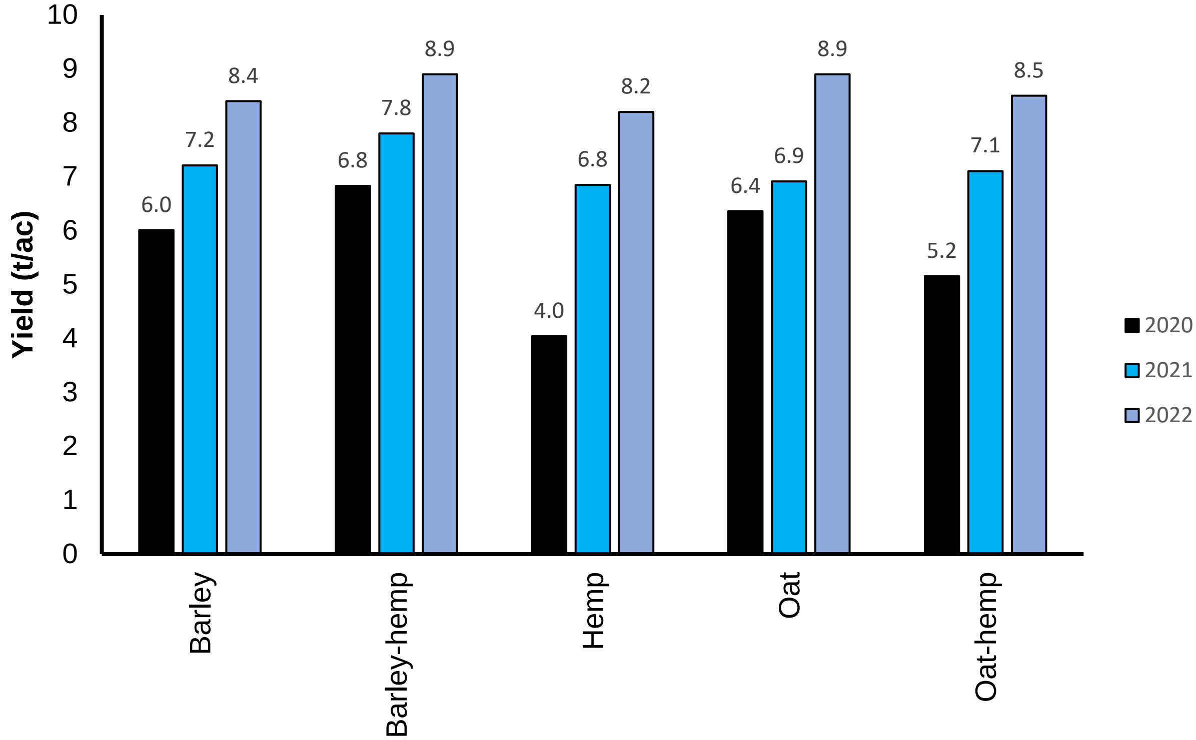


Figure 4: MHPEC wet silage yield (t/ac) by treatment; all yields adjusted to 65% moisture.

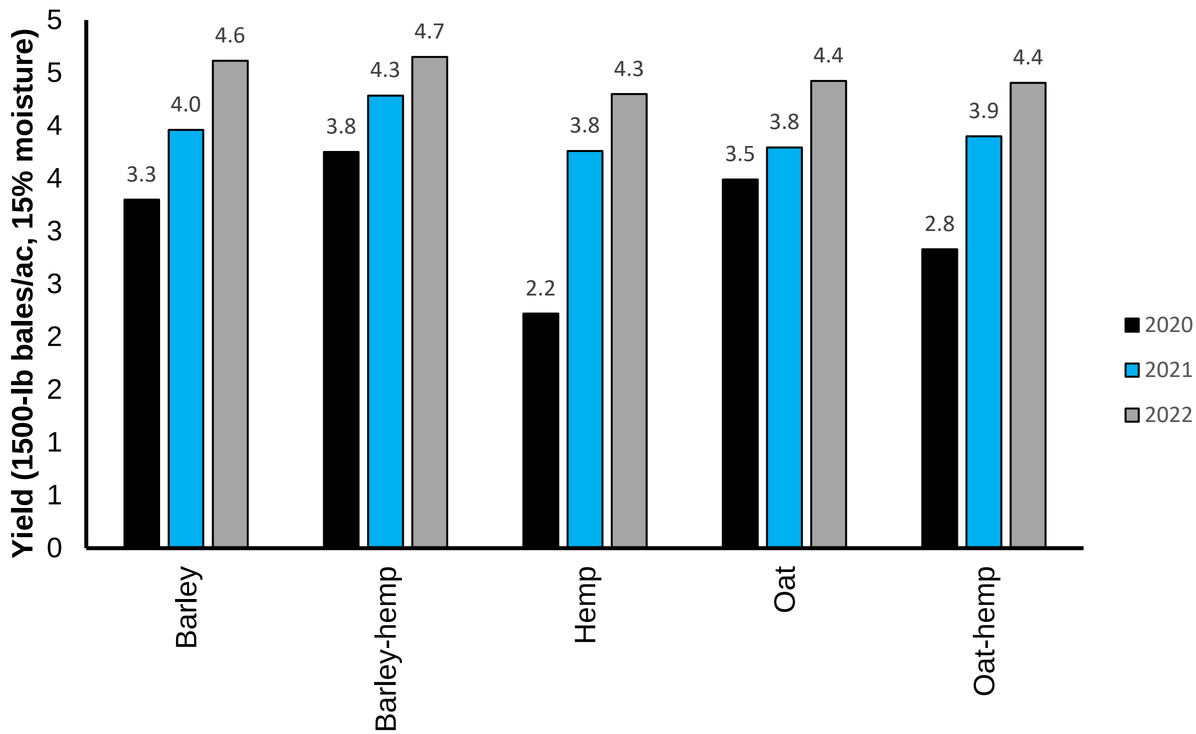


Figure 5: MHPEC hay yield (1500-lb bales/ac, 15% moisture) by treatment.

Summary of statistical information and feed values

Table 1: PCDF summary of statistical information for silage yield

Entry	Statistical significance*					
	2020		2021		2022	
Barley	A		A		A	
Barley-hemp	A		A	B	A	
Oat	A		A	B	A	
Oat-hemp	A		A	B	A	
Hemp		B		B		B
% CV	**27.8**		**22.9**		**27.1**	

* Treatments not marked with the same letter are statistically different from other treatments.

Table 2: MHPEC summary of statistical information for silage yield

Entry	Statistical significance*			
	2020	2021		2022
Barley	A	A		A
Barley-hemp	A	A		A
Oat	A	A		A
Oat-hemp	A	A		A
Hemp	A		B	A
% CV	**26.2**	**24.4**		**6.0**

* Treatments not marked with the same letter are statistically different from other treatments.

The feed values and mineral content for each treatment for PCDF and MHPEC are in Tables 3 and 4.

Table 3: PCDF and MHPEC feed values for silage by treatment compared to animal feed requirements*

Entry	% Crude Protein			% TDN		
	2020	2021	Average	2020	2021	Average
PCDF values						
Barley	10.1	10.6	10.4	58.3	69.4	63.8
Oat	10.8	11.4	11.1	59.8	65.8	62.8
Hemp	12.6	10.2	11.4	43.7	50.5	47.1
Barley-hemp	12.2	12.0	12.1	58.7	56.1	57.4
Oat-hemp	12.2	11.4	11.8	58.9	67.2	63.1
MHPEC values						
Barley	10.8	10.3	10.6	71.9	68.2	70.0
Oat	8.4	9.8	9.1	55.5	63.4	59.4
Hemp	11.9	11.4	11.6	43.3	53.5	48.4
Barley-hemp	10.2	10.8	10.5	62.4	75.1	68.8
Oat-hemp	9.6	11.7	10.7	63.2	65.1	64.2

Animal feed requirements**		
Mature cows		
Mid gestation	7	50-53
Late gestation	9	58
Lactating	11-12	60-65
Replacement heifers	8-10	60-65
Breeding bulls	7-8	48-50
Yearling bulls	7-8	55-60

* Dry matter feed values from Central Testing Laboratories, Winnipeg

** Animal feed requirements developed by Elisabeth Nernberg (ARD).

Table 4: PCDF and MHPEC mineral content for silage by treatment

		Mineral									
Treatment		**Ca**	**P**	**Mg**	**Na**	**K**	**Mo**	**Cu**	**Zn**	**Mn**	**Fe**
PCDF values											
Barley	2020	0.35	0.19	0.12	0.39	1.25	1.29	4.23	17.3	30.24	112.85
	2021	0.30	0.22	0.16	0.13	1.73	1.05	2.96	17.23	17.36	68.24
	Average	**0.33**	**0.21**	**0.14**	**0.26**	**1.49**	**1.17**	**3.60**	**17.27**	**23.80**	**90.55**
Oat	2020	0.28	0.2	0.13	0.49	1.42	2.54	3.54	17.88	52.04	153.07
	2021	0.40	0.21	0.21	0.36	1.97	1.10	2.90	11.46	38.59	99.71
	Average	**0.34**	**0.21**	**0.17**	**0.43**	**1.70**	**1.82**	**3.22**	**14.67**	**45.32**	**126.39**
Hemp	2020	1.55	0.27	0.36	0.12	1.46	1.33	7.51	23.54	64.06	151.36
	2021	1.65	0.19	0.31	0.01	1.68	0.72	5.85	16.23	48.48	190.25
	Average	**1.60**	**0.23**	**0.34**	**0.07**	**1.57**	**1.03**	**6.68**	**19.89**	**56.27**	**170.81**
Barley-hemp	2020	0.64	0.24	0.18	0.3	1.29	1.13	5.35	21.34	36.88	145.81
	2021	1.20	0.22	0.31	0.09	1.88	1.20	4.86	19.30	44.60	239.80
	Average	**0.92**	**0.23**	**0.25**	**0.20**	**1.59**	**1.17**	**5.11**	**20.32**	**40.74**	**192.81**
Oat-hemp	2020	0.38	0.21	0.15	0.47	1.56	2.07	3.68	19.39	54.02	184.17
	2021	0.37	0.24	0.18	0.19	1.65	1.47	3.04	15.11	42.12	151.66
	Average	**0.38**	**0.23**	**0.17**	**0.33**	**1.61**	**1.77**	**3.36**	**17.25**	**48.07**	**167.92**
MHPEC Values											
Barley	2020	0.26	0.31	0.16	0.03	1.33	0.34	4.13	21.69	31.75	125.09
	2021	0.36	0.13	0.20	0.06	1.44	0.18	3.79	25.01	51.03	124.86
	Average	**0.31**	**0.22**	**0.18**	**0.05**	**1.39**	**0.26**	**3.96**	**23.35**	**41.39**	**124.98**
Oat	2020	0.25	0.18	0.16	0.14	2.31	0.52	2.75	14.79	82.19	143.81
	2021	0.26	0.14	0.17	0.16	1.65	0.81	3.18	21.41	97.59	151.66
	Average	**0.26**	**0.16**	**0.17**	**0.15**	**1.98**	**0.67**	**2.97**	**18.10**	**89.89**	**147.74**
Hemp	2020	1.46	0.26	0.51	0.04	1.64	0.44	7.98	24.24	79.26	217.14
	2021	2.20	0.13	0.77	0.02	1.24	0.29	8.54	22.70	121.52	244.91
	Average	**1.83**	**0.20**	**0.64**	**0.03**	**1.44**	**0.37**	**8.26**	**23.47**	**100.39**	**231.03**
Barley-hemp	2020	0.44	0.25	0.23	0.09	1.76	0.41	4.82	19.56	41.27	134.41
	2021	0.25	0.18	0.19	0.06	1.43	0.21	4.22	31.12	42.00	111.41
	Average	**0.35**	**0.22**	**0.21**	**0.08**	**1.60**	**0.31**	**4.52**	**25.34**	**41.64**	**122.91**
Oat-hemp	2020	0.25	0.22	0.17	0.19	1.96	0.84	3.42	16.66	76.83	164.26
	2021	0.53	0.17	0.24	0.19	1.42	1.00	3.95	24.85	99.40	188.61
	Average	**0.39**	**0.20**	**0.21**	**0.19**	**1.69**	**0.92**	**3.69**	**20.76**	**88.12**	**176.44**

Observations

At PCDF, the yield results differ statistically by treatment for all years (Table 1). In all years, the hemp treatment yielded significantly less than the other treatments. In 2021, the barley-only treatment yielded significantly more than all other treatments. At CMCDC, yields only differed significantly in 2021, with hemp yielding lower than all other treatments.

The results for silage yield differ statistically by treatment (Table 1). The hemp-only treatment provided significantly lower silage yields than treatments including barley and oat. Further, the inclusion of hemp in the silage mixture did not significantly increase yield over barley-only or oat-only. In 2021 at PCDF, the yield for the barley-only treatment was significantly greater than for other treatments. Note that the reliability of these results is low due to a high percent CV for silage yield.

The silage was prepared by running the harvested material from each plot through a plant shredder (see Figure 1.5). Hemp is a plant with long fibres that become tougher towards maturity. If the crop becomes too mature, these fibres have the potential to tangle in the chopping equipment. Further, the higher fiber content makes for lower digestibility by livestock. This is reflected in the lower percent-TDN figure for the hemp-only treatment (Table 3). Nevertheless, even a reduced rate of hemp may positively increase percent-protein content for the oat-hemp and barley-hemp treatments.

Materials and methods

The experimental is a random complete block design with five entries and three reps. Seed costs for both PCDF and MHPEC are provided in Table 4. Agronomic data is summarized in Tables 5 and 6.

Table 5: Treatments, seeding rates and costs

Treatments	Percent of each monocrop seeding rate	Seeding Rate (lb/ac)	Cost per acre
Barley (Maverick)	100	90	$14.91
Oat (Haymaker)	100	90	$19.72
Hemp (Katani)	100	25	$50.00
Barley-hemp (Maverick-Katani)	75-33	68-8	$27.26
Oat-hemp (Haymaker-Katani)	75-33	68-8	$30.90

Table 6: Agronomic data

	PCDF		MHPEC	
	2020	2021	2020	2021
Seeding date	May 25	May 20	May 25	May 24
Harvest date	Aug 12	Aug 11	Aug 19	Aug 16
Previous crop	Barley silage	Oat silage	Soybean	Canola
Soil type	Erickson Loam Clay		Clay Loam	
Seedbed prep	Heavy harrow	Vertical tillage	No-till	No-till

Table 7: Fertility information

	PCDF		MHPEC	
	Available	Added	Available	Added
N				
2020	79 lb/ac	47 lb/ac	19 lb/ac	124 lb/ac
2021	151 lb/ac	10 lb/ac	24 lb/ac	113 lb/ac
P				
2020	22 ppm	10 lb/ac	14 ppm	11 lb/ac
2021	47 ppm	15 lb/ac	11 ppm	16 lb/ac
K				
2020	257 ppm	none	-	-
2021	143 ppm	none	-	-

There are some herbicides registered for use with hemp, and there are no herbicides registered for both hemp and barley or oats, making silage intercropping for hemp and cereals a challenge. Good weed control prior to seeding is crucial. The trials were hand-weeded.

Pea-Cereal Silage

Project duration: May 2019 – August 2022
Objectives: To evaluate pea-cereal intercrop mixes for silage production
Collaborators: PCDF, Manitoba Horticulture Productivity Enhancement Centre (MHPEC)

Background

Silage plays an important part in the Manitoba livestock industry. Corn silage provides high yields, relative to barley silage (14 t/ac, over 7.5 t/ac, 2023 Silage Cost of Production, MARD). In the Parkland area, the yield for corn silage is variable and many producers opt to produce a cereal silage, such as barley or oat. Some producers have explored pea-cereals mixtures as a means to increase silage protein content. PCDF is eager to explore options for cereals silage production.

Results

The silage was harvested at soft-dough stage (approximately 65% moisture). Figure 1 shows PCDF wet silage yields (t/ac) for 2019-2022, adjusted to 65% moistures. Figure 2 shows PCDF dry yields (1500-lb bales/ac at 15% moisture). Figure 3 shows MHPEC silage yields for 2020-2022, and Figure 4 shows dry yields.

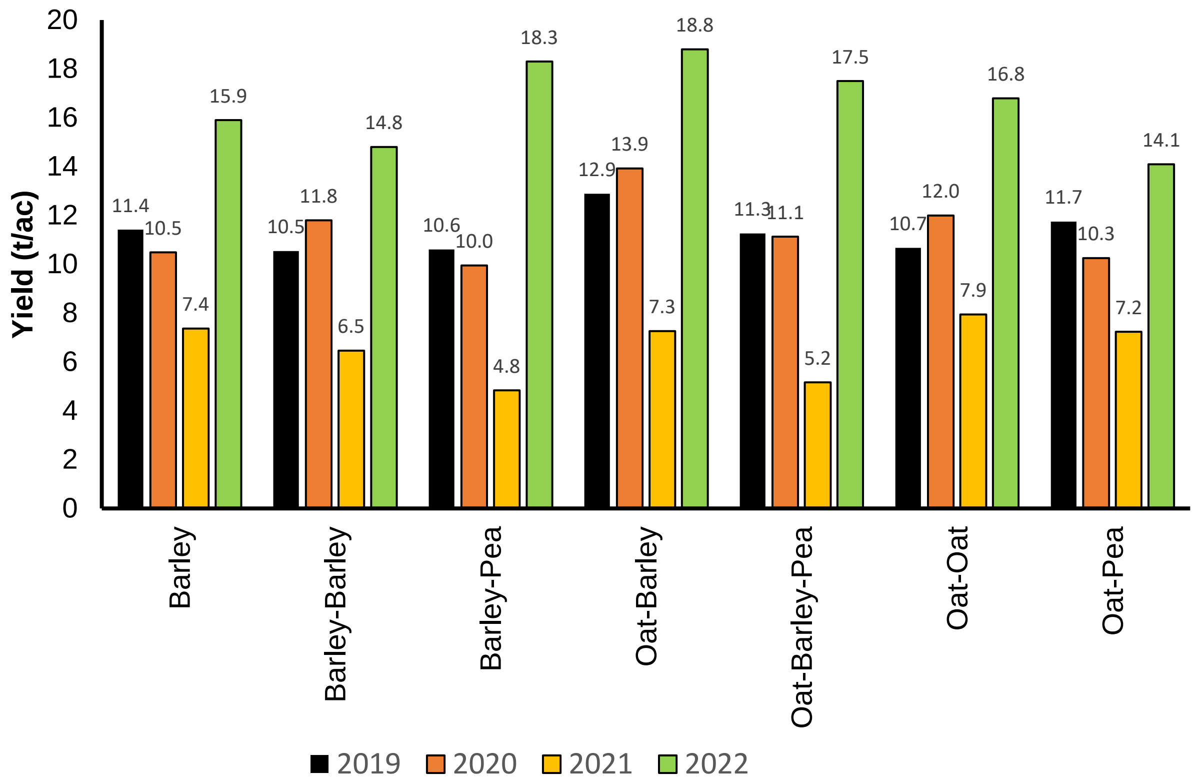


Figure 1: PCDF wet silage yield (t/ac, 65% moisture) by treatment.

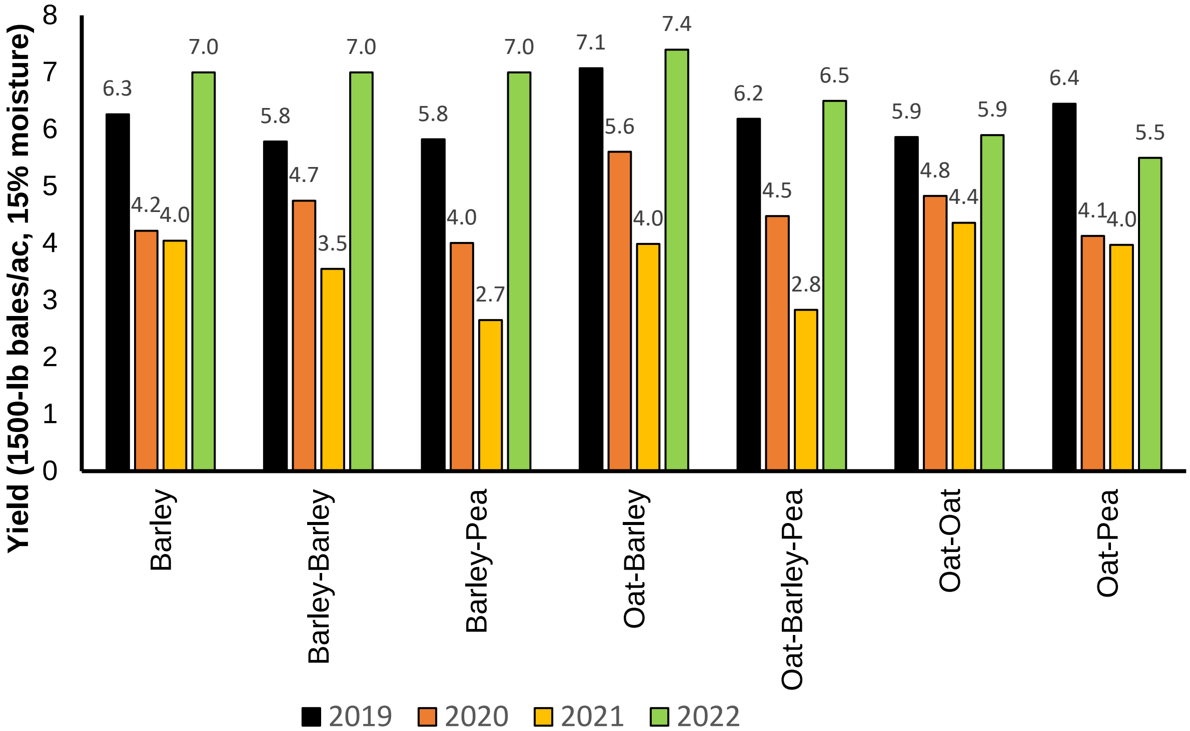


Figure 2: PCDF hay yield (1500-lb bales/ac, 15% moisture) by treatment.

Table 1: PCDF summary of statistical information for silage yield

Entry	Statistical significance*							
	2019		2020			2021	2022	
Barley	A	B	A	B		A	A	
Barley-Barley	A	B	A			A	A	
Barley-Pea	A	B		B		A	A	B
Oat-Barley	A				C	A	A	
Oat-Barley-Pea	A		A	B		A	A	
Oat-Oat	A	B	A			A	A	
Oat-Pea	A	B	A	B		A	A	B
% CV	**10.7**		**13.8**			**34.1**	**14.7**	

* Treatments not marked with the same letter are statistically different from other treatments.

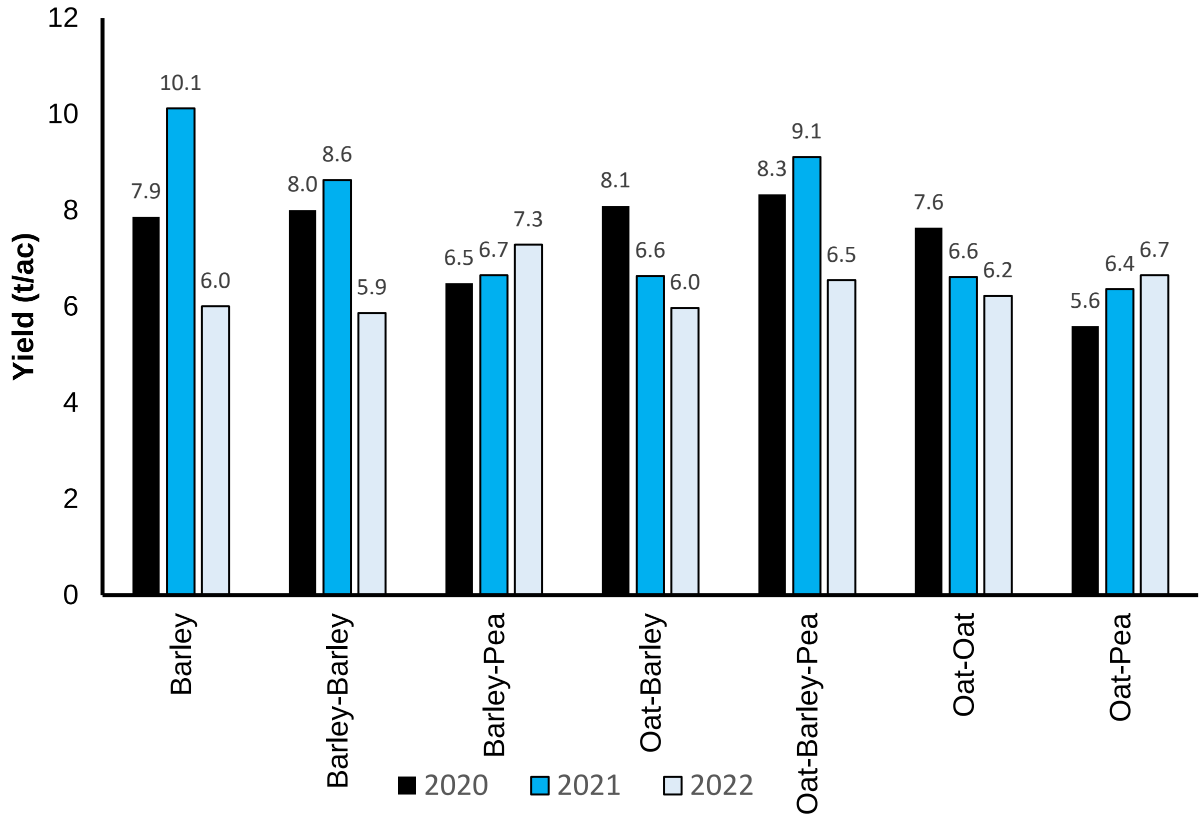


Figure 3: MHPEC wet silage yield (t/ac, 65% moisture) by treatment.

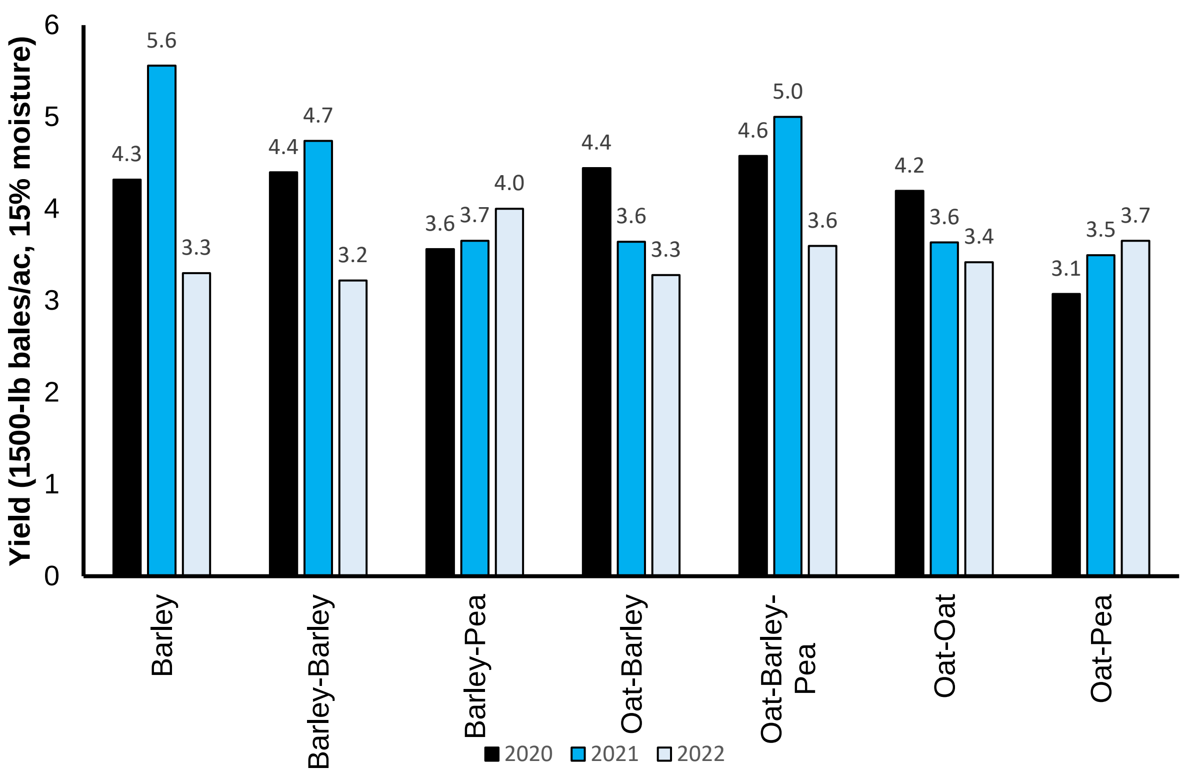


Figure 4: MHPEC hay yield (1500-lb bales/ac, 15% moisture) by treatment.

Table 2: MHPEC summary of statistical information for silage yield

Entry	**Statistical significance***					
	2020	**2021**			**2022**	
Barley	A		B	C	A	B
Barley-Barley	A		B		A	B
Barley-Pea	A			C	A	B
Oat-Barley	A	A			A	
Oat-Barley-Pea	A		B	C	A	B
Oat-Oat	A		B		A	
Oat-Pea	A		B	C	A	B
% CV	**26.5**	**13.8**			**15.7**	

* Treatments not marked with the same letter are statistically different from other treatments.

The feed values and mineral content for each treatment for PCDF and MHPEC are shown in Table 3.

Table 3: PCDF and MHPEC feed values for silage by treatment compared to animal feed requirements*

Entry	% Crude Protein				% TDN			
	2019	2020	2021	Average	2019	2020	2021	Average
PCDF values								
Barley	10.2	8.2	10.7	9.7	67.6	58.9	70.3	65.6
Barley-Barley	11.0	8.2	11.0	10.1	68.6	60.5	71.2	66.8
Barley-Pea	10.6	10.9	11.4	11.0	72.9	60.7	70.0	67.9
Oat-Barley	12.1	7.1	11.2	10.1	71.3	63.2	70.1	68.2
Oat-Barley-Pea	12.2	8.8	11.7	10.9	69.0	60.4	62.9	64.1
Oat-Oat	10.8	7.8	10.9	9.8	69.8	61.5	65.8	65.7
Oat-Pea	13.4	9.1	12.8	11.8	66.0	59.3	60.0	61.8
MHPEC values								
Barley	-	10.4	10.1	10.3	-	66.7	73.3	70.0
Barley-Barley	-	10.7	10.7	10.7	-	73.1	77.5	75.3
Barley-Pea	-	12.0	12.2	12.1	-	54.9	72.7	63.8
Oat-Barley	-	9.4	11.0	10.2	-	61.1	72.1	66.6
Oat-Barley-Pea	-	12.8	11.3	12.1	-	60.3	65.6	63.0
Oat-Oat	-	9.0	10.2	9.6	-	58.2	67.5	62.9
Oat-Pea	-	12.5	13.8	13.2	-	61.1	69.9	65.5
Animal feed requirements**								
Mature cows								
Mid gestation	7				50-53			
Late gestation	9				58			
Lactating	11-12				60-65			
Replacement heifers	8-10				60-65			
Breeding bulls	7-8				48-50			
Yearling bulls	7-8				55-60			

* Dry matter feed values from Central Testing Laboratories, Winnipeg

** Animal feed requirements developed by Elisabeth Nernberg (ARD).

Table 3: Seasonal Data, May 15 – August 15

	Carberry		Roblin	
	Actual	% Normal	Actual	% Normal
Precipitation (mm)				
2019			156	79
2020	219	112	208	105
2021	145	74	157	80
2022	298	153	287	146
Crop Heat Units				
2019			1606	95
2020	1916	107	1751	104
2021	1905	106	1825	108
2022	1780	99	1656	98
Growing Degree Days				
2019			963	95
2020	1199	110	1068	105
2021	1259	115	1165	115
2022	1093	100	996	98

Observations

- Yield trends for all treatments at both PCDF and MHPEC are closely related to annual climatic conditions.
    - The poor yields overall for 2021 at Roblin can be best explained by the low moisture and higher temperatures in that growing season. Conversely, the excellent yields at Roblin for 2022 can be linked to the high moisture and moderate temperatures of that growing season.
    - Carberry also experienced dry conditions in 2021, but timely rains resulted in good yields for most treatments. Conversely, excess moisture in early 2022 resulted in lower yields.
- At PCDF, yields
- At PCDF, yield for all silage mixtures fell in 2021, due to dry growing conditions (Table 4). However, yield at MHPEC did not drop substantially, or even increased, during the 2021 season.
- In 2021, the yields at PCDF did not differ significantly by treatment. At MHPEC, oat-barley silage provided significantly higher yields than other treatments.
- The trend across all years and sites is for crude protein to increase in mixtures containing pea. However, total digestible nutrients (TDN) tends to be less for these mixtures.

The silage was prepared with a plant shredder. The oat-barley treatment appears to be a promising option, both for higher yields relative to other treatments (Tables 1 and 2) and high TDN values (Table 3). Oat-barley silage allows for good weed control, but there are no herbicides registered for barley-oat-pea silage intercrops. Good weed control prior to seeding is crucial. The trial was hand-weeded.

Materials and methods

The experimental is a random complete block design with seven entries and three reps. Seed costs for both PCDF and MHPEC are provided in Table 4. Agronomic data is summarized in Tables 5 and 6. Barley-

barley and oat-oat treatments combine a forage- and grain-type variety to maximize biomass and energy production.

Table 4: Treatments, seeding rates and seeding costs

Treatments	Percent of Monocrop Seeding Rate	Seeding Rate (lb/ac)	Cost per acre
Barley (Maverick)	100	90	$14.91
Barley-barley (Maverick-Austenson)	75-75	68-68	$22.53
Barley-pea (Maverick-Lacombe)	25-100	22-150	$34.89
Oats-oats (Haymaker-Summit)	75-75	68-68	$28.40
Oats-barley (Haymaker-Maverick)	75-75	22-150	$26.16
Oat-pea (Haymaker-Lacombe)	25-100	22-150	$36.07
Oats-barley-pea (Haymaker-Maverick-Lacombe)	12.5-12.5-100	11-11-150	$35.48

Table 5: Agronomic data

	PCDF				MHPEC		
	2019	2020	2021	2022	2020	2021	2022
Seeding date	May 16	May 25	May 20	May 27	May 25	May 24	
Harvest date	Aug 9	Aug 12	Aug 11	Aug 4	Aug 19	Aug 16	
Previous crop	Barley Silage	Barley silage	Oat silage	Canola	Soybean	Canola	
Soil type	Erickson Loam Clay				Clay Loam		
Seedbed prep	Heavy harrow		Vertical tillage	No-till	No-till		

Table 6: Fertility information

	PCDF		MHPEC	
	Available	Added	Available	Added
N				
2019	156 lb/ac	-		
2020	79 lb/ac	47 lb/ac	19 lb/ac	124 lb/ac
2021	151 lb/ac	10 lb/ac	24 lb/ac	113 lb.ac
2022	119 lb/ac	10 lb/ac		
P				
2019	9 ppm	20 lb/ac		
2020	22 ppm	10 lb/ac	14 ppm	11 lb/ac
2021	47 ppm	15 lb/ac	11 ppm	16 lb/ac
2022	48 ppm	10 lb/ac		
K				
2019	170	none		
2020	257 ppm	none	-	-
2021	143 ppm	none	-	-
2022	572 ppm	none		

Teff Forage Evaluation

Project Duration: May 2021 – October 2022

Objectives: To evaluate different seeding rates of teff for forage production potential

Collaborators: PCDF; Prairies East Sustainable Agricultural Initiative, Arborg

Background

Teff *(Eragrostis tef)* is a warm-season annual grass that originates in northeast Africa, where it is grown for grain and forage production. As a forage, the crop is notable for its high protein content and palatability, as well as its potential for high yields. The crop is relatively new to Manitoba. For a detailed examination of teff forage nitrogen and irrigation requirements, see this Pacific Northwest Extension Publication.

This report is for the period of 2021-2022. In 2021, the test was done at Roblin and examined the yield potential for teff forage, seeded at 5 lb/ac and 7 lb/ac. This was compared with the yield for barley greenfeed. Two cuts were taken for both seeding rates, and all treatments were tested for nutrient values.

In 2022, the test was done at Roblin and Arborg sites, and included seeding rates of 4 lb/ac, 5 lb/ac, 6 lb/ac and 7 lb/ac. Two cuts of forage were taken for each seeding rate. Additionally, a single late cut treatment was also kept (for all 4 seeding rates) for comparisons.

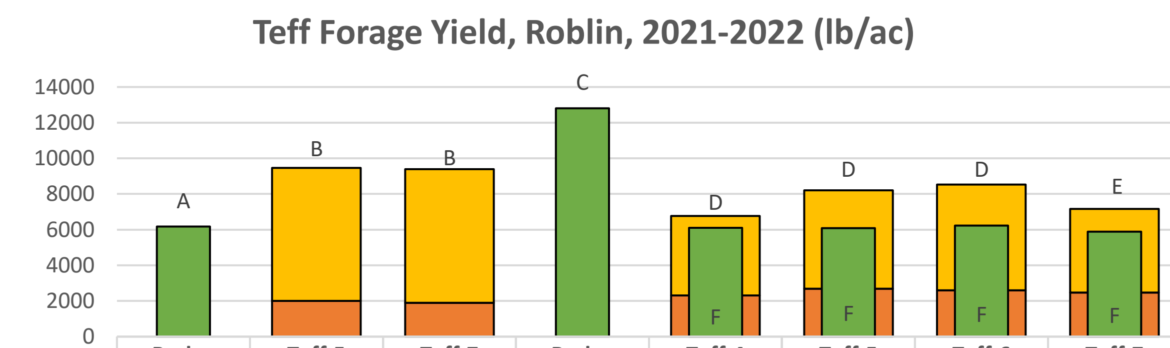
Figure 1: (a) 1st cut teff hay (Roblin, July 15, 2022) (b) 2nd cut teff hay (Roblin, Sept 28, 2021)

Figure 2: (a) 2nd cut teff hay (Roblin, Sept 28, 2021)   (b) 1st cut teff hay (left) and 2nd cut teff hay (right)

Results

Total hay yields (15% moisture) for Roblin site are shown in Figure 3, along with the average barley green feed (single-cut) yield. In 2021, barley yield was significanty lower than teff treatments. However in 2022, barley greenfeed yields were greater than hay from any of the teff seeding rate treatments. When teff seeding rates were compared for forage yield from a single late cut (green bars), there was no difference. In dual cut (orange & brown bars) treatments, forage yields were signifincalty lower when teff was planted at seeding rate of 7 lbs/ac. A single late cut yielded lower forage than the dual cut system, irrespective of seeding rate.

Arborg results are shown in figure 4. Barley forage yield was significantly higher than forage from any of the teff seeding rate treatment. The ual cut system (orange & brown bars) consistently produced greater forage yield than the single late cut (green bars) system irrespective of seeding rate. Seeding rate of teff did not have any effect on forage yield.



	Barley	Teff-5	Teff-7	Barley	Teff-4	Teff-5	Teff-6	Teff-7
		2021				2022		
2nd cut		7470	7506		4444	5512	5932	4689
1st cut		1997	1892		2315	2694	2602	2466
One-cut	6176			12813	6094	6077	6222	5895

1st cut 2nd cut One-cut

Figure 3: Roblin 2021-2022 yield (lb/ac, 15% moisture) for 1st cut, 2nd cut, and single-cut teff by seeding rate (lb/ac), plus yield for barley greenfeed comparison.

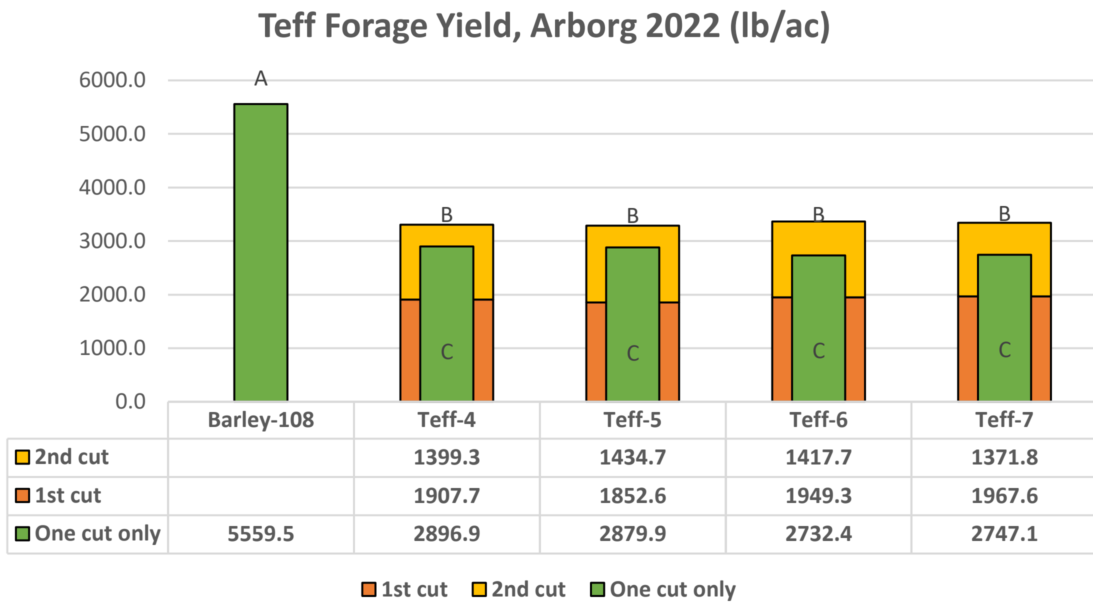


Figure 4: Arborg 2022 yield (lb/ac, 15% moisture) for 1st cut, 2nd cut, and single-cut teff by seeding rate (lb/ac), plus yield for barley greenfeed comparison.

Table 1 shows the cost per treatment, including the cost of cutting the hay. Table 2 shows the feed values for teff and barley treatments by cut, as well as animal feed requirements for beef. Table 3 shows mineral content by treatment.

Table 1: Cost of production by treatment for teff and barley by seeding rate and cut

Treatment	**Seeding cost ($/lb)**	**Seeding rate (lb/ac)**	**Cutting cost ($/ac)***	**Seeding plus cutting cost ($/ac)**
Barley (single cut)	0.29	108	17.55	49.05
Teff (single cut)	4.99	4	17.55	37.51
		5		42.50
		6		47.49
		7		52.48
Teff (Two cuts)	4.99	4	35.10	55.05
		5		60.04
		6		65.03
		7		70.02

* *Based on an average of costs for disc bine and sickle mower cuts from the Manitoba Agriculture Cost of Production for Farm Machinery.*

*Table 2: Feed values for teff and barley by cut compared to animal feed requirements**

Entry	% Crude Protein	% TDN
Teff 1st cut	20.9	69.2
Teff 2nd cut	11.4	59.9
Barley	10.5	69.9
Teff screenings (chaff and light seed)	18.5	66.7
Animal feed requirements**		
Mature cows		
Mid gestation	7	50-53
Late gestation	9	58
Lactating	11-12	60-65
Replacement heifers	8-10	60-65
Breeding bulls	7-8	48-50
Yearling bulls	7-8	55-60

* *Dry matter feed values from Central Testing Laboratory, Winnipeg, ** Animal feed requirements developed by Elisabeth Nernberg (Manitoba Agriculture).*

*Table 3: Mineral content for feed by treatment**

Treatment	**Mineral**									
	(%)					**(ppm)**				
	Ca	**P**	**Mg**	**Na**	**K**	**Mo**	**Cu**	**Zn**	**Mn**	**Fe**
Teff (1st cut)	0.77	0.22	0.16	0.04	2.25	2.41	9.00	21.36	26.10	138.15
Teff (2nd cut)	0.51	0.23	0.24	0.02	1.62	1.20	4.72	20.05	22.82	110.44
Barley	0.33	0.21	0.14	0.26	1.49	1.17	3.60	17.27	23.80	90.55
Teff screenings (chaff and light seed)	0.58	0.44	0.28	0.03	1.00	2.35	7.54	56.51	91.41	956.60

* *Central Testing Laboratory, Winnipeg*

Observations

In 2021, the yields for barley greenfeed averaged about half of the barley yields for 2022, largely due to the exceptionally dry growing conditions and poorly timed precipitation at Roblin site. Nevertheless, the teff was able to thrive in these conditions, and yielded well.

In 2022, better growing conditions for barley resulted in good yields. Despite improved moisture conditions, the teff yields were lower (in Roblin) than in 2021, likely due to lower overall heat units (about 93% of 2021). This reflects teff's preference for heat, but also indicates that it is tolerant of both dry and wet growing conditions.

The timing and number of hay cuttings impact not only hay quantity and quality, but also the overall cost of production. More cuttings cost more, but with the advantage providing more yield. Timing of the second teff cutting is important. At Roblin and Arborg, the first cut was in mid- to late-July. However, the second cut in Arborg (Aug 23, 2022) occurred more than one month before the second cut in Roblin (Sept 28, 2021 and Oct 6, 2022). This likely explains the relatively lower yields observed for the second cut in Arborg.

The individual costs for the different treatments (Table 1) are used to identify the relative cost of production, which shows the cost of producing each treatment, relative to the cost of producing barley greenfeed. Because different amounts of land are required to achieve the same relative yield, the cost of land has been included, estimated at $60/acre. The cost to produce the same amount of hay, TDN and protein at Roblin (relative to barley greenfeed) in 2021 is shown in Figure 5. The costs for Roblin in 2022 are shown in Figure 6, and for Arborg in Figure 7.

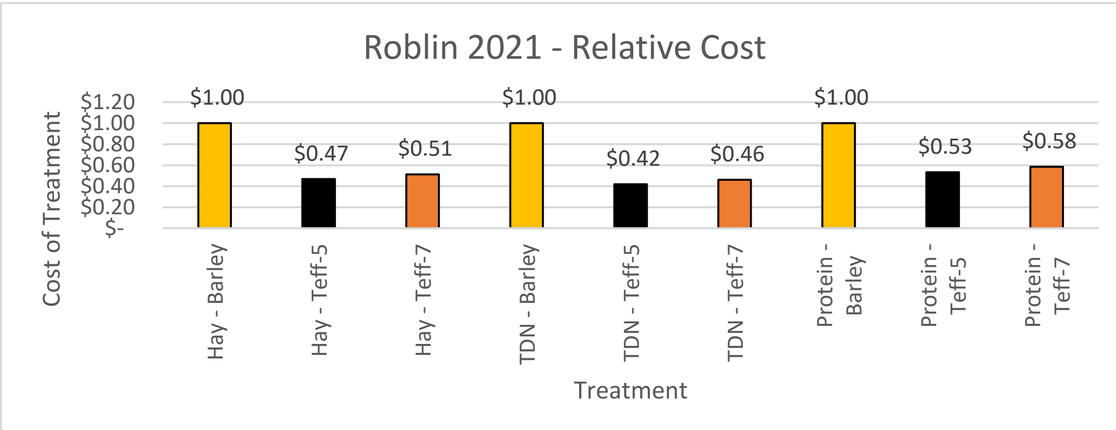


Figure 5: Roblin 2021 relative cost of production for hay, TDN and protein, including cost of seed, cutting, and land rental (estimated at $60/acre). Comparison is for barley greenfeed.

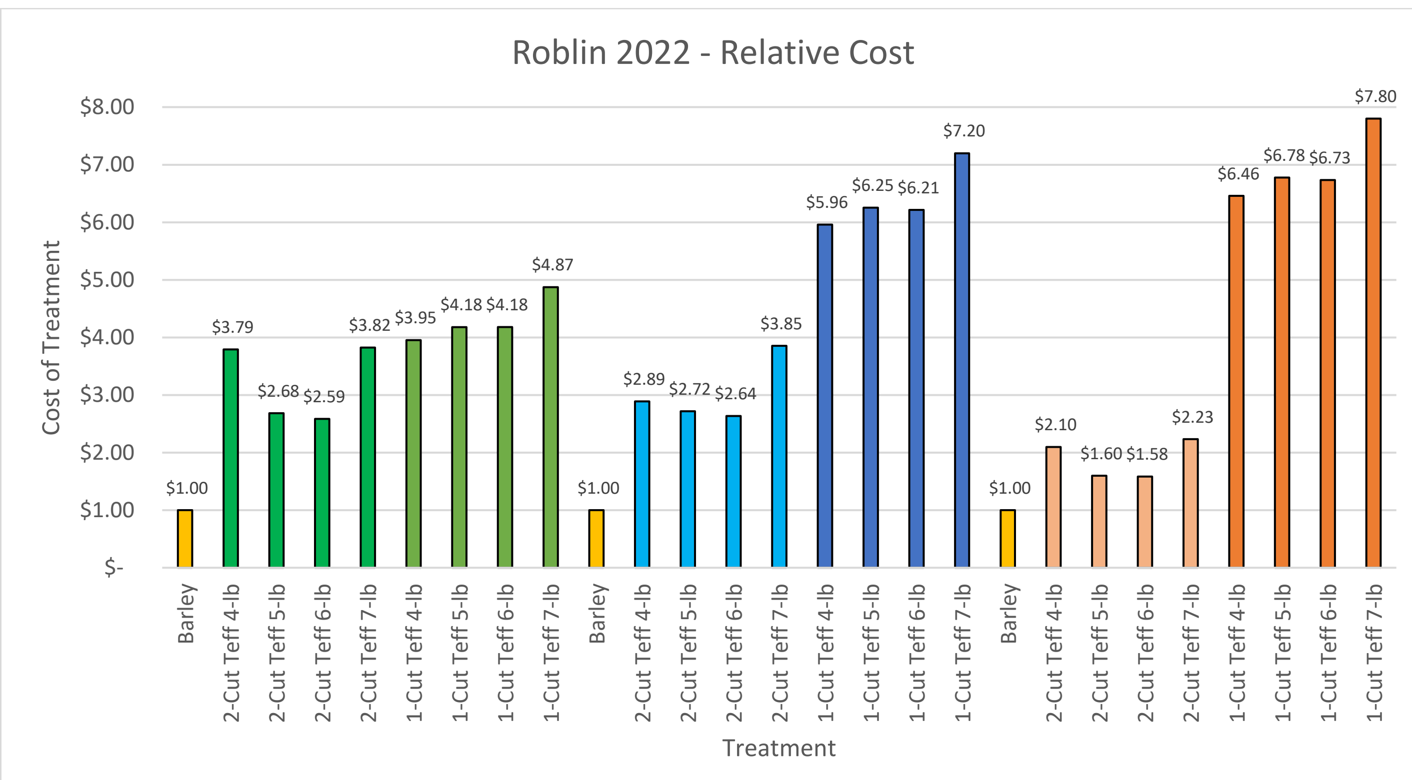


Figure 6: Roblin 2022 relative cost of production for hay (green bars), TDN (blue bars) and protein (orange bars), including cost of seed, cutting, and land rental (estimated at $60/acre). Comparison is for barley greenfeed.

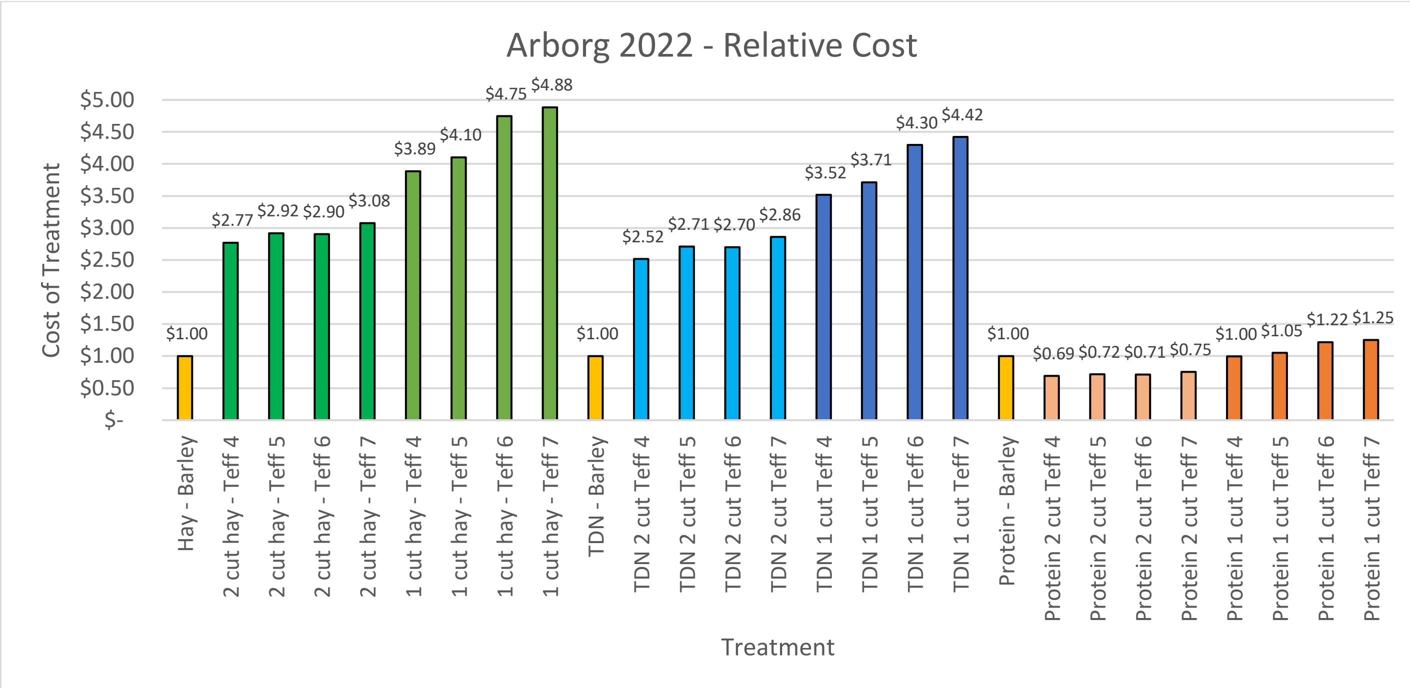


Figure 7: Arborg 2022 relative cost of production for hay, TDN and protein, including cost of seed, cutting, and land rental (estimated at $60/acre). Comparison is for barley greenfeed.

The relative cost of production is highly influenced by the yield of barley greenfeed. In 2021, when dry conditions resulted in low barley yields, the relative cost of production for teff was low (about half the cost of barley greenfeed). However, under the more favorable conditions for barley in 2022, the relative cost for producing teff increases considerably. The only category in which the cost of production for teff compared favorably to barley in 2022 was for protein in a two-cut system. In fact, the cost of production for protein at Arborg was lower for teff than for barley. Further, although barley greenfeed provided more protein overall than some treatments, because of the lower concentration in the forage, animals would have to consume more forage to obtain the same amount of protein. This highlights the strategic role that teff may play for some producers as a source of high quality forage.

The screenings from teff provide a promising additional source of animal nutrition. Due to the very small size of the seed, appropriate combine harvester settings may result in the collection of moderate amounts of chaff. This is primarily comprised of the seed head, as well as lightweight seed. With more than 18% protein and good energy values (Table 2), it may be advantageous to feed this material to livestock in bulk or pelletized form. The very high values for mineral content (especially zinc, manganese and iron) result from the presence of teff seed, which is higher in minerals than the chaff alone.

Note that the cool temperatures at Roblin at the time of the second cut resulted in elevated levels of nitrates (0.5 percent). Producers should consult a livestock specialist and exercise caution when feeding forage with high nitrate content to livestock to avoid exceeding safe levels.

The large difference in performance between 2021 and 2022 shows that more testing is needed before conclusions can be drawn about the performance of teff for forage. Additionally, testing is needed to identify the agronomic best management practices, including seeding date and fertility.

Materials & Methods

Table 4: Activities and dates

	PCDF		PESAI
	2021	**2022**	**2022**
Seeding	May 14	May 26	June 10
1st cut (teff)	July 15	July 28	July 15
2nd cut (teff)	Sept 28	Oct 6	Aug 23
Single cut (teff)		Oct 6	Aug 23
Barley	Aug 11	Aug 4	Aug 8

Table 5: Fertility Information

	Available	Added	Type
	PCDF		
N	120 lb/ac	10 lb/ac	46-0-0
P	52 ppm	10 lb/ac	11-52-0-0
K	670 ppm		
	PESAI		
N	61lb/ac	50 lb/ac	46-0-0
P	50lb/ac	15 lb/ac	11-52-0-0
K			

No herbicide applied (hand weeded)

Teff Grain Evaluation

Project Duration: May – October 2022
Objectives: To evaluate different seeding rates of teff for grain production potential
Collaborators: PCDF, Food Development Centre (Portage la Prairie), Tana Ethiopian Cuisine (Brandon)

Background

Teff *(Eragrostis tef)* is a warm-season annual grass that originates in northeast Africa, where it is grown for grain and forage production. The grain is very small, with approximately 1.2 million seeds per pound (2.6 million seeds per kilogram). The flour is used to produce a traditional flatbread called *injera*, which is naturally gluten-free.

The grain evaluation was done as part of the teff forage trial, which examined forage production at four seeding rates: 4, 5, 6 and 7 lb/ac. The forage trial also examined the difference in forage yield and quality for single- and double-cut systems. The single- and double-cut teff both produced grain, which was combined in early October.

The grain was cleaned and tested for germination rate. Additionally, the harvest material was milled and analyzed by the Food Development Centre in Portage la Prairie. The milled flour was provided to Tana Ethiopian Cuisine in Brandon for qualitative assessment of the suitability for producing *injera*.

Figure 1: (a) teff at combining (Oct 6, 2022) (b) mature teff (Oct 6, 2022)

Figure 2: Seed, with tape markings for 1/16th inch

Figure 3: Flour, processed with a hammer-mill with 0.020-inch screen

Figure 4: Fermented injera *flatbread, prepared by the staff at Tana Ethiopian Cuisine*

Results

Total grain yields (lb/ac) for each seeding rate and timing of cut are shown in Figure 5. Grain yield was lower for teff that was cut for hay in mid-July than for teff that was not hayed.

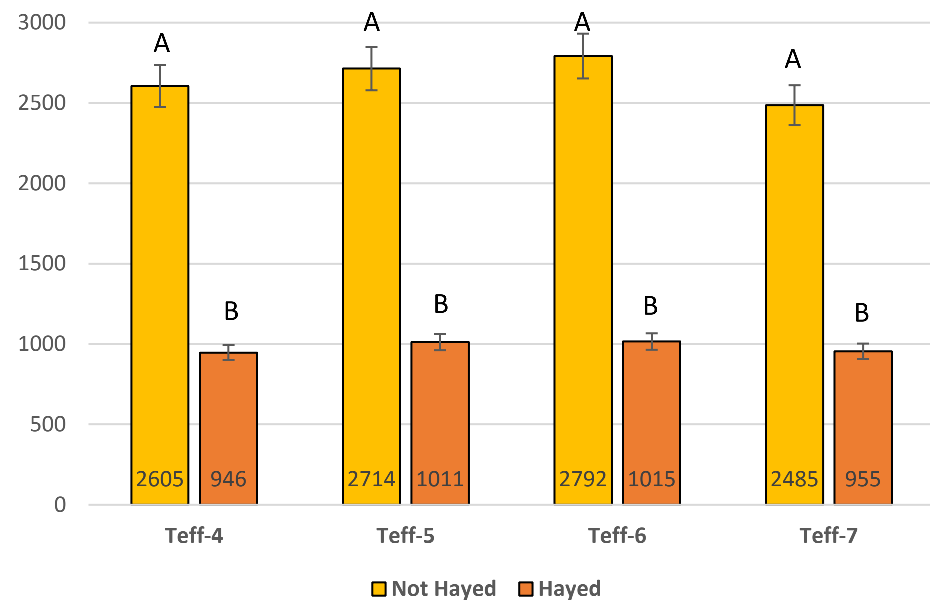


Figure 5: Grain yield (lb/ac) for not-hayed (yellow) and hayed (orange), by seeding rate.

Table 1 shows the germination rate for grain from the hayed and not-hayed treatments. Table 2 shows nutritional and physical characteristics for the flour for both treatments.

*Table 1: Germination rate for hayed and not-hayed grain**

Treatment	Germination rate
Hayed (July 28)	70%
Not-hayed	98%

** Central Testing Laboratory, Winnipeg*

*Table 2: Nutritional analysis and physical characteristics by treatment**

Characteristic	Hayed	Not-hayed	Comparison Values for Teff‡	Comparison Values for Whole Wheat
Moisture (%)	8.76	9.18	10.9	14.00
Crude protein (%)	14.35	14.02	10.99	14.00
Fat (%)	3.03	3.62	2.53	2.50
Total dietary fibre†	9.63	8.34	81.35 (dietary fibre and starch)	10.70
Starch (%)	68.01	66.52		68.00
Ash (%)	2.56	2.66	2.13	>1.50
Falling number	330	224	Unstated	Unstated
Amylase†	Positive		N/A	N/A

** Source: Central Testing Laboratories, Winnipeg, except † Merieux Nutrisciences, Markham, ON*

‡ Assefa et al.

Figure 6 (not-hayed) and Figure 7 (hayed) show the starch damage after milling.

Sample Weight 3.86 (g)	Water Weight 24.64 (g)	Sample Moisture 9.38 (%)	Moisture Basis 0.00 (%)

Test Results

Test	Peak 1	Trough 1	Breakdown	Final Visc	Setback	Peak Time
	2028.00	1482.00	546.00	3289.00	1807.00	5.67
	Pasting Temp					
	80.15					

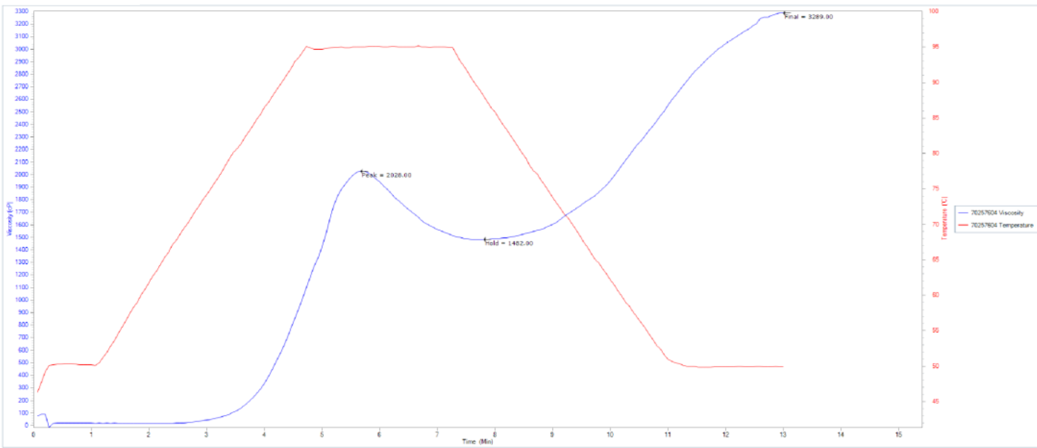


Figure 6: Starch damage, "Not-Hayed" flour.
Source: Merieux Nutrisciences, Markham, ON

Sample Weight 3.83 (g)	Water Weight 24.67 (g)	Sample Moisture 8.61 (%)	Moisture Basis 0.00 (%)

Test Results

	Peak 1	Trough 1	Breakdown	Final Visc	Setback	Peak Time
	1774.00	1329.00	445.00	2771.00	1442.00	5.60
	Pasting Temp					
	80.75					

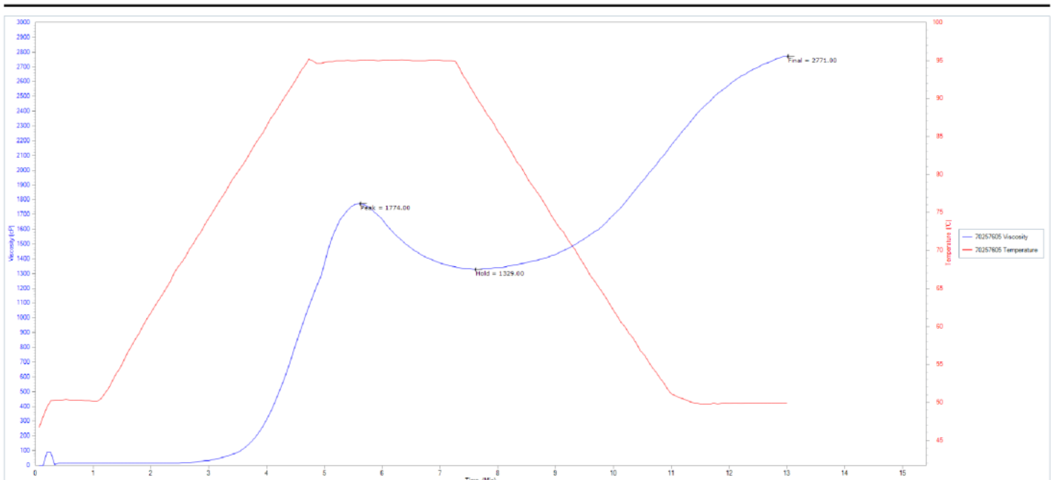


Figure 7: Starch damage, "Hayed" flour.
Source: Merieux Nutrisciences, Markham, ON

The full report for the milling and analysis at the Food Development Centre can be found here.

Field and laboratory observations

The average grain yield for treatments that were hayed was about 41% of the yield for treatments that were not hayed. The lower yield was most likely due to the fact that cutting for hay delays physical maturity. However, grain yield did not differ significantly by seeding rate within the hayed or not-hayed treatments. The germination rate for seed collected from the hayed treatment was lower (70%) than for the not-hayed treatment (95%), also likely caused by delayed maturity after cutting. (See the "2022 Teff Forage Evaluation" report for details on hay yield.)

The nutritional characteristics for teff grain are roughly comparable between treatments (Table 2). Protein, starch and fat content were slightly higher for the hayed treatments. Total dietary fibre was higher for the hayed treatment by more than one percentage point.

The test for the enzyme alpha-amylase was positive for both the hayed and not-hayed samples, indicating that sprouting occurred in the samples. Alpha-amylase degrades starch quality and reduces the viscosity of the slurry used to test the falling number. (The falling number is the number of seconds required for a stirrer to fall through a hot slurry of flour; a high value indicates a slurry that provides more resistance.) The falling number for the hayed treatment was roughly 150% higher than for the not-hayed treatment, suggesting that sprouting damage for the not-hayed sample was higher than for the hayed sample.

The sprouting damage in the harvest material is likely due to the lateness of the harvest (October 6). The small seed size, the tendency of the crop to lodge, and the heavy dews in late September, increase the changes of sprouting. In the future, sprouting may be reduced by harvesting the teff earlier. However, based on the timing of maturity observed in 2022, earlier harvesting may require swathing to promote adequate dry-down of the crop before combining.

Although the main use of teff flour is making *injera*, the falling number impacts the use of teff flour in other non-traditional applications, such as cakes and cookies. As a gluten-free flour, the potential applications for teff present an area of opportunity.

Traditional *injera* flatbread is produced by mixing flour and water with *ersho*, a culture of bacteria and yeast. The slurry is fermented for several days, resulting in bubbles caused by gas production. During the cooking process, the bubbles give the bread a porous texture on one side. As the fermented bread, *injera* has a slightly sour taste, similar to sourdough bread.

Studies find that the flour particle size and starch damage impact the fermentation process: smaller particle size and higher amounts of starch damage result in more surface area for enzymatic action. The samples were milled with a screen size of 0.020 inches (0.508 mm). A slightly larger particle size (0.031 inches; 0.800 mm) appears to be acceptable.

Food preparation observations

The staff at Tana Ethiopian Cuisine prepared two batches of injera, using the flour from the hayed and not-hayed treatments. They observed that the flour fermented well and formed good "eyes" (small holes in the injera that allow the bread to soak up food sauces). The staff noted that the flour for the not-hayed treatment had better characteristics and yielded better injera than the flour from the hayed treatment. Nevertheless, for both flours, the texture was not ideal, with a coarser, grittier texture than is preferred. As a result, the injera did not have the same pliability and a slightly different mouthfeel than is normally desired.

The difference in flour texture is likely due to the type of mill that was used. Teff is traditionally milled using a flat disc-type mill, such as a stone mill. With this type of mill, all parts of the seed are crushed to a relatively uniform size. With a hammer mill, which was used for this project, the seed is shattered by many small flails within the mill, and the particles fall downward through a screen. As a result, the hard seed coat was likely shattered, but not to a uniform size. Although the sieve size on the hammer mill was smaller than is typical for a disc-type mill, the presence of irregularly sized particles of hard seed coat gave the flour an undesirably crunchy texture.

Future work with the Food Development Centre will include milling teff flour with a disc-type mill.

The results provided in this report are for one year only and should be interpreted with caution. PCDF has plans to continue testing teff for grain production, including white and red varieties.

Materials & Methods

Table 4: Activities and dates

Seeding	May 26
1st cut (double-cut only)	July 28
2nd cut (double-cut only)	Oct 6
Single-cut	Oct 6

Table 5: Fertility Information

	Available	Added	Type
N	120 lb/ac	10 lb/ac	46-0-0
P	52 ppm	10 lb/ac	11-52-0-0
K	670 ppm		

No herbicide applied (hand weeded)

References

Assefa, Y., Emire, S., Villanueva, M., Adebe, W. and Ronda, F. "Influence of Milling Type on Tef Injera Quality."
https://uvadoc.uva.es/bitstream/handle/10324/32636/Influence_Milling_Tef_Injera_Quality.pdf?sequence=1

Blue Lupin Evaluation

Project duration: May – Sept 2022
Objectives: To evaluate the potential for blue lupin as a forage and grain crop
Collaborators: PCDF

Background

Lupin is a leguminous species that is grown for forage and grain. White lupin is grown extensively in Western Australia, where it thrives in the warm, dry conditions. Blue lupin is characterized by narrower leaves and smaller, rounder seeds than white lupin (see this factsheet on lupin for more details about lupin agronomy). The blue lupin seed is about the size of a small pea. The crop is relatively unknown in Manitoba, but has potential as a good source of forage and protein.

In 2022, PCDF examined blue lupin for forage and grain yield, seeded at rates of 50, 60, 70 and 80 lb/ac. Yields were compared against that of 40-10 forage pea. Feed tests were done for lupin forage.

Results

The forage plots were harvested on August 5. Yields are shown in Figure 1.

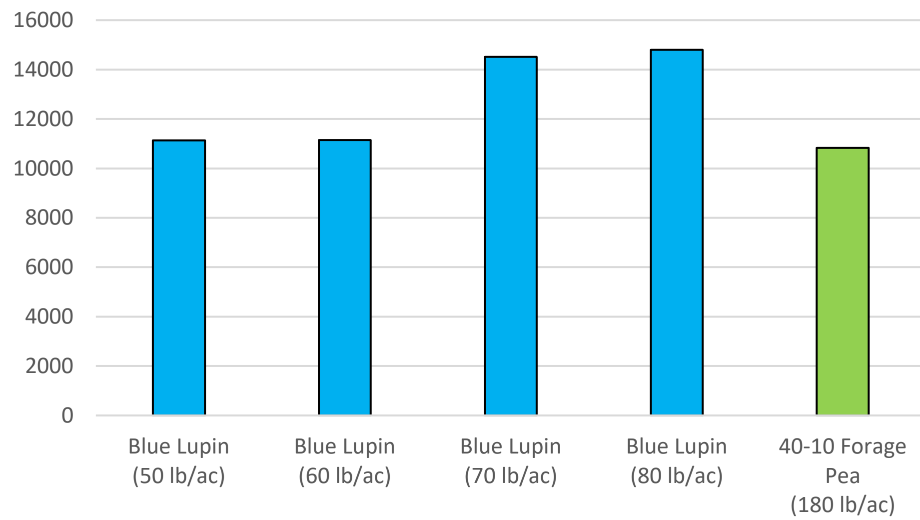


Figure 1: Forage yield for blue lupin and 40-10 forage pea, by treatment.

Following the forage harvest, the lupin crop was damaged by herbicide drift in an adjacent trial. This resulted in a severe yellowing of the majority of plants, and the death of others. Consequently, the trial was terminated and grain harvested did not occur. Statistical differences are shown in Table 1.

Table 1: Statistical data for forage yield*

Entry (seeding rate, lb/ac)	**Statistical significance***		
Lupin (50)	A	B	
Lupin (60)		B	
Lupin (70)		B	C
Lupin (80)			C
40-10 Forage Pea (180)	A	B	C
% CV	**19.8**		

Figure 2: Blue lupin at early pod maturity (left). Note that this photo was taken of a portion of the trial that was not damaged by herbicide drift.

Figure 3: (a) Blue lupin pod at early maturity; (b) pod at full maturity.

Table 2: Feed values for blue lupin and pea forage

Entry	% Crude Protein	% TDN
Blue lupin	21.31	62.54
40-10 forage pea	12.38	64.35
Animal feed requirements**		
Mature cows		
Mid gestation	7	50-53
Late gestation	9	58
Lactating	11-12	60-65
Replacement heifers	8-10	60-65
Breeding bulls	7-8	48-50
Yearling bulls	7-8	55-60

* *Dry matter feed values from Central Testing Laboratory, Winnipeg.*
** *Animal feed requirements developed by Elisabeth Nernberg (Manitoba Agriculture).*

*Table 3: Mineral content for feed by treatment**

Treatment	**Mineral (%)**				
	Ca	**P**	**Mg**	**Na**	**K**
Blue lupin	1.37	0.23	0.45	0.04	1.24
40-10 forage pea	0.99	0.20	0.26	0.04	1.33

* *Central Testing Laboratory, Winnipeg*

Observations

Based on the forage yields and feed values, blue lupin appears to have potential as a stand-alone forage crop or as part of a multi-species forage mix in Manitoba. In a stand-alone crop, forage yields at seeding rates of below 70 lb/ac were significantly lower than for higher seeding rates. However, the results shown here are for one year only, and should be interpreted with caution.

Materials and methods

Experimental Design: Random Complete Block Design
Entries: 5
Seeding: May 11
Forage harvest: August 5

Agronomic info
Previous year's crop: Canola
Soil Type: Erickson Clay Loam
Landscape: Rolling with trees to the south
Seedbed preparation: Direct seed

Table 3: Spring 2022 Soil Test

	Available	
N	84	lb/ac
P	29	ppm
K	463	ppm

Organic Trials

AAFC Organic Oats Variety Evaluation

Project duration: May 2022 – October 2022
Objective: To evaluate oat varieties for organic production.
Collaborators: Kirby Nilsen, Agriculture and Agri-Food Canada, Brandon

Background
Research suggests that selection of cereal crops specific to organic agriculture should be conducted on organically managed land [1,2]. Conventional management systems may mask or confound certain plant characteristics, resulting in selection of sub-optimal cultivars for organic production systems. The trial was grown on certified organic land belonging to a local organic producer.

Results

Table 1: Varieties, mean yield (bu/ac), and mean height (cm)

Variety	Average height (cm)	Average Yield (bu/ac) adjusted to 14% moisture
AC Morgan	102.3	6229
Summit	86.5	5972
AAC Oravena	108.5	5904
AAC Kongsore	107.5	5571
CS Camden	97.0	5553
CDC Arborg	107.2	5184
CDC Endure	102.5	4985
11P19-16-FB	103.7	5120
17P07-AA050	88.3	5452
17P07-AA068	104.8	5571
17P11-AA026	96.5	5690
17P11-AA065	98.2	5949
17P13-AA021	100.7	6289
17P13-AA047	100.7	6539
17P13-AA053	110.5	6433
17P14-AA006	94.8	6304
17P14-AA018	91.8	5965
17P14-AA033	96.7	5894
17P14-AA047	92.8	5857
17P14-AA063	96.0	6074
17P14-AA065	96.3	6151
17P15-AA002	94.7	6466
17P15-AA052	98.2	6465
17P15-AA078	103.0	6380
17P15-AA088	100.5	6132

The majority of the entries in this test are unregistered varieties. The yield and plant heights (Table 1) are provided for reference and to allow interested producers to track the entries in the future.

Materials and methods

Experimental Design: Random Complete Block Design
Entries: 25 varieties
Seeding: May 16
Harvest: Sep 8

Table 2: Varieties included at Roblin 2021

AAC Oravena	CDC Arborg	17P11-AA026	17P14-AA006	17P14-AA065
AAC Kongsore	Summit	17P11-AA065	17P14-AA018	17P15-AA002
AC Morgan	11P19-16-FB	17P13-AA021	17P14-AA033	17P15-AA052
CS Camden	17P07-AA050	17P13-AA047	17P14-AA047	17P15-AA078
CDC Endure	17P07-AA068	17P13-AA053	17P14-AA063	17P15-AA088

Data collected: Date collected
Height: Beginning of Aug
Lodging: Sep 8
Yield: Sep 8
Moisture: Sep 8

Agronomic info
Previous year's crop: Canola
Soil Type: Erickson Clay Loam
Landscape: Rolling with trees to the south
Seedbed preparation: Direct seed

Table 3: Spring 2022 Soil Test

	Available	
N	84	lb/ac
P	29	ppm
K	463	ppm

References

[1] Reid, T., Yang, R.-C., Salmon, D. and Spaner, D. (2009). Should spring wheat breeding for organically managed systems be conducted on organically managed land? Euphytica 169:239-252.
[2] Dalhousie University, Organic Agriculture Centre of Canada. The crafting of organic oats. https://www.dal.ca/faculty/agriculture/oacc/en-home/about/about-oacc/documents/newpaper-articles/newsarticles-2012/newsarticles-2012-fetch.html

Organic Wheat Participatory Plant Breeding

Project duration: May 2022 – August 2022
Objective: To evaluate wheat varieties for organic production.
Collaborators: Martin Entz, Michelle Carkner, University of Manitoba

Background
The Participatory Plant Breeding project has been led by the Natural Systems Agriculture Laboratory, University of Manitoba. The project's objective is to develop cultivars that are relevant to farmers' needs by conducting selection in the farm environment. A second aim is to give farmers more control over seed resources by helping them to develop and maintain their own varieties. The project is coming to an end in March 2022. Several promising lines have been identified by farmers that will be brought to commercial production.

Results
The majority of the entries in this test are unregistered varieties. The yield and plant heights (Table 1) are provided for reference and to allow interested producers to track the entries in the future.

Table 1: PPB wheat yield (bu/ac)

Variety	Mean Height (cm)	Mean Yield (bu/ac) at 14.5%
BJ08A-CG	83.3	30.9
BJ08A-IG	95.2	37.3
BJ10A-KB	94.8	35.4
BJ10A-SC	86.8	33.4
BJ11A-CG	95.8	38.4
BJ11A-KB	87.8	38.5
BJ11A-SC	90.0	37.9
BJ13-GW	88.2	36.1
BJ13-HRE	92.5	32.4
BJ15-GW	93.7	44.2
BJ15A-GM	93.2	39.5
BL22A-SW	86.5	37.1
BL23-AS	78.3	26.9
BL23-JM	82.5	35.0
BL28-JM	94.8	38.4
BL28-TM	96.3	40.1
BL28-WM	94.7	40.6
BL34A-JM	91.2	37.8
BL34A-WM	93.2	43.5
BL34-SW	87.3	32.0
BL39A-WM	35.7	35.7
BL41A-AS	84.8	29.1
BL41A-MS	84.5	27.7

BL43C-TM	90.2	38.7
PWA10B-LD	81.3	30.3
AAC Brandon	69.2	31.0
Vesper	82.7	36.2
AAC Tradition	75.2	34.0
Zealand	88.5	37.0
Jake	82.3	32.6
CDC Kernen	83.3	27.4

Materials and methods

Experimental Design:	Random Complete Block Design
Entries:	31 varieties
Seeding:	May 12
Harvest:	Aug 26

Table 2: Varieties included at Roblin 2022

BJ13-GW	BL28-JM	BL34-SW	PWA10B-LD
BJ15A-GM	BL28-TM	BL39A-WM	AAC Brandon
BL22A-SW	BL28-WM	BL41A-AS	Vesper
BL23-AS	BL34A-JM	BL41A-MS	AAC Tradition
BL23-JM	BL34A-WM	BL43C-TM	Zealand
BJ11A-SC	BJ11A-KB	BJ10A-SC	Jake
BJ08A-IG	BJ11A-CG	BJ10A-KB	CDC Kernen
BJ08A-CG	BJ13-HRE	BJ15-GW	

Data collected	Date collected
Weekly Maturity:	Every Monday, Wednesday, and Friday from the beginning of August
Height:	Aug 14
Lodging:	Aug 26
Yield:	Aug 26
Moisture:	Aug 26

Agronomic info

Previous year's crop:	Soybean
Soil Type:	Erickson Clay Loam
Landscape:	Rolling with trees to the south
Seedbed preparation:	Hand weeding

Table 3: Spring 2022 Soil Test

	Available
N	101 lb/ac
P	159 ppm
K	191 ppm

(Organic trial: no fertilizer or herbicide applied)

Oat Trials

University of Saskatchewan Standard Oat Yield Trial

Project duration: May 2022 – September 2022
Objective: To evaluate oat entries for the Crop Development Centre, University of Saskatchewan
Collaborators: Aaron Beattie Crop Development Centre University of Saskatchewan

Background
Adapted from the Crop Development Centre (CDC) website: The CDC was established in 1971 to improve economic returns for farmers and the agriculture industry in western Canada by improving existing crops, creating new uses for traditional crops, and developing new crops.

Results
The average yield for oat entries is shown in Figure 1. Numbered, non-registered varieties are provided for tracking purposes only. The results are for one site-year only, and should be interpreted with caution. Consult a seed guide for multi-site-year data for available varieties.

Materials and methods

Experimental Design:	Random Complete Block Design
Entries:	36 varieties
Seeding:	May 4
Harvest:	Sep 15

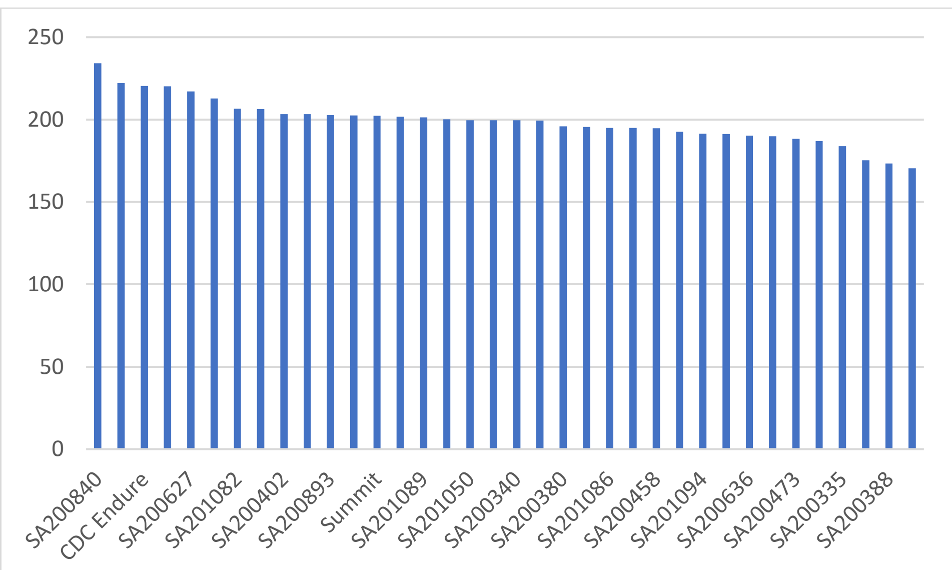


Figure 1: Average yield (bu/ac) for oat entries

Data collected	Date collected
Rust:	Throughout season
Height:	Aug 14
Lodging:	Sep 2
Yield:	Sep 2
Moisture:	Sep 2

Agronomic info

Previous year's crop:	Canola
Soil Type:	Erickson Clay Loam
Landscape:	Rolling with trees to the south
Seedbed preparation:	Direct seeded

Table 1: Spring 2022 Soil Test

	Available		Added	Type
N	84	lb/ac	36 lb/ac	46-0-0
P	29	ppm	15 lb/ac	11-52-0-0
K	463	ppm		

Table 2: Spraying Information

Crop stage	Date	Product	Rate
Pre-emerge	May 11	Heat	59 ml/ac
		Merge	400 ml/ac
		Glyphosate	670 ml/ac
In-crop	Jun 20	Dicamba	110 ml/ac

University of Saskatchewan Oat Yield Variety Trial

Project duration: May 2022 – September 2022
Objective: To evaluate oat entries for the Crop Development Centre, University of Saskatchewan
Collaborators: Aaron Beattie, Crop Development Centre University of Saskatchewan

Background

Adapted from the Crop Development Centre (CDC) website: The CDC was established in 1971 to improve economic returns for farmers and the agriculture industry in western Canada by improving existing crops, creating new uses for traditional crops, and developing new crops.

Results

The average yield for oat entries is shown in Figure 1. Numbered, non-registered varieties are provided for tracking purposes only. The results are for one site-year only, and should be interpreted with caution. Consult a seed guide for multi-site-year data for available varieties.

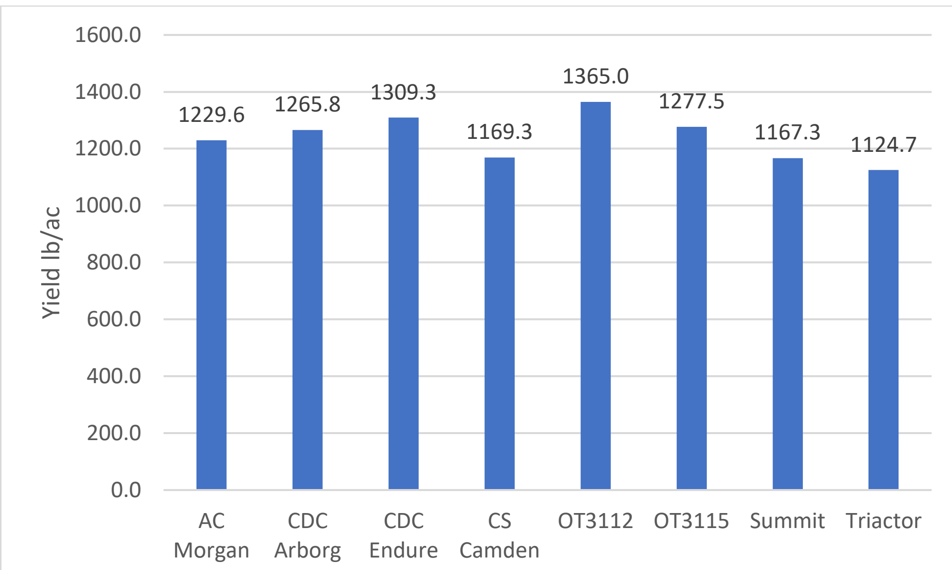


Figure 1: Average yield (bu/ac adjusted to 14% moisture) for oat entries

Materials and methods

Experimental Design: Random Complete Block Design
Entries: 8 varieties
Seeding: May 11
Harvest: Sep 7

Table 1: Varieties included at Roblin 2022

AC Morgan	OT3115	CDC Arborg	OT3112
Summit	Triactor	CS Camden	CDC Endure

Data collected — Date collected
Height: Aug 14
Lodging: Sep 7

Yield: Sep 7
Moisture: Sep 7

Agronomic info
Previous year's crop: Canola
Soil Type: Erickson Clay Loam
Landscape: Rolling with trees to the south
Seedbed preparation: Direct seeded

Table 2: Spring 2022 Soil Test

	Available		Added	Type
N	84	lb/ac	36 lb/ac	46-0-0
P	29	ppm	15 lb/ac	11-52-0-0
K	463	ppm		

Table 3: Spraying Information

Crop stage	Date	Product	Rate	
Pre-emerge	May 11	Heat	59	ml/ac
		Merge	400	ml/ac
		Glyphosate	670	ml/ac
In-crop	Jun 20	Dicamba	110	ml/ac

SVPG Oat Variety Evaluation

Project duration: May 2022 – September 2022
Objectives: To evaluate oat varieties for the Saskatchewan Variety Performance Group
Collaborators: SVPG, Saskatchewan Agriculture

Background
(From the Saskatchewan Wheat Development Commission website): The Saskatchewan Variety Performance Group (SVPG) is an informal group made up of stakeholders who are interested in variety performance testing in Saskatchewan. SVPG has coordinated the post-registration regional performance testing of spring wheat, durum, barley, oats, and flax varieties since 2006. The data collected from these trials is entered into annual publications "Varieties of Grain Crops" and the Saskatchewan Seed Guide.

Results
Yield results (bu/ac) for the Roblin site are shown in Figure 1. The results are for one site-year only, and should be interpreted with caution. Consult a seed guide for multi-site-year data for available varieties.

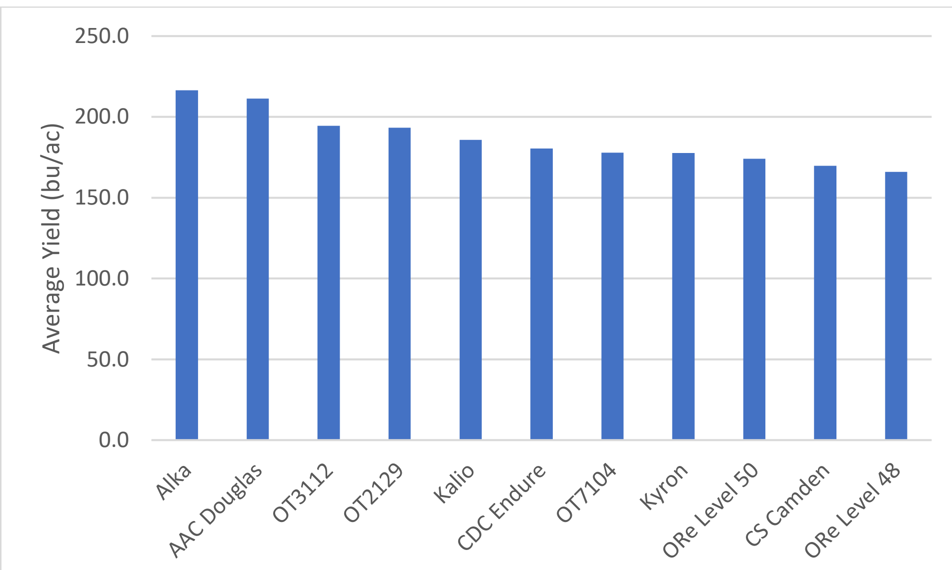


Figure 1: Average yield for oat entries adjusted to 14%

Materials & Methods
Experimental Design: Random Complete Block Design
Entries: 11 entries, 3 replications
Seeding: May 11
Harvest: Sep 7

Agronomic information
Previous year's crop: Canola
Soil Type: Erickson Loam Clay
Landscape: Rolling with trees to the east
Seedbed preparation: Direct seeded

Data collected	**Date collected**
Yield:	Sep 7
Moisture:	Sep 7

Table 2: 2022 Fertility Information

	Available		Added	Type
N	89	lb/ac	36 lb/ac	46-0-0
P	29	ppm	15 lb/ac	11-56-0-0
K	463	ppm	-	-

Table 3: 2022 Pesticide Application

Crop stage	Date	Product	Rate	
Pre-emerge	May 11	Heat	59	ml/ac
		Merge	400	ml/ac
		Glyphosate	670	ml/ac
In-crop	Jun 20	Dicamba	110	ml/ac

Pulse Trials

Saskatchewan Pulse Growers Pea Variety Trial

Project duration: May 2022 – October 2022
Objectives: To evaluate pea entries for the Saskatchewan Pulse Growers (SPG)
Collaborators: Laurie Friesen, SPG

Background
(Adapted from the SPG website): The SPG works to boost yield of established pulse crops, develop new crops, connect with growers, expand the utilization of pulse crops, and decrease barriers to market access. The projects further on-farm yield gains through the identification and enhancement of genetic yield potential.

Results
The average yield for pea entries is shown in Figure 1. The average height for entries is shown in Figure 2. Numbered, non-registered varieties are provided for tracking purposes only. The results are for one site-year only, and should be interpreted with caution. Consult a seed guide for multi-site-year data for available varieties.

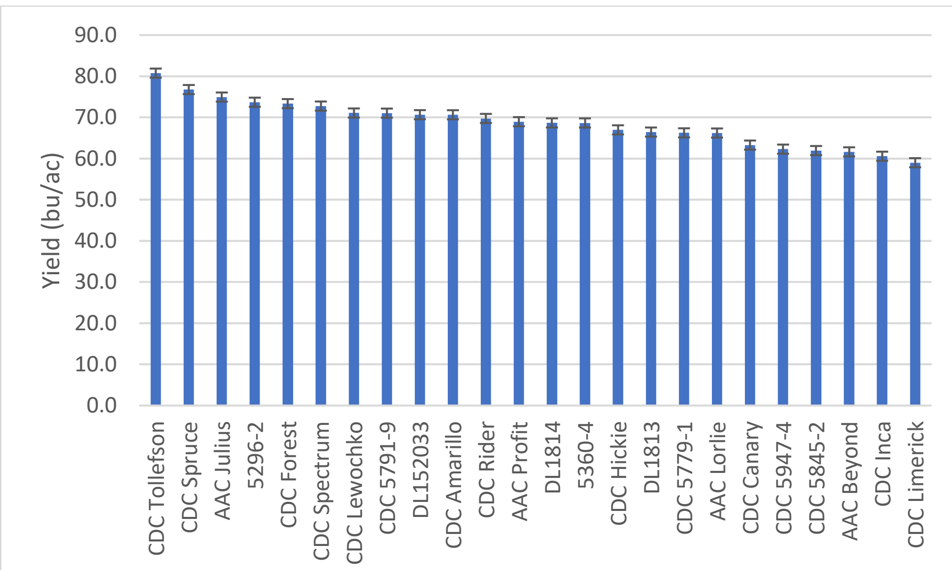


Figure 1: Average yield for peas, adjusted to 16% moisture

Materials and methods
Experimental Design: Random Complete Block
Entries: 24 entries; 3 replications
Seeding: May 11
Harvest: Aug 30

Table 1 (Long Season): Varieties included in trial

CDC Lewochko	AAC Profit	DL 152033	CDC Limerick
AAC Lorlie	CDC 5947-4	AAC Julius	CDC Tollefson
CDC Inca	DL 1813	CDC 5791-9	CDC Rider

CDC 5779-1	DL 1814	5360-4	CDC Forest
CDC Amarillo	CDC Canary	CDC 5845-2	AAC Beyond
CDC Spectrum	CDC Hickie	CDC Spruce	5296-2

Materials and methods

Experimental Design:	Random Complete Block
Entries:	30 entries; 3 replications
Seeding:	May 6
Data collected	Date collected
% Plant Stand:	Jun 22
Yield:	Aug 30
Moisture:	Aug 30

Agronomic info

Previous year's crop:	Canola
Soil Type:	Erickson Clay Loam
Landscape:	Rolling with trees to the east
Seedbed preparation:	Direct seeded

Table 2: Spring 2022 Soil Test

	Available		Added	Type
N	112	lb/ac	-	-
P	39	ppm	10 lb/ac	11-52-0-0
K	472	ppm	-	-

Inoculant added with seed; P banded with seed

Table 3: Pesticide Application

Crop stage	Date	Product	Rate	
Pre-emerge	May 11	Heat	59	ml/ac
		Merge	400	ml/ac
In-crop	Jun 20	UAN 28%	810	ml/ac
		Viper	400	ml/ac
	Aug 24	Reglone/240g	600	ml/ac
		LI700	250	ml/ac

Saskatchewan Pulse Growers Long Season and Short Season Soy Variety Trial

Project duration: May 2022 – October 2022
Objectives: To evaluate long and short season soybean entries for the Saskatchewan Pulse Growers (SPG)
Collaborators: Laurie Friesen, SPG

Background
(Adapted from the SPG website): Soybeans are photosensitive and latitude greatly affects day length. For this reason, varieties are bred for specific north-south ranges of adaptation, typically in a range of 150 to 250 kilometres. Growing a variety north of its maturity band may delay maturity and it will be at a great risk of not reaching full maturity prior to frost. The test examines some of the long and short season (i.e., most northern-adapted) glyphosate-tolerant soybean lines.

Results
The average yield for long-season soybean entries is shown in Figure 1 and the average yield for short-season soybean entries is shown in Figure 2. The average height for long-season soybean entries is shown in Figure 3 and the average height for short-season soybean entries is shown in Figure 4. Numbered, non-registered varieties are provided for tracking purposes only. The results are for one site-year only, and should be interpreted with caution. Consult a seed guide for multi-site-year data for available varieties.

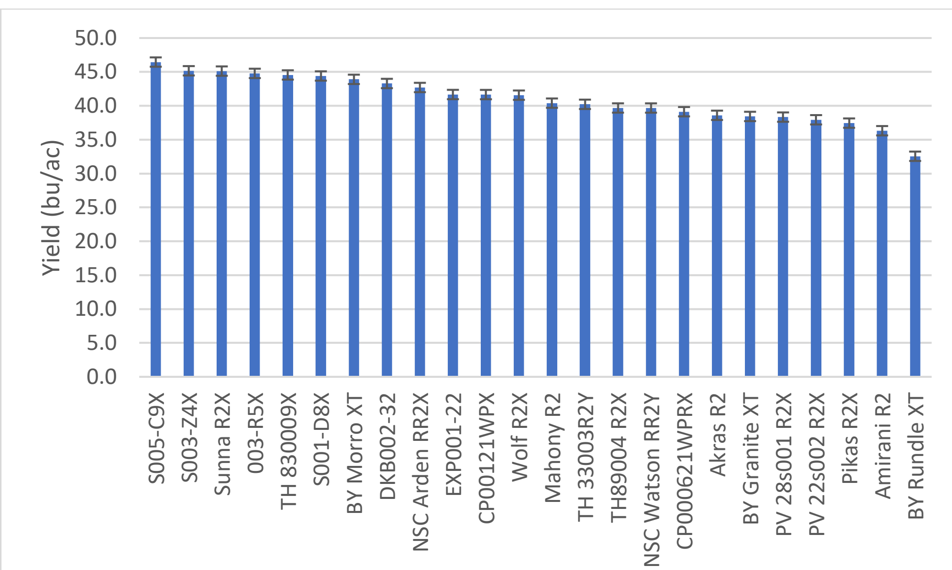


Figure 1: Average yield for long season soybeans, adjusted to 14% moisture

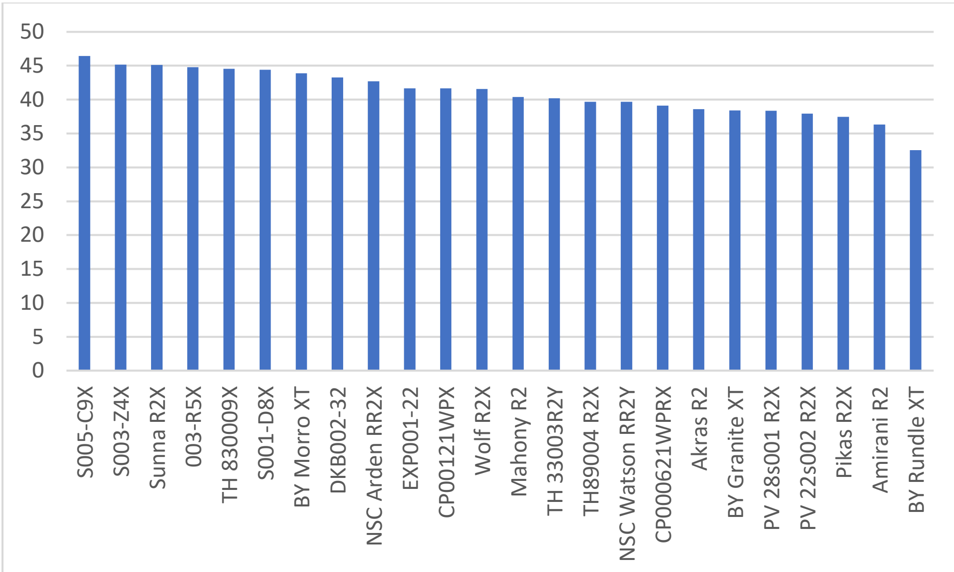


Figure 2: Average yield for short season soybeans, adjusted to 14% moisture

Materials and methods

Experimental Design:	Random Complete Block
Entries:	Long season 24 entries, Short season 24 entries; 3 replications each
Seeding:	May 24
Harvest:	Oct 19 and 20

Data collected	Date collected
% Plant Stand:	Jun 22
Maturity:	Sep 22
Yield:	Oct 26
Moisture:	Oct 26

Agronomic info	
Previous year's crop:	Canola
Soil Type:	Erickson Clay Loam
Landscape:	Rolling with trees to the east
Seedbed preparation:	Direct seeded

Table 1: Spring 2022 Soil Test

	Available		Added	Type
N	112	lb/ac	-	-
P	39	ppm	10 lb/ac	11-52-0-0
K	472	ppm	-	-

Inoculant added with seed; P banded with seed

Table 2: Pesticide Application

Crop stage	Date	Product	Rate
Pre-emerge	May 26	RoundUp	640 ml/ac
		Heat	28.0 g/ac
In-crop	Jun 20	Bentazon	910 ml/ac
		Quizalofop	200 ml/ac
		Glyphosate	1.0 L/ac

University of Saskatchewan Fababean A&B Variety Trials

Project duration: May 2021 – October 2021
Objectives: To evaluate coloured and white fababean entries for the Crop Development Centre, University of Saskatchewan
Collaborators: Jaret Horner, University of Saskatchewan

Background

Adapted from the Crop Development Centre (CDC) website: The CDC was established in 1971 to improve economic returns for farmers and the agriculture industry in western Canada by improving existing crops, creating new uses for traditional crops, and developing new crops.

Results

The average yield for white fababean entries is shown in Figure 1. The average yield for coloured fababean entries is shown in Figure 2. Numbered, non-registered varieties are provided for tracking purposes only. The results are for one site-year only, and should be interpreted with caution. Consult a seed guide for multi-site-year data for available varieties.

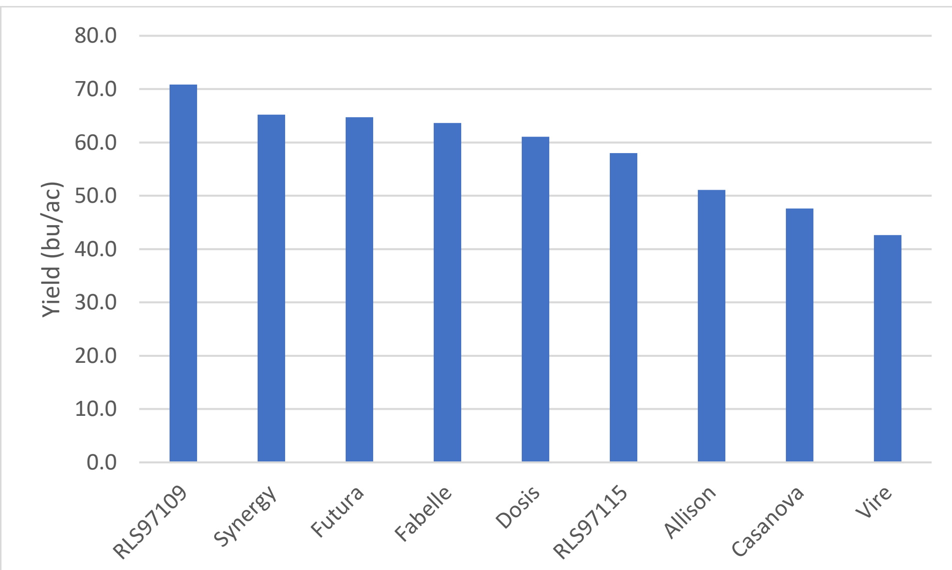


Figure 1: Average yield for white fababean entries adjusted to 16% moisture

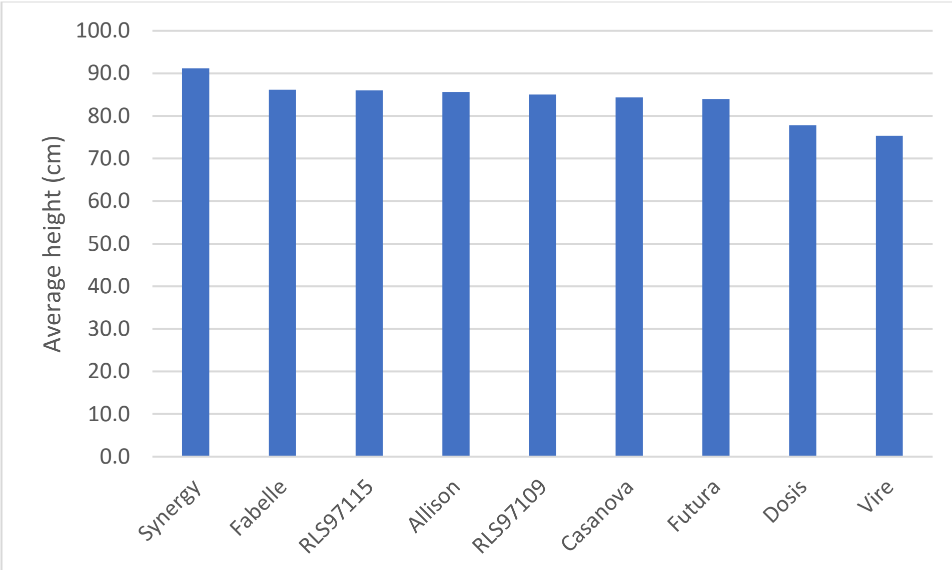


Figure 2: Average height for white fababean entries

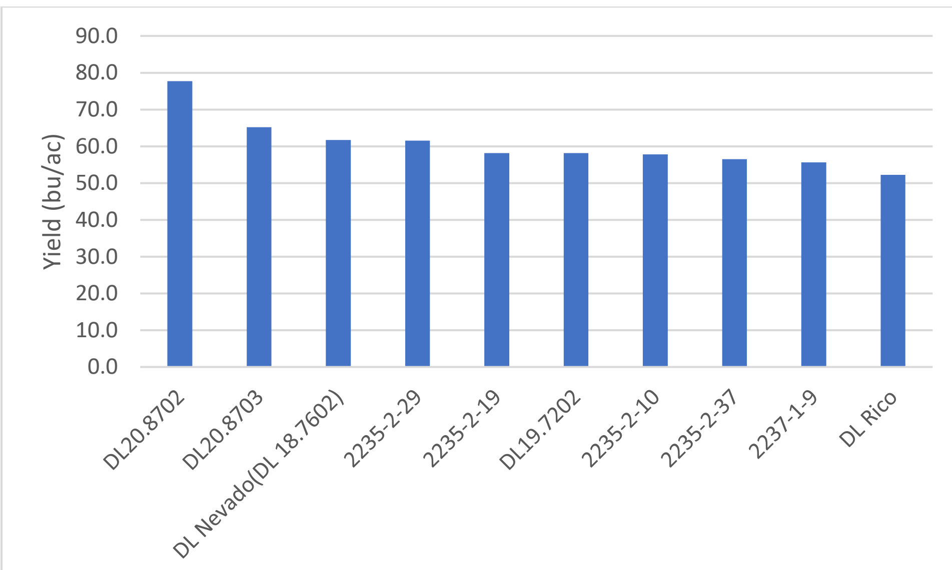


Figure 3: Average yield for colored fababean entries adjusted to 16% moisture

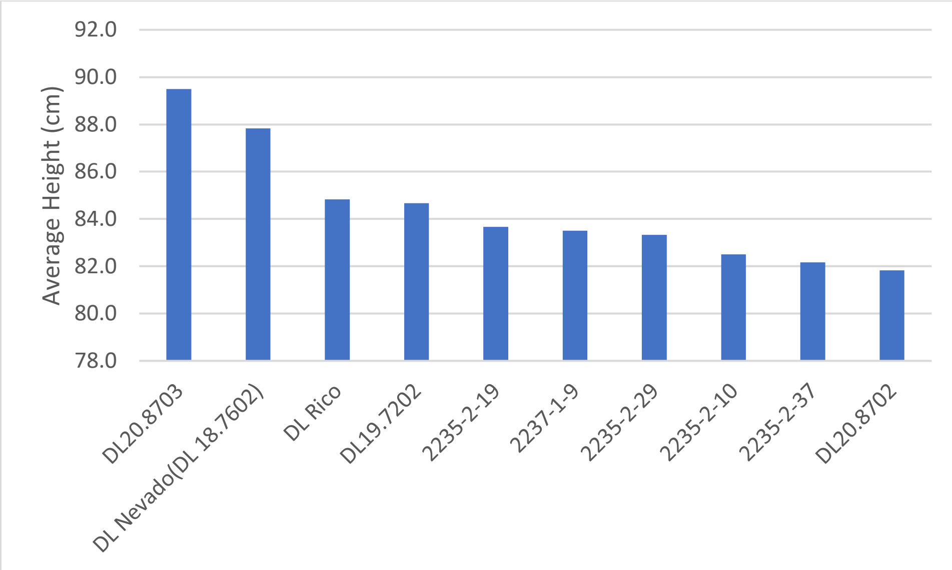


Figure 4: Average height for colored fababean entries

Materials and methods

Experimental Design:	Random Complete Block
Entries:	10 Trial A entries, 9 Trial B entries; 3 replications
Seeding:	May 6
Harvest:	Sep 29

Table 1 Trial A: Varieties included in trial

DL20.8702	2235-2-19	DL Rico	DL Nevado	DL18.7602
2237-1-9	2235-2-37	2235-2-29	DL19.7202	2235-2-10

Table 2 Trial B: Varieties included in trial

Fabelle 06	Allison	Casanova	Vire	RLS97115
Futura	Doris	Synergy	RLS97109	

Data collected	Date collected
% Plant Stand:	May 31
Yield:	Sep 29
Moisture:	Sep 29

Agronomic info

Previous year's crop:	Canola
Soil Type:	Erickson Clay Loam
Landscape:	Rolling with trees to the east
Seedbed preparation:	Direct seeded

Table 3: Spring 2022 Soil Test

	Available		Added	Type
N	119	lb/ac	-	-
P	48	ppm	10 lb/ac	11-52-0-0
K	572	ppm	-	-

Inoculant added with seed; P banded with seed

Table 4: Pesticide Application

Crop stage	Date	Product	Rate
Pre-emerge	May 11	Aim	30 ml/ac
		Authority	118 ml/ac
		Agral 90	250 g/ac
		Glyphosate	670 ml/ac
In-crop	Jun 20	Bentazon	910 ml/ac
		Quizalofop	200 ml/ac

Saskatchewan Pulse Growers White and Coloured Fababean Variety Trials

Project duration: May 2021 – September 2021
Objectives: To evaluate white and coloured fababean entries for the Saskatchewan Pulse Growers (SPG)
Collaborators: Laurie Friesen, SPG

Background
(Adapted from the SPG website):

Results

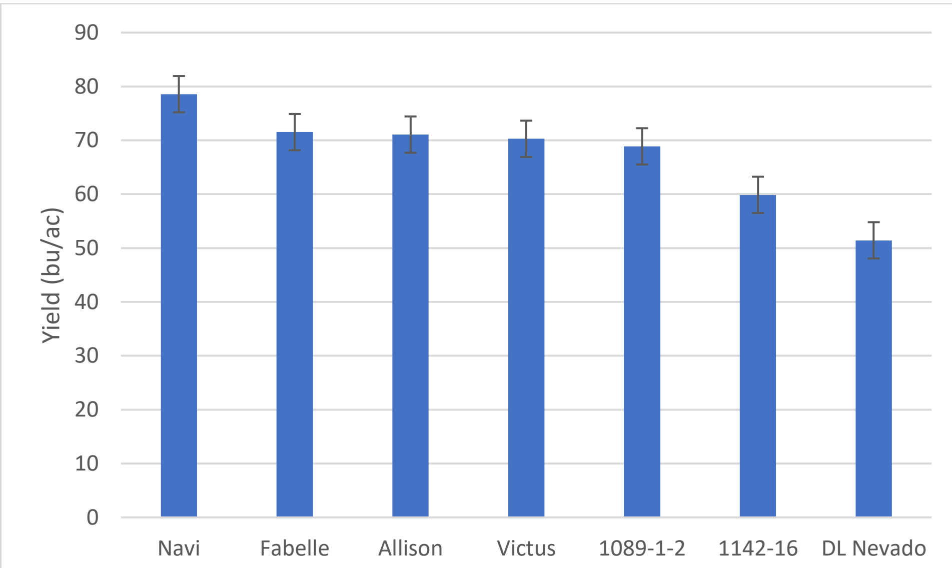


Figure 1: Average yield (bu/ac) adjusted to 16%

Materials and methods

Experimental Design:	Random Complete Block
Entries:	10 white entries; 6 coloured entries; 3 replications
Seeding:	May 6
Harvest:	Sep 29

Table 1: Varieties included in trial

Navi	1089-1-2
Fabelle	DL Nevado
Allison	1142-16
Victus	-

Data collected	Date collected
Maturity:	Throughout September
Yield:	Sep 29
Moisture:	Sep 29

Agronomic info

Previous year's crop:	Canola
Soil Type:	Erickson Clay Loam
Landscape:	Rolling with trees to the east
Seedbed preparation:	Direct seeded

Table 2: Spring 2022 Soil Test

	Available		Added	Type
N	119	lb/ac	-	-
P	48	ppm	10 lb/ac	11-52-0-0
K	572	ppm	-	-

Inoculant added with seed; P banded with seed

Table 3: Pesticide Application

Crop stage	Date	Product	Rate
Pre-emerge	May 11	Aim	30 ml/ac
		Authority	118 ml/ac
		Agral 90	250 g/ac
		Glyphosate	670 ml/ac
In-crop	Jun 20	Bentazon	910 ml/ac
		Quizalofop	200 ml/ac

Wheat Trials

Parkland Coop Wheat Variety Evaluation

Project duration: May 2022 – August 2022
Objectives: To evaluate spring wheat varieties for the Parkland Coop
Collaborators: Dean Spanner – Coordinator, University of Alberta Research Station
Klaus Strenzke – Research Technician, University of Alberta Research Station

Background
The Parkland Cooperative wheat trial is conducted across the Prairies as a resource for wheat breeders to generate data in support of registration of new Canada Western Red Spring varieties. Additional samples taken to test for wheat midge were sent away at the end of July.

Results
The average yield for wheat entries is shown in Figure 1. Numbered (coded) entries are provided for reference only. For more information on the Parkland Coop trial, contact Klaus Strenzke, University of Alberta. The results are for one site-year only, and should be interpreted with caution. Consult a seed guide for multi-site-year data for available varieties.

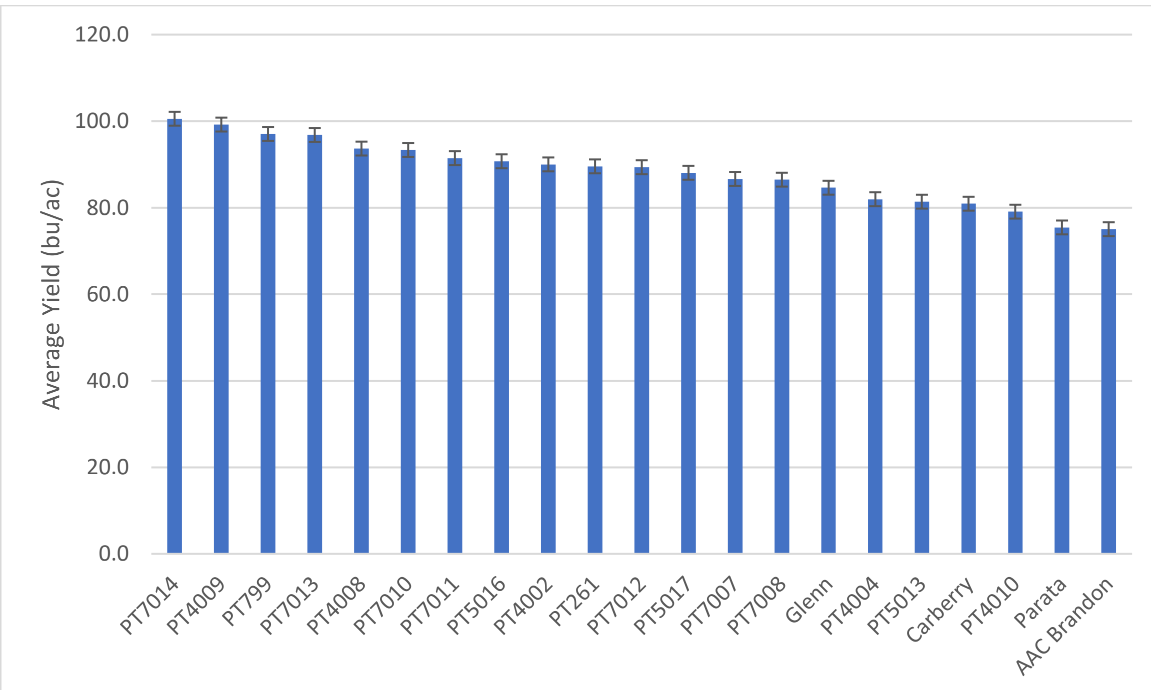


Figure 1: Average yield by variety in bu/ac, adjusted to 14.5% moisture

Materials and methods

Experimental Design:	Rectangular Lattice
Entries:	21 varieties
Repetitions:	3
Seeding:	May 11
Harvest:	Sep 1

Table 1: Varieties included in trial at Roblin, 2021

AAC Brandon	PT5013	PT7008	PT7011	PT7014
AC Carberry	PT4009	PT7012	PT4008	PT799
Glenn	PT7013	PT799	PT5017	PT7010
Parata	PT7007	PT4002	PT4004	PT5013
PT4006	PT261	PT5016	PT4008	PT7005

Agronomic information

Previous year's crop:	Canola
Soil Type:	Erickson Clay Loam
Landscape:	Rolling with trees to the east
Seedbed preparation:	Direct Seeded

Data collected	Date collected
Height:	Beginning of August
Lodging:	Aug 31
Yield:	Sep 1
Moisture:	Sep 1

Table 2: 2022 Fertility Information

	Available		Added	Type
N	104	lb/ac	85 lb/ac	46-0-0
P	47	ppm	15 lb/ac	11-56-0-0
K	642	ppm	-	-

Table 3: Pesticide Application

Crop stage	Date	Product	Rate
Pre-emerge	May 11	Heat	59 ml/ac
		Merge	400 ml/ac
		Glyphosate	670 ml/ac
In-crop	Jun 20	Dicamba	110 ml/ac
		Puma	270 ml/ac
Desiccant	Aug 25	Heat LQ	450 ml/ac
		Merge	400 ml/ac

SVPG Wheat Variety Evaluation 1 (CWRS) and Evaluation 2 (HY)

Project duration: May 2022 – August 2022
Objectives: Two tests to evaluate spring wheat varieties for the Saskatchewan Variety Performance Group
Collaborators: Mitchell Japp, Saskatchewan Agriculture

Background
(From the Saskatchewan Wheat Development Commission website): The Saskatchewan Variety Performance Group (SVPG) is an informal group made up of stakeholders who are interested in variety performance testing in Saskatchewan. SVPG has coordinated the post-registration regional performance testing of spring wheat, durum, barley, oats, and flax varieties since 2006. The data collected from these trials is entered into annual publications "Varieties of Grain Crops" and the Saskatchewan Seed Guide. In this project, SVPG collects data on priority traits including maturity, height, lodging, test weight, thousand kernel weight, protein, ergot and wheat midge.

Results
The average yield for spring wheat entries in Evaluation 1 (Canadian Western Red Spring) is shown in Figure 1. The average yield for entries in Evaluation 2 (High Yielding) is shown in Figure 2. The results are for one site-year only, and should be interpreted with caution. Consult a seed guide for multi-site-year data for available varieties.

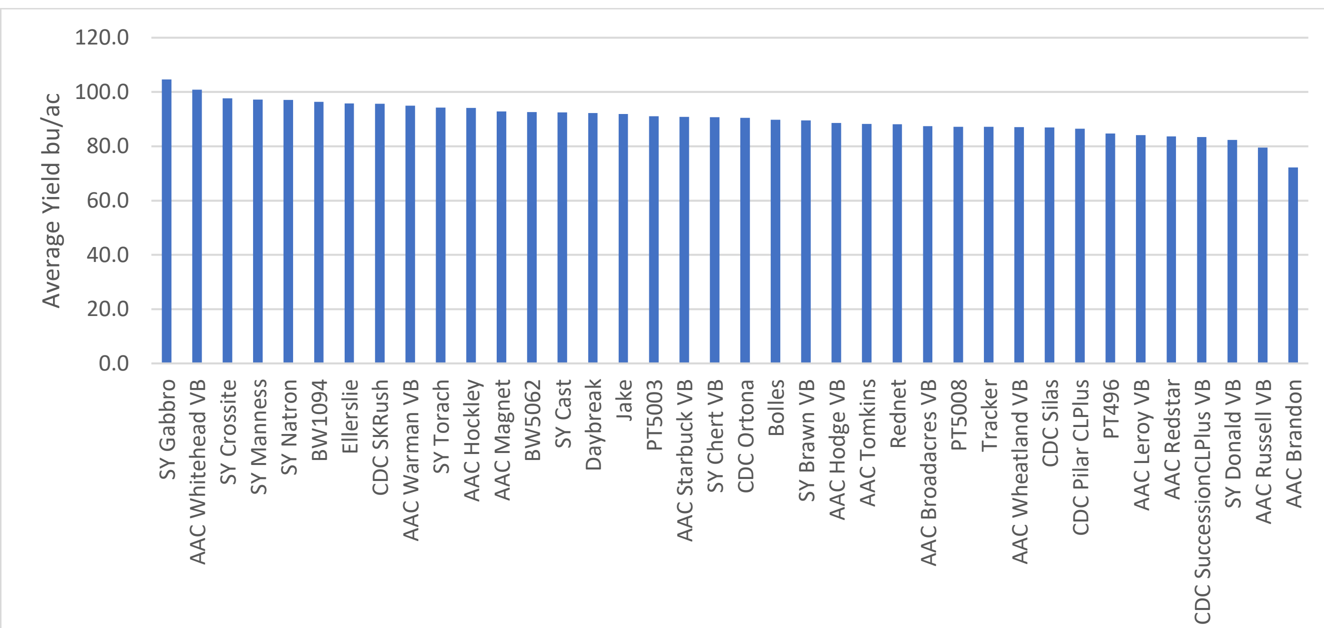


Figure 1: Wheat 1 average yield by variety in bu/ac, adjusted to 14.5% moisture

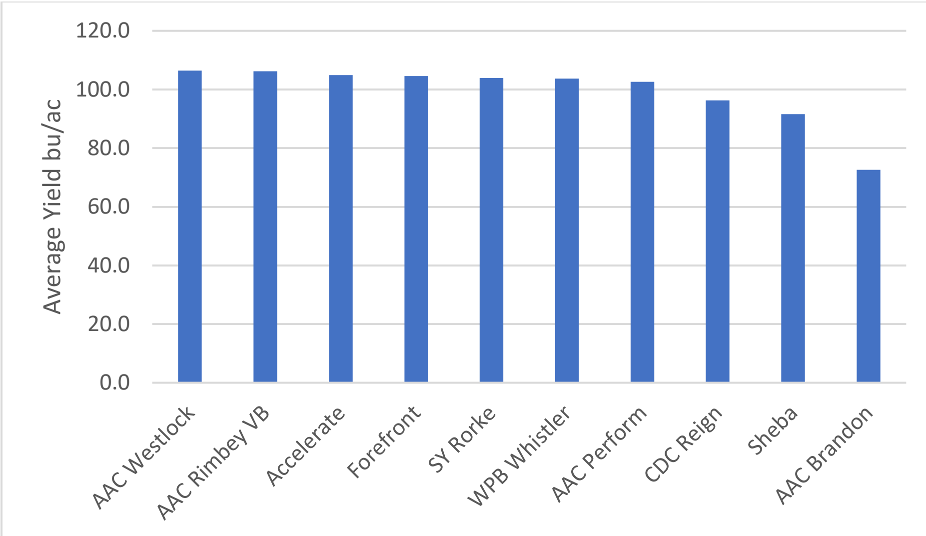


Figure 2: Wheat 2 average yield by variety in bu/ac, adjusted to 14.5%

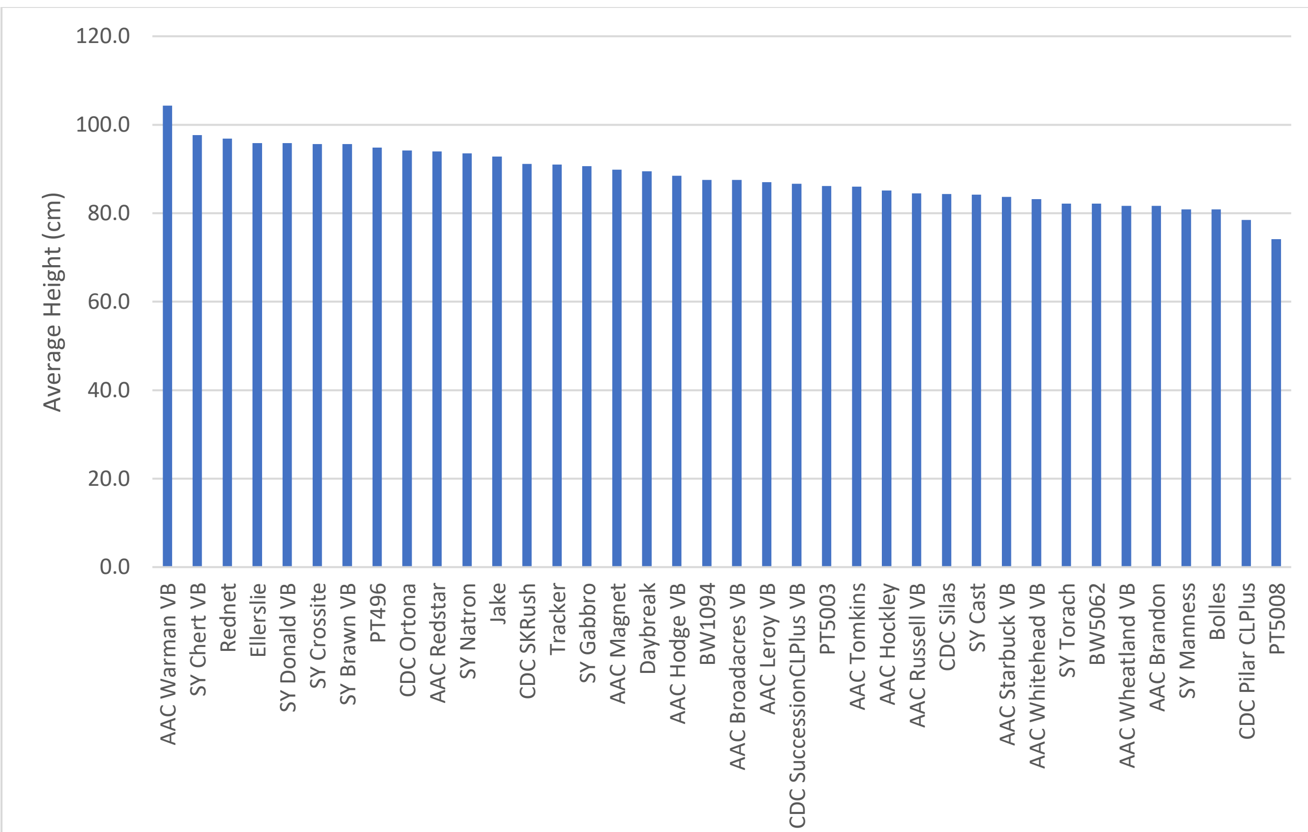


Figure 3: Wheat 1 average height (cm)

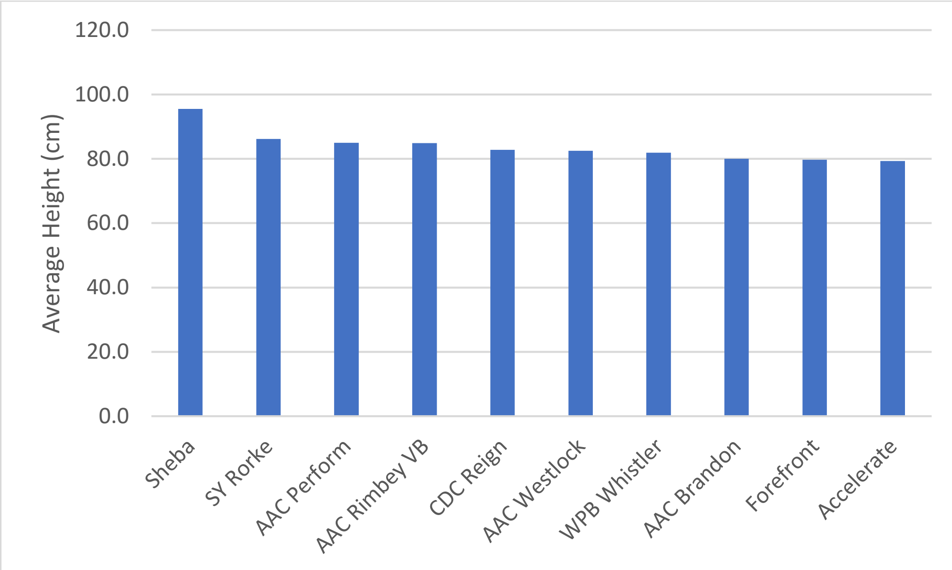


Figure 4: Wheat 2 average height (cm)

Materials and methods

Experimental Design:	Random Complete Block Design
Entries:	Wheat 1, 38 entries; Wheat 2, 10 entries
Seeding:	May 11
Harvest:	Wheat 1 Sep 1; Wheat 2 Sep 1

Table 1: Varieties included in SVPG Wheat Variety Evaluation 1

AAC RUSSELL VB	AAC MAGNET	PT5008	ELLERSLIE	CDC SKRUSH
SY GABRO	CDC SILAS	SY DONALD VB	SY TORACH	TRACKER
AAC BRANDON	SY CHERT VB	AAC TOMKINS	AAC LEROY VB	PT496
SY CROSSITE	CDC SUCCESSION CLPLUS VB	AAC WHEATLAND VB	JAKE	PT5003
CDC PILAR PLUS	AAC BROADACRES VB	BOLLES	AAC HODGE VB	BW1094
CDC ORTONA	AAC REDSTAR	REDNET	AAC STARBUCK VB	BW5062
DAYBREAK	AAC HOCKLEY	AAC WARMAN	SY NATRON	
SYCAST	AAC WHITEHEAD VB	SY MANNESS	SY BRAWN VB	

Table 2: Varieties included in SVPG Wheat Variety Evaluation 2

ACCERLATE	SHEBA	AAC WESTLOCK
AAC BRANDON	FOREFRONT	AAC PERFORM
AAC RIMBEY	CDC REIGN	SY RORKE
WPB WHISTLER		

Agronomic information

Previous year’s crop:	Canola
Soil Type:	Erickson Clay Loam
Landscape:	Rolling with trees to the east
Seedbed preparation:	Direct seeded

Data collected	Date collected
Maturity:	Aug 16 - 23
Height:	Aug 10
Lodging:	Sep 1
Yield:	Sep 1
Moisture:	Sep 1

Table 3: 2022 Fertility Information

	Available		Added	Type
N	104	lb/ac	85 lb/ac	46-0-0
P	47	ppm	15 lb/ac	11-56-0-0
K	642	ppm	-	-

Table 4: Pesticide Application

Crop stage	Date	Product	Rate
Pre-emerge	May 11	Heat	59 ml/ac
		Merge	400 ml/ac
		Glyphosate	670 ml/ac
In-crop	Jun 20	Dicamba	110 ml/ac
		Puma	270 ml/ac
Desiccant	Aug 25	Heat LQ	450 ml/ac
		Merge	400 ml/ac

Optimizing Nitrogen Fertility in Winter Wheat Varieties

(Adapted from a report by McKenzie Rowe, WADO)

Project duration:	Fall 2021 – August 2022
Objectives:	(1) Update the winter wheat fertility recommendations in the Manitoba Soil Fertility Guide. (2) Compare spring broadcast only application, to fall and spring split application of nitrogen for yield and protein. (3) Examine varietal differences in nitrogen use efficiency between Wildfire and Vortex.
Collaborators:	Ducks Unlimited Canada (Ken Gross, Alex Griffiths, Elmer Kaskiw), Manitoba Agriculture & Resource Development (John Heard)

Background

Following decades of extensive work in winter wheat production in North America, many researchers and producers have begun to implement best management practices to obtain higher grain yield and improve profitability in the crop. Management practices presently being implemented to improve winter wheat production include; increasing seeding rate, application of starter fertilizer by banding during seeding, variety selection, pest control (Anderson, 2008) and split application, during planting in fall and at tillering or stem elongation in spring (Schulz et al., 2015).

Fertility management, especially for nitrogen and phosphorus, remains the integral part of the overall management package aimed at achieving higher yields in winter wheat (Halvorson et al. 1987). Recommended fertilizer management differs widely in winter wheat production, but the crop's nitrogen demand is correlated to yield potential and availability of moisture in dryland productions systems (Beres et al., 2018). Compared to spring wheat, winter wheat presents more challenges in development as a result of its higher nitrogen demand during the long vegetative phase, hence the reason why it requires 25 to 50% more N than spring wheat in the Prairies (Fowler et al., 1989).

Developing an ideal fertility management package would help counteract the escalating cost of production per unit area. There is still a knowledge gap on the rates, as well as timing of application of nitrogen fertilizer, particularly in Western Canada, that would result in improved yield without compromising the quality of grain and economic returns. Morris et al. (2018) suggested the implementation of adaptive use of nitrogen to help augment and improve nitrogen application rate decision making by farmers. Therefore, there is a great need to continue with research on the best management practices that can be availed to producers to improve economic returns in winter wheat production. Nitrogen is most often the focus of crop fertility in field studies. However, having a balanced approach and considering other essential nutrients, such as phosphorus, potassium, sulfur and micronutrients available in the soil, offers great yield potential when nitrogen needs of the crop are met. More efficient returns on investment potential can be achieved as fertility management is optimized.

Materials and Methods

This study was established in Arborg, Carberry, Melita and Roblin in the fall of 2021. The trial design consisted of two variety and 7 fertility treatments, replicated three times, that were laid out factorially in a complete randomized block design. The plots were seeded on September 16th, 2021, at a rate of 33 plants/ft^2 and a depth of 0.5-inches. A granular blend of fertilizer was applied to achieve 35lbs ac^{-1} of phosphorus, 60lbs ac^{-1} K was sideband on during seeding using MAP and potash, respectively. Specific treatment nitrogen rates were placed at 1.25-inch depth in a separate pass before seeding the wheat. The nitrogen treatments were balanced with the soils test results and the rate of MAP applied with the seed.

The plots were burned-off using Roundup (0.67L ac^{-1}) mixed with Heat LQ (37mL ac^{-1}). Bentazon (0.71L ac^{-1}) was applied on July 15, 2022, for in-crop weed control. Prosaro (325mL ac^{-1}) was applied on June 23, 2022, at early anthesis for Fusarium Head Blight protection. All plots were harvested on August 25, 2022. Data collected throughout the growing season included soil tests at time of seeding, emergence counts, lodging scores, heights, yield, grain moisture, test weight, and protein. Data was analyzed with Minitab 18.1 statistical software using a GLM ANOVA with Fishers Least Significant Difference at a 0.05 level of significance. A test for equal variance was used to determine if data could be combined.

Table 1a. Fall soil test results by site and fertilizer treatments for winter wheat in the 2021/2022 season

	Fall Soil Test Results (lbs/ac)			Producer Practice Application (All N applied in Spring)			Balance Practive Application Recommendations* (50% of N applied in Fall)		
	Melita	Roblin	Arborg	Melita	Roblin	Arborg	Melita	Roblin	Arborg
N	35	24	36	100	100	100	120	106	110
P	31	48	18	30	30	30	30	15	35
K	132	61	11	0	0	0	0	33	60
S	42	29	20	0	0	0	0	0	0
Zn	0.45	0.64	0.12	0	0	0	0.09	0	0.40

*Balance application practice based on recommendations from the Western Ag Professional Agronomy Laboratory

Treatments

Fertilizer treatments:

- **Producer practice**: 100 lbs of nitrogen (urea plus agrotain) per acre applied in spring and 30 lbs phosphorus banded at seeding in fall and,
- **Balanced fertility practice:** Nitrogen was applied as per Western Ag recommendations based on soil test results, and application was split with 50% N banded at seeding and the other 50% N (urea plus Agrotain) broadcasted in spring. In addition, site specific P, K, S, and micronutrient recommendations were applied.

Plot Treatments:

1. Wildfire – Highest yielding winter wheat on the market
2. Vortex – New Emerson replacement with great disease resistance and winter hardiness

Subplot Plot

1. Check – No fertility except starter phosphorus
2. 60 Kg ha^{-1} nitrogen, split 50:50
3. 90 Kg ha^{-1} nitrogen, split 50:50
4. 120 Kg ha^{-1} nitrogen, split 50:50
5. 150 Kg ha^{-1} nitrogen, split 50:50
6. 180 Kg ha^{-1} nitrogen, split 50:50
7. 120 Kg ha^{-1} nitrogen all applied in spring

Fall nitrogen treatments used a 50/50 blend of ESN and urea while spring treatments were broadcasted urea that was treated with Agrotain. All 5 split applications had 50% of the rate being applied in the fall, and 50% of the rate being applied in the following spring. All spring applications were applied on April 4th, 2022. The spring nitrogen application of 120kg ha^{-1} is the currently producer fertility practice when growing winter wheat.

Each site where this trial was grown used slightly different agronomic practices and had different growing conditions which are outlined in the following Table 1b.

Table 1b. Agronomic practices and Description of Sites in the 2022 Ducks Unlimited Winter Wheat Fertility Trial in Melita, Roblin, and Arborg.

Location	Melita	Roblin	Arborg
Cooperator	WADO	PCDF	PESAI
Legal	SW22-3-27W1	NE20-25-28W1	River Lot-37-22-02E
Rotation (2 yr.)	2020: S. Wheat 2021: Liberty Link Canola	2020: Oat Silage 2021: Round Up Ready Canola	2021: Liberty Link Canola
Soil Series	Waskada Loam	Erickson Clay Loam	Heavy Clay
Soil Test Done? (Y/N)	Yes	Yes	Yes
Field Prep	None	None	None
Stubble	Yes. LL Canola	Yes. RR Canola	Yes. LL Canola
Burn off	Yes	Yes	None
(Date/Rate per acre/Products)	Sep. 10 - Round Up (0.67L/ac) + Heat LQ (20mL/ac)	Sep. 16 - Round Up (0.67L/ac) + Heat LQ (37mL/ac) + Merge (0.4gal/ac)	
Soil Moisture at Seeding	Good	Dry	Good
Seed Date	10-Sep	16-Sep	14-Sep
Seed depth (Inches)	0.5	0.5	0.5
Seeder (drill/planter?)	Air Drill	Disc Drill	Disc Drill
Errors at seeding	None	None	None
Topdressing Date	04-Apr	End of May	06-Apr
Herbicides: (Date, Rate/ ac, Name)	May. 27 - Achieve (0.2L/ac) + Turbocharge (0.5%) + Mextrol (0.5L/ac)	July 15 - Bentazon (0.105gal/ac)	Sep. 22 - Pardner (480mL/ac)
Fungicides	Jun. 3 - Prosaro (325mL/ac)	None	Jun. 30 - Prosaro (325mL/ac)
Insecticides	None	None	Matador (34mL/ac)
Harvest Date	12-Aug	25-Aug	17-Aug
Total Precipitation (Seeding to Harvest)	369mm	437mm	617mm

Results and Discussion

Variety use was found to have a significant ($P < 0.001$) effect on wheat yield at the Roblin trial site in 2022 (Table 2). Wildfire winter wheat produced the highest yield at that site and was significantly different than the yield of Vortex at Roblin. Across the two site years, Wildfire winter wheat produced the greatest average yield, and this yield was significantly ($P < 0.001$) different from that of Vortex. Winter wheat variety significantly influenced grain protein content at the Roblin and Arborg sites in the 2021/2022 growing season. At the Roblin site, protein content of Vortex (12.3%) was significantly ($P < 0.001$) greater than that of Wildfire (11.4%). At the Arborg site, protein content of Vortex (13.4%), again, was significantly ($P < 0.001$) greater than the protein of Wildfire (12.8%). Wildfire resulted in the lowest average grain protein content at the Roblin and Arborg sites, as well as the Melita site, though protein was not found to be significant at that site. This indicates a potential protein content disadvantage of this variety in Manitoba compared to the other variety used in this trial. The data for grain protein content was not able to be combined and analyzed for the Roblin and Arborg sites as the yield was. Test weight significantly varied across the two varieties at the Melita and Arborg sites. At these sites, the greatest average test weight was observed from Vortex winter wheat.

Fertilizer management practice had a significant influence on grain yield at the Melita and Roblin sites. In Melita, winter wheat grown with the current producer fertility practice (100% N in spring) had a significantly ($P < 0.001$) greater average yield than winter wheat grown with a balanced fertility practice (50% N in fall). Also in Roblin, winter wheat grown with the current producer fertility practice (100% N in spring) had a significantly ($P < 0.001$) greater average yield than winter wheat grown with a balanced fertility practice (50% N in fall). At Roblin, the spring fertility yield (6515 kg ha^{-1}) was the greatest yield at that site, though was not significant from the that of balanced (50% N in fall) applications of 90, 120, and 150kg ha^{-1} of N. There was no significant effect of fertility on yield found at the Arborg site, but when that data is combined with Roblin's site data, there is a significant ($P < 0.001$) effect seen on yield. When Roblin and Arborg site years are combined, the balanced (50% N in fall) fertility practice of 15 kg ha^{-1} had the greatest yield (7351kg ha^{-1}), though it was not significantly different that the yield of the balanced fertility practices of 120 and 180kg ha^{-1}, or the current producer fertility practice of 120kg ha^{-1} applied in the spring. Significant effects of fertility practice on winter wheat grain protein content were observed at the Melita and Roblin sites, but not on the winter wheat grown in Arborg. Winter wheat grown at the Roblin and Melita sites, were found to have significantly ($P < 0.001$) higher grain protein contents (12.3% and 12.7%) using the current producer fertility practice (120lbs ac of N in the spring) than using balanced fertility practices. Fertility management practice had a significant influence on grain test weight at the Roblin site and the Arborg site. In Roblin, the test weight of grain grown under the check rate of fertilizer (no added N) was significantly ($P = 0.005$) higher (70.5kg hL^{-1}) that the other fertility practices but was not significantly different from the balanced fertility practices of 60 and 90kg ha^{-1}. In Arborg, the test weight of grain grown under the balanced fertilizer practice of 60lb ac^{-1} was significantly ($P < 0.001$) higher (73.1kg hL^{-1}) that the other fertility practices but was not significantly different from the balanced fertility practice of 90lbs ac^{-1}. However, when data from Roblin and Arborg sites was combined and analyzed, no significant influence of fertility management practice on winter wheat grain test weight or protein content was observed.

No significant variety and fertility practice interactions (variety x fertility) were observed at the Melita site, but there were significant interactions seen individually in Roblin and in Arborg. No significant yield differences were observed between fertility practices for Wildfire and Vortex winter wheat varieties over three site years. When Roblin and Arborg site data was combined and analyzed, Wildfire grown with the current producer fertility practice (100% N in spring) was found to have a significantly ($P = 0.037$) higher yield (7476kg ha) than other fertility practices, but it was only significantly different than the yield of four other treatments in the trial. In Arborg, the protein content of Vortex grown under the check rate of fertilizer (no added N) was significantly ($P = 0.022$) higher (13.8kg hL^{-1}) that the other fertility practices interactions but was not significantly different from Vortex grown with a balanced fertility practice of 180kg ha^{-1}. At the Roblin site, Vortex winter wheat grown under balanced fertility practice (e150kg ha^{-1}) resulted in the greatest average test weight (70.9 kg hL^{-1}), though this test weight was only significantly different from that of four other treatments. Finally, at the Arborg site, Vortex winter wheat grown under balanced fertility practice (90kg ha^{-1}) resulted in the greatest average test weight (73.6 kg hL^{-1}), though this test weight was not significantly different from that Vortex grown with the balances fertility practices of 120 and 150kg ha^{-1}, or Wildfire grown with 60kg ha^{-1} balanced fertility practice.

Overall, results from the 2022 growing season indicate that yields of two winter wheat varieties grown in Manitoba respond better to the current producer fertility practice (100% N in spring) in some areas, and in other areas respond better to balanced fertility programs. Additionally, yield results from the Arborg site demonstrate a potential yield benefit of a balanced fertility program, as wheat grown under a balanced fertility program at this site yielded significantly higher than wheat grown under a current producer fertility program. Arborg also received more moisture during the growing season than the other two sites did. Winter wheat protein content was not demonstrated to be more or less influenced by variety or fertility program in the 2022 growing season. This could be explained by the drought conditions faced this year, that could have resulted in protein content results not fitting in a particular trend. It was also difficult to find a pattern when looking at test weight; at some sites test weight was higher in balanced fertility programs, then at a different site it was higher under the current producer practice. Environmental conditions seemed to influence the characteristics of the two varieties of winter wheat under the different fertility practices. Also, grain protein content and test weight across the sites were not able to be combined then analyzed because the values were too variable. This implies that the geographical area could also be a factor affecting the performance of the winter wheat. Continued field study is necessary to further evaluate the performance of new winter wheat varieties under fertility management strategies, and to effectively develop fertilizer management recommendations that winter wheat producers in different areas of the province can implement in their production systems. The table of results discussed can be found in the table below.

Figure 1. The winter wheat nitrogen optimization trial located at Melita in 2022. Differences in treatments are easily seen.

Table 2. Results including yield, protein, and test weight from the 2022 Ducks Unlimited Winter Wheat Fertility Trial in Melita, Roblin, and Arborg.

Treatment			Melita Yield (kg ha^{-1})	Melita Protein (%)	Melita Test Wt. (kg hL^{-1})	Roblin Yield (kg ha^{-1})	Roblin Protein (%)	Roblin Test Wt. (kg hL^{-1})	Arborg Yield (kg ha^{-1})	Arborg Protein (%)	Arborg Test Wt. (kg hL^{-1})	Arborg & Roblin Combined* Yield* (kg ha^{-1})
Variety	Wildfire	1	5266	10.7	77.5**b**	6232**a**	11.4**b**	68.40	8185	12.8**b**	71.2**b**	7195**a**
	Vortex	2	5053	10.8	78.5**a**	5731**b**	12.3**a**	69.50	7803	13.4**a**	73.0**a**	6767**b**
Fertility	check	1	3031**f**	10.2**c**	77.5	5034**c**	11.0**c**	70.5**a**	7646	13.1	72.2**c**	6340**c**
	60	2	4366**e**	10.1**c**	78.0	5706**b**	11.0**c**	69.9**a**	8030	12.9	73.1**a**	6868**b**
	90	3	4844**d**	10.4**bc**	77.5	6005**b**	11.8**b**	70.1**a**	7808	13.0	73.0**ab**	6906**b**
	120	4	5312**c**	10.5**bc**	77.9	6042**b**	12.0**b**	68.4**abc**	8180	12.9	72.3**bc**	7111**ab**
	150	5	5799**b**	10.5**bc**	78.5	6507**a**	11.9**b**	69.6**ab**	8195	13.2	71.6**cd**	7351**a**
	180	6	5955**b**	10.9**b**	78.3	6065**ab**	12.3**ab**	67.8**bc**	8056	13.5	70.8**d**	7060**ab**
	Spring120	7	6810**a**	12.3**a**	78.1	6515**a**	12.7**a**	66.5**c**	7948	13.2	71.7**c**	7232**ab**
Variety x Fertility		1,1	3230	10.1	77.0	5386	10.6	70.4**ab**	8386	12.4**f**	71.7**cd**	6886**bcd**
		1,2	4532	10.1	77.6	5800	10.5	70.1**ab**	8109	12.6**ef**	72.9**ab**	6955**abcd**
		1,3	5192	10.4	76.6	6578	11.0	69.9**ab**	8155	12.7**def**	72.4**bc**	7367**ab**
		1,4	5525	10.5	77.3	6028	11.6	66.3**cd**	8505	12.6**ef**	71.3**de**	7266**abc**
		1,5	5740	10.5	78.4	6648	11.4	68.3**abc**	8295	13.0**cde**	69.9**f**	7472**a**
		1,6	6095	10.8	78.0	6188	12.1	66.1**cd**	7700	13.3**bc**	69.8**f**	6944**abcd**
		1,7	6545	12.3	77.3	6999	12.2	67.9**bcd**	7953	13.2**bcd**	70.4**ef**	7476**a**
		2,1	2831	10.3	77.9	4683	11.4	70.5**ab**	6906	13.8**a**	72.7**abc**	5795**e**
		2,2	4199	10.2	78.4	5612	11.4	69.6**ab**	7950	13.3**bc**	73.3**ab**	6781**cd**
		2,3	4495	10.5	78.5	5431	12.6	70.3**ab**	7460	13.3**bc**	73.6**a**	6446**d**
		2,4	5099	10.5	78.4	6056	12.3	70.5**ab**	7856	13.2**bc**	73.3**ab**	6956**abcd**
		2,5	5857	10.5	78.6	6365	12.5	70.9**a**	8095	13.4**abc**	73.3**ab**	7230**abc**
		2,6	5815	11.1	78.6	5942	12.5	69.4**ab**	8412	13.6**ab**	71.8**cd**	7177**abc**
		2,7	7076	12.3	78.9	6030	13.1	65.1**d**	7943	13.2**bc**	73.0**ab**	6987**abcd**
P-Values	Variety		0.074	0.465	**<0.001**	**<0.001**	**<0.001**	0.064	0.065	**<0.001**	**<0.001**	**<0.001**
	Fertility		**<0.001**	**<0.001**	0.251	**<0.001**	**<0.001**	**0.005**	0.676	0.060	**<0.001**	**<0.001**
	V x F		0.132	1.000	0.599	0.110	0.384	**0.025**	0.108	**0.022**	**0.011**	**0.037**
	CV%		7.2	4.7	1.01	6.5	3.8	2.6	7.46	2.34	0.91	7.19

Values followed by the same letter are not significantly different by Fisher's mean separation method at 95% confidence.

*Does not include Melita site

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Horticulture Trials

Fruit Demonstration

Established: May 2009
Objectives: To demonstrate varieties of fruits being developed by the University of Saskatchewan
Collaborator: PCDF

Background

Dwarf sour cherries are not a native crop to the Canadian Prairies. They are the product of a number of crosses were initially begun by Dr. Les Kerr of the University of Saskatchewan by crossing a cold hardy cherry from Siberia, *Prunus fruiticosa,* with a sour cherry originating in Europe (brought over by settlers) by the name of *Prunus cerasus.* Since then the development has continued by incorporations of other cherries and by the use of dwarfing root stalks. The advantage of the dwarfing root stalk is that it forces earlier fruiting from the plant and it also creates a more workable tree when harvesting, for both manual and mechanical pickers. Dwarf sour cherries constitute a very typical "cherry pie filling" cherry.

Figure 1: a) dwarf sour cherries (photo credit); b) haskap berries (photo credit).

The haskap berry was introduced to Canada around 1967 and now grows across the country, thanks to new varieties developed by the University of Saskatchewan Fruit Program. The berries are similar in tast and texture blueberry, with a tartness closer to raspberry. The tartness makes them excellent for baking. Haskap plants attract fewer pests than many other prairie fruit crops and require little maintenance. Further, the crop thrives in cold climates, making it a natural fit for the Canadian prairies. Haskap is one of the first berries to ripen, and pickers can enjoy the berry beginning in the mid-June.

Birds are a problem for both fruits and appropriate measures must be taken to prevent the loss of berries.

Results

A bird net was erected over the sour cherry and haskap plants in late 2019, resulting in much higher yield results for haskaps in 2020. Sour cherries tend to yield more biennially (that is, yield are higher every other year), so 2020 was a lower year than 2019. A comparative chart below shows successive yields since 2016.

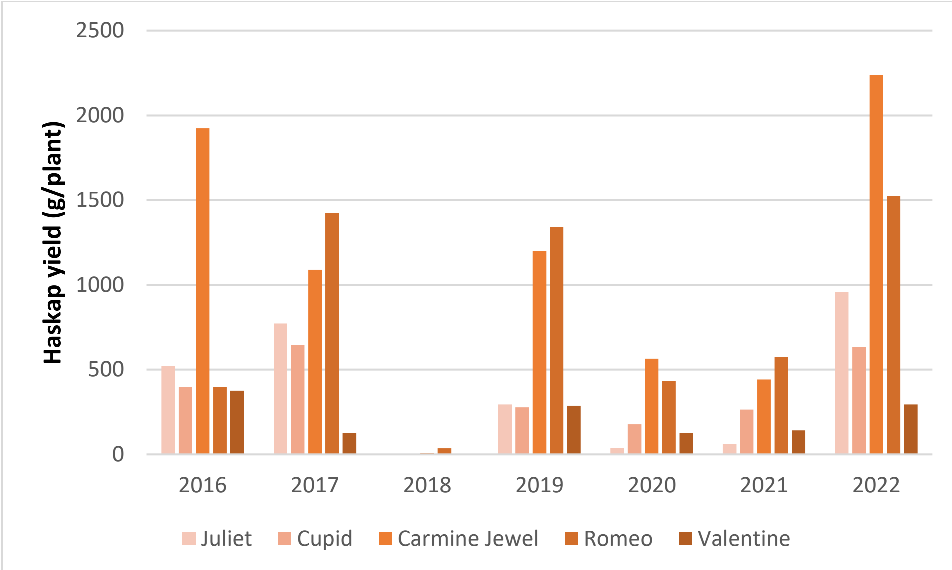

Figure 1: Roblin Sour Cherry Performance 2016-2022 (lb/plant)

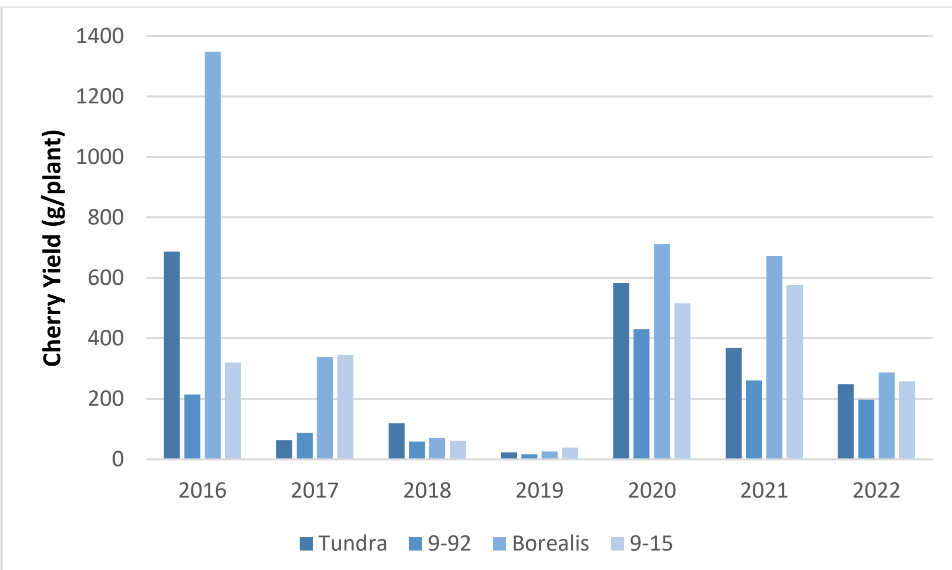

Figure 2: Roblin Haskap Performance 2016-2022 (lb/plant)

Materials and methods

Entries:	4 Haskap varieties; 5 Dwarf Sour Cherry varieties
Agronomic info	
Soil Type:	Erickson Loam Clay
Landscape:	Rolling with trees to the east
Planted:	Jun 2009
Fertilized:	Spring 2021
Pruned:	Spring 2019

Table 1: Dwarf Sour Cherry and Haskap Varieties

Haskap	Cherry
Borealis	Valentine
Tundra	Romeo
9-92	Juliet
9-15	Carmine Jewel
	Cupid

PCDF

Parkland Crop
Diversification
Foundation

Manitoba's diversification centres are funded in part by the Canadian Agricultural Partnership.

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