Manitoba Crop Diversification Centre

2024 ANNUAL REPORT

Manitoba Crop Diversification Centre (MCDC)

Manitoba Diversification Centres are non-profit, applied research organizations directed by local producers and industry. The province's four centres conduct applied research and demonstrations on crops, technology and best management practices. Diversification Centres do applied research and demonstrations on crops, technology and best management practices. Their work advances primary production while supporting sustainable agronomic solutions that benefit local communities and supports the growth of agri-food and agri-product processing.

The centres' goals:

- Increase the profitability, sustainability and adaptability of farms.
- Speed up adoption or commercialization of research innovations at the farm level.
- Facilitate the adoption of technical innovations or practices from outside the province/country.
- Improve the overall growth of the agriculture, agri-food and agriproduct sector.

Transfer of technology is a priority, ensuring producers and industry have access to project results, technical information and emerging opportunities through displays, annual reports, field days and tours.

The Manitoba Crop Diversification Centre (MCDC) marked its 31st anniversary in 2023. The MCDC was established between the Government of Canada, the Government of Manitoba, and Manitoba Horticulture Productivity Enhancement Centre (MHPEC) in 1993. The Centre's mission is to facilitate the development and adoption of science-based solutions for crop production. MCDC's strategic areas include sustainable irrigation, sustainable potato production, improving the environmental sustainability of intensive crop production, and crop diversification. MCDC's activities include testing and demonstrating current irrigation technologies and crop performance field tests; forages and crop-livestock systems; cover crops and regenerative agriculture projects. The Centre is located at the north-east corner of the junction of highway number 1 and number 5 in Carberry, Manitoba.

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The 2024 Growing Season at MCDC – Planting Year in Review

Weather Conditions:

The 2024 growing season at the Manitoba Crop Diversification Centre (MCDC) in Carberry was marked by variable moisture conditions and fluctuating temperatures. The spring began with relatively dry soils following snowmelt, with below-normal runoff levels. However, timely April showers replenished surface and subsoil moisture. May brought intermittent rain showers and cooler temperatures, which slowed early crop development but provided necessary moisture for germination. Figure 1, 2, 3, and 4 illustrate seasonal temperature trends, precipitation levels, Growing Degree Days (GDD), and Corn Heat Units (CHU) recorded at MCDC throughout the growing season (May 1 to September 30, 2024).

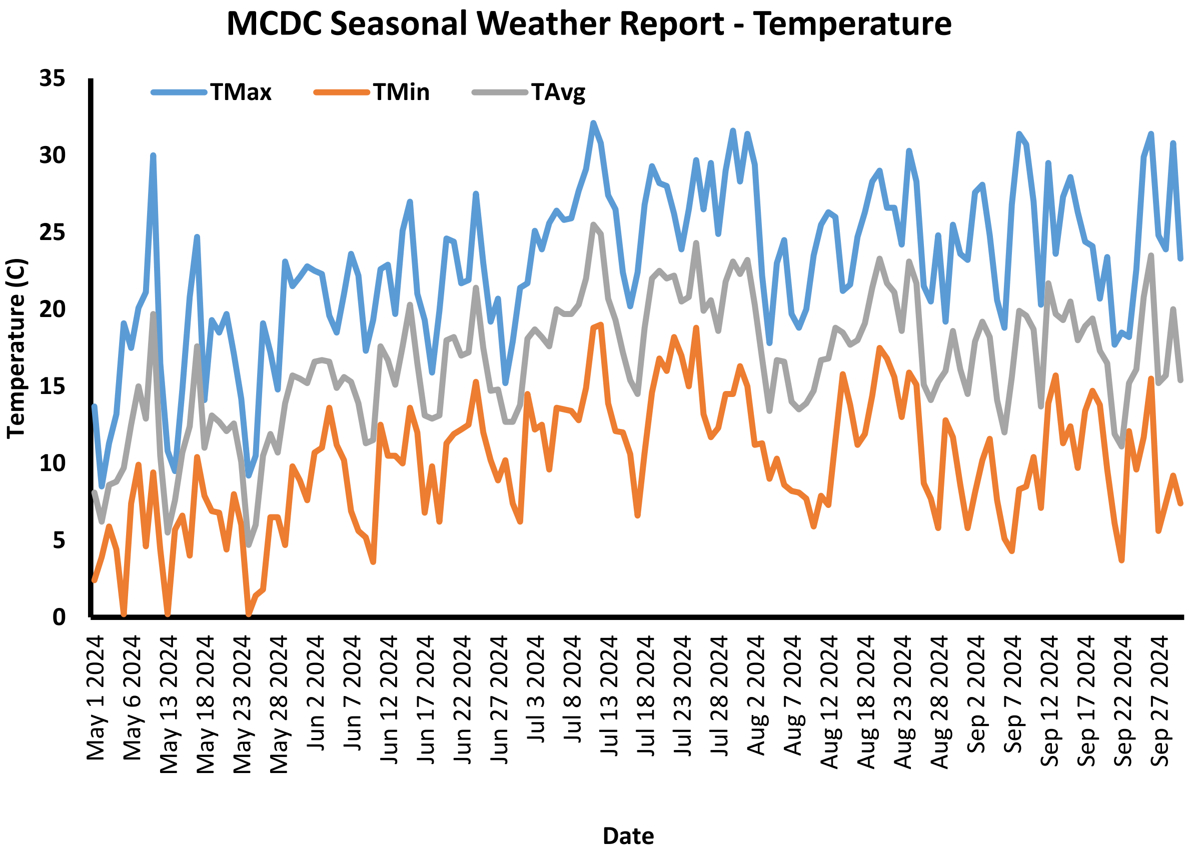


Figure 1: Temperature – 2024 Growing Season (MCDC)

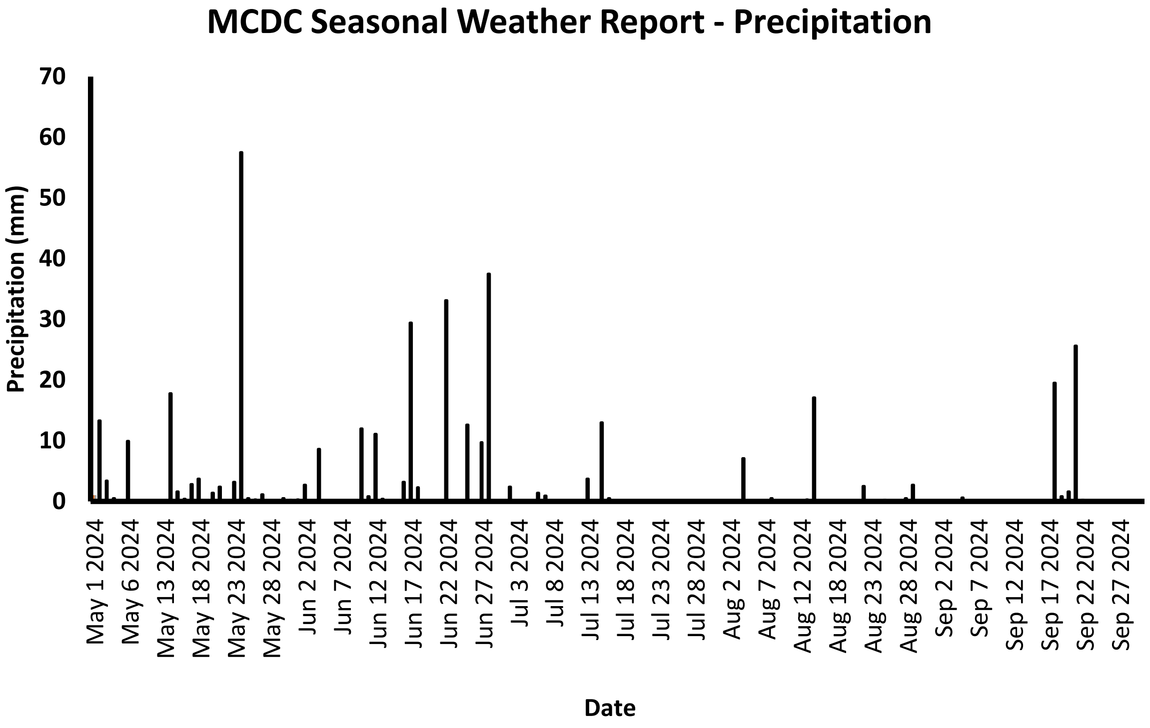


Figure 2: Precipitation – 2024 Growing Season (MCDC)

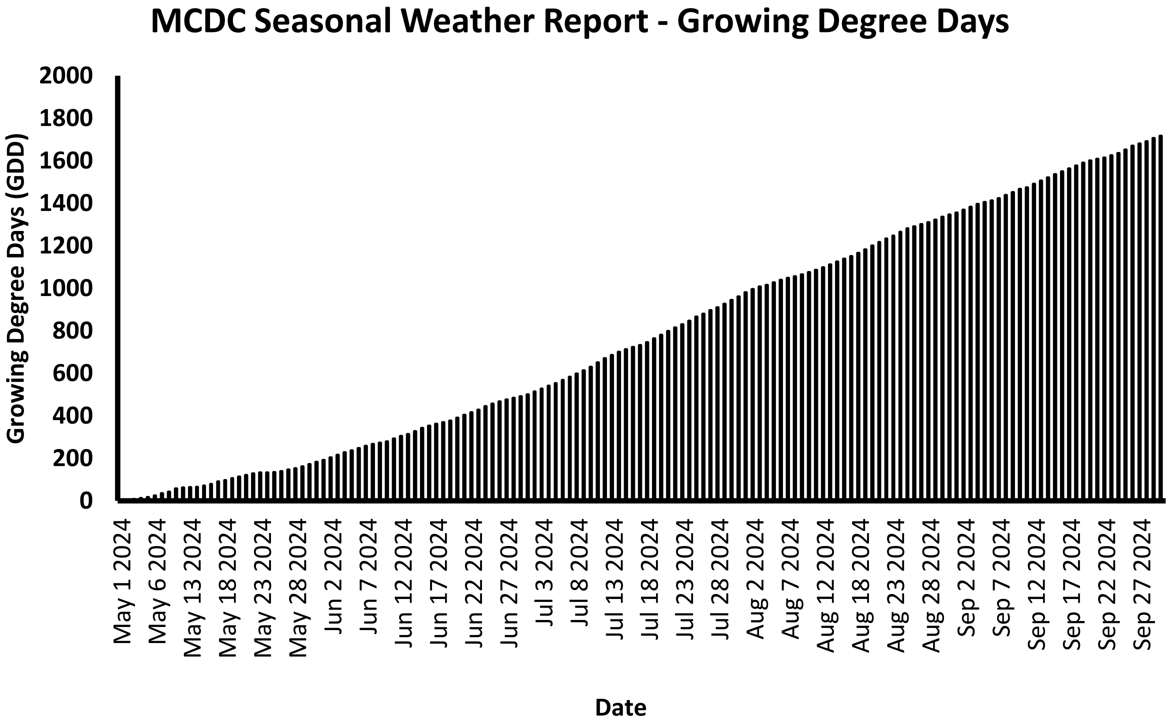


Figure 3: Growing Degree Days – 2024 Growing Season (MCDC)

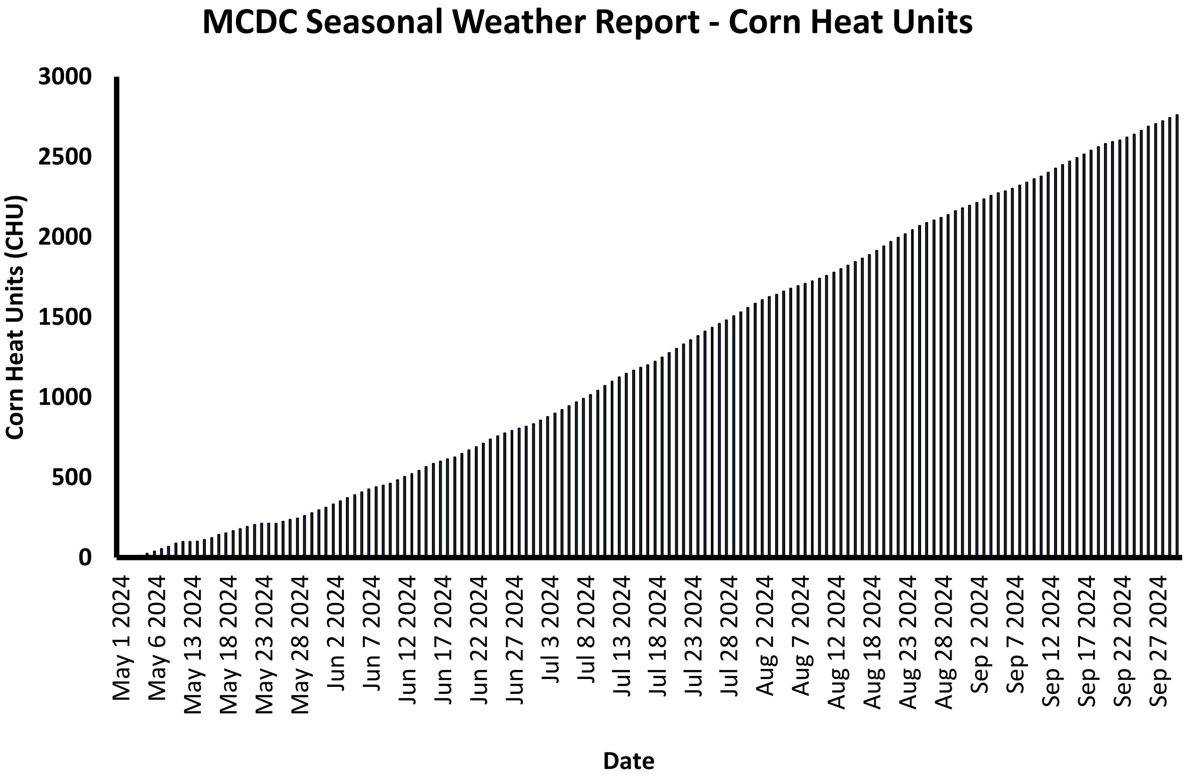


Figure 4: Corn Heat Units – 2024 Growing Season (MCDC)

The Table 1 reports the average and cumulative amount of different weather parameters recorded during the 2024 growing season.

Table 1: Weather Summary for Manitoba Crop Diversification Centre (MCDC)

From: May 01, 2024 To: September 30, 2024

Weather Parameters	**T_{Max}**	**T_{Min}**	**T_{Avg}**	**Precipitation (mm)**	**GDD**	**CHU**
Average	22.9	10.1	16.5	2.6	776.3	1261.3
Total				385.8	1715.7	2761.4

June experienced cool and rainy conditions, delaying weed control and impacting crop emergence. However, well-spaced rainfall events contributed to overall crop health. July temperatures were above normal, accompanied by average precipitation levels, creating favorable conditions for cereals and oilseeds. August saw localized heavy rain and wind events, leading to lodging in some crops and making harvest more challenging. September remained relatively dry, allowing for steady harvest progress. Overall, the combination of early-season moisture and well-timed rains contributed to strong yields across several crop categories at MCDC.

Spring Seeding (May 2024):

Seeding operations at MCDC began in early May. While peas and cereal crops were seeded on schedule, many producers delayed planting oilseeds, such as canola and soybeans, until late May to mitigate flea beetle pressure and ensure warm soil temperatures for rapid emergence. The moisture conditions at seeding were favorable, leading to good germination and strong plant stands.

Harvest (Fall 2023):

Harvest at MCDC commenced in August with the cutting of winter cereals and annual forages. Rain and wind events in August caused lodging in some fields, making harvest more challenging. Despite these setbacks, dry September conditions helped facilitate a smoother harvest for most crops. Pre-harvest applications were used where necessary, although their effectiveness was reduced in lodged fields. Post-harvest management focused on controlling winter annuals and preserving soil moisture for the next season.

Pest and Disease Impact:

Crop diseases were more prevalent in 2024 due to higher moisture levels. Canola was particularly affected by verticillium stripe, sclerotinia, and blackleg. Fungicide applications were strategically timed to manage disease pressure, especially in dense crop canopies following rainfall events. Grasshopper pressure was lower than in previous years, while flea beetle infestations were moderate, necessitating targeted insecticide applications in some canola fields.

Crop Yields at MCDC:

Winter Cereals:

- Winter wheat yields ranged from 60 to 90 bu/acre, with good grain quality.
- Fall rye yields were strong, ranging from 80 to 110 bu/acre.

Spring Cereals:

- Spring wheat yields ranged from 60 to 95 bu/acre, with protein levels between 13.5% and 15%.
- Barley yielded between 80 and 120 bu/acre, with good quality.
- Oat yields were excellent, ranging from 110 to 180 bu/acre, with test weights between 37 and 44 lbs/bushel.

Corn:

- Grain corn yields ranged from 120 to 180 bu/acre, with an average moisture content of 15% to 24% at harvest.

Oilseeds:

- Canola yields were variable, ranging from 25 to 65 bu/acre, with an average near 45 bu/acre.
- Flax yields averaged between 25 and 30 bu/acre.
- Sunflower oilseed yields ranged from 1,200 to 2,000 lbs/acre, with 39% of the crop harvested by late September.

Pulses & Soybeans:

- Field pea yields ranged from 40 to 60 bu/acre, averaging 45 bu/acre.
- Soybean yields ranged from 34 to 65 bu/acre, with a provincial average of approximately 40 bu/acre.
- Dry edible bean yields ranged from 500 to 3,000 lbs/acre, with variable quality in some regions due to heavy September rainfall.

Forages & Livestock:

- Forage species conditions were generally good at MCDC, benefiting from adequate early-season moisture.
- By mid-August, dry soils slowed crops regrowth, but timely rainfall allowed for recovery.

Summary:

The 2024 growing season at MCDC was characterized by early moisture availability, moderate disease pressure, and generally strong crop yields. While lodging in some fields presented harvest challenges, overall grain and forage production was favorable. The season highlighted the importance of strategic management practices in response to variable weather patterns, ensuring successful crop production at MCDC.

Manitoba Crop Variety Evaluation Team (MCVET) Trials

Background:

The Manitoba Crop Variety Evaluation Team (MCVET) serves as an independent third party crop variety evaluation program for producers and the seed industry in Manitoba. MCVET strives to provide producers with the most recent yield data available not only in their own growing region but throughout the whole province. MCVET collects data on an average of 23 major/minor crops types over numerous locations annually. The number of locations is dependent upon the crop type's adaptation to areas of Manitoba. All sites use a standardized protocol and are inspected by MCVET.

Agronomic, disease and some of the quality data presented in Seed Manitoba is not collected annually as part of the MCVET program. This data is from the variety registration trials tested regionally across western Canada and is included in Seed Manitoba guide to complete the data package for each variety. Seed Manitoba guide printed and digital editions have been developed through partnership since the mid 1980's between the Manitoba Seed Growers' Association (MSGA), Manitoba Agriculture, and Farm Business Communications (FBC). Funding for the MCVET program is provided by Manitoba Agriculture, profit-sharing through FBC, sponsorship and in-kind trials provided by the seed industry. There is no entry fee for the MCVET crop variety evaluation program.

Annual planning of crop variety trials commences in January. Meetings are held to determine the number and types of variety trials and locations for the upcoming field season. Entry lists of new and current crop varieties are generated by a call for entries sent out at the end of February. Once the entry lists are generated plot randomizations are created to ensure varieties are randomly placed in replicated trials in the field. Entries are replicated three times to help decrease variation in soil topography, texture, fertility, or other factors that could bias the results.

Seed companies and breeding institutions ship bare seed to the co-operator who will be treating and packaging the seed as early as the end of March. Seed treatment used is reflective of the industry standard. The amount of seed that is packaged per entry is dependent upon plot size, germination, and thousand kernel weights. Plot size varies throughout province from 8 to 16 meters squared. Seed is shipped to trial co-operators the last week of April.

Plot randomizations, workbooks and protocols are sent to co-operators to ensure the trials will be managed properly. Trial protocols remind co-operators of important factors when conducting plots including site selection, seeding, maintenance, weed control, and harvest. For example when selecting a site, the co-operator must ensure the plots are at least 30 meters away from a tree line and the field area is level and uniform. The site should follow proper crop rotation so there are not volunteers of the same crop type and confirm no chemical residues that will affect the plots in the trial. Site selection in a producer field with the same crop type is most desirable; therefore, the field has been prepared with appropriate fertilizer and chemical regime as the surrounding crop.

Based on crop type and weather conditions, co-operators will plant the variety trial similar time to producers to ensure data will be relevant to the area. Once seeding is complete a tour of all trials is conducted at the start of July by Manitoba Agriculture staff to ensure the trials were properly planted, have a good stand, and early weed control has been performed. This early season tour allows co-operators to correct any issues with the trials before there is major impact to the trial. If there is a major problem, the trial will be terminated at that time.

Notes taken on stand establishment usually help when data is received at the end of the season to detect problems with plots or if there is variety specific problem (i.e seed vigor or germination). Plots severely affected may be treated as missing plots when the data is analyzed. A second tour is completed pre-harvest to determine if the trial was well maintained and to ensure there was no damage to the plots during herbicide application, weeds, or by wildlife. In crop types where phenotypic differences can be seen between varieties, such as awned and awnless varieties, staff verify varieties are located as per plot plan to ensure no seeding errors have occurred.

No fungicides are applied as the purpose of the variety trial is to measure genetic potential. Fungicides are not utilized on the trials as it is very difficult to determine the most appropriate time to apply the fungicide on 45 wheat varieties without introducing another source of variation to the results.

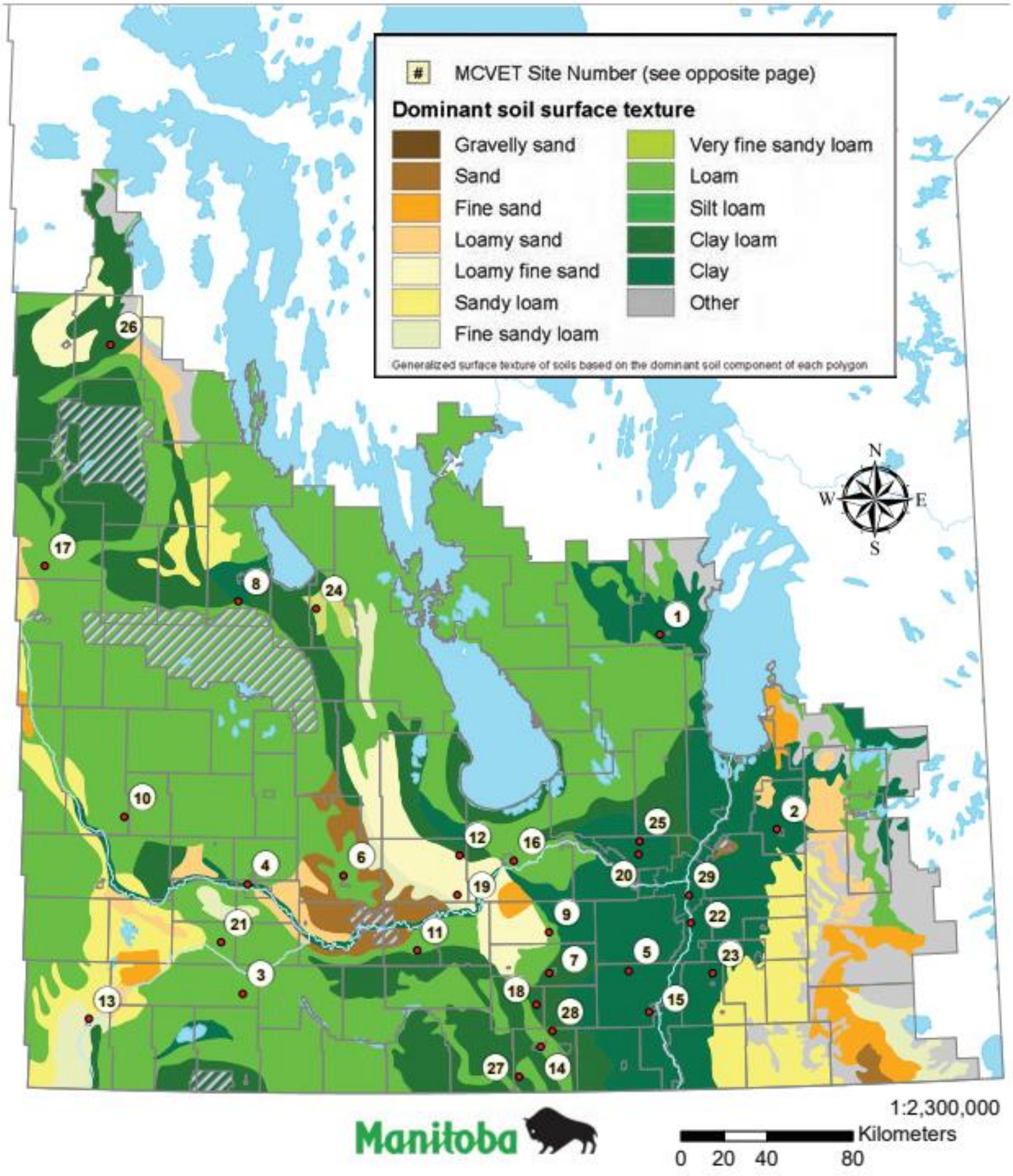
Plots are harvested once all varieties have matured. At harvest time, small plots are individually combined, bagged and tagged. Moisture is measured for each sample. Samples are cleaned and weighed in grams per plot or kilograms per hectare. Before the data can be analyzed the yield data is adjusted to the appropriate crop moisture to ensure all data is treated the same. Data is then converted into units that are understood by the producer (e.g., wheat yields are converted from grams/plot to bu/acre). Quality testing is performed on clean samples to determine protein for wheat or oil for oilseed crops.

The release of third party independent yield data for new crop varieties is critical for producers. Small plot variety evaluation trials require plots to be harvested, bagged, tagged, cleaned, moisture adjusted, unit conversion and quality testing. The larger the number of varieties in a trial the longer the time to process samples to obtain the final yield number accurately. Variety trial summaries can be found in the Seed Manitoba printed edition or digitally at www.seedmb.ca.

The Manitoba Crop Diversification Centre (MCDC) is one of the many contractors that are part of the Manitoba Crop Variety Evaluation Team (MCVET) trials program, which facilitates variety evaluations of many different crop types in this province. The purpose of the MCVET variety evaluation trials are to grow both familiar (check varieties) 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 aspects.

During the 2024 planting year, MCDC conducted MCVET trials on winter wheat, fall rye, flax, spring wheat, oats, barley, malting barley, field peas, corn, sunflowers and annual forages in Carberry. From each MCVET site across the province, yearly data is collected, combined, and summarized in the ‘Seed Manitoba’ guide. Hard copies are available at most Manitoba Agriculture and Ag Industry offices. Seed Manitoba guide and the websites www.seedinteractive.ca and www.seedmb.ca, provide valuable variety performance information for Manitoba farmers. Please refer to the Table 1 for plot information of all MCVET trials conducted at MCDC during the 2024 planting year.

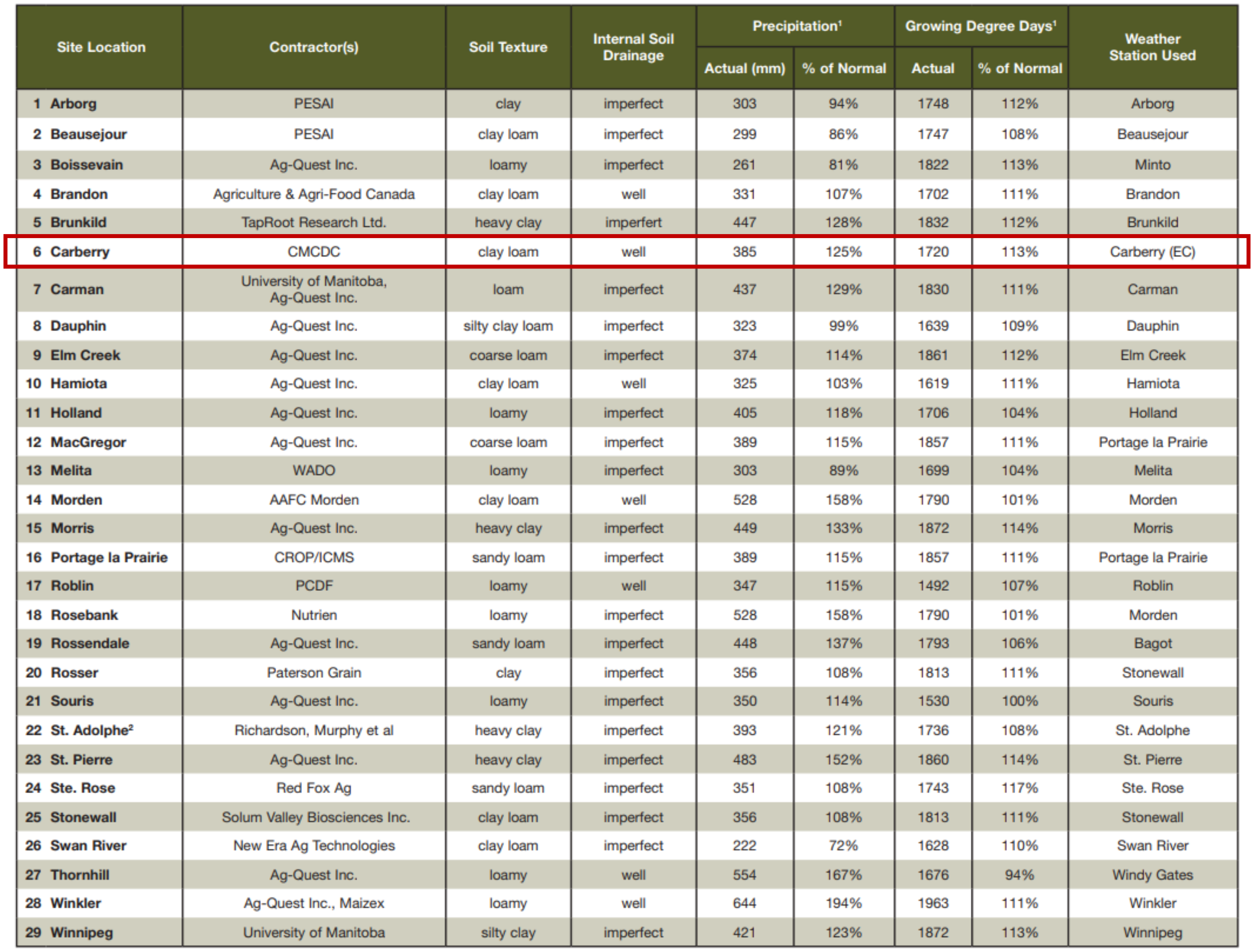
2024 LOCATIONS OF VARIETY EVALUATION TRIALS



Source: Seed Manitoba Guide, 2025

Site Characteristics

Manitoba Crop Diversification Centre, Carberry



Site Location	Contractor(s)	Soil Texture	Internal Soil Drainage	Precipitation[1]		Growing Degree Days[1]		Weather Station Used
				Actual (mm)	% of Normal	Actual	% of Normal	
1 Arborg	PESAI	clay	imperfect	303	94%	1748	112%	Arborg
2 Beausejour	PESAI	clay loam	imperfect	299	86%	1747	108%	Beausejour
3 Boissevain	Ag-Quest Inc.	loamy	imperfect	261	81%	1822	113%	Minto
4 Brandon	Agriculture & Agri-Food Canada	clay loam	well	331	107%	1702	111%	Brandon
5 Brunkild	TapRoot Research Ltd.	heavy clay	imperfert	447	128%	1832	112%	Brunkild
6 Carberry	CMCDC	clay loam	well	385	125%	1720	113%	Carberry (EC)
7 Carman	University of Manitoba, Ag-Quest Inc.	loam	imperfect	437	129%	1830	111%	Carman
8 Dauphin	Ag-Quest Inc.	silty clay loam	imperfect	323	99%	1639	109%	Dauphin
9 Elm Creek	Ag-Quest Inc.	coarse loam	imperfect	374	114%	1861	112%	Elm Creek
10 Hamiota	Ag-Quest Inc.	clay loam	well	325	103%	1619	111%	Hamiota
11 Holland	Ag-Quest Inc.	loamy	imperfect	405	118%	1706	104%	Holland
12 MacGregor	Ag-Quest Inc.	coarse loam	imperfect	389	115%	1857	111%	Portage la Prairie
13 Melita	WADO	loamy	imperfect	303	89%	1699	104%	Melita
14 Morden	AAFC Morden	clay loam	well	528	158%	1790	101%	Morden
15 Morris	Ag-Quest Inc.	heavy clay	imperfect	449	133%	1872	114%	Morris
16 Portage la Prairie	CROP/ICMS	sandy loam	imperfect	389	115%	1857	111%	Portage la Prairie
17 Roblin	PCDF	loamy	well	347	115%	1492	107%	Roblin
18 Rosebank	Nutrien	loamy	imperfect	528	158%	1790	101%	Morden
19 Rossendale	Ag-Quest Inc.	sandy loam	imperfect	448	137%	1793	106%	Bagot
20 Rosser	Paterson Grain	clay	imperfect	356	108%	1813	111%	Stonewall
21 Souris	Ag-Quest Inc.	loamy	imperfect	350	114%	1530	100%	Souris
22 St. Adolphe[2]	Richardson, Murphy et al	heavy clay	imperfect	393	121%	1736	108%	St. Adolphe
23 St. Pierre	Ag-Quest Inc.	heavy clay	imperfect	483	152%	1860	114%	St. Pierre
24 Ste. Rose	Red Fox Ag	sandy loam	imperfect	351	108%	1743	117%	Ste. Rose
25 Stonewall	Solum Valley Biosciences Inc.	clay loam	imperfect	356	108%	1813	111%	Stonewall
26 Swan River	New Era Ag Technologies	clay loam	imperfect	222	72%	1628	110%	Swan River
27 Thornhill	Ag-Quest Inc.	loamy	well	554	167%	1676	94%	Windy Gates
28 Winkler	Ag-Quest Inc., Maizex	loamy	well	644	194%	1963	111%	Winkler
29 Winnipeg	University of Manitoba	silty clay	imperfect	421	123%	1872	113%	Winnipeg

Source: Seed Manitoba Guide, 2025

MCVET Winter Wheat Variety Evaluation

Project duration: September 2023 – August 2024

Objectives: To evaluate the adaptation and performance of new and existing winter wheat varieties in regards to yield & quality potential.

Collaborators: Chami Amarasinghe (Former Innovation Specialist Crop – Manitoba Agriculture)

Anne Kirk (Crop Specialist Grains – Manitoba Agriculture)

Manasah Mkhabela (Climate Change Specialist – Manitoba Agriculture)

Seed Manitoba

MCVET Fall Rye Variety Evaluation

Project duration: September 2023 – August 2024

Objectives: To evaluate the adaptation and performance of new and existing fall rye varieties in regards to yield & quality potential.

Collaborators: Chami Amarasinghe (Former Innovation Specialist Crop – Manitoba Agriculture)

Anne Kirk (Crop Specialist Grains – Manitoba Agriculture)

Seed Manitoba

MCVET Flax Variety Evaluation

Project duration: May 2024 – October 2024

Objectives: To evaluate the adaptation and performance of new and existing flax varieties in regards to yield & quality potential.

Collaborators: Chami Amarasinghe (Former Innovation Specialist Crop – Manitoba Agriculture)

Daryl Rex (Research Trial Specialist – Manitoba Crop Alliance)

Megan House (Research Officer – University of Saskatchewan)

Ken Jackle (Field Research Technician – Crop Development Centre)

Seed Manitoba

MCVET Spring Wheat Variety Evaluation

Project duration: May 2024 – October 2024

Objectives: To evaluate the adaptation and performance of new and existing spring wheat varieties in regards to yield & quality potential.

Collaborators: Chami Amarasinghe (Former Innovation Specialist Crop – Manitoba Agriculture)

Anne Kirk (Crop Specialist Grains – Manitoba Agriculture)

Manasah Mkhabela (Climate Change Specialist – Manitoba Agriculture)

Seed Manitoba

MCVET Oats Variety Evaluation

Project duration: May 2024 – October 2024

Objectives: To evaluate the adaptation and performance of new and existing oats varieties in regards to yield & quality potential.

Collaborators: Chami Amarasinghe (Former Innovation Specialist Crop – Manitoba Agriculture)

Anne Kirk (Crop Specialist Grains – Manitoba Agriculture)

Seed Manitoba

MCVET Barley Variety Evaluation

Project duration:	May 2024 – October 2024
Objectives:	To evaluate the adaptation and performance of new and existing barley varieties in regards to yield & quality potential.
Collaborators:	Chami Amarasinghe (Former Innovation Specialist Crop – Manitoba Agriculture) Anne Kirk (Crop Specialist Grains – Manitoba Agriculture) Manasah Mkhabela (Climate Change Specialist – Manitoba Agriculture) Seed Manitoba

MCVET/CMBTC Malt Barley Variety Evaluation

Project duration:	May 2024 – October 2024
Objectives:	Evaluation of new and existing malt barley varieties in regards to yield and quality potential.
Collaborators:	Chami Amarasinghe (Former Innovation Specialist Crop – Manitoba Agriculture) Anne Kirk (Crop Specialist Grains – Manitoba Agriculture) Canadian Malt Barley Technical Centre (CMBTC) Manasah Mkhabela (Climate Change Specialist – Manitoba Agriculture) Seed Manitoba

MCVET Field Peas Variety Evaluation

Project duration:	May 2024 – October 2024
Objectives:	To evaluate the adaptation and performance of new and existing field peas varieties in regards to yield & quality potential.
Collaborators:	Chami Amarasinghe (Former Innovation Specialist Crop – Manitoba Agriculture) Dennis Lange (Crop Specialist Pulses – Manitoba Agriculture) Manitoba Pulse & Soybean Growers Seed Manitoba

MCVET Annual Forages Variety Evaluation

Project duration:	May 2024 – August 2024
Objectives:	To evaluate the adaptation and performance of new and existing annual forage varieties in regards to yield & quality potential.
Collaborators:	Chami Amarasinghe (Former Innovation Specialist Crop – Manitoba Agriculture) Shawn Cabak (Former Ag. Adaptation Specialist Livestock – Manitoba Agriculture) Manitoba Seed Growers Association Manitoba Beef Producers Seed Manitoba

Figure 1: Winter Weather Station Installed in MCVET Winter Cereals Trials at MCDC

Table 1. MCVET Trials Conducted at MCDC during the 2024 Planting Year

Crop type	**# of plots**	**Site**
Winter Wheat	32	Carberry
Fall Rye	32	Carberry
Flax	33	Carberry
Field Peas	66	Carberry
Spring Wheat	54	Carberry
Oats	33	Carberry
Barley	60	Carberry
Malting Barley		Carberry
Annual Forages	51	Carberry
Total plots	**361**	**Carberry**

Results:

The crop data collected from the MCDC site during the 2024 growing season is reported in the 2025 ‘Seed Manitoba’ guide. The hard copies of Seed Manitoba guide are available at Manitoba Agriculture offices, and can be accessed online at www.seedmb.ca. Please click the image below for the 2025 digital edition of Seed Manitoba Guide for results and recommendations from the Manitoba Crop Diversification Centre (MCDC).

SEED MANITOBA

2025 Variety Selection & Growers Source Guide

Compliments of:

Manitoba Agriculture

Manitoba Seed Growers' Association

the Manitoba Co-operator

www.seedmb.ca

Wheat Leaf Rust Evaluation in Manitoba

Project duration: September 2023 – August 2024

Objective: To evaluate and manage leaf rust in MCVET winter wheat and MCVET spring wheat varieties.

Collaborators: Chami Amarasinghe (Former Innovation Specialist Crop – Manitoba Agriculture)

Anne Kirk (Crop Specialist Grains – Manitoba Agriculture)

Debbie Miranda (Research Assistant, Agriculture and Agri-Food Canada – Modern, MB)

Seed Manitoba

Background:

Wheat leaf rust is a fungal disease caused by the pathogen Puccinia triticina. To evaluate and manage wheat leaf rust, following steps are followed:

Field Surveys and Monitoring:

Regular field surveys are conducted to monitor the presence and severity of wheat leaf rust. Various scouting methods may be employed, including visual inspections of plants, use of disease forecasting models, and remote sensing technologies.

Disease Identification:

Accurate identification of the rust pathogen is crucial. Laboratory analysis may be used to confirm the presence of Puccinia triticina.

Pathogen Races:

Understanding the races of the pathogen is important for selecting resistant wheat varieties. The race analyses are conducted to identify the predominant races in a given area.

Resistant Varieties:

Planting resistant wheat varieties is one of the most effective strategies for managing wheat leaf rust. Breeders work on developing and promoting varieties with genetic resistance to the specific races present in a region.

Fungicide Application:

Fungicides may be used as a preventative or curative measure, especially when environmental conditions are conducive to disease development. Timely application based on disease forecasting models can be an integral part of disease management.

Cultural Practices:

Crop rotation, adjusting planting dates, and other cultural practices can be employed to reduce the risk of wheat leaf rust.

Results:

The Manitoba Seed Guide and Agriculture and Agri-Food Canada provide information and recommendations about the latest developments in disease management. The crop data collected from the MCDC site during the 2024 growing season is reported in the 2025 'Seed Manitoba' guide. The hard copies of Seed Manitoba guide are available at Manitoba Agriculture offices, and can be accessed online at www.seedmb.ca.

Figure 1: Leaf Rust (Brown Rust), is one of the Major Types of Rust Infections in Wheat

Oats Leaf Rust Evaluation in Manitoba

Project duration: May 2024 – August 2024

Objective: To evaluate and manage leaf rust in MCVET oats varieties

Collaborators: Chami Amarasinghe (Former Innovation Specialist Crop – Manitoba Agriculture)

Anne Kirk (Crop Specialist Grains – Manitoba Agriculture)

Agriculture and Agri-Food Canada – Morden, MB

Seed Manitoba

Background:

Oats leaf rust is a fungal disease caused by the pathogen Puccinia coronata f. sp. avenae. This disease primarily affects oats but can also infect other cereal crops such as barley and wheat. Here are the typical symptoms and some management strategies for oats leaf rust:

Oats Leaf Rust Symptoms:

Oats leaf rust (Puccinia coronata f. sp. avenae) is a fungal disease that affects oats. Symptoms of oats leaf rust typically include:

Rust Pustules:

Small, orange to brown pustules that develop on the upper and lower surfaces of leaves.

Leaf Lesions:

Circular to oval-shaped lesions on leaves, which may coalesce as the infection progresses.

Yellowing and Necrosis:

Infected areas may turn yellow, and severe infections can lead to necrosis (death of plant tissue).

Reduced Yield:

Severe infections can result in reduced grain yield and quality.

Management of Oats Leaf Rust:

Resistant Varieties: Planting resistant oat varieties is one of the most effective strategies for managing oats leaf rust. Resistant varieties can significantly reduce the risk and severity of the disease.

Fungicide Applications:

In cases where resistance is not available or not sufficient, fungicides may be applied. Timely application during the early stages of infection can help manage the disease. Consult with local agricultural authorities for approved fungicides and application recommendations.

Crop Rotation:

Avoid planting oats in fields that have a recent history of oats leaf rust. Crop rotation can help break the disease cycle.

Monitoring and Early Detection:

Regularly scout oat fields for signs of leaf rust. Early detection allows for timely management interventions, such as fungicide application.

Proper Plant Spacing:

Adequate plant spacing can promote air circulation and reduce humidity within the crop canopy, creating less favorable conditions for rust development.

Remove Crop Residues:

Remove and destroy crop residues after harvest to reduce the carryover of inoculum to the next season.

Cultural Practices:

Practices such as proper fertilization, irrigation, and overall crop management can contribute to the overall health and resilience of the oats, making them less susceptible to diseases.

Results:

The Manitoba Seed Guide and Agriculture and Agri-Food Canada provide information and recommendations about the latest developments in disease management. The crop data collected from the MCDC site during the 2024 growing season is reported in the 2025 ‘Seed Manitoba’ guide. The hard copies of Seed Manitoba guide are available at Manitoba Agriculture offices, and can be accessed online at www.seedmb.ca.

Optimizing Nitrogen Fertility in Winter Wheat Varieties

Project duration: September 2023 – August 2024

Objective: To update the winter wheat fertility recommendations in the Manitoba Soil Fertility Guide.

To compare spring broadcast only application, to fall and spring split application of nitrogen for yield and protein.

To see if there are varietal difference in nitrogen use efficiency between Wildfire and Vortex.

Collaborators: Ken Gross, Alex Griffiths, Elmer Kaskiw (Ducks Unlimited Canada)

Manitoba Agriculture

Western Ag & Professional Agronomy

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 and split application, during planting in fall and at tillering or stem elongation in spring (Anderson, 2008; Schulz et al., 2015). Fertility management, in particular nitrogen and phosphorus fertility, remains an integral part of the overall management package aimed at achieving higher yields in winter wheat (Halvorson et al. 1987).Recommended fertilizer management, particularly nitrogen management, differs widely in winter wheat production, but the crop's nitrogen demand is correlated to yield potential and availability of moisture in dryland production 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). The ideal fertility management package would help counteract the escalating cost of winter wheat production per unit area, which is the main goal of winter wheat producers. There is still a knowledge gap on the rates and timing of nitrogen fertilizer application, particularly in Western Canada, that result in improved yield without compromising grain quality 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 which can be adopted by producers to improve economic returns in winter wheat production. This study aims to understand varietal demand to nitrogen as well as whether fall/spring split applications of nitrogen are more effective than single spring applications.

Materials & Methods:

This study was established at Melita, Roblin, Carberry and Arborg, Manitoba. The trial design consisted of two varieties and 7 nitrogen treatments, replicated three times, that were laid out factorially in a complete randomized block design.

Primary Treatments:

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

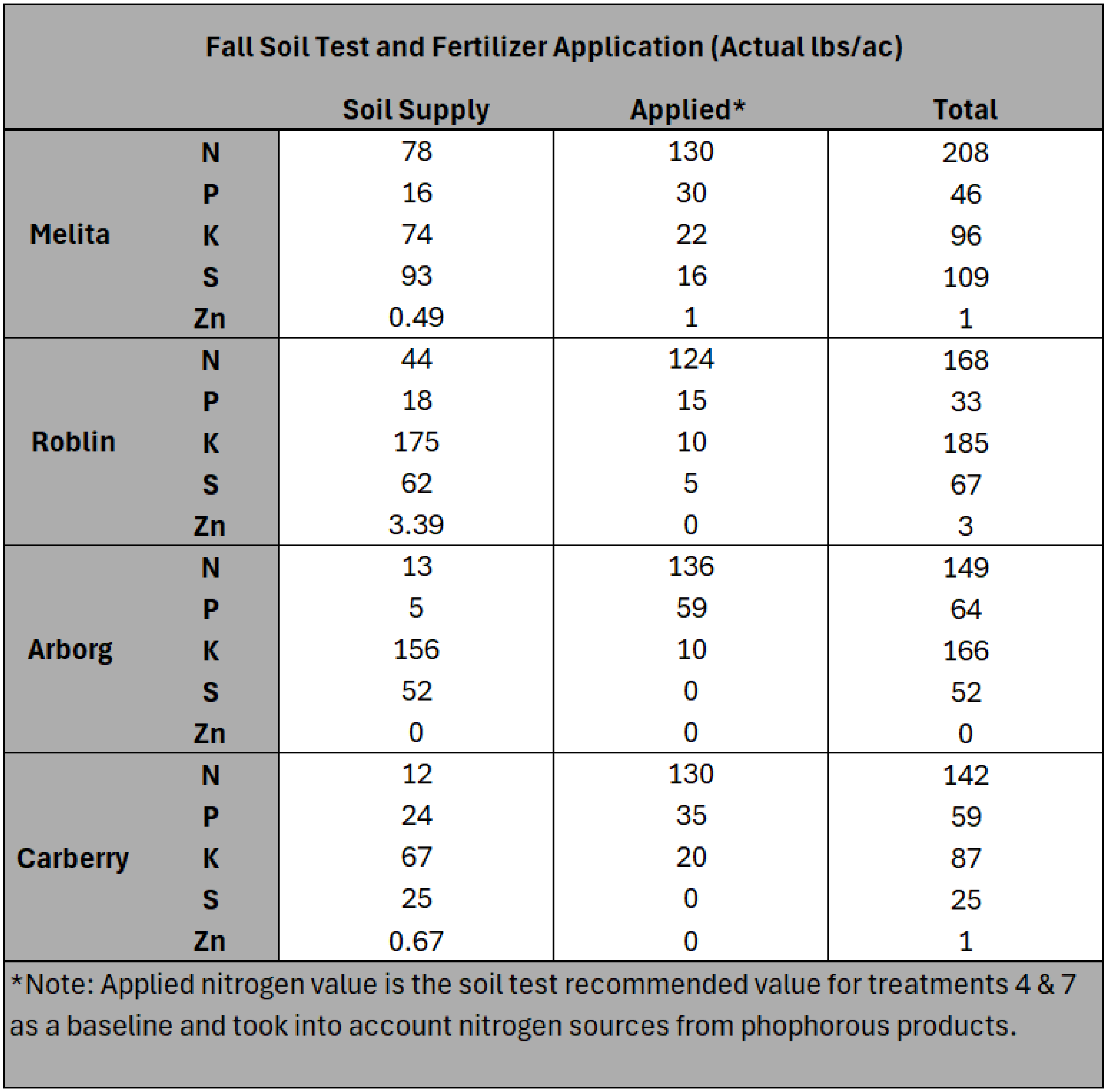
Secondary Treatments:

1. Check – No fertility except starter phosphorus
2. 60 Kg ha^{-1} (53.5 lbs ac^{-1}) nitrogen, split 50:50
3. 90 Kg ha^{-1} (80.3 lbs ac^{-1}) nitrogen, split 50:50
4. 120 Kg ha^{-1} (107.1 lbs ac^{-1}) nitrogen, split 50:50
5. 150 Kg ha^{-1} (133.8 lbs ac^{-1}) nitrogen, split 50:50
6. 180 Kg ha^{-1} (160.6 lbs ac^{-1}) nitrogen, split 50:50
7. 120 Kg ha^{-1} (107.1 lbs ac^{-1}) nitrogen all applied in spring

The soil test results and the applied fertilizer amounts are listed for each site in Table 1. All five split applications had 50% of the rate being applied in the fall, and 50% of the rate being applied in the following spring. Specific treatment nitrogen rates using granular ESN/urea (50:50 blend) were placed at approximately 1.25-inch depth in a separate pass before seeding the wheat.

Seeding target density was 325 plants m^{-2}. Germination was 95% for both varieties. Treatment-specific nitrogen rates were top-dressed in the early spring, as urea coated with Agrotain. The spring nitrogen application of 120kg ha^{-1} is the currently producer fertility practice when growing winter wheat representing treatment 7. Each site where this trial was grown used slightly different agronomic practices and had different field conditions which are outlined in the following Tables 1 through 3.

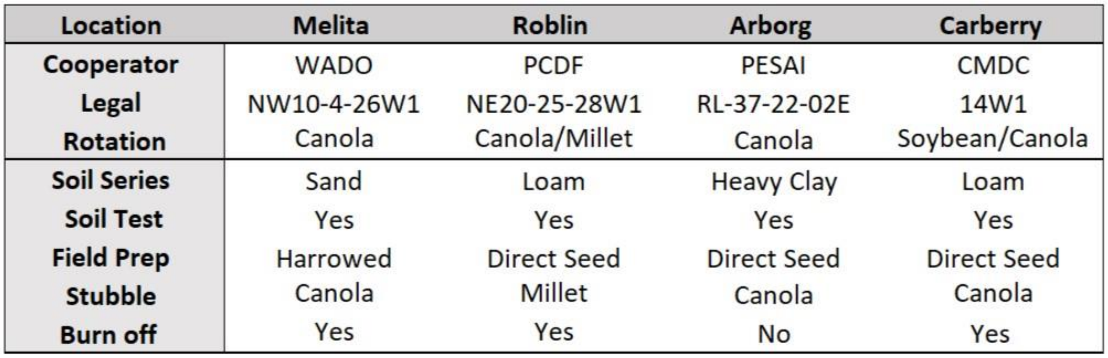
Table 1. Fall soil test results by site and fertilizer treatments for winter wheat in the 2022/2023 season.



Fall Soil Test and Fertilizer Application (Actual lbs/ac)				
		Soil Supply	Applied*	Total
Melita	**N**	78	130	208
	P	16	30	46
	K	74	22	96
	S	93	16	109
	Zn	0.49	1	1
Roblin	**N**	44	124	168
	P	18	15	33
	K	175	10	185
	S	62	5	67
	Zn	3.39	0	3
Arborg	**N**	13	136	149
	P	5	59	64
	K	156	10	166
	S	52	0	52
	Zn	0	0	0
Carberry	**N**	12	130	142
	P	24	35	59
	K	67	20	87
	S	25	0	25
	Zn	0.67	0	1

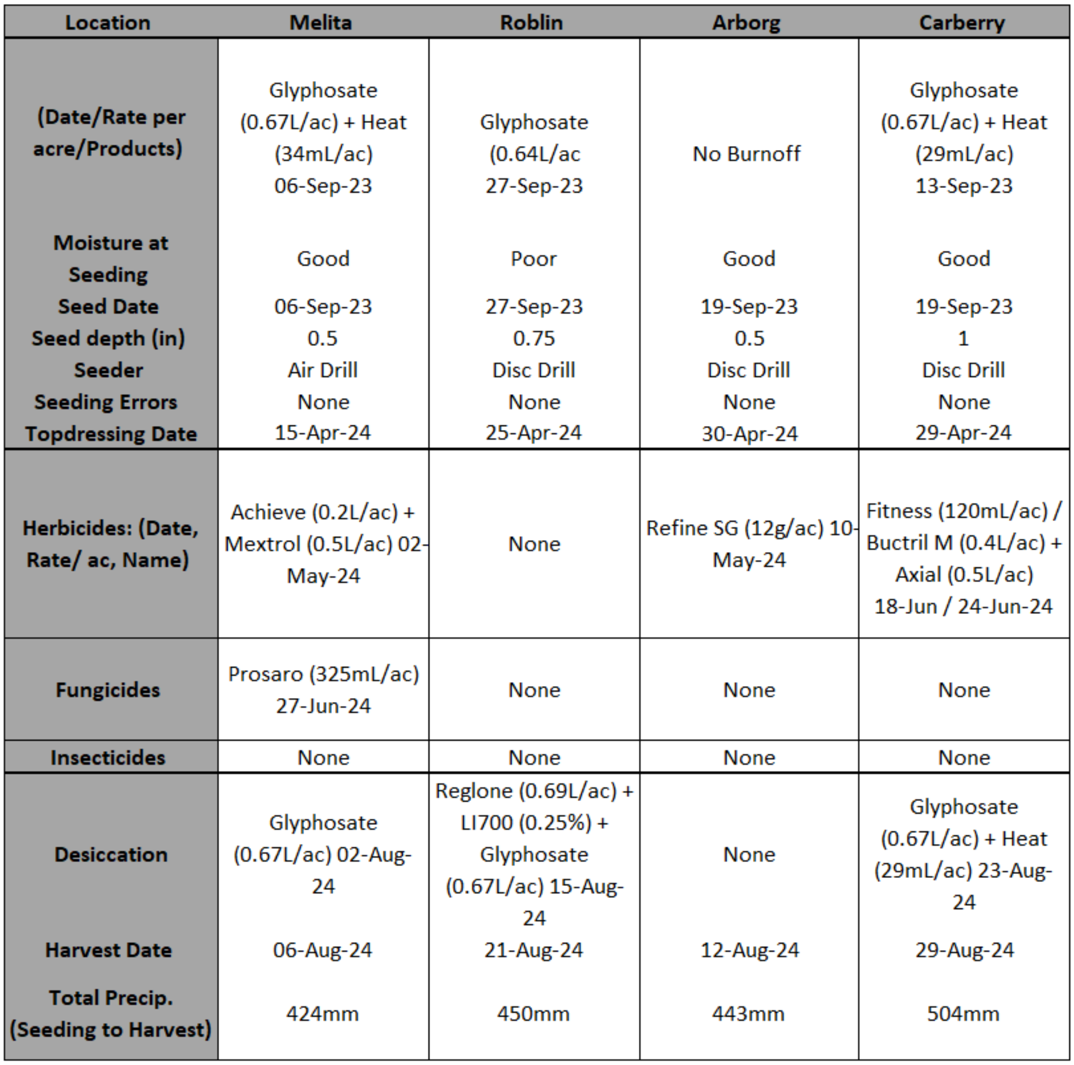
*Note: Applied nitrogen value is the soil test recommended value for treatments 4 & 7 as a baseline and took into account nitrogen sources from phophorous products.

Table 2. Description of Site fields in the 2023 Ducks Unlimited Winter Wheat Fertility Trial in Melita, Roblin, Carberry, and Arborg.



Location	Melita	Roblin	Arborg	Carberry
Cooperator	WADO	PCDF	PESAI	CMDC
Legal	NW10-4-26W1	NE20-25-28W1	RL-37-22-02E	14W1
Rotation	Canola	Canola/Millet	Canola	Soybean/Canola
Soil Series	Sand	Loam	Heavy Clay	Loam
Soil Test	Yes	Yes	Yes	Yes
Field Prep	Harrowed	Direct Seed	Direct Seed	Direct Seed
Stubble	Canola	Millet	Canola	Canola
Burn off	Yes	Yes	No	Yes

Table 3. Agronomic practices and Description of Sites in the 2023 Ducks Unlimited Winter Wheat Fertility Trial in Mlita, Roblin, Carberry and Arborg.



Location	Melita	Roblin	Arborg	Carberry
(Date/Rate per acre/Products)	Glyphosate (0.67L/ac) + Heat (34mL/ac) 06-Sep-23	Glyphosate (0.64L/ac 27-Sep-23	No Burnoff	Glyphosate (0.67L/ac) + Heat (29mL/ac) 13-Sep-23
Moisture at Seeding	Good	Poor	Good	Good
Seed Date	06-Sep-23	27-Sep-23	19-Sep-23	19-Sep-23
Seed depth (in)	0.5	0.75	0.5	1
Seeder	Air Drill	Disc Drill	Disc Drill	Disc Drill
Seeding Errors	None	None	None	None
Topdressing Date	15-Apr-24	25-Apr-24	30-Apr-24	29-Apr-24
Herbicides: (Date, Rate/ ac, Name)	Achieve (0.2L/ac) + Mextrol (0.5L/ac) 02-May-24	None	Refine SG (12g/ac) 10-May-24	Fitness (120mL/ac) / Buctril M (0.4L/ac) + Axial (0.5L/ac) 18-Jun / 24-Jun-24
Fungicides	Prosaro (325mL/ac) 27-Jun-24	None	None	None
Insecticides	None	None	None	None
Desiccation	Glyphosate (0.67L/ac) 02-Aug-24	Reglone (0.69L/ac) + LI700 (0.25%) + Glyphosate (0.67L/ac) 15-Aug-24	None	Glyphosate (0.67L/ac) + Heat (29mL/ac) 23-Aug-24
Harvest Date	06-Aug-24	21-Aug-24	12-Aug-24	29-Aug-24
Total Precip. (Seeding to Harvest)	424mm	450mm	443mm	504mm

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.

Results and Discussion:

The 2024 trial was successfully completed at all the Diversification Centers and agronomic characteristics that were evaluated included test weight, protein, and yield. In Melita, variety had a significant effect ($p < 0.001$) on test weight while in Arborg, the combined effects of variety and fertility significantly influenced ($p = 0.031$) test weight. In Melita, Vortex had a greater test weight (83.7 kg/hL) than Wildfire (82.9 kg/hL). This trend was consistent amongst the other sites, but the difference was not significant. Test weight was not found to be significantly influenced by variety or fertility at either the Roblin or Carberry sites.

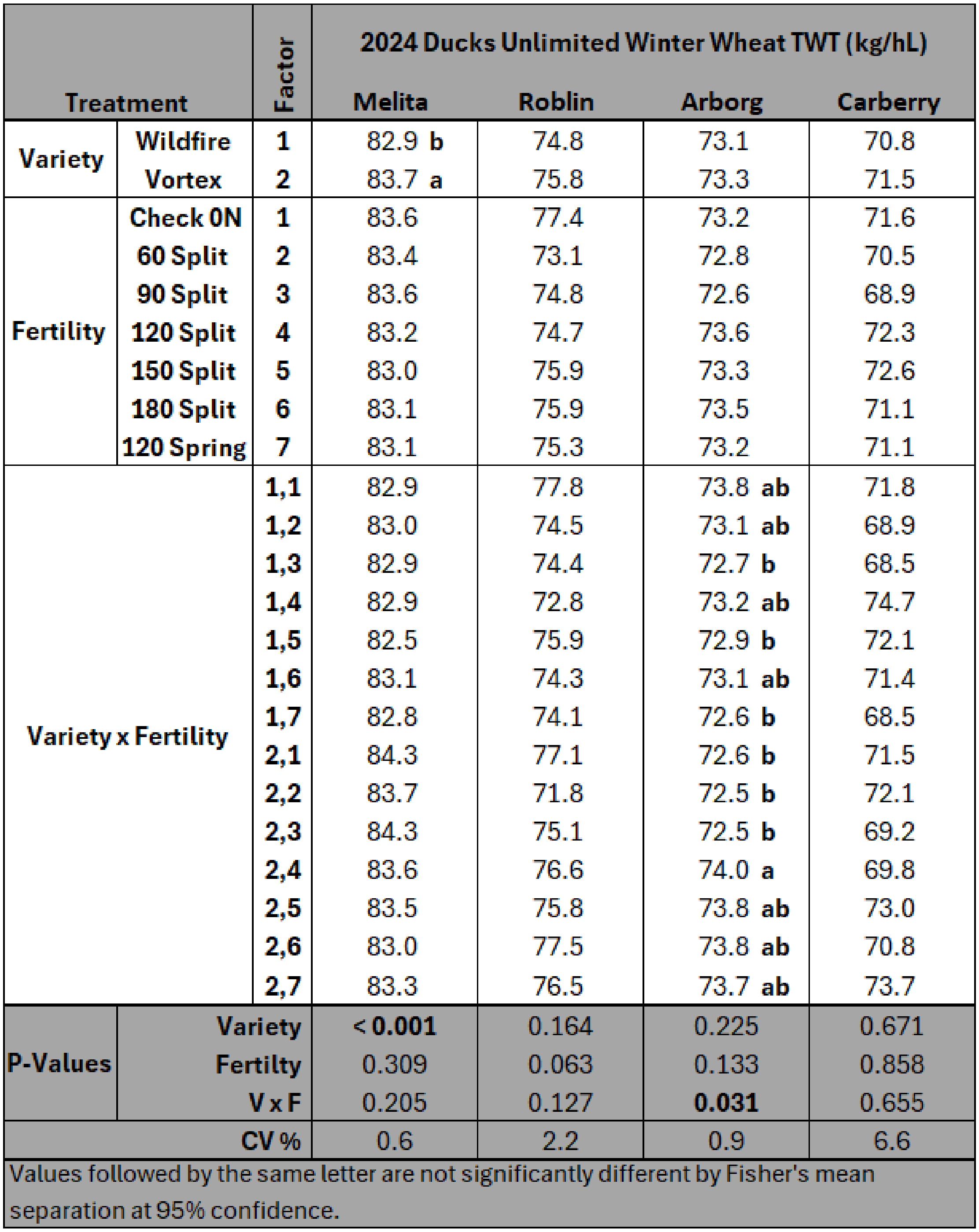
The significant interaction of variety and fertility at Arborg suggests that the effect of fertility was dependent on which variety was used. In fact, when nitrogen rates were 90 kg/ha and below Wildfire had greater test weights than Vortex and as nitrogen rates increased to 120 kg N/ha and above, Vortex had higher test weights. This trend appeared to be specific to Arborg. While test weight has been found to be significant in some situations, it was not particularly affected by the treatments in the 2023-2024 growing season.

In Melita, protein was found to be significant ($p < 0.001$) between the varieties. Vortex had a higher protein (11.8%) than Wildfire (10.9%). Fertility was also found to have a significant effect ($p < 0.001$) on protein in Melita; 150 kg N/ha split applied produced the highest protein (12.3%) but it was not significantly higher than the split application of 180 kg N/ha (12.1%). The check treatment with no additional nitrogen applied had the lowest protein (10.4%) in Melita.

In Roblin, protein was found to be significant ($p < 0.001$) between varieties; Vortex being higher (9.7%) than Wildfire (9.1%). Fertility treatment was also found to be significant ($p < 0.001$) in Roblin. The 180 kg/ha nitrogen split application produced the highest protein (10.6%) while 90 kg/ha nitrogen split application produced the lowest protein (8.5%) in Roblin, but it was not significantly lower than the check treatment with no additional nitrogen applied (8.9%).

In Arborg, protein was only found to be significantly affected (p = 0.025) by fertility. The 180 kg N/ha split application produced the highest protein grain (10.9%), and it was significantly greater than the proteins achieved by split applications of 60 kg N/ha (9.5%) and 90 kg N/ha (9.6%).

Table 4. Test weight results from 2024 in Melita, Roblin, Arborg, and Carberry.



Treatment		Factor	2024 Ducks Unlimited Winter Wheat TWT (kg/hL)			
			Melita	Roblin	Arborg	Carberry
Variety	**Wildfire**	**1**	82.9 **b**	74.8	73.1	70.8
	Vortex	**2**	83.7 **a**	75.8	73.3	71.5
Fertility	**Check 0N**	**1**	83.6	77.4	73.2	71.6
	60 Split	**2**	83.4	73.1	72.8	70.5
	90 Split	**3**	83.6	74.8	72.6	68.9
	120 Split	**4**	83.2	74.7	73.6	72.3
	150 Split	**5**	83.0	75.9	73.3	72.6
	180 Split	**6**	83.1	75.9	73.5	71.1
	120 Spring	**7**	83.1	75.3	73.2	71.1
Variety x Fertility		**1,1**	82.9	77.8	73.8 **ab**	71.8
		1,2	83.0	74.5	73.1 **ab**	68.9
		1,3	82.9	74.4	72.7 **b**	68.5
		1,4	82.9	72.8	73.2 **ab**	74.7
		1,5	82.5	75.9	72.9 **b**	72.1
		1,6	83.1	74.3	73.1 **ab**	71.4
		1,7	82.8	74.1	72.6 **b**	68.5
		2,1	84.3	77.1	72.6 **b**	71.5
		2,2	83.7	71.8	72.5 **b**	72.1
		2,3	84.3	75.1	72.5 **b**	69.2
		2,4	83.6	76.6	74.0 **a**	69.8
		2,5	83.5	75.8	73.8 **ab**	73.0
		2,6	83.0	77.5	73.8 **ab**	70.8
		2,7	83.3	76.5	73.7 **ab**	73.7
P-Values	**Variety**		**< 0.001**	0.164	0.225	0.671
	Fertilty		0.309	0.063	0.133	0.858
	V x F		0.205	0.127	**0.031**	0.655
	CV %		0.6	2.2	0.9	6.6

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

Table 5. Protein results from 2024 in Melita, Roblin, Arborg, and Carberry.

Treatment		**Factor**	**2024 Ducks Unlimited Winter Wheat Protein (%)**			
			Melita	**Roblin**	**Arborg**	**Carberry**
Variety	**Wildfire**	**1**	10.9 **b**	9.1 **b**	10.3	10.3 **b**
	Vortex	**2**	11.8 **a**	9.7 **a**	10.1	11.1 **a**
Fertility	**Check 0N**	**1**	10.4 **d**	8.9 **cd**	10.1 **ab**	9.9 **cd**
	60 Split	**2**	10.3 **d**	8.5 **d**	9.5 **b**	9.7 **d**
	90 Split	**3**	10.8 **cd**	9.0 **cd**	9.6 **b**	10.6 **b**
	120 Split	**4**	11.4 **bc**	9.8 **b**	10.3 **ab**	10.6 **b**
	150 Split	**5**	12.3 **a**	9.7 **b**	10.5 **a**	11.2 **a**
	180 Split	**6**	12.1 **a**	10.6 **a**	10.9 **a**	11.7 **a**
	120 Spring	**7**	11.9 **ab**	9.6 **b**	10.6 **a**	11.1 **ab**
Variety x Ferility		**1,1**	10.0	8.5	10.1	9.2
		1,2	9.6	8.3	9.7	9.5
		1,3	10.3	8.5	9.7	10.0
		1,4	11.0	9.3	10.1	10.5
		1,5	11.7	9.4	10.9	10.6
		1,6	12.1	10.4	11.2	11.1
		1,7	11.3	9.3	10.3	10.9
		2,1	10.9	9.2	10.1	10.6
		2,2	10.9	8.7	9.3	9.9
		2,3	11.3	9.5	9.4	11.2
		2,4	11.7	10.2	10.4	10.7
		2,5	12.8	10.0	10.2	11.8
		2,6	12.1	10.7	10.5	12.3
		2,7	12.6	9.9	10.8	11.3
P-Values	**Variety**		**< 0.001**	**< 0.001**	0.392	**< 0.001**
	Fertility		**< 0.001**	**< 0.001**	**0.025**	**< 0.001**
	V x F		0.554	0.587	0.701	0.064
	CV %		5.7	3.5	7.3	3.9

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

Variety and fertility were found to significantly influence protein in Carberry ($p < 0.001$). Again, Vortex produced the higher protein (11.1%), and Wildfire had lower protein grain (10.3%). The fertility treatment that produced the highest protein grain was the split application of 180 kg N/ha (11.7%), but it was not significantly different from the protein than that of split applied 150 kg N/ha (11.2%) or 120 kg N/ha applied in the spring (11.1%).

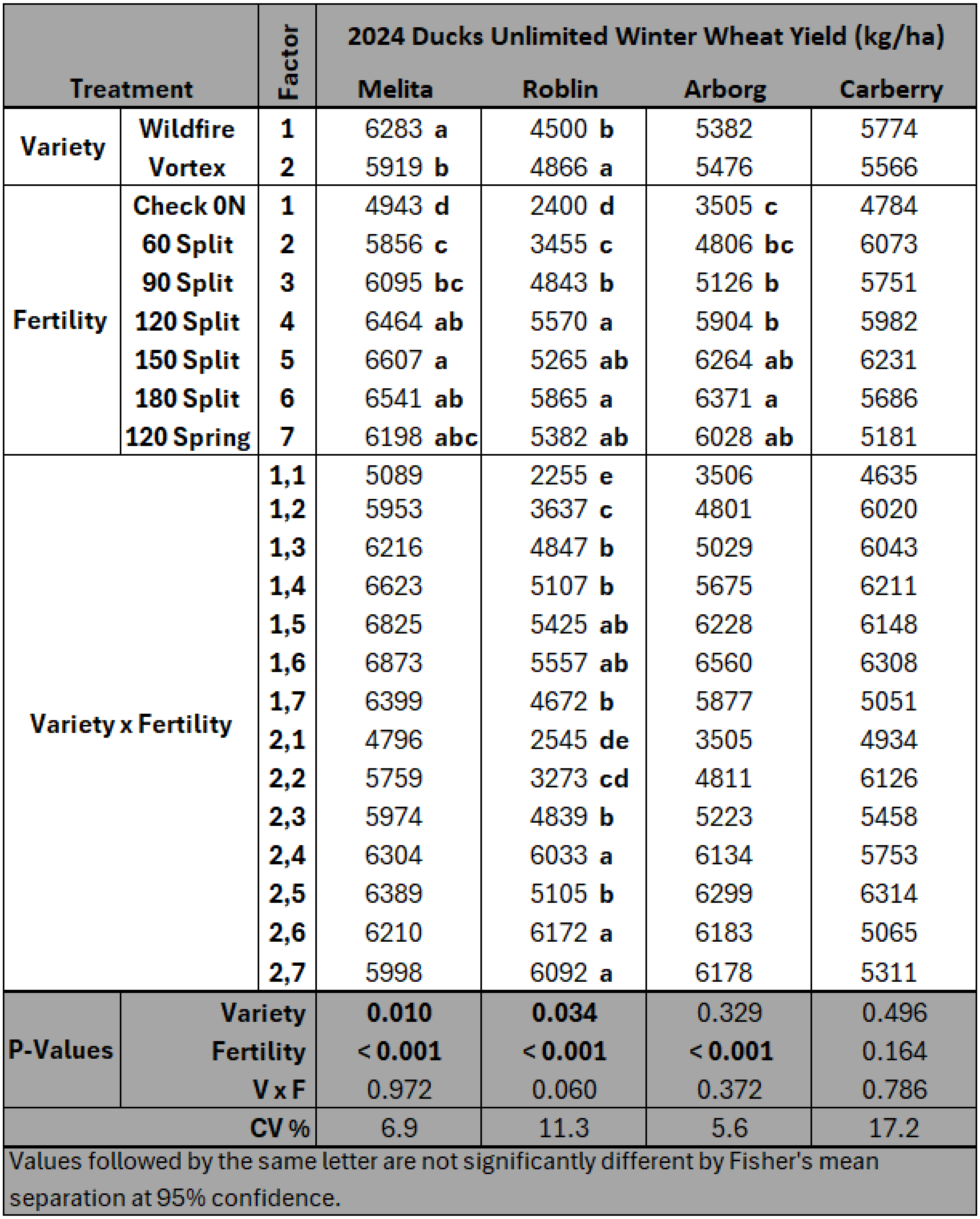
In Melita, grain yield was found to be significantly different ($p = 0.010$) between varieties; Wildfire was the higher yielding variety (6283 kg /ha) compared to Vortex (5919 kg/ha). Fertility was also found to have a significant effect ($p < 0.001$) on yield. When nitrogen was split applied at the 150 kg N/ha rate the highest yield (6607 kg/ha) was achieved, though it was not significantly different from the yield of 180 kg N/ha and 120 kg N/ha split applications or spring applied 120 kg N/ha nitrogen (6541 kg/ha, 6464 kg/ha, and 6198 kg/ha respectively). The lowest yield (4943 kg/ha) was observed for check treatment where no additional nitrogen was applied.

Grain yield was significantly affected by variety ($p = 0.034$) and fertility treatment ($p < 0.001$) in Roblin. Vortex produced the highest yield (4866 kg/ha) and Wildfire the lowest (4500 kg/ha). The 180 kg N/ha split applied had the greatest yield (5865 kg/ha) and was statistically the same as both 120 kg N/ha treatments and 150 kgN/ha split applied. The check treatment with no additional nitrogen applied had the lowest yield (2400 kg/ha).

In Arborg, only fertility treatment had a significant effect ($p < 0.001$) on yield. The split application of 180 kg N/ha achieved the highest yield (6371 kg/ha), though it was not significantly higher than the yields produced by 150 kg N/ha split applied (6264 kg/ha) or 120 kg N/ha applied in the spring (6028 kg/ha).

In Carberry, yield was not affected by variety or fertility enough to result in a significant p-value. However, trends were similar to the other three sites. Vortex had a greater yield than Wildfire by just over 200 kg/ha. The greatest yields were observed for the split applications of 120 kg N/ha (5982 kg/ha) and 150 kg N/ha (6231 kg/ha) treatments.

Table 6. 2024 yield results in Melita, Roblin, Arborg, and Carberry



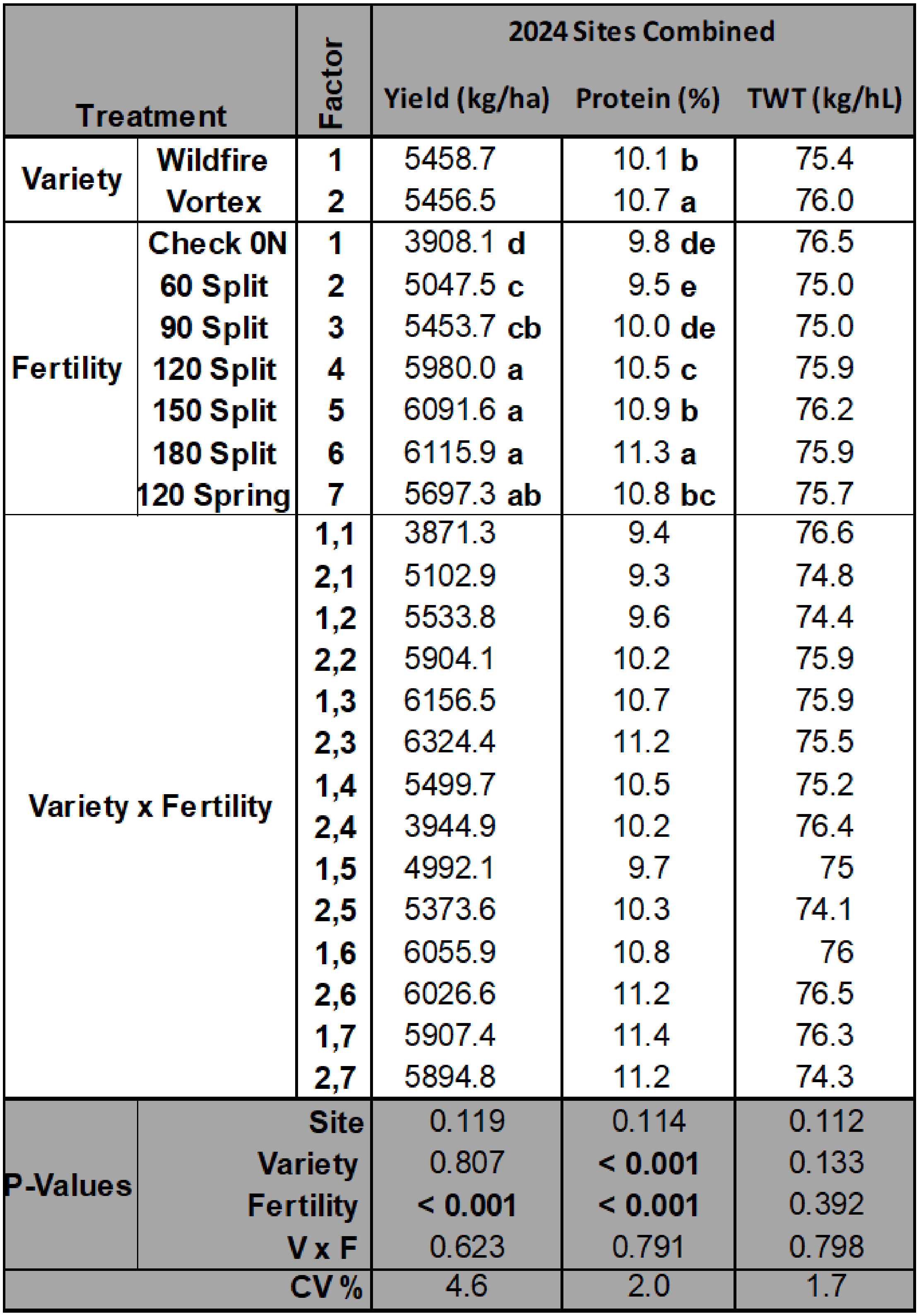
Treatment		Factor	2024 Ducks Unlimited Winter Wheat Yield (kg/ha)			
			Melita	Roblin	Arborg	Carberry
Variety	Wildfire	1	6283 a	4500 b	5382	5774
	Vortex	2	5919 b	4866 a	5476	5566
Fertility	Check 0N	1	4943 d	2400 d	3505 c	4784
	60 Split	2	5856 c	3455 c	4806 bc	6073
	90 Split	3	6095 bc	4843 b	5126 b	5751
	120 Split	4	6464 ab	5570 a	5904 b	5982
	150 Split	5	6607 a	5265 ab	6264 ab	6231
	180 Split	6	6541 ab	5865 a	6371 a	5686
	120 Spring	7	6198 abc	5382 ab	6028 ab	5181
Variety x Fertility		1,1	5089	2255 e	3506	4635
		1,2	5953	3637 c	4801	6020
		1,3	6216	4847 b	5029	6043
		1,4	6623	5107 b	5675	6211
		1,5	6825	5425 ab	6228	6148
		1,6	6873	5557 ab	6560	6308
		1,7	6399	4672 b	5877	5051
		2,1	4796	2545 de	3505	4934
		2,2	5759	3273 cd	4811	6126
		2,3	5974	4839 b	5223	5458
		2,4	6304	6033 a	6134	5753
		2,5	6389	5105 b	6299	6314
		2,6	6210	6172 a	6183	5065
		2,7	5998	6092 a	6178	5311
P-Values	Variety		**0.010**	**0.034**	0.329	0.496
	Fertility		**< 0.001**	**< 0.001**	**< 0.001**	0.164
	V x F		0.972	0.060	0.372	0.786
		CV %	6.9	11.3	5.6	17.2

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

When the data from all four sites were combined from the 2024 season, fertility had a significant effect on yield and protein ($p < 0.001$), and variety significantly affected ($p < 0.001$) protein. Results indicate that the split application of 180 kg N/ha produced the greatest yield (6115.9 kg/ha), though it was not significantly higher than the 150 and 120 kg N/ha split applied, or spring applied 120 kg N/ha (6091.6 kg/ha, 5980.0 kg/ha, and 5697.3 kg/ha, respectively). While not significant ($p = 0.623$), the combination of variety and fertility that produced the highest yield was when Vortex was grown with the fertility treatment of 150 kg/ha split nitrogen (6324.4 kg/ha). The variety Vortex produced higher protein (10.7%) across all the sites. As well as the highest yield, the split application of 180 kg N/ha also produced the highest protein grain (11.3%) across all four sites and was significantly higher than the protein produced by all other fertility treatments in the trial. Test weight was not found to be significant between the sites in 2024.

To gain a broader sense of the results from this research, data was combined from all four sites for the 2022, 2023, and 2024 growing seasons. Statistical results indicated that fertility treatment had an influence on yield and protein while variety had an effect on protein and test weight (Table 7.). Winter wheat that received 150 kg N/ha split between fall and spring had the highest yield (5933 kg/ha), though it was not significantly higher than the yield produced by most of the other treatments except when nitrogen rates were reduced to 90 kg/ha and less. The check treatment with no nitrogen applied produced the lowest yield (4510 kg/ha) which was expected and shows that there was a strong yield response to nitrogen fertilization. Variety and fertility had a significant effect ($p < 0.001$) on protein. Vortex had the highest protein (12.1%) and Wildfire had a marginally lower protein (11.4%). The fertility treatment, 180 kg N/ha split produced the highest grain protein (12.5%), though it was not significantly higher than the protein produced when all nitrogen was spring applied (12.4%) or 150 kg N/ha split applied (12.1%). The check treatment with no additional nitrogen and 60 kg N/ha split applied produced the lowest protein (11.1%). Variety had a significant effect ($p = < 0.001$) on grain test weight whereby Vortex had a slightly greater test weight (74 kg/hL) than Wildfire (73 kg/hL). No statistical differences were observed between fertility treatments for test weight. Trends amongst fertility treatments regarding test weight indicated that when no nitrogen fertilizer was applied, test weight was highest (94 kg/hL). Results of this trial across three growing seasons and multiple sites were similar as indicated by a non-significant p-value for site and year.

Table 7. Results including yield, protein, and test weight from all sites included combined for the 2024 season.

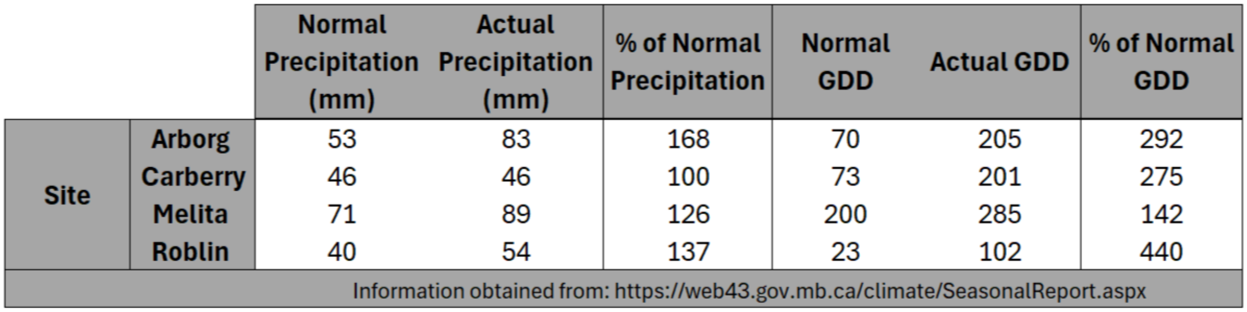


Treatment		Factor	2024 Sites Combined		
			Yield (kg/ha)	Protein (%)	TWT (kg/hL)
Variety	**Wildfire**	**1**	5458.7	10.1 **b**	75.4
	Vortex	**2**	5456.5	10.7 **a**	76.0
Fertility	**Check 0N**	**1**	3908.1 **d**	9.8 **de**	76.5
	60 Split	**2**	5047.5 **c**	9.5 **e**	75.0
	90 Split	**3**	5453.7 **cb**	10.0 **de**	75.0
	120 Split	**4**	5980.0 **a**	10.5 **c**	75.9
	150 Split	**5**	6091.6 **a**	10.9 **b**	76.2
	180 Split	**6**	6115.9 **a**	11.3 **a**	75.9
	120 Spring	**7**	5697.3 **ab**	10.8 **bc**	75.7
Variety x Fertility		**1,1**	3871.3	9.4	76.6
		2,1	5102.9	9.3	74.8
		1,2	5533.8	9.6	74.4
		2,2	5904.1	10.2	75.9
		1,3	6156.5	10.7	75.9
		2,3	6324.4	11.2	75.5
		1,4	5499.7	10.5	75.2
		2,4	3944.9	10.2	76.4
		1,5	4992.1	9.7	75
		2,5	5373.6	10.3	74.1
		1,6	6055.9	10.8	76
		2,6	6026.6	11.2	76.5
		1,7	5907.4	11.4	76.3
		2,7	5894.8	11.2	74.3
P-Values	**Site**		0.119	0.114	0.112
	Variety		0.807	**< 0.001**	0.133
	Fertility		**< 0.001**	**< 0.001**	0.392
	V x F		0.623	0.791	0.798
CV %			4.6	2.0	1.7

Table 8. Combined results including yield, protein, and test weight from all sites from the 2022, 2023, and 2024 growing seasons.

2022, 2023 & 2024 Site Years Combined					
Treatment		Factor	Yield (kg/ha)	Protein (%)	TWT (kg/hL)
Variety	**Wildfire**	**1**	5640	11.4 **b**	73 **b**
	Vortex	**2**	5423	12.1 **a**	74 **a**
Fertility	**Check 0N**	**1**	4511 **d**	11.1 **d**	74
	60 Split	**2**	5346 **c**	11.1 **d**	73
	90 Split	**3**	5512 **bc**	11.4 **c**	74
	120 Split	**4**	5825 **ab**	11.8 **b**	74
	150 Split	**5**	5933 **a**	12.1 **ab**	74
	180 Split	**6**	5827 **ab**	12.4 **a**	73
	120 Spring	**7**	5770 **ab**	12.4 **a**	74
Variety*Fertility		**1,1**	4660	10.6	74
		1,2	5478	10.8	71
		1,3	5698	11.0	73
		1,4	5872	11.4	73
		1,5	6049	11.8	73
		1,6	5987	12.2	73
		1,7	5740	12.0	73
		2,1	4362	11.6	74
		2,2	5214	11.3	74
		2,3	5326	11.9	74
		2,4	5778	12.2	74
		2,5	5818	12.4	74
		2,6	5668	12.6	74
		2,7	5800	12.8	74
Year		**2022**	6534	11.9	72
		2023	4591	13.0	73
		2024	5471	10.4	76
Site		**Arborg**	5457	12.6	70
		Carberry	6046	11.7	70
		Melita	5282	11.5	80
		Roblin	5343	11.2	74
P-Values		**Year**	0.161	0.159	0.167
		Site	0.138	0.115	0.112
		Variety	0.051	**< 0.001**	**0.014**
		Fertility	**< 0.001**	**< 0.001**	0.582
		V x F	0.954	0.672	0.959
		CV%	22.0	8.1	6.2

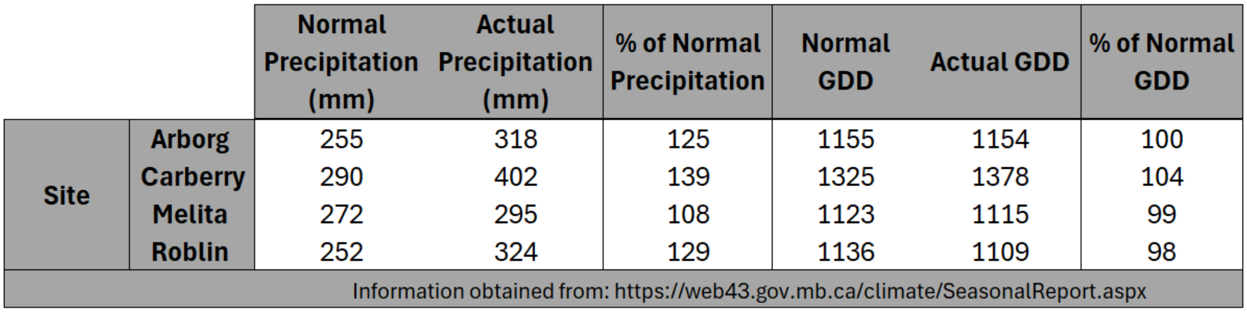
Table 9. Seasonal precipitation and growing degree days from the fall seeding date to November 15th, 2023, in Melita, Roblin, Arborg, and Carberry sites.



		Normal Precipitation (mm)	Actual Precipitation (mm)	% of Normal Precipitation	Normal GDD	Actual GDD	% of Normal GDD
Site	Arborg	53	83	168	70	205	292
	Carberry	46	46	100	73	201	275
	Melita	71	89	126	200	285	142
	Roblin	40	54	137	23	102	440

Information obtained from: https://web43.gov.mb.ca/climate/SeasonalReport.aspx

Table 10. Seasonal precipitation and growing degree days from April 1st, 2024, to the harvest date in Melita, Roblin, Arborg, and Carberry.



		Normal Precipitation (mm)	Actual Precipitation (mm)	% of Normal Precipitation	Normal GDD	Actual GDD	% of Normal GDD
Site	Arborg	255	318	125	1155	1154	100
	Carberry	290	402	139	1325	1378	104
	Melita	272	295	108	1123	1115	99
	Roblin	252	324	129	1136	1109	98

Information obtained from: https://web43.gov.mb.ca/climate/SeasonalReport.aspx

Nitrogen use efficiency (NUE) as a function of yield over amount fertilizer was evaluated over the course of the study from 2022 to 2024. There were no differences between Vortex and Wildfire in NUE ($p = 0.091$) or an interaction effect when looking at variety and fertility together proving that the NUE response was consistent across varieties. Furthermore, while fertility had a significant effect on NUE ($p < 0.001$), both Vortex and Wildfire responded similarly to changes in fertility ($p = 0.823$). Nitrogen use efficiency decreased as nitrogen fertilizer increased which is a typical NUE trend as nitrogen rates increase. When comparing the 100% spring applied nitrogen to the same rate that was split applied, NUE is the same indicating that in this study year, split application of N at this rate did not improve NUE.

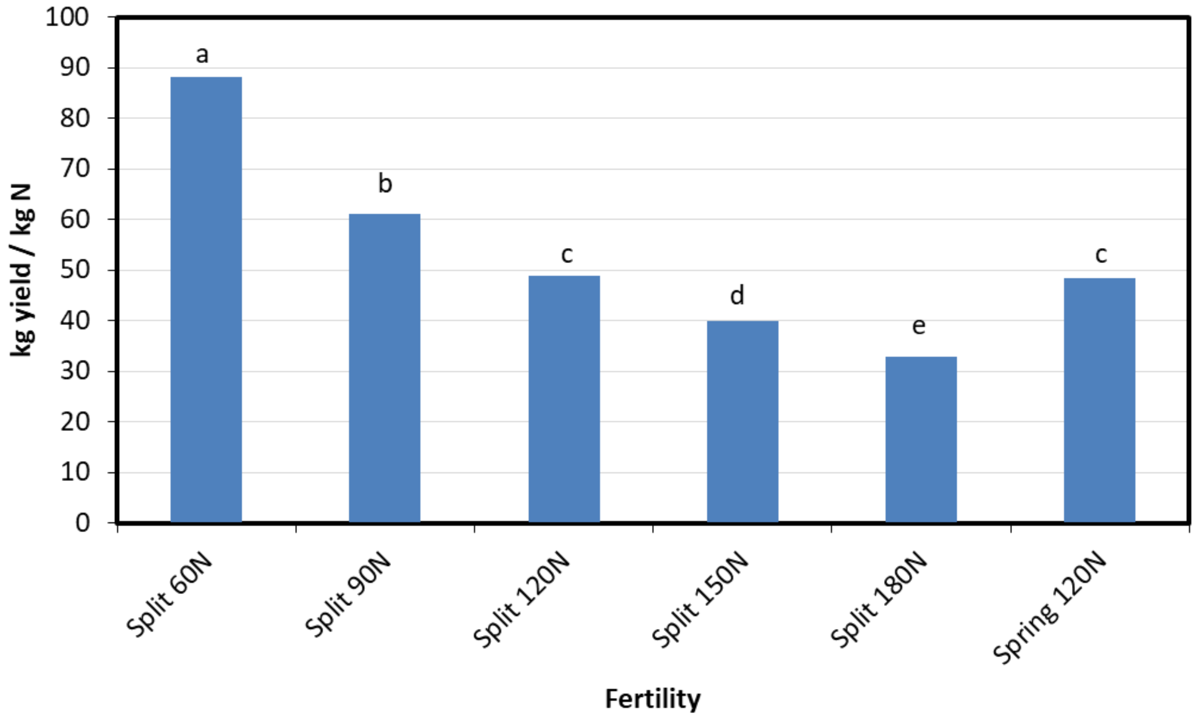


Figure 1: The relationship between nitrogen treatment and nitrogen use efficiency (NUE = seed yield (kg/ha) / fertilizer N (kg/ha). Letters above bars indicate significant differences between treatments.

Greenhouse Gas (GHG) Emissions Estimation in Winter Wheat

Project duration: September 2023 – August 2024

Objective: To update the winter wheat fertility recommendations in the Manitoba Soil Fertility Guide.

To compare spring broadcast only application, to fall and spring split application of nitrogen for yield and protein.

To see if there are varietal difference in nitrogen use efficiency between Wildfire and Vortex.

Collaborators: Ken Gross, Alex Griffiths, Elmer Kaskiw (Ducks Unlimited Canada)

John Heard (Manitoba Agriculture)

Western Ag & Professional Agronomy

Background:

Nitrogen (N) fertilizer is a critical input for winter wheat production, directly influencing yield, protein content, and overall crop performance. However, the timing and method of nitrogen application can also impact greenhouse gas (GHG) emissions, particularly nitrous oxide (N_2O), which is a potent greenhouse gas. Efficient nitrogen management is essential to optimize productivity while mitigating environmental impacts.

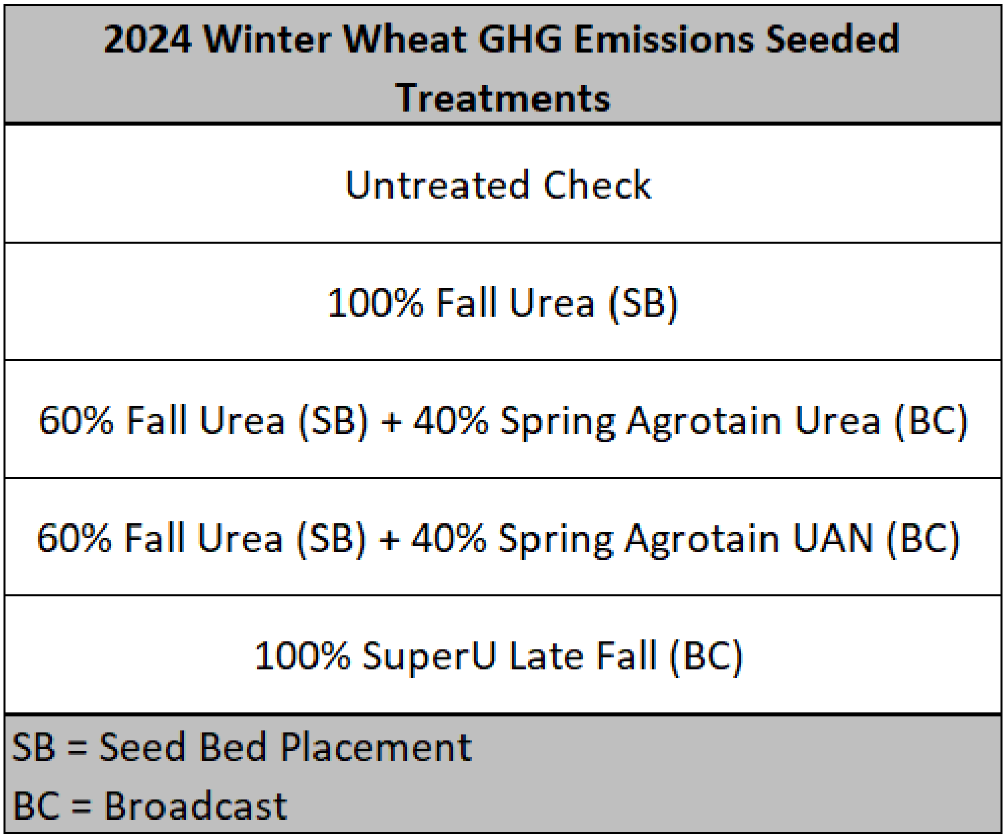
Previous research has shown that nitrogen application strategies, including the timing and form of nitrogen fertilizer, can significantly affect crop uptake efficiency and losses through leaching or volatilization. Fall-applied nitrogen, particularly stabilized forms such as SuperU, may reduce spring workload and improve nitrogen availability. Conversely, split applications, where nitrogen is applied in both fall and spring, have been suggested to enhance nitrogen use efficiency and minimize losses.

This study aims to evaluate the effects of different nitrogen fertilizer treatments on winter wheat yield, protein content, test weight, and greenhouse gas emissions. The trial was conducted across four locations in Manitoba, including Melita, Arborg, Carberry, and Roblin, to assess site-specific responses to nitrogen management. By analyzing these factors, the study seeks to provide recommendations on best nitrogen management practices for optimizing winter wheat production while reducing environmental impacts.

Materials and Methods:

The trial was established near Melita (SW11-4-26 W1) in Waskada Loam soil with excellent moisture. On September 12th, 2023, winter wheat was seeded into canola stubble at a depth of 0.5-inches. All plots received chemical burn off as Roundup Transorb (0.67 L/ac) and Heat LQ (40mL/ac) before seeding on September 6th. Nitrogen fertilizer was applied as variable treatments; plot treatments can be found below in Table 1. Each plot also received 11-35-21-19-1 actual lbs/ac (N-P-K-S-Zn) at a depth of 1.25-inches. Certain treatments needed to be top dressed; fall top dressing was applied on November 17th, 2023, while spring top dressing was applied on April 15th, 2024. In-crop herbicide was needed to control weeds; Achieve (0.2 L/ac) and Mextrol (0.5 L/ac) were applied on May 2nd. All plots were desiccated on August 2nd with Roundup Transorb (0.67 L/ac) and were harvested on August 6th.

Table 1. List of fertilizer treatments that were applied to winter wheat in 2024 for evaluation of green house gas emission measurements.



2024 Winter Wheat GHG Emissions Seeded Treatments
Untreated Check
100% Fall Urea (SB)
60% Fall Urea (SB) + 40% Spring Agrotain Urea (BC)
60% Fall Urea (SB) + 40% Spring Agrotain UAN (BC)
100% SuperU Late Fall (BC)
SB = Seed Bed Placement BC = Broadcast

Results and Discussion:

In 2024, when the data from this winter wheat green house gas emissions evaluation were analyzed, there was multiple significant effects found across the four sites where this trial was grown (Table 2).

In Arborg, yield ($p < 0.001$), protein ($p = 0.005$), and test weight ($p = 0.011$) were found to be significantly affected by N fertilizer application (Table 2). the greatest yield resulted when 100% of the nitrogen was applied in the fall during seeding (5467 kg/ha). Though higher, that yield was not significantly different from the yield produced by either of the split nitrogen applications, whether UAN was broadcasted (5369 kg/ha) or urea (5268 kg/ha). The untreated check produced the lowest yield at Arborg (2396 kg/ha). When 100% of the nitrogen was applied as broadcasted SuperU late in the fall, it resulted in the highest protein at Arborg (11.3%), though it was not significantly higher than when 100% of the nitrogen was applied at seeding (11.0%) or when the nitrogen application was split using urea in the spring (10.8%). The untreated check produced the lowest protein at Arborg (10.0%), though it was not significantly lower than the protein produced when the nitrogen application was split using UAN in the spring (10.4%). When 100% of the nitrogen was applied in the fall at seeding, it resulted in the highest test weight (73.6 kg/hL). Though, the test weights produced by any other nitrogen application where not significantly lower. The untreated check produced the lowest test weight at Arborg (71.5 kg/hL).

In Carberry, yield was the only factor found to be significantly affected ($p = 0.039$) by fertilizer application (Table 2). the highest yield was produced when all of the nitrogen fertilizer was applied at seeding (3940 kg/ha), though the yield was not significantly different from the yield produced when the nitrogen application was split using UAN in the spring (3643 kg/ha). The lowest yields were observed when all nitrogen was broadcasted in late fall (3037 kg/ha), though not significantly different from the yield produced by the untreated check (3564 kg/ha) or when nitrogen was split using urea in the spring (3516 kg/ha). While not significant, the highest protein was produced at Carberry when the nitrogen application was split using UAN in the spring (13.4%) and the lowest was produced by the untreated check (12.2%). While not found to be significant, the highest test weight was produced when all the nitrogen was applied in the fall during seeding (73.2 kg/hL), and the lowest was produced when the nitrogen application was split using urea in the spring (66.7 kg/hL).

In Melita, yield was found to be significantly affected ($p < 0.001$) by fertilizer treatment (Table 2). The highest yield was produced when all nitrogen was applied in the fall at seeding (5691 kg/ha), though it was not significantly higher than the yield of any other fertilizer application evaluated except for the untreated check which had the lowest yield (3681 kg/ha). Protein was also found to be significantly affected ($p < 0.001$) by N fertilizer application at Melita. When all the nitrogen was broadcasted as SuperU in the late fall, the highest protein was produced (13.2%). The untreated check produced the lowest protein grain at Melita (10.9%). Though not significant, the highest test weight was produced at Melita when no nitrogen was applied in the untreated check (82.9 kg/hL), and the lowest was produced when the nitrogen application was split using UAN in the spring (81.4 kg/hL).

In Roblin, yield was found to be significantly influenced ($p < 0.001$) by fertilizer application (Table 2). When nitrogen was applied as a split application broadcasting urea in the spring, the greatest yield was produced (5372 kg/ha), though it was not significantly higher yielding than when nitrogen was applied in a split application using UAN in the spring (5051 kg/ha).

Table 2. Results of the 2024 winter wheat green house gas evaluation at four sites including yield, protein, and test weight.

2024 Winter Wheat Green House Gas Emissions

Factor	Site	Untreated Check	100% Fall Urea (SB)	60% Fall Urea (SB) + 40% Spring Urea (BC)	60% Urea Fall (SB) + 40% Spring UAN (BC)	100% SuperU Late Fall (BC)	P-Value	CV%
Yield (kg/ha)	Arborg	2396**c**	5467**a**	5369**a**	5268**ab**	4892**b**	**< 0.001**	5.7
	Carberry	3564**b**	3940**a**	3516**b**	3643**a**	3037**b**	**0.039**	9.8
	Melita	3681**b**	5691**a**	5416**a**	5545**a**	5380**a**	**< 0.001**	7.8
	Roblin	3108**c**	4585**b**	5372**a**	5051**ab**	4562**b**	**< 0.001**	8.1
Protein (%)	Arborg	10.0**c**	11.0**a**	10.8**ab**	10.4**bc**	11.3**a**	**0.005**	3.6
	Carberry	12.2	12.4	13.1	13.4	13.3	0.320	7.2
	Melita	10.9**c**	12.1**b**	12.3**b**	12.4**b**	13.2**a**	**< 0.001**	3.1
	Roblin	9.9**c**	11.3**ab**	11.0**b**	11.8**a**	10.8**b**	**< 0.001**	3.5
Test Weight (kg/hL)	Arborg	71.5**b**	73.6**a**	73.2**a**	73.5**a**	72.9**a**	**0.011**	1.0
	Carberry	70.0	73.2	66.7	70.8	73.0	0.330	6.6
	Melita	82.9	82.2	81.7	81.4	81.5	0.054	0.8
	Roblin	78.1	77.5	80.4	78.6	78.3	0.150	2.0

*Values that do not share a letter are signficantly different

SB = Seed Bed Placed, BC = Broadcast

The untreated check produced the lowest yield at Roblin (3108 kg/ha). Protein was found to be significant ($P < 0.001$) at Roblin. When nitrogen was split applied using UAN in the spring, the highest protein was produced (11.8%), though it was not significantly higher than the protein when all the nitrogen was applied in the fall at seeding (11.3%). The untreated check produced the lowest protein grain at Roblin (9.9%). Though not significant, the highest test weight was produced at Roblin when nitrogen was split using urea in the spring (80.4 kg/hL), and the lowest was produced when all nitrogen was applied in the fall at seeding (77.5 kg/hL).

When the data from all four sites were combined, it was found that both yield and protein were significantly influenced ($p < 0.001$) by fertilizer application, while test weight was not (Table 3.) when all the nitrogen was applied at seeding, the highest yield was produced (4920.7 kg/ha), though it was not significantly more than the yield produced by either split nitrogen applications. The untreated check produced the lowest yield overall (3187.2 kg/ha). When all nitrogen was applied as a fall broadcast of SuperU, the highest protein was produced (12.2%), though it was not significantly higher than the protein achieved by the two split nitrogen treatments. The untreated check produced the lowest protein (10.8%).

Between the sites, while not found to be statistically significant, Melita produced the highest average yield (5119.3 kg/ha) and the highest average test weight (81.9 kg/hL). Carberry produced the highest average protein (12.9%), but produced the lowest average yield (3572.5 kg/ha) and the lowest average test weight (70.8 kg/hL). Arborg produced the lowest protein on average (10.7%).

Table 3. Results of all four sites combined for the 2024 winter wheat green house gas evaluation including yield, protein, and test weight.

		2024 Winter Wheat GHG Emissions Sites Combined		
		Yield (kg/ha)	**Protein (%)**	**Test Weight (kg/hL)**
Untreated Check		3187.2**c**	10.8**c**	75.6
100% Fall Urea (SB)		4920.7**a**	11.7**b**	76.6
60% Fall Urea (SB) + 40% Spring Urea (BC)		4918.3**a**	11.8**ab**	75.5
60% Urea Fall (SB) + 40% Spring UAN (BC)		4876.8**a**	12.0**ab**	76.1
100% SuperU Late Fall (BC)		4467.9**b**	12.2**a**	76.4
Arborg		4671.5	10.7	72.9
Carberry		3572.5	12.9	70.8
Melita		5119.3	12.2	81.9
Roblin		4533.3	11.0	78.6
P-Values	**Site**	0.119	0.115	0.114
	Treatment	**< 0.001**	**0.001**	0.791
	CV%	5.1	2.3	1.6

Integrating Legume Cover Crops in Winter Wheat

Project duration: September 2023 – September 2024

Objective: To evaluate the establishment and dry matter production of legume cover crops in winter wheat.

To assess the effects of these cover crops on grain yield of the winter wheat.

To assess the nitrogen fixation potential of the legume cover crops.

To assess the effect of legume cover crops on performance of canola in the following year

Collaborators: Manitoba Crop Alliance

Anne Kirk (Manitoba Agriculture)

Parkland Crop Diversification Foundation (PCDF)

Prairies East Sustainable Agriculture Initiative (PESAI)

Westman Agricultural Diversification Organisation (WADO)

Background:

There is increased interest in cover crops for soil health benefits, nitrogen contribution, and the potential for grazing or silage. Relay cropping provides an opportunity to incorporate legume crops into a cropping system without sacrificing a whole season of grain production. Relay cropping may have a good fit with winter wheat since winter wheat is typically harvested in late July to early August, leaving time for cover crop growth prior to frost. The success of the relay crop is dependent on the ability of the cover crop to establish in the winter wheat crop, and to produce enough biomass in the fall to provide a benefit to the soil and main crops.

Materials & Methods:

This study was established at Arborg, Carberry, Melita and Roblin in September 2023. The experimental design is a randomized complete block design with four replicates. Winter wheat was planted in September 2023, with cover crop treatments seeded in the fall and spring. Fall seeded cover crops were seeded in the same row and depth as the winter wheat, while spring seeded cover crops were broadcast as early as possible. Established cover crops will continue to grow in 2025 when canola will be direct seeded into the trial area.

Treatments include four different legume cover crops, a non-legume cover crop, and no cover crop. See Table 1 for a complete treatment list. Data collection in year one includes winter wheat and legume plant populations, winter wheat yield and protein, dry matter production of the legume crop, and nitrate nitrogen (N) in late fall. Protein and nitrate N were measured on composite samples and therefore do not have any statistical analysis associated with these results.

Table 1. Treatment List

Treatment	**Cover crop**	**Cover crop timing**	**Fertilizer rate in year 2 (% of recommended rate)**
1	No cover crop	n/a	0%
2	No cover crop	n/a	100%
3	No cover crop	n/a	60%
4	Sweet clover	Fall	60%
5	Alfalfa	Fall	60%
6	Red clover	Fall	60%
7	White clover	Fall	60%
8	Sweet clover	Spring	60%
9	Alfalfa	Spring	60%
10	Red clover	Spring	60%
11	White clover	Spring	60%
12	Perennial ryegrass	Fall	60%

Table 2. Agronomic Information

	Arborg	**Carberry**	**Melita**	**Roblin**
Soil Series	Peguis Clay	Wellwood Loam	Waskada Loam	Erickson Loamy Clay
Winter wheat/fall legume seeding date	Sept 19, 2023	Sept 15, 2023	Sept 6, 2023	Sept 27, 2023
Legume spring seed date	May 14, 2024	May 14, 2024	April 15, 2024	April 25, 2024
Fertility (lb/ac)	Background N topped up to 150 lb/ac, 30 lb/ac P2O5			
Herbicides	May 10, 2024 – Refine SG @ 12 g/acre	Sept 12, 2023 – Glyphosate @ 0.7 L/ac; June 20, 2024 – Gasagran Forte @ 0.9 L/ac	Sept 2023 – Glyphosate @ 0.67 L/ac, Heat LQ @ 40 ml/ac; May 2, 2024 – Achieve @ 0.2 L/ac, Basagran @ 0.91 L/ac	Sept 25, 2023 – Glyphosate @ 0.64 L/ac
Winter wheat harvest date	Aug 12, 2024	Sept 19, 2024	Aug 6, 2024	Sept 4, 2024
Legume biomass sampling	October 3, 2024	n/a	n/a	n/a

Table 3. Seeding Rate by Crop Type

Crop Type (Variety)	Seeding Rate
Winter wheat (AAC Wildfire)	323 pl/m^2
Alfalfa (Stellar II)	12 lb/ac
Red clover (single cut, common)	10 lb/ac
White clover (Bombus)	6 lb/ac
Sweetclover (common)	10 lb/ac
Perennial ryegrass (Melpetra)	12 lb/ac

Table 4. Seasonal precipitation and growing degree days from September 1 to November 15, 2023.

Data from Manitoba Agriculture Growing Season Report web43.gov.mb.ca/climate/SeasonalReport.aspx

	Arborg	Carberry	Melita	Roblin
Precipitation (mm)	116	64	100	69
% of Normal precipitation[1]	136	84	126	77
Growing degree days (GDD)	379	388	362	358
% of Normal GDD[1]	178	179	143	205

Table 5. Monthly and growing season (April 1 - October 31, 2024) precipitation and growing degree days for Arborg, Carberry, Melita, and Roblin.

Data from Manitoba Agriculture Growing Season Report web43.gov.mb.ca/climate/SeasonalReport.aspx

	Arborg							
	Apr	May	June	July	Aug	Sept	Oct	Apr – Oct
Precipitation (mm)	33	74	120	62	39	7	10	347
% of Normal precipitation[1]	116	139	154	104	49	15	34	92
Growing degree days (GDD)	36	177	320	468	416	359	80	1860
% of Normal GDD[1]	201	86	95	108	108	189	360	117
	Carberry							
	Apr	May	June	July	Aug	Sept	Oct	Apr - Oct
Precipitation (mm)	65	121	163	21	30	48	8	459
% of Normal precipitation[1]	181	251	233	32	44	99	41	126
Growing degree days (GDD)	57	181	318	461	384	369	102	1876
% of Normal GDD[1]	464	98	95	108	99	194	400	120
	Melita							
	Apr	May	June	July	Aug	Sept	Oct	Apr - Oct
Precipitation (mm)	29	91	109	64	27	10	4	337
% of Normal precipitation[1]	101	169	108	93	35	30	15	85

Growing degree days (GDD)	69	203	307	466	372	345	110	1874
% of Normal GDD[1]	286	99	87	103	90	163	270	110
	Roblin							
	Apr	May	June	July	Aug	Sept	Oct	Apr - Oct
Precipitation (mm)	20	78	116	45	75	32	1	369
% of Normal precipitation[1]	86	174	157	63	134	60	5	105
Growing degree days (GDD)	32	152	242	427	347	319	59	1581
% of Normal GDD[1]	415	89	77	109	98	195	533	112

[1] Based on 30-year averages

Results and Discussion:

Cover Crop Establishment

At all locations cover crop establishment was better with spring broadcast compared to fall seeding. Method of planting likely had an effect on establishment of spring and fall seeded cover crops. Fall seeded cover crops were planted at the same depth as the winter wheat. Deep seeding may have aided emergence if the fall had been dry, but in a year with adequate precipitation likely hindered emergence.

All locations had higher than normal precipitation in May and June (Table 5), which would have aided legume establishment in the spring broadcast treatments.

Fall planted alfalfa had the best establishment of the fall planted cover crops at Arborg and Melita (Table 6). In Roblin there was no significant difference in the establishment of any fall seeded cover crops. Cover crops established better in Arborg than the other locations. This may have been the result of timing of seeding and precipitation, surface residue and soil conditions.

Table 6. Cover crop establishment (pl/m^2) measured in the spring and after winter wheat harvest in the fall.

Least significant difference (LSD) values are shown for sites where there is a significant difference (Pr<0.05) between treatments. Means within the same site year followed by the same letter within a column are not significantly different.

		Arborg		**Melita**		**Roblin**	
Cover Crop	**Timing**	**Spring (pl/m^2)**	**Fall (pl/m^2)**	**Spring (pl/m^2)**	**Fall (pl/m^2)**	**Spring (pl/m^2)**	**Fall (pl/m^2)**
Sweet clover	fall	3d	3d	0b	1d	76b	0b
Alfalfa	fall	111c	73c	16b	26c	12b	4b
Red clover	fall	13d	26d	2b	7d	18b	1b
White clover	fall	5d	7d	0b	1d	2b	1b
Sweet clover	spring	298b	149a	77a	67a	98a	18b
Alfalfa	spring	487a	160a	72a	43b	45b	20b
Red clover	spring	344b	120b	60a	8d	103a	44b
White clover	spring	527a	127ab	63a	13cd	155a	94a
Perennial ryegrass	fall	52cd	63c	0b	10d	5b	2b
LSD		*95*	*33*	*21*	*14*	*77*	*24*

Cover Crop Biomass

Cover crop biomass was collected in the fall, after winter wheat harvest. Due to poor cover crop growth at Melita, Carberry and Roblin, biomass was collected at the Arborg location only.

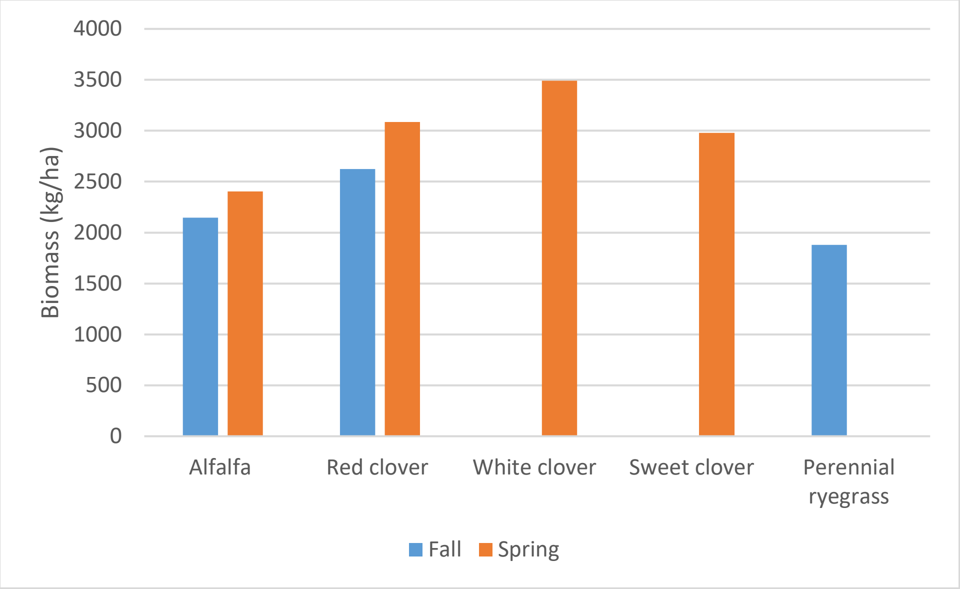


Figure 1: Fall cover crop biomass (kg/ha) at Arborg. Treatments with the same letter above the bars are not significantly different.

Wheat Yield and Protein

Cover crops did not affect winter wheat grain yield. There were no significant differences in wheat yield across all treatments or protein trends between legume and non-legume treatments (Table 7).

Table 7. Winter wheat yield (bu/ac) and protein (%) content.

Least significant difference (LSD) values are not shown since there were no significant differences (Pr<0.05) between treatments at any location.

		Arborg		**Melita**		**Roblin**	
Cover Crop	**Timing**	**Yield (bu/ac)**	**Protein (%)**	**Yield (bu/ac)**	**Protein (%)**	**Yield (bu/ac)**	**Protein (%)**
No cover crop	n/a	66	9.6	92	11.5	87	11.6
No cover crop	n/a	64	9.4	94	10.6	84	11.4
No cover crop	n/a	66	9.3	97	10.9	85	11.6
Sweet clover	fall	68	10.1	90	11.1	86	11.5
Alfalfa	fall	63	9.0	99	11.6	86	11.6
Red clover	fall	62	9.5	101	11.0	87	11.7
White clover	fall	61	9.0	96	10.3	90	11.7
Sweet clover	spring	62	10.0	92	10.5	90	11.7
Alfalfa	spring	63	9.5	96	10.9	85	11.8
Red clover	spring	66	9.9	103	10.7	85	11.3
White clover	spring	60	9.2	98	11.3	82	11.1
Perennial ryegrass	fall	67	9.2	94	10.7	84	11.4
Mean		*64*	*9.5*	*96*	*10.9*	*86*	*11.5*
LSD		-	*n/a*	-	*n/a*	-	*n/a*

Fall Soil Fertility

Nitrate N varied across treatments, but there was no trend towards high N levels in legume treatments or in treatments with higher legume biomass (Table 8). Soil samples were not collected at the Melita location.

Table 8. Nitrate nitrogen (lb/acre) measured in the in the top 0-24" of soil in late fall 2024.

		Nitrate N (lb/acre)	
Cover crop	**Timing**	**Roblin**	**Arborg**
No cover crop	n/a	24	4
No cover crop	n/a	20	4
No cover crop	n/a	16	4
Sweet clover	fall	8	4
Alfalfa	fall	28	8
Red clover	fall	28	8
White clover	fall	24	4
Sweet clover	spring	20	4
Alfalfa	spring	12	8
Red clover	spring	24	4
White clover	spring	16	4
Perennial ryegrass	fall	20	4

Summary:

Fall seeded cover crops did not establish well at Carbery, Melita, and Roblin (Carberry data not shown). Poor establishment may have been related to planting time and depth. Spring seeded cover crops had better establishment, which was in part related to the wet spring conditions at all locations. Wheat yield was not impacted by cover crops. Cover crop biomass production was poor at Carberry, Melita, and Roblin, this may have been due to the winter wheat out competing the cover crops. Cover crop biomass production was excellent at Arborg, with the exception of fall seeded white clover and sweet clover. Soil nitrate N levels at Arborg did not reflect the high biomass production but may be evident in year two of the project. This an interim project report, year 2 of the experiment will be conducted at Arborg only in 2025.

Establishing an Annual Crop-Living Mulch System

Project duration: May 2023 – September 2024

Objectives: To examine the performance of living mulches planted with a spring wheat crop, as well as the impact on wheat grain yield, at four Manitoba locations.

Collaborators:
Jessica Frey, Parkland Crop Diversification Foundation
Joanne Thiessen Martens Department of Soil Science, University of Manitoba
Manitoba Crop Alliance
Prairies East Sustainable Agriculture Initiative
Manitoba Crop Diversification Centre
Westman Agricultural Diversification Organisation

Background:

The use of perennial cover crops outside of the normal growing season provides well-documented benefits to the soil. In Manitoba, where the growing season typically consists of 90-110 frost-free days, establishing a cover crop that persists into the next growing season is a niche form of cover cropping that is termed "living mulch". Perennial legumes are of particular interest in this system for their ability to take up atmospheric nitrogen into their root tissues. When a legume living mulch is planted with an annual field crop, the latter can benefit from the transfer of nitrogen though direct contact with the roots of the legume crop (Xiao et al., 2004). After harvest, the legume remains in the soil, providing similar benefits to the following crop.

Growing multiple crops in the same system results in three possible outcomes: complementarity, facilitation, or competition.

- Complementary systems are typically observed in nature, where plants of different species make use of the same soil space and other resources at different times, varying depths, and even different chemical forms, creating a diverse, resilient, and multipurpose system (Martens et al., 2015). The potential for species to complement each other comes about because of differences in root structure, and timing and balance of nutrient demand (Dowling et al., 2021a).

- Facilitative systems are interplant relationships that take time to develop, such as the decomposition of roots and organic matter from one plant that then contributes to the plant and soil health of the other. In the case of legumes, this leads to an increase in soil N (Wivstad, 1999).
- A competitive system is described by (Dowling et al., 2021a) as one in which "two individuals in a stand interact in such a way that at least one exerts a negative effect on the other", such as through competition for water, soil nutrients and light. In an agricultural setting, this interaction will typically result in decreased yields and financial loss.

The goal of a living mulch system is to take advantage of the complementary and facilitative features of the interacting crop species, while minimizing competition. To achieve this, the living mulch can be seeded in Year 1 at the same time and the same depth as the annual field crop, which allows the more vigorous annual field crop to establish ahead of the slower growing living mulch crop. After harvest of the annual field crop, the living mulch grows without competition. In Year 2, the living mulch is strategically set back through mowing or a non-lethal application of herbicide. This is done to decrease the competitiveness of the living mulch before the seeding of the annual field crop. Importantly, research indicates that damage caused to the top growth of a legume can result in a release of nitrogen in a stable, plant-available form from the legume's roots (Bergkvist, 2003). This release could provide a timely boost of nutrients to the annual field crop.

Materials and Methods

This report presents preliminary results for a spring wheat-living mulch system established in May 2023 at four Manitoba sites (Arborg, Carberry, Melita, and Roblin). Four legume species and one grass species were seeded in the same row and at the same depth as wheat.

Table 1: Treatments

Wheat- only Control 1	Wheat-only Control 3	Wheat – Alfalfa	Wheat – White Clover
Wheat-only Control 2	Wheat – Sweet Clover	Wheat – Red Clover	Wheat – Perennial Ryegrass

Wheat-only control plots will be assigned differing fertility targets in Year 2

Table 2: Site Profiles

	Arborg	Carberry	Melita	Roblin
Soil Sample Date	08-May	28-Apr	28-Apr	27-Apr
Stubble	Canola	Canola	Canola	Millet
Soil Preparation	Direct seed	Direct seed	Direct seed	Direct seed
Seeding Date	23-May	12-May	10-May	12-May
Moisture at Seeding	dry	good	Very good	poor
Added N	All sites background N topped up to 140 lb/ac			
Added P	All sites applied P to match 70 bu/ac target yield			
Pre-emergence spray	May 31 Pardner @ 0.4 L	May 8 Glyphosate @ 0.8L + Heat @ 60ml	May 10 Roundup @ 0.67L + Aim @ 20ml	Glyphosate @ 0.64 L
Mid season spray	Jul 14 Pardner @ 0.4L	Jun 19 Basagran Forte @ 0.8 L + UAN @ 1.6L	Jun 1 Koril @ 0.5L (3 leaf)	Jun 21 Axial @ 0.5L + Basagran Forte @ 0.7L
Anthesis	12-Jul	06-Jul	27-Jun (heading)	28-Jun
Soft Dough	first week August	20-Jul	17-Jul	03-Aug
Reseed	NA	30-Aug	05-Sep	NA

Table 3: Seasonal Weather Data January 1 to December 21, 2023

	Arborg		**Carberry**		**Melita**		**Roblin**	
	Actual	**% Normal**	**Actual**	**% Normal**	**Actual**	**% Normal**	**Actual**	**% Normal**
Precipitation	296	67	255	59	438	89	248	58
Crop Heat Units	3116	115	3097	115	3155	109	2888	118
Growing Degree Days	1898	119	1922	123	1970	116	1757	124

The seeding rate for all the mulch crops targeted the high end of recommendations. The wheat seeding rate targeted the low end of recommendations and was uniform across all treatments. The seeding rates are provided in Table 4.

Table 4: Seeding rate by crop type

Crop type (variety)	**Seeding rate**
Wheat (Landmark)	250 plants/m2
Alfalfa (Stellar II)	12 lb/ac
Red Clover (Single Cut)	10 lb/ac
Sweet Clover (Yellow Blossom)	10 lb/ac
White clover (Bombus)	6 lb/ac
Perennial Ryegrass (Soraya)	12 lb/ac

Results and Discussion:

Establishment

Wheat establishment at three out of the four sites was found to be unaffected by the presence of the living mulch as compared to the wheat-only control plots, even though precipitation received between May 1 and June 15 was well below the 30-year average at all four locations (Arborg 21%, Carberry 41%, Melita 63%, Roblin 67%). In only one case (Roblin) was the emergence for wheat seeded with alfalfa found to be significantly lower. However, subsequent measurements throughout the summer did not show those wheat plots to be disadvantaged. Establishment for wheat is shown in Table 5.

Table 5: Wheat Establishment in pl/m^2 (target plant stand 250 pl/m^2)

Treatment	Arborg	Carberry	Melita	Roblin	
Seeding Date	May 23	May 12	May 10	May 12	
Date of plant count	May 30	May 30	May 23	May 29	
Wheat-only Control	351	255	234	122	a
Sweet Clover	368	225	224	80	ab
Alfalfa	401	276	248	56	b
Red Clover	374	266	254	81	ab
White Clover	410	264	251	76	ab
Perennial Ryegrass	377	280	253	72	ab
SEM	27	2	21	12	
p-value	0.7	0.4	0.9	0.03	

Mulches in Melita established equally well, with no significant outliers performing better or worse. Alfalfa established significantly better at both Arborg and Carberry with sweet clover not far behind alfalfa in Carberry. Alfalfa also established very well in Roblin, although it was initially surpassed by white clover. Establishment for mulches is shown in Table 6.

Table 6: Mulch Establishment (pl/m^2)

Treatment	**Arborg**		**Carberry**		**Melita**	**Roblin**	
	Jun 8		Jun 7		May 31	Jun 9	
Sweet Clover	18	b	110	a	148	89	c
Alfalfa	90	a	148	a	158	193	ab
Red Clover	12	b	49	bc	101	128	bc
White Clover	25	b	22	c	145	206	a
Perennial Ryegrass	37	b	97	ab	130	167	ab
SEM	11		13		20	15	
p-value	0.02		0.0002		0.3	0.0007	

Summer Wheat Biomass

No significant differences were noted between treatments at any of the sites for biomass produced by the wheat plants at soft dough stage when compared to the wheat-only control. The ability of wheat to produce enough biomass to subsequently harness and store the sun's energy through photosynthesis was unaffected by the competitive presence of the mulch.

Mulches did not perform equally well for production of biomass. By late July, biomass samples of the mulch crops began to show some clear advantages or disadvantages for the individual mulches by site. The mulches with superior establishment at Arborg and Carberry continued to perform the best with perennial ryegrass coming forward as a late contender in Arborg. In Roblin, good early establishment did not guarantee the most biomass production. Red clover and alfalfa produced the most biomass, but a sharp decline was seen between the emergence of white clover and its subsequent biomass production, while sweet clover (which did not establish well) demonstrated a marked increase of growth by late July.

Table 7: Wheat Biomass at Soft Dough (kg/ha)

Treatment	Arborg	Carberry	Melita	Roblin
Date	Aug 9	Jul 24	Jul 24	Aug 3
Wheat-only Control	9786	6733	7213	7774
Sweet Clover	8682	7713	6412	7128
Alfalfa	9006	7120	7281	6715
Red Clover	8358	6733	7728	7291
White Clover	10,155	7532	7296	7357
Perennial Ryegrass	8543	6990	7059	6981
SEM	695	571	588	409
p-value	0.4	0.8	0.7	0.9

Table 8: Summer Mulch Biomass (kg/ha)

Treatment	Arborg	Carberry	Melita	Roblin	
Date	Aug 9	Jul 24		Aug 3	
Sweet Clover	14	820	-	94	a
Alfalfa	121	895	-	153	a
Red Clover	-	-	-	125	a
White Clover	-	-	-	10	b
Perennial Ryegrass	159	-	-	11	b
SEM	34	337	-	18	
p-value	0.08	0.9	-	0.0002	

Anomalies

The following anomalies occurred at the participating sites:

- At Melita, all mulch crops were killed due to a spraying error of Bromoxynil at Melita. These plots were reseeded after the wheat harvest, with the aim of continuing the trial in Year 2.
- At Carberry, red clover, white clover, and perennial ryegrass was reseeded at the end of summer, due to negligible emergence for those crops.
- At Arborg, red clover and white clover produced very low amounts of biomass, but based on the plant counts, the crops were not reseeded. The plants are expected to produce sufficient biomass in Year 2.

It is interesting to note that, with the exception of perennial ryegrass in Arborg, the mulches with the lowest biomass production were the ones that have fibrous root systems. It is possible that these mulches were less able to compete with wheat for the limited moisture, as they were exploring the same rooting zone.

Wheat Yield and Protein

Whereas yields and protein content differed between sites, no significant difference was observed between treatments on each site when compared to the wheat-only control. Although higher yields and protein content were observed at Arborg as compared to the other sites, the results remain comparable with the wheat-only control, with no significant difference between treatments. Wheat-only treatments are likewise comparable to the other wheat-mulch treatments at Roblin and Carberry (Table 9).

Table 9: Wheat Yield (bu/ac) and Protein content (%)

Treatment	**Arborg**		**Carberry**		**Melita**		**Roblin**	
Harvest Date	Sep 13		Aug 29		Aug 17		Aug 30	
	Yield	Protein	Yield	Protein	Yield	Protein	Yield	Protein
Wheat-only Control	92	15	37	12	60	12.4	60	12.9
Sweet Clover	91	15	38	12	53	12.0	61	13.2
Alfalfa	88	14.2	39	12	59	12.8	53	13.6
Red Clover	91	15.1	33	13	66	11.8	57	12.9
White Clover	94	15.1	40	12	53	13.4	58	13.0
Perennial Ryegrass	83	14.9	40	12	60	12.0	60	13.3
SEM	6	0.3	2	1	5	0.7	2	0.3
p-value	0.8	0.4	0.2	0.6	0.5	0.6	0.4	0.5

Post-harvest Mulch Performance

After the annual field crop is harvested, the mulch has unrestricted access to sunlight and soil moisture. Biomass samples taken in the late fall indicate the mulch's ability to grow before a killing frost, fixing nitrogen in the case of the legumes, and enhancing features such as soil structure and aeration, water penetration, and mycorrhizal activity. Table 10 shows the post-harvest performance of the mulch crops.

Table 10: Post-harvest mulch performance (kg/ha)*

Treatment	Arborg		Carberry	Melita	Roblin	
Date	Oct 18		Oct 20	Oct 20	Oct 17	
Sweet Clover	84	b	R	R	290	bc
Alfalfa	452	ab	273	R	557	a
Red Clover	-		301	R	339	b
White Clover	-		R	R	118	c
Perennial Ryegrass	1365	a	R	R	297	b
SEM	203		83	-	40	
p-value	0.03		0.8	-	0.0001	

** R = Reseeded after wheat harvest*

Trends already observed at earlier points in the season continued with the fall biomass cut. Alfalfa was the only mulch crop with a significantly higher level of biomass production at Roblin. Alfalfa also performed well (though not “best”) at Carberry and Arborg. Perennial ryegrass produced the most biomass at Arborg and red clover produced slightly more biomass than alfalfa at Carberry. For the mulches that were reseeded at Carberry and Melita, perennial ryegrass re-established significantly better than the other reseeded mulches.

Discussion:

The dry field conditions in early 2023 made challenges to the establishment of the treatments more readily observable than if soil moisture had been abundant. Each of the mulch crops has a different type of rooting system: whereas wheat has a fibrous system of roots, alfalfa and sweet clover are best described as having deep tap roots. It is hypothesized that these differences are a determining factor in whether the interaction that develops between the two crops is complementary (i.e., one that drives both crops to greater exploration of their soil resources), or competitive (i.e., where one crop overpowers the other for water and nutrients). When moisture is scarce, wheat roots will tend to explore more laterally for soil moisture, while alfalfa and sweet clover will tend to explore deeper into the soil. Dowling et al. (2021) refer to this more complementary interaction as "sparing" relationship, in which each crop "spares" soil moisture for the other. Conversely, when moisture is scarce, the more fibrous root systems of red clover, white clover, and perennial ryegrass can result in direct competition with the root systems of wheat plants, as each plant will search for moisture.

Biomass production at mid-season is an important measurement for both crops that have been seeded together. For wheat, this measurement, taken at soft dough stage, represents how much resources the plants have been able to allocate to vegetative growth throughout the season. The measurement corresponds with the photosynthetic capacity to harness and store energy for the next generation of seeds (yield) and protein storage (as a measure of seed quality). A significant decrease in biomass production for wheat seeded with a mulch crop, as compared to a wheat-only crop, would indicate that the mulch had outcompeted the wheat for water and nutrients.

For the mulch crop, biomass production signifies the plant's ability to perform its beneficial functions. Although not measured directly in this project, it is well understood that below-ground biomass (roots) increases in tandem with above-ground biomass. More root growth translates to increased soil aeration, water penetration and soil structure, the ability to form beneficial fungal hyphae networks, and increased surface area for nitrogen fixing soil bacteria to nodulate (Blackshaw et al., 2010). In the complementary relationship between legumes and nitrogen fixing bacteria, greater photosynthetic capacity for legume mulches also enhances the bacteria's nitrogen fixing potential. In an intercrop scenario, excess nitrogen can be shared with the non-leguminous annual field crop.

The measurement of greatest interest in Year 1 is wheat yield and protein content. The comparable wheat yields for intercropped and wheat-only treatments is an indicator that, at the very least, the competition from the mulch has not detracted from the quantity (yield) and quality (protein content) of wheat that was produced.

Summary:

Ultimately, it is desirable for both plants in this system to do well. Whereas no decline in wheat performance is an encouraging result, there was also no increase in wheat grain yield. This indicates that, in the year of establishment, the mulch crops did not provide observable advantages to the wheat crop (such as nitrogen resulting in increased yield or protein content). Based on the relatively dry growing conditions and the overall low levels of biomass production that were observed, these results are not surprising.

Year 2 will provide another layer for understanding the interactions between the annual field crop (canola) and the living mulch. As a tap-rooted crop, it is anticipated that the interactions between canola and the mulch crops will be effectively reversed: the deep-rooted alfalfa and sweet clover crops may develop a more competitive relationship with canola, whereas the more fibrous-rooted crops may develop more complementary relationships. Nevertheless, the release of nitrogen caused by disturbing the top growth of the mulches, is expected to benefit the canola crop during critical phases of its development.

Effect of Nitrification Inhibitors and Lower Nitrogen Rates on GHG Emissions in Manitoba Field Crops

Project duration:	May 2024 – September 2024
Objectives:	To examine two approaches to reduce emissions, reduce nitrogen (N) rates and include nitrification inhibitors with fertilizer nitrogen. To compare the agronomics of sustained additions of 100, 90 and 70% of recommended N, and emissions at 100% N without and with nitrification inhibition.
Collaborators:	Mario Tenuta (University of Manitoba) Manasah Mkhabela (Climate Change Specialist – Manitoba Agriculture) Parkland Crop Diversification Foundation (PCDF) Prairies East Sustainable Agriculture Initiative (PESAI) Westman Agricultural Diversification Organisation (WADO)

Background:

Manitoba farmers seek practical and cost-effective methods to reduce nitrous oxide (N_2O) emissions from field crop production. This project utilizes the four Crop Diversification Centres in Manitoba to investigate two strategies: reducing nitrogen (N) rates and using nitrification inhibitors with fertilizer nitrogen. Over three years, trials will assess the agronomics of sustained reductions in N rates (100%, 90%, and 70% of recommended) and emissions at 100% N with and without nitrification inhibition.

The Federal Government aims to decrease greenhouse gas (GHG) emissions, particularly N_2O from fertilizer use, by 30% below 2020 levels by 2030. Achieving this reduction in Manitoba's agriculture sector requires a shift in farming practices. Research suggests various methods to reduce emissions, but farmers are uncertain about the practicality and financial impact. Currently, N_2O emissions are calculated using a Tier II protocol based on nitrogen fertilizer application rates and emission factors by eco-district. Concerns arise that N use reductions may be mandated to meet emission targets, potentially impacting farmers' profits and GDP. However, research indicates that modest N rate reductions may not decrease yields in the short term. While short-term results show no yield decrease, long-term effects are uncertain. This project aims to investigate sustained rate reductions' impact on yields across Manitoba regions and explore whether strategies like the 4Rs can support such reductions.

Research Plan:

This study, conducted in collaboration with the four Diversification Centres (DCs) in Manitoba, involves establishing replicated trials over three years. Different N rate treatments and the use of a nitrification inhibitor (SuperU) are tested across four locations. Each plot maintains the same treatment throughout the study to evaluate cumulative effects. Gas emissions, soil properties, crop performance, and weather data are monitored and analyzed to assess treatment impacts.

Project findings:

Led by Dr. Mario Tenuta, this project contributes to a broader, multi-site study. Combined findings from all four diversification centres will be disseminated by Dr. Tenuta and the research team, with the MCDC posting a link to the report on their website.

Development of Decision Support Tools for Fusarium Head Blight Management in Western Canada

Project duration: September 2023 – August 2024

Objectives: To increase understanding of resulting Fusarium Head Blight (FHB) infection for spring and winter wheat, barley and durum based on the current model.

To develop weather-based models to assess the risk of FHB infection and DON in spring wheat, winter wheat, barley and durum crops with different FHB resistance ratings.

To develop an interactive prairie-wide viewer and FHB/DON risk-mapping tool that is accessible to producers and industry to assist with fungicide application decisions.

Collaborators: Manasah Mkhabela (Climate Change Specialist – Manitoba Agriculture)

Results:

During the 2023-24 planting year, FHB samples were collected from MCVET Winter Wheat Variety Evaluation trial, MCVET Spring Wheat Variety Evaluation trial, and MCVET Barley Variety Evaluation trial. Grain samples were sent for Fusarium specific analysis, but no report for these results has yet been generated. The MCDC will post a link when this report is available. The quality ratings for the crops are not included here.

Project Findings:

The 2024-planting year was the sixth year of testing at MCDC site and data were handed over to University of Manitoba. Researchers are compiling data from all diversification centres sites and will report later on.

Background:

Fusarium head blight (FHB), also known as scab or tombstone, is a serious fungal disease of wheat (including durum), barley, oats and other small cereal grains and corn. It can also affect wild and tame grass species. However, the crops most affected are wheat, barley and corn. FHB affects kernel development, reducing yield and grade. It can also contaminate grain with a fungal toxin (mycotoxin) produced in infected seeds. Infection of the harvested grain and/or mycotoxin production negatively affects:

- livestock feed
- baking and milling quality of wheat
- biofuel (ethanol) production
- malting and brewing qualities of malt barley

Farmers need improved decision-making tools in order to assess the local risk of Fusarium Head Blight (FHB). Better tools would improve judgement on whether or not to use fungicide and how to time application. The project recognizes that the current model for predicting the presence of FHB is insufficient and is gathering data across the province for different treatment plans using both known fusarium resistant and fusarium susceptible varieties. This project design centred on learning more about how spore density in the air at specific times of plant maturation affected FHB infection. The specific window of interest is during flowering and up to five days before flowering.

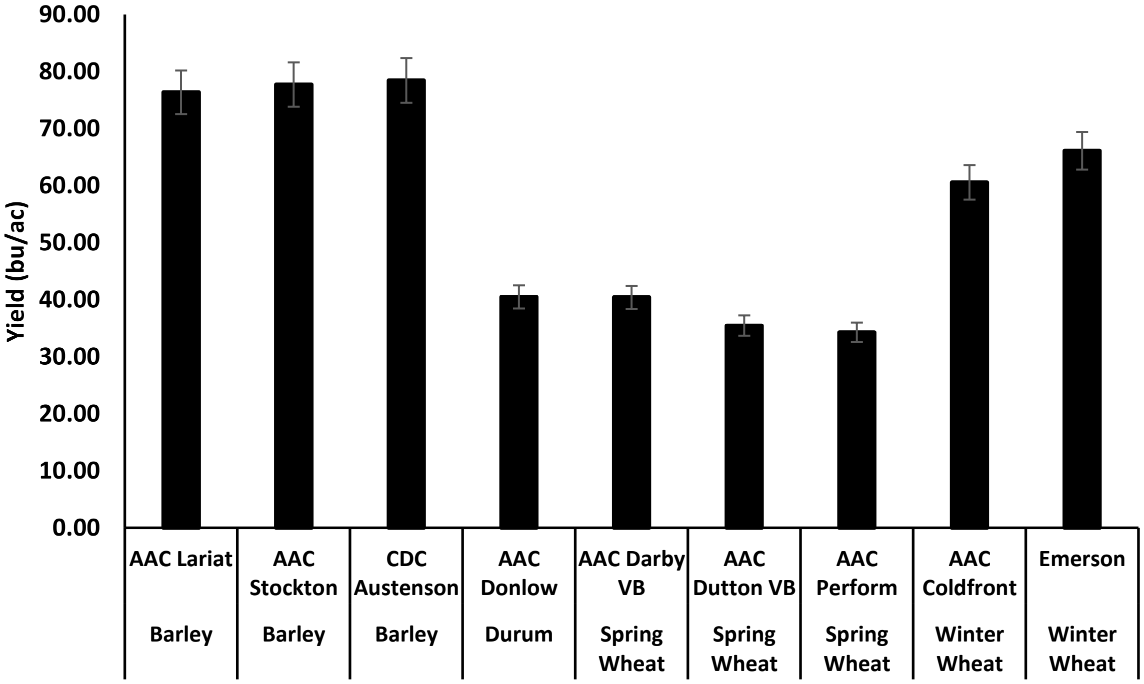


Figure. 1 Average yields for cereals tested during 2023-24

Fusarium head blight is caused by several species of the fungal genus Fusarium. Fusarium graminearum (F. graminearum or Fg) is the species that causes the most serious damage to crops. FHB is favoured by warm, humid conditions during flowering and early stages of kernel development.

Materials & Methods:

Entries: Three varieties for each spring wheat and barley, two varieties for winter wheat, and one variety for durum

Seeding: Winter Wheat seeded in September 2023;

Barley, Spring Wheat and Durum seeded in May 2024.

Harvest: All cereals were harvested in August 2024.

Varieties: Winter Wheat: AAC Coldfront, and Emerson

Spring Wheat: AAC Darby VB, AAC Dutton VB, and AAC Perform,

Barley: AAC Lariat, AAC Stockton, and CDC Austenson

Durum: AAC Donlow

Data collected	**Date/Stage collected**
Plant Counts:	Three leaf stage (and spring emergence for winter wheat)
Plant Staging:	Weekly staging beginning at late booting through late flowering
Spore Collection:	Beginning just before winter wheat flowering spanning five weeks and covering all cereals flowering
FHB sampling & rating:	18-21 days after flowering – Enumeration of FHB afflicted kernels per head in a given sample size of fifty heads per plot
Heights:	Multiple
Yield:	Multiple
Moisture:	Multiple

Grain samples sent to University of Manitoba to analyze for grading, fusarium species assessment, and mycotoxin analysis.

Discussion (Yield):

The yield data analysis revealed significant differences among the tested varieties. CDC Austenson recorded the highest yield (78.44 bu/ac), forming a distinct group (a), followed by AAC Stockton (77.72 bu/ac) and AAC Lariat (76.36 bu/ac) in groups b and c, respectively. These barley varieties consistently outperformed wheat varieties, highlighting barley’s superior productivity under the given conditions. Emerson and AAC Coldfront, both winter wheat varieties, had significantly higher yields than the spring wheat and durum wheat varieties, with mean yields of 66.11 bu/ac and 60.57 bu/ac, respectively. Among spring wheat varieties, AAC Darby VB and AAC Donlow (durum wheat) showed moderate performance, while AAC Dutton VB and AAC Perform had the lowest yields, placing them in group h.

The statistical differences identified through the Tukey HSD test suggest that varietal selection is a key determinant of yield potential. The significantly lower yields of spring wheat and durum wheat varieties, compared to winter wheat and barley, suggest that environmental factors such as growing season length and resilience to stress may influence productivity. The superior performance of barley varieties may be due to their adaptability and shorter growing season requirements. Additionally, the grouping of AAC Dutton VB and AAC Perform in the lowest yield category suggests that these varieties may be less suited to the tested conditions or require different management strategies to maximize productivity. These findings highlight the importance of selecting high-performing varieties to optimize yield in specific environments.

Agronomic info:

Standard recommended agronomic protocols were adopted for each crop. Fertilizers were applied according to soil test results. Herbicide were applied, when required.

Effect of Fertilizer Management on Dry Beans Agronomic and Economic Performance

Project 1:

Black Beans Nitrogen Study

Project 2:

Black Beans Phosphorous Study

Project 3:

Pinto Beans Nitrogen Study

Project 4:

Pinto Beans Phosphorous Study

Project duration: May 2024 – October 2024

Objective: To determine the effect of rate of fertilizer N, applied with and without inoculant, on the growth, yield and quality of solid-seeded dry bean in southwestern Manitoba.

To determine the effect of fertilizer P rate and placement on dry bean performance.

Collaborators: Ramona Mohr, Gordon Finlay (Agriculture and Agri-Food Canada)

Manitoba Pulse & Soybean Growers.

Background:

In Manitoba, dry bean acreage has grown from 90,000 acres in 2015 to 168,300 acres in 2019, with total production ranging from 80,000 to 110,000 metric tonnes over this period (Statistics Canada 2020). Increasing interest in dry bean in southwestern Manitoba, which has not traditionally been a major bean-producing area, has generated questions as to optimum management practices for the growing conditions in this region. However, as a smaller acreage crop, comparatively little research has been done on dry bean production in Manitoba, particularly for the southwest region.

Increasing interest in dry bean production in southwestern Manitoba has generated questions regarding optimum nitrogen (N) and phosphorus (P) management practices for this region. As a smaller acreage crop, comparatively little research has been done on dry bean production in Manitoba, particularly for the southwest region.

In 2021, a two-year field study was initiated on black and pinto bean: 1) to determine the effect of fertilizer N rate, applied with and without commercial inoculant, and 2) to determine the effect of rate of fertilizer P, seed-placed or side-banded. From 2021 to 2022, five site-years of data were collected from randomized, replicated plot trials at AAFC-Brandon, MCDC-Carberry, and WADO-Melita. In 2022, one additional study was conducted under irrigation at AAFC-Brandon and MCDC-Carberry to determine the effect of fertilizer N rate on white mould in black and pinto bean. These studies were continued in 2024 at AAFC-Brandon and MCDC-Carberry.

In 2024, the yield of black and pinto bean increased with increasing N rate at both Brandon and Carberry, with yield typically increasing with N application then levelling off or declining as N rate increased. Results suggested that yield response to N varied with inoculation for black bean in Carberry, but no clear trends were evident. Overall, yield responses to N in 2024 appeared to be more pronounced than in 2021-22 trials, with the highest-yielding N treatments averaging from 121 to 153% of the 0N treatment depending on the experiment. Inoculation was not found to increase yield in 2024. In irrigated trials, N rate did not have a statistically significant effect on white mould at Brandon although results suggested that higher N rates may be associated with increased disease incidence and severity, which may have contributed in part to an observed reduction in the yield of pinto bean with higher N rates.

In 2024 at Carberry, neither P fertilizer rate nor placement affected the yield of pinto bean. In contrast, the yield of black bean increased with P application but was not affected by P placement. These studies will be continued in 2025.

Project Activities:

Field studies were initiated at Brandon (AAFC) and Carberry (Manitoba Crop Diversification Centre) in 2024 to determine the effect of nitrogen (N) and phosphorus (P) management on dry bean. Treatments in the N study consisted of a factorial combination of five N rates (0, 35, 70, 105, 140 kg N/ha, as sidebanded urea), applied with or without commercial inoculant. In addition, an irrigated study was conducted at Brandon to determine the effect of five fertilizer N rates (0, 35, 70, 105, 140 kg N/ha, as sidebanded urea) on white mould. In the P study, treatments consisted of four P rates (0, 20, 40, 60 kg P_2O_5/ha as monoammonium phosphate), seed-placed or sidebanded. Each trial was conducted with recommended varieties of black and pinto bean, with plot size determined by the equipment at each site. Dry bean was direct-seeded into standing stubble on a narrow row spacing in late May to early June, and harvested by plot combine in September. Generally-accepted agronomic practices were used. Excess spring moisture in the P Study at Brandon resulted in reduced and uneven emergence and crop variability through the growing season; therefore, data from this field trial is not reported herein and the trial will be conducted again in 2026.

Based on preliminary soil tests at Brandon, soil test N in fall 2023 averaged 34 kg NO_3-N ha^{-1} to 60 cm in the N study, and 18-21 kg NO_3-N ha^{-1} to 60 cm in the irrigated N Study. At Carberry, initial soil tests from the field where trials were located measured 29 kg NO_3-N ha^{-1} to 15 cm and 20 ppm Olsen P to 15 cm. Detailed soil samples were collected in spring 2024 and analysis is ongoing.

Information collected included plant density, days to emergence, vigour score, plant height, lodging score, days to flowering and maturity, nodulation score (N study), and yield. In the irrigated N study disease incidence and severity in dry bean were determined on pinto and black beans (50 plants per plot) for Sclerotinia stem rot using a 0-4 disease rating scale. Grain quality and nutrient analysis is underway. For this report, data were analyzed separately for each experiment using Proc Mixed in SAS. Average data are presented for rate, inoculation and placement where interactions between main factor effects were not significant.

Preliminary Results:

Nitrogen Study

Neither inoculation nor the application of side-banded urea affected plant stand. Fertilizer N application increased the in-crop N status of dry bean in 3 of 4 experiments, with in-season chlorophyll meter readings at the 3rd trifoliate (V3) and beginning flowering (R1) stages showing numerical or statistical increases with increasing N rate for one or both crop stages (data not presented). Inoculation did not affect chlorophyll meter readings in 2024. Nitrogen application increased the plant height of both black and pinto bean at Brandon but not at Carberry, while inoculation had no effect at either site. Lodging was negligible in all experiments regardless of treatment. Nodulation score varied somewhat among sites, suggesting differences in the potential for biological N fixation. At Brandon, nodulation score was relatively low overall, and decreased with increasing fertilizer N rate from 1.1/4 to 0.2/4 for black bean and from 1.4/4 to 0.6/4 in pinto bean as N rate increased from 0 and 140 kg N ha^{-1}. In contrast, at the Carberry site, nodulation score increased with increasing fertilizer N rate, from 0.7/4 to 2.3/4 in black bean and from 1.2/4 to 2.4/4 in pinto bean as fertilizer N rate increased from 0 and 140 kg N ha^{-1}. This contrasts with previous years' data which typically demonstrated a decline in nodulation score with increasing fertilizer N rate. At Brandon only, inoculation slightly increased nodulation score for pinto bean (0.8/4 to 1.1/4), with a similar trend (P=0.08) for black bean (0.4/4 to 0.55/4).

Fertilizer N application increased yield of black bean at Brandon and pinto bean at both sites, with yield typically increasing with N application then levelling off or declining with further increases in N rate (Fig. 1a); inoculation had no effect on yield (Fig. 1b). For black bean at Carberry, a significant interaction was evident between N fertilizer rate and inoculation indicating that the effect of N rate varied with inoculation; however, no clear trend was observed (Fig. 2). Overall, yield increased with increasing N rate and was higher on average without inoculant in this experiment. Percent protein in black bean at Brandon increased with increasing N rate from 21.4% with 0N to 25.6% with the application of 140 kg N ha^{-1}; treatment had no effect on % protein in black bean at Carberry. Protein analysis of pinto bean is underway.

Irrigated Nitrogen Study

Black and pinto bean averaged 3360 and 2920 kg ha^{-1}, respectively. Based on analysis of variance, N rate did not affect seed yield in 2024; however, contrast analysis showed a decline in the yield of pinto bean with increasing N rate from 3033 kg ha^{-1} in the 0N treatment to 2504 kg ha^{-1} with the highest N rate.

In pinto bean, the mean disease incidence (%) ranged from 49 to 72 with an overall mean of 56, and mean disease severity (on a 0-4 scale) across all plants averaged 1.6, ranging from 1.4 to 2.2. The highest disease incidence (72%) and severity (2.2) was observed with the highest N rate (140 kg N ha^{-1}). In black bean, the incidence of white mould ranged from 23 to 49%, with an overall mean of 33%, while severity ranged from 0.5 to 1.3, with a mean of 0.7. As for pinto bean, the highest disease incidence (49%) and severity (1.3) was associated with the highest N rate (140 kg N ha-1). Despite the observed differences, there were no statistically significant differences in disease incidence and disease severity among N rates for Sclerotinia disease. However, this indicates that the field study demonstrated relatively uniform disease pressure, allowing for a clear assessment of the impact of different nitrogen rates on Sclerotinia white mould in pinto and black beans. The trends suggest that N application might be associated with increased disease incidence and severity due to conditions like earlier canopy closure, increased canopy density, and humidity, which are more favorable for disease development, potentially leading to detrimental effects on crop yield.

Phosphorous Study

At Carberry in 2024, P rate and placement had occasional but inconsistent effects on black and pinto bean. Fertilizer P application had no effect on the number of days from planting to emergence, with black and pinto bean averaging 8 and 11 days respectively, regardless of treatment. In pinto bean, plant stand increased slightly with increasing P rate than decreased with the highest P rate, averaging 36, 40, 42 and 34 plants m^{-2} for P rates of 0, 20, 40 and 60 kg P_2O_5 ha^{-1}, respectively. Regardless of P rate, plant stand in pinto bean was lower where P was sidebanded rather than seed-placed (35 vs 40 plants m^{-2}); however, the reason for this effect is unclear. Neither P rate nor placement affected plant stand for black bean. Further, fertilizer P had no effect on early-season biomass production or plant vigour ratings for either black or pinto bean, although the plant vigour score in black bean tended (P=0.07) to be slightly greater overall where P was side-banded rather than seed-placed (8 vs 8.6 on a scale of 0 to 10).

Neither P fertilizer rate nor placement affected the yield of pinto bean. In contrast, the yield of black bean increased with P application while P placement had no effect on yield (Figure 2). In part, higher soil test P levels at the Carberry site (20 ppm Olsen P to 15 cm based on preliminary testing) may have reduced crop responses to fertilizer P application. Detailed soil analysis is ongoing.

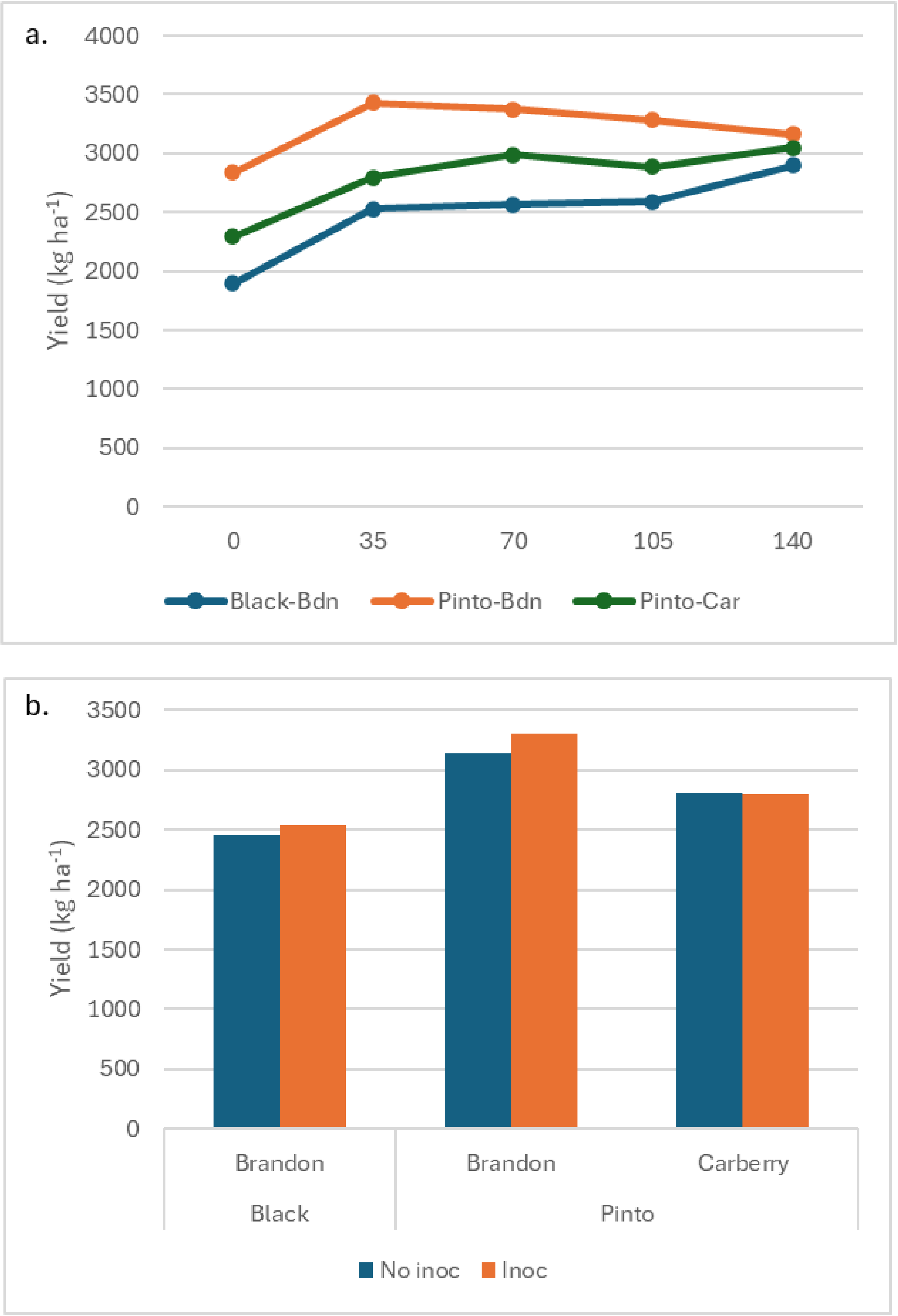


Figure 1. Effect of nitrogen fertilizer rate (a) and inoculation (b) on dry bean yield at Brandon and Carberry in 2024. Rate effects were significant ($P \leq 0.05$) at all sites. Effects of inoculant and interactions were not significant ($P > 0.05$).

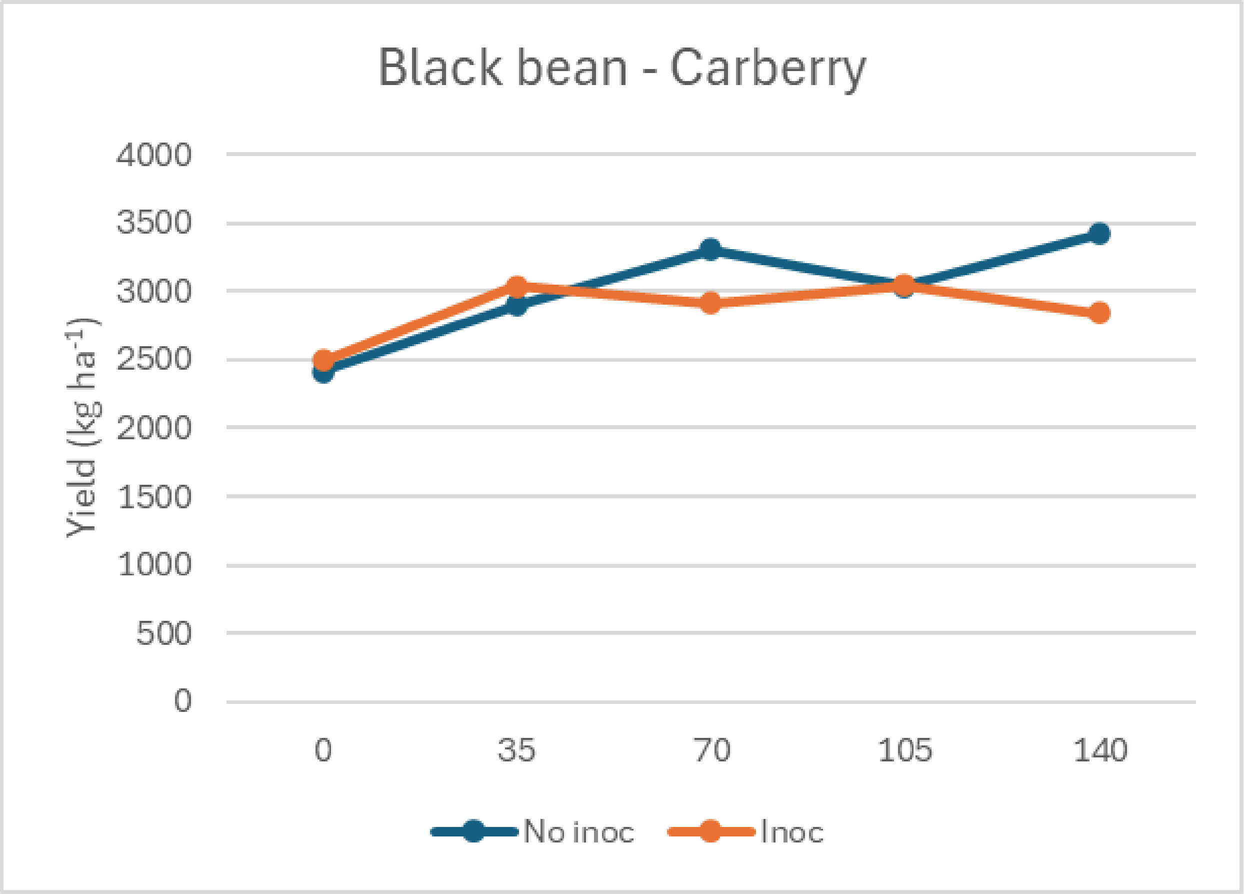


Figure 2. Effect of nitrogen fertilizer rate and inoculation on black bean yield at Carberry in 2024. Rate (P<0.001), inoculation (P=0.02), and rate x inoculation (P=0.001) effects were statistically significant at this site.

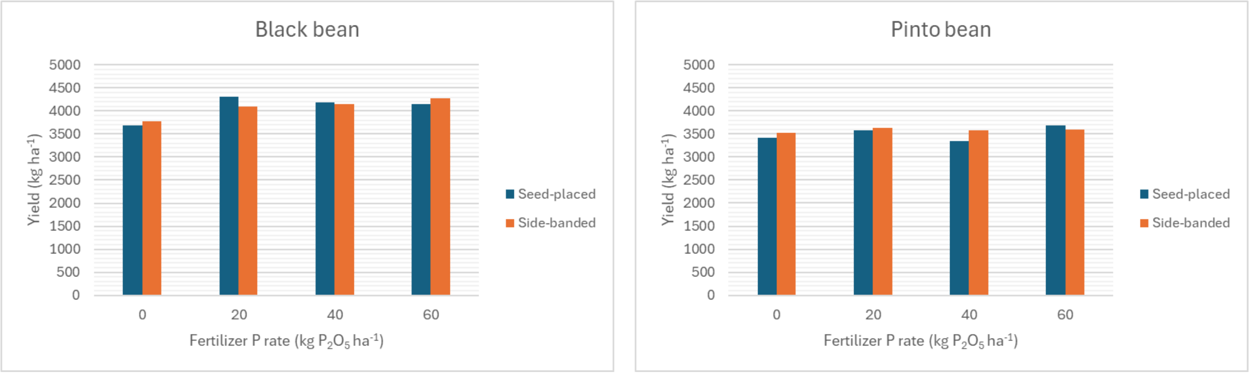


Figure 3. Effect of phosphorus fertilizer rate and placement on yield of black and pinto bean at Carberry in 2024. Rate was significant for black bean only (P=0.03), with yield increasing linearly (P=0.02) with increasing P rate. Effects of placement and interactions were not significant (i.e. P>0.05).

Methodology

Site Selection: A site with wheat (cereal) stubble with no recent history of dry bean was selected. A site with low soil test N that is expected to be responsive to fertilizer N application, was required. The study was conducted under rain-fed conditions. Study 1a was conducted at Brandon site under irrigated conditions to support disease development. A site with low soil test P (Olsen P) was required to increase the potential for a crop response to fertilizer P application.

Experimental design: Separate but otherwise identical trials were conducted for each of black and pinto bean at each site, for both the N and P experiments. Black and pinto bean trials were established adjacent to one another.

Study 1: Experimental design was RCBD with 4 reps; with treatments consisting of a factorial combination of five N rates, applied with or without inoculant and two additional treatments of 35, 105 kg N/ha, as sidebanded SuperU:

- N rate: 0, 35, 70, 105, 140 kg N/ha, as sidebanded urea
- Inoculants: +/- commercial inoculant, BOS self-adhering peat (BOS Inoculants – Nutriag)

Total plots per experiment = 40 (10 trt x 4 reps)

> *ie. Two separate experiments – one consisting of 40 plots of pinto beans, and one consisting of 40 plots of black beans - will be established at each site.

Treatment	kg N/ha applied	+/- inoculant
1	0	+ inoc
2	0	- no inoc
3	35 kg N/ha	+ inoc
4	35 kg N/ha	- no inoc
5	70 kg N/ha	+ inoc
6	70 kg N/ha	- no inoc

7	105 kg N/ha	+ inoc
8	105 kg N/ha	- no inoc
9	140 kg N/ha	+ inoc
10	140 kg N/ha	- no inoc

Study 1a: RCBD with 4 reps; with treatments consisting of five N rates, with all treatments receiving commercial inoculant (BOS self-adhering peat inoculum as outlined above):

- N rate: 0, 35, 70, 105, 140 kg N/ha, in the form of an enhanced efficiency N fertilizer (to reduce leaching potential under irrigated conditions)

Total plots per experiment = 20 (5 trt x 4 reps)

> *ie. Two separate experiments – one consisting of 20 plots of pinto beans, and one consisting of 20 plots of black beans - will be established at each site.

Study 2: RCBD with 4 reps; with treatments consisting of a factorial combination of four P rates, seed-placed or side-banded:

- P rate: 0, 20, 40, 60 kg P_2O_5/ha, as monoammonium phosphate (11-52-0)
- Placement: seed-placed or side-banded

Total plots per experiment = 32 (8 trt x 4 reps)

> *ie. Two separate experiments – one consisting of 32 plots of pinto beans, and one consisting of 32 plots of black beans - will be established at each site.

Treat	kg P_2O_5/ha	Placement
1	0	seed placed
2	0	sideband
3	20	seed placed
4	20	sideband
5	40	seed placed

6	40	sideband
7	60	seed placed
8	60	sideband

General Management:

Plot size: The plot size was 4 m wide and 10 m long.

Seeding: Direct seed into standing stubble; solid-seeded/narrow row spacing.

Seeder: Small plot Wintersteiger Victory Planter.

Cultivar: Cultivars with good agronomic characteristics well-adapted to the region:

Black bean: Blackstrap

Pinto bean: Windbreaker

Inoculant: For inoculated treatments, commercially-available rhizobia (BOS self-adhering peat, BOS Inoculants – Nutriag) was applied at recommended rates and using recommended methods, as appropriate for dry bean (*Rhizobium leguminosarium* biovar *phaseoli*).

Seeding rate: Pinto and Black: 90-120,000 plants/ac (22-30 live plants/m^2)

Adjusted seeding rate for germination and seed size to achieve goal plant density.

Seeding rate (kg/ha) = Seed weight (g/1000 seeds) * Target plant population (plants per square metre) divided by % expected emergence (eg. 80).

Seeding date: Dry beans were seeded when soil temperature was consistently above 15°C. May 31 and June 01

Seeding Depth: 1.5”

Rolling: Beans were rolled after seeding and prior to emergence.

Effect of Residue Management on Growth, Yield and Quality of Black Beans

Project duration: May 2024 – October 2024

Objective: To determine the effect of preceding residue management on dry bean production in the eastern Prairies

Collaborators: Ramona Mohr, Gordon Finlay (Agriculture and Agri-Food Canada)

Manitoba Pulse & Soybean Growers.

Background:

In Manitoba, dry bean seeded acreage has grown from 113,900 acres in 2016 to 193,300 acres in 2021, with total production ranging from 79,900 to 109,436 metric tonnes over this period (Statistics Canada 2022). At the same time, there has been increasing interest in dry bean production in southwestern Manitoba which has generated questions regarding optimum management practices for this area.

Although dry bean is commonly grown under conventional tillage, recent field trials in Carman and Portage la Prairie, Manitoba found that pinto bean produced the same or higher yields when seeded into untilled versus tilled wheat, canola, corn or bean stubble (MacMillan 2021). While preceding crop species did not affect bean yield, yields were 10 to 17% higher in 2 of 6 site-years for direct-seeded versus tilled treatments. Increased plant densities in tilled treatments, and impacts on weed populations were also noted. In Alberta studies, Blackshaw et al. (2007) similarly found that dry bean yield was similar in zero- and conventional-till across a range of crop stubble types, although zero till delayed dry bean emergence in 1 of 6 site-years albeit with no effect on maturity date.

Dry bean, like soybean, is a warm season crop and sensitive to frost damage in the spring and fall. As a result, recommended planting dates range from mid-May to early June, once soil temperatures are consistently greater than 15C, for Manitoba (Manitoba Pulse and Soybean Growers). By influencing soil temperature and/or moisture conditions, residue management practices may create conditions more favourable for early season crop establishment and growth.

Experimental Design and Treatments:

A Randomized Complete Block Design (RCBD) with four replications was implemented. The experiment included seven preceding crop treatments:

1. Fall-tilled wheat residue
2. Fall + spring tilled wheat residue
3. Short wheat stubble with straw retained (15 cm standing stubble)
4. Short wheat stubble with straw removed (15 cm standing stubble)
5. Tall wheat stubble with straw retained (30 cm standing stubble)
6. Tall wheat stubble with straw removed (30 cm standing stubble)
7. Fall-burned wheat stubble

Cropping Schedule:

In 2024, wheat was grown as a stubble crop to establish residue treatments for the 2025 dry bean planting. The cropping sequence for the trial was as follows:

	2024	**2025**	**2026**
Year 1	Stubble crop	Dry Bean	
Year 2		Stubble crop	Dry Bean

Seeder / Plot Size:

Plots measuring 4 m x 10 m were used. Large plot sizes were preferred to minimize edge effects on soil temperature and moisture. Dry beans will be seeded midway between standing stubble rows for uniformity. Whenever feasible, all plots were oriented in the same direction (e.g., north-south) to maintain consistent shading conditions.

Seeding Details:

Seeding was conducted using a solid-seeding (narrow row spacing) approach, ensuring uniformity across treatments. The target seeding date was set for when soil temperatures in tilled plots consistently exceeded 15°C at a 5 cm depth. Although Manitoba Pulse and Soybean

Growers (MPSG) recommended seeding between May 20 and June 7, early planting within this window was prioritized to capture treatment differences more effectively.

Cultivars and Seeding Rates:

At the Brandon site, **AAC Brandon** wheat and **Eclipse black bean** (with seed treatment) were used. The target plant populations were:

- **Wheat:** 250 plants per m^2 (400 seeds per m^2)
- **Black bean:** 105,000 plants per acre (26 live plants per m^2)

Seeding rates were adjusted based on germination rates and seed size to achieve these target plant densities.

Seeding Depth and Rolling:

Dry beans were seeded at a depth of 1.25–1.5 inches. Rolling was conducted immediately after seeding and before emergence to prevent plant damage.

Fertility Management:

Fertilization was applied based on target soil test values:

- **Wheat:** 150 kg N/ha (soil test NO_3-N to 2' + fertilizer N), 35 kg P_2O_5/ha (MAP)
- **Black beans:** 85 kg N/ha, 30 kg P_2O_5/ha (MAP)

Potassium and sulfur were supplemented if deficiencies were identified.

Pest Management:

Weed control followed Manitoba Pulse Growers' guidelines. Herbicide applications included pre-seed, pre-emergence, and in-crop treatments, with a second post-emergence application where necessary. Disease and insect outbreaks were monitored, and recommended fungicides/insecticides were applied as needed.

Residue Management:

Residue management treatments were applied as per the experimental design. Data collection focused on soil temperature and moisture effects on dry bean establishment and early growth, rather than above-ground microclimate modifications.

Data Collection:

1) Soil Temperature Monitoring:

Pre-programmed iButtons were installed in fall stubble treatments to assess soil temperature. They were placed at a 2-inch depth and retrieved at the R1 stage for analysis.

2) Site Characterization:

Soil samples (0-15 cm, 15-60 cm) were collected in late fall or spring prior to dry bean planting. Samples were analyzed for pH, EC, texture, NO_3-N, Olsen P, and extractable K.

3) Residue Cover Assessment:

Digital photos were taken before planting to document residue cover, with measurements standardized using a drywall T-square.

4) Soil Temperature and Moisture at Seeding:

Measurements were taken at three locations per plot using manual thermometers and soil moisture probes before seeding commenced.

5) Emergence Date Recording:

Emergence was monitored every two days (M-W-F) until 90% of plants had emerged.

6) Plant Counts:

Plant counts were conducted thrice weekly in flagged 2-m row segments at two locations per plot. Counts continued until full emergence was reached across all treatments.

7) Early-Season Biomass:

Four weeks after seeding, two 1.5 m row segments were harvested per plot. Fresh weights were recorded, and samples were dried for total nitrogen and phosphorus analysis.

8) In-Season Crop Stage Assessments:

Crop growth stages were recorded at 8 and 12 weeks post-planting.

9) Maturity Date:

Maturity was recorded at the R9 stage when at least 80% of pods had ripened and 30% of leaves remained green.

10) Yield and Seed Quality:

Plots were harvested using a combine, and yield was recorded along with seed moisture. Samples were analyzed for quality metrics.

This study aimed to generate insights into the effects of residue management on dry bean establishment, yield, and quality, providing valuable information for optimizing dry bean production in the eastern Prairies.

Figure 1. Positioning of the i-button in Ground

Evaluation of Corn for Goss's Wilt Resistance

Project duration:	May 2024 – September 2024
Objectives	Evaluation of hybrids adapted to Carberry region for Goss's Wilt Resistance.
Collaborators	Aida Kebede – Agriculture and Agri-Food Canada

Background:

Goss’s wilt has been in Western Canada for only a few years, but plant pathologists, agronomists and breeders are already working to learn more about this corn disease and enhance management options for Prairie growers. Goss’s wilt is caused by the bacterium Clavibacter michiganensis subspecies nebraskensis. The bacteria overwinter on infected stubble, so the disease is a concern in fields with shorter corn rotations. But even in fields with longer rotations, it can be a problem because corn stubble is very mobile in the fall, blowing across the roadways and carrying the disease to new fields. The disease usually occurs in a non-systemic form in which the pathogen infects the plant’s foliage. The bacterium enters the plant through a wound from hail or wind or sand blasting. The infection usually appears on the upper canopy at first. Then with high humidity and rain splash, the disease moves very rapidly throughout the plant, usually from the top down.

The disease also has a systemic form where the bacteria infect the corn plant’s vascular tissues. A relatively new disease, Goss’s wilt was first identified in Nebraska in 1969. In the 1970s and early 1980s, the disease spread through Nebraska and into some surrounding states. Then very little disease occurred until about 2006 when Goss’s wilt resurged and began spreading into new areas. Goss’s is continuing to expand. In the U.S., it has moved right across most of the Corn Belt as far south as Louisiana. It moved into the southwestern edge of Michigan, so it has moved east of the Mississippi River. In Western Canada, the disease was first found in Manitoba in 2009 and in Alberta in 2013.

In Manitoba, over the past five or six years, we’ve seen anything from an insignificant infection which doesn’t have any yield loss all the way up to the most severe fields experiencing close to 50 to 60 per cent yield loss. So it can be very impactful. The severity of the disease depends on weather conditions, the amount of inoculum in the field and the susceptibility of the hybrid to

Goss's wilt. Fortunately, late summer conditions in Manitoba didn't favour the disease. Manitoba corn producers have found the disease in many fields in mid to late July.

Managing Goss's wilt:

Symptoms of Goss's wilt may sometimes be confused with problems like drought, frost damage or sunscald, or with other diseases like Stewart's wilt or northern corn leaf blight. To identify Goss's wilt, look for greyish brown lesions with water-soaked margins when you are walking through your corn field. The telltale sign of Goss's wilt is the black freckling that shows up along the lesion edges. If you scout during drier conditions, you will see that black freckling. If conditions are damp, like a heavy dew in the early morning, you will sometimes see a glossy sheen on the lesion.

Fungicides are not effective for controlling Goss's wilt because it is a bacterial disease. Two main recommendations for managing the disease are:

1. Lengthen your crop rotation. However, that may not always be enough to prevent the disease if neighbouring fields have Goss's wilt.
2. The other key is to grow a resistant corn variety.

At this time there isn't any third-party testing to compare varieties from different companies, but most companies have a range of tolerances to Goss's wilt, so you can check with your seed supplier for information.

Figure. 1 The bacterium enters the corn plant through a wound on a leaf and then spreads from there.

Project findings:

This project is part of a long-term, multi-site study led by Aida Kebede. Research findings will be made available by Aida Kebede and team.

Materials & Methods:

Experimental Design	100 row observation nursery
Entries	100
Seeding	May 10, 2024
Termination	September 12, 2024

Data collected	**Date collected**
% Emergence	June 6
Tasseling Date	Jun 28 – Jul 31
Silking Date	Jul 08 – Aug 09
Ear Formation	Jul 26 – Aug 23
Heights	Aug 05

The nursery was terminated on September 4 after collecting data for Goss's Wilt observations.

Conditions favorable for Goss's Wilt disease and Symptoms:

Goss's wilt primarily infects leaves that have been wounded, such as by hail, sand-blasting, rain, wind, and strong storms. The disease spreads in the plant following leaf infection, and can spread from plant to plant. Disease development is favored by warm (greater than 80 degrees F) conditions. Symptoms often become most visible and increase in severity after silking. The disease is favored by planting susceptible hybrids, reduced tillage, and planting corn-on-corn. It overwinters in infested corn debris near the soil surface. The pathogen can possibly be seed transmitted at very low levels. Grain sorghum and some grasses such as sudan, several foxtail species, shattercane, and eastern gamagrass are also susceptible to this pathogen.

The primary symptoms on leaves are elongated tan lesions with irregular margins extending parallel to the veins. Large sections of leaf area can be affected. Dark, water-soaked spots ('freckles') develop in the lesions. Shiny patches of dried bacterial ooze that appear similar to dry varnish are often present on the lesions. In plants with stalk infection, orange vascular bundles may be seen in the stalk. The seedling blight phase of this disease may cause wilting and death of seedlings, but is not common in Minnesota. Confirmatory diagnosis is based on the presence of characteristic symptoms and signs on leaves, bacterial streaming from lesions seen with a microscope, and confirmation of the presence of the bacterial pathogen.

Evaluation of Corn Breeding Material Adapted to Carberry Region

Project duration: May 2024 – October 2024

Objectives: Evaluation of parental corn screening lines adapted to Carberry region.

Collaborators: Shawn Winter – Maizex Seeds Inc.

Results:

This project is part of a long-term, multi-site study led by Shawn Winter. Research findings will be made available by Shawn Winter and team.

Background:

The great economic value of the com crop has led to the production of many varieties, and com is now being grown in many regions where formerly the crop was a failure. These facts support the conclusion that the production of varieties adapted to various regions has been of great aid to the farmer. Because of the importance of the crop, studies have been carried on in order to furnish accurate information regarding rates and dates of seeding, proper rotation, cultural methods, and systems of seed selection which will produce the greatest return per acre. Adapted varieties are available for most sections of the corn belt, and for these regions it does not seem desirable or necessary to produce more varieties. The list of varieties is already much too long and what is needed is a standardization of varieties and the discard of the more undesirable ones. In many localities the more desirable varieties are known and the natural question in the minds of many corn growers is, "How can I keep my variety in a state of improvement and can it be further improved by selection?" A series of experiments was outlined for the purpose of learning the value of different methods of seed selection for the corn grower or seedsman who produces his own seed. In order to solve the problem it was necessary to use methods which the corn grower could practice on his own farm. This project determines the (l) the comparative value of different methods of seed selection of an adapted variety, and (2) the value of first generation varietal crosses between standard varieties.

Important types of corn cultivars are inbreds, single-cross hybrids, double-cross hybrids, and various kinds of populations. Differences among these types can be understood in terms of their genetics. For example, among these types only inbreds are pure-breeding. Any inbred has this characteristic because it is homozygous at all loci. A hybrid is a cross between two genetically different plants. A single cross is produced by crossing two inbreds. Corn hybrids generally are more vigorous than their parents. This increase in vigor is called hybrid vigor. When two inbreds are crossed that are not closely related, considerable vigor in plant and ear size relative to the parental inbreds is often observed in the single-cross hybrid. Usually a lesser amount of hybrid vigor is observed in other types of hybrids, such as a population x population hybrid or a population x inbred hybrid

Project Findings:

These data were generated for Maizex Seeds Inc.; however, due to intellectual property issues pertaining to Plant Breeders' Rights, results for individual lines are not provided in this report.

Materials & Methods:

Experimental Design	Random Complete Block Design
Entries	30 varieties
Replications	03
Seeding	May 13, 2024
Harvest	October 30, 2024
Data collected	**Date collected**
% Emergence	Jun 10
Tasseling Date	Jul 15 – Aug 15
Silking Date	Jul 22 – Aug 29
Ear Formation	Aug 12 – Sep 12
Heights	Aug 29
Lodging	October 30, 2024
Yield	October 30, 2024
Moisture	October 30, 2024

Agronomic Info and Discussion:

Standard recommended agronomic protocols were adopted for each crop. It is important to grow a variety of corn which is well adapted to your locality. Corn seed should be selected from perfect stand hills and from vigorous healthy stalks. Plants which are green when the ear approaches maturity insure normal maturity of the ear. Close selection for ear type leads to a reduction in yielding· ability. For this reason no close selection to ear type should be made. Proper storing of seed ears is fully as important as methods of seed selection. In order to obtain benefit from a first-generation cross the crossed seed must be produced each year. Crossed seed can be obtained by planting the varieties in alternate rows and detasseling all of one variety before the silks of that variety appear. To cross an early with a later variety it is necessary to plant the late variety several clays before the early variety is planted so that both mature at about the same date. The only type of first generation varietal cross which proved to be of much value was the cross between an early flint and a later dent.

Evaluation of Corn Advanced Material Adapted to Carberry Region

Project duration:	May 2024 – October 2024
Objectives:	To evaluate the performance of high yielding corn advanced variety in different climatic zones.
Collaborators:	Shawn Winter – Maizex Seeds Inc.

Results:

This project is part of a long-term, multi-site study led by Shawn Winter. Research findings will be made available by Shawn Winter and team.

Background:

Disease management can be a real challenge. Disease outbreaks are dependent on three key factors, the presence and type of pathogen, the status of the host, and the environment that influences the pathogen and the corn plant. When all the factors interact in a suitable combination, disease can occur. To effectively manage corn for disease, it is preferable to prevent or manage a disease outbreak when the disease is at low levels, as opposed to attempting to deal with a disease in which significant damage has already occurred. Field scouting for disease throughout the growing season, planting disease-resistant varieties (if possible) and crop rotations can all reduce the likelihood of most disease outbreaks in the future. Field scouting on a weekly basis can provide information on what diseases are present, the severity, and potential for crop loss if untreated. There is no better way of determining the status of disease on a corn crop, than actually being in the field to view these problems for yourself, and make informed decisions on what management tactics should be employed.

Reviewing the field history, identifying the diseases, and mapping the location of disease problems in the field, are all beneficial investments of time that will assist in the management of corn diseases. The decision on what variety/varieties of corn to grow can be a difficult, and accounting for disease resistance can increase the difficulty. In some cases, higher yield performance and a high level of disease resistance, may not be possible, (as in the cases of stalk rots) or resistant varieties simply may not be available. Whenever possible, it is always a good idea to use varieties resistant to a disease, especially if a particular disease has been a problem in the past. Growing corn in the same field for successive years may be desirable for a number of reasons. There are risks however, in not rotating other crops through the field, as the population of corn disease organisms can increase over time, increasing the likelihood of a large outbreak of disease with subsequent crop loss. In areas where disease is becoming a problem, the field should not be planted with corn (or any related crops) for several years, in order to reduce the pathogen level (and the risk of disease outbreaks) in the field. Generally diseases of corn are not of great concern in Manitoba, however there are increasing instances of crop loss due to root and stalk rots, in addition to the recurring problems of both common and head smut.

Project Findings:

These data were generated for Maizex Seeds Inc.; however, due to intellectual property issues pertaining to Plant Breeders' Rights, results for individual lines are not provided in this report.

Materials & Methods:

Experimental Design	Random Complete Block Design
Entries	30 varieties
Replications	03
Seeding	May 13, 2024
Harvest	October 30, 2024

Data collected	**Date collected**
% Emergence	Jun 10
Tasseling Date	Jul 15 – Aug 15
Silking Date	Jul 22 – Aug 29
Ear Formation	Aug 12 – Sep 12
Heights	Aug 29
Lodging	October 30, 2024
Yield	October 30, 2024
Moisture	October 30, 2024

Agronomic Info and Discussion:

Standard recommended agronomic protocols were adopted for each crop. Poor stand establishment, varying emergence times, and gaps in rows are generally an indication of seed rot or seedling blight. Individual plant symptoms include stunting, yellowing, wilting, and death of leaves. Seed rots and blights may be confused with mechanical or chemical injury, or insect damage. Examination of plant parts under the ground is therefore necessary for accurate diagnosis. In pre-emergence seedling blight, the coleoptile and developing root system appear brown, wet and slimy. In post-emergence seedling blight, the seedlings may have a constricted stem at the soil line, appear yellow, wilt, and die. Strands of fungus growth (mycelium) contact seed or seedling tissue and enter the seed through cracks in the seed coat or by direct penetration. The mycelium grows rapidly through and between the cells, killing the seed. Similar attacks may occur through rootlets and stems by direct penetration or through wounds. The mycelium proliferates in young cells causing rapid collapse and death of tissues.

Manitoba Corn Hybrid Performance Trials

Project duration	May 2024 – October 2024
Collaborators	Daryl Rex – Manitoba Crop Alliance (MCA), Manitoba Corn Committee.
Objectives	Evaluate candidate corn hybrids for regional variety adaptation and performance. Collect sound, unbiased, replicated data on hybrids that will be or currently are available in the marketplace.

Background:

Corn is a versatile crop. It's a food staple for humans – from fresh corn on the cob, to corn tortillas, to popcorn. Corn can be made into cornstarch, a thickener in foods; corn oil, used for cooking; and corn syrup, a sweetener in so many of our food and drink products. But corn doesn't just feed us; livestock eat feed corn, and corn can be processed to make both bio-diesel fuel and ethanol that can be mixed with the gasoline that we use in our cars.

The market for corn is enormous. Unlike most grasses, corn plants have separate male and female flowers. The tassel at the top of the plant contains the male reproductive organs that produce the pollen. Lower, where the leaf blades attach to the stem, the plant forms female flowers that contain the ovules. Each ovule has a long, thin silk that grows up to the top of the cob. After the silks at the top of the cob capture the pollen grains on the sticky stigmas, the male reproductive cells travel down the long styles to pollinate the ovules. Corn typically cross-pollinates as the wind blows the pollen from one plant to the silks of other corn plants. Corn can pollinate itself, though self-pollination is not common. Instead, cross-pollination helps maintain the genetic diversity of corn because genetic information from two different parents mixes during fertilization of the ovule.

As long as the plant gets the right amount of light, water, and nutrients, each fertilized ovule grows into what we call a corn kernel or seed. Hundreds of kernels cover each cob. The kernels are the support packages for the next generation. Each kernel contains a plant embryo and the starchy energy reserves to sustain growth until it can start doing photosynthesis. The energy, or calories, we eat from corn come largely from the kernels' starches! Although each plant produces a few cobs, usually only the uppermost cob produces a large, complete ear. Hybrid corn varieties– both single- and double-crosses – have significant benefits. Plant breeders intentionally create varieties with particular traits; they might be fast-growing, or able to tolerate drought, or particularly resistant to a pest like European corn borer. In addition to key desirable traits, hybrid yields are higher and fields planted with hybrid varieties are genetically uniform. Genetic uniformity has some advantages. Genetic variability means that plants are often different heights and that they usually have different timing for flowering, pollination, and harvest, as well as different grain characteristics.

The uniformity of a field of hybrids made it easier to use farming technology like mechanical harvesting. Doing so reduced the need for manual labor and reduced crop losses, thus further increasing yield. Since the 1940s, there have been many other changes to corn farming that contributed to increased yields and reduced production costs including increased use of fertilizers, increased use of herbicides, increased irrigation in arid climates, and additional mechanization of the farming process.

Project Findings:

These results are a source of unbiased, local hybrid performance information from small-plot trials being conducted at various locations across Manitoba. The MCC has the authority to provide information to Manitoba producers about the performance of corn hybrids within the province and the performance trials have had significant support from the seed industry as well. In a typical year, there are seven grain corn trials and three silage corn trials seeded within Manitoba.

GRAIN CORN — SHORT SEASON SITES (WEST)

Carberry 2024

The grain corn hybrid trials were tested and the data released by the Manitoba Corn Committee (MCC).
The data presented here is for one year only. Use with CAUTION!
A target plant population of 32,000 plants per acre.
Yields are corrected to 15.5% moisture.

CHU[1] Rating	Hybrid	Distributor	Technology/Genetic Trait (s)[2]	Carberry 2024			
				50% Silk	Yield (bu/ac)	Moisture (%)	Bushel Wgt (lbs/bu)
1925	TH6370 VT2P	Thunder Seed	VT2P	71	161.6	18.4	54.6
1950	P6910AM	Corteva Agriscience (Pioneer)	YGCB/HX1/LL/RR2	70	172.5	18.8	53.0
2000	NS EXP69	NorthStar Genetics	VT2P	67	160.6	19.3	53.3
2025	TH6072 VT2P	Thunder Seed	VT2P	71	152.8	19.1	54.7
2025	CX23071A/VT2P	WinField United (CROPLAN)	VT2P	71	152.2	21.7	54.6
2025	A3979G2 RIB	PRIDE Seeds	VT2P	71	165.1	18.5	54.7
2025	MZ 1200DBR	Maizex Seeds Inc.	VT2P	73	169.0	18.6	54.4
2050	PV 60371RIB	Nutrien Ag Solutions (Proven Seed)	VT2Pro	71	159.3	21.8	53.4
2050	CP1225VT2P/RIB	WinField United (CROPLAN)	VT2P	70	175.6	19.5	52.0
2050	DKC20-23RIB	Bayer Crop Science (DEKALB)	VT2P	70	151.3	19.8	52.4
2050	P72068AM	Corteva Agriscience (Pioneer)	YGCB/HX1/LL/RR2	71	173.3	20.7	53.3
2050	P7211AM	Corteva Agriscience (Pioneer)	YGCB/HX1/LL/RR2	72	153.0	18.5	53.1
2050	MZ 1231DBR	Maizex Seeds Inc.	VT2P	70	156.6	19.6	56.0
2075	TH6474 VT2P	Thunder Seed	VT2P	70	162.9	20.1	53.2
2075	NS 271	NorthStar Genetics	VT2P	67	152.3	19.6	52.3
2075	DKC21-36RIB	Bayer Crop Science (DEKALB)	VT2P	71	158.0	18.1	50.9
2075	DKC072-12RIB	Bayer Crop Science (DEKALB)	VT2P	71	148.3	19.4	52.7
2075	P7389AM	Corteva Agriscience (Pioneer)	YGCB/HX1/LL/RR2	70	164.9	18.8	55.3
2075	DLF 2158VT2P RIB	DLF Canada Inc.	GENVT2P	73	156.1	19.0	55.3
2100	PV 60273RIB	Nutrien Ag Solutions (Proven Seed)	VT2Pro	73	161.9	20.1	53.9
2100	CP1440VT2P/RIB	WinField United (CROPLAN)	VT2P	70	162.0	20.6	51.7
2100	DKC24-06RIB	Bayer Crop Science (DEKALB)	VT2P	73	162.4	18.4	51.2
2100	P7455R	Corteva Agriscience (Pioneer)	RR2	71	165.7	20.7	54.5
2125	PV 60474RIB	Nutrien Ag Solutions (Proven Seed)	VT2Pro	70	154.5	21.1	53.8
2125	P74691PCE	Corteva Agriscience (Pioneer)	VTP/HX1/LL/RR2/ENL	70	151.2	19.7	56.5
2150	HZ 1265	Horizon Seeds	Agrisure GT	67	165.9	20.4	54.7
2150	MZ 1397DBR	Maizex Seeds Inc.	VT2P	71	166.2	19.8	55.9
2175	PV 61276RIB	Nutrien Ag Solutions (Proven Seed)	VT2Pro	72	156.4	21.0	55.0
2175	XFS1022 x XFS1023	IFSI	VT2P	67	153.2	21.8	52.3
2175	NS 274	NorthStar Genetics	VT2P	70	157.7	20.6	55.4
2200	NS EXP75C	NorthStar Genetics	VT2P	71	162.3	20.2	53.6
2200	A4494G2 RIB	PRIDE Seeds	VT2P	67	144.0	18.5	53.9
2225	TH6278 VT2P	Thunder Seed	VT2P	73	176.5	19.2	55.3
2225	TH6578 VT2P	Thunder Seed	VT2P	70	155.9	21.1	53.1
2225	HX 1435	Horizon Seeds	PowerCore Enlist	74	150.2	19.6	55.6
2250	NS 277	NorthStar Genetics	VT2P	73	155.9	19.0	56.5
2250	DKC28-25RIB	Bayer Crop Science (DEKALB)	VT2P	71	158.0	19.1	54.3
2250	NK7837-V	Syngenta Canada Inc.	Agrisure Viptera	71	153.8	19.2	55.9
2250	P7822AM	Corteva Agriscience (Pioneer)	YGCB/HX1/LL/RR2	70	162.8	18.9	56.0
2250	P7844AM	Corteva Agriscience (Pioneer)	YGCB/HX1/LL/RR2	70	163.2	19.6	54.8
2250	MZ 1544DBR	Maizex Seeds Inc.	VT2P	73	158.2	20.0	51.5
2300	A4646G2 RIB	PRIDE Seeds	VT2P	73	162.9	18.1	52.4
			Site Average	71	159.7	19.7	54.0
			CV	0.63	7.51	6.94	3.02
			Sign. Diff.	Yes	No	Yes	Yes
			LSD	0.6	--	1.9	2.8
			Planting Date	May 21, 2024			
			Harvest Date	October 20 & 21, 2024			

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1 Each company assigns a corn heat unit (CHU) rating to each of their hybrids. The CHU rating is a measure of relative maturity and is one criteria for choosing a hybrid suitable to your growing region.

2 Seeds Canada provides a database for corn hybrids available in Canada at https://seeds-canada.ca/corn-hybrid-database. Information provided includes technology, brand name and refuge requirements.

Manitoba Oilseed Sunflower Variety Performance Testing (VPT)

Project duration	May 2024 – October 2024
Objectives	Evaluate candidate sunflower hybrids for regional variety adaptation and performance. Collect sound, unbiased, replicated data on hybrids that will be or currently are available in the marketplace.
Collaborators	Daryl Rex – Manitoba Crop Alliance

Background:

The Manitoba Sunflower Variety Performance Trials (VPT) were organized and conducted by the Manitoba Crop Alliance (MCA) in co-ordination with Manitoba Agriculture. The 2024 planting year was the 18th year that these trials have been coordinated and serve to continue as an important tool for sunflower growers for generating 3rd party, impartial hybrid performance data within Manitoba. The trials included hybrids that are either commercially available and registered within Canada or new hybrids that are being considered for registration. In 2024, the MCA coordinated the VPTs at 4 locations within the province: Carberry, Elm Creek, Melita and Rossendale.

All sunflower varieties grown in Manitoba are hybrids and based on their end use, can be classified as either oil- or confection-type sunflowers. Approximately 60% of all Canadian sunflowers are confection-type, which are marketed primarily as roasted snack food in the shell or as dehulled seeds for the baking industry. Although a significant percentage of this market is domestic (North America), Canadian processors are increasingly accessing markets in Europe, the Middle East and Asia. Oilseed sunflowers are used in the birdfeed and crushing industry for sunflower oil, which is one of the highest quality vegetable oils. The birdfood market primarily uses oilseed sunflowers, however some of the smaller confection seeds are also used for birdseed.

Sunflowers grown for oil are characterized by black hulls. With oil-type sunflowers there are 3 different groupings: traditional, mid-oleic (NuSun), and high oleic. These groupings are based according to their specific oil profile. The mid-oleic varieties have an oil profile that is intermediate to the traditional and the high-oleic sunflower varieties. The non-oil or confection-type sunflowers have striped hulls and are used primarily for the human food market. Yields of confectionary sunflowers are closely tied to the quality of the seeds. Only the largest of the confection type sunflowers are used for human consumption and there is little tolerance for bird or insect damage. Confection-type sunflowers have a standard bushel weight of 25 lb/bushel as compared to 30 lb/bushel for oil- type sunflowers. Canadian Grain Commission minimum test weights for No. 1 Canada sunflowers are 155g/0.5L for confection-type sunflowers, 169g/0.5L for oil-type sunflowers.

SUNFLOWER HYBRID PERFORMANCE TRIALS

Carberry 2024

Oil Sunflower markets – include birdfood, oil crush and de-hull. Variety selection becomes more important when trying to capture de-hull markets. Choose varieties with better de-hull ratio, larger size and higher test weight. Environment will contribute greatly to final product. Plant population and environment will contribute greatly to the final product. Percent (%) oil content was unavailable at press time, visit **www.mbcropalliance.ca** for more details.

OILS — CARBERRY 2024

Hybrid	Herbicide/ Disease Tolerance	Oil Type	Company	Yield (lb/ac)	Moisture (%)	Maturity[1] (days to R9)	Height (inches)	Test Wt[2] (lb/bu)	Oil (%)
CP432E	ExSun	NS	Winfield United / CROPLAN	1390	18.2	143	61	27.0	36.6
CP455E	ExSun	HO	Winfield United / CROPLAN	1350	17.4	141	60	27.3	38.6
P63ME80	ExSun/DM	NS	Pioneer Hi-Bred	1269	17.7	145	59	28.9	40.5
P63HE501	ExSun	HO	Pioneer Hi-Bred	1213	19.1	142	59	29.3	38.5
N4HM354	CL/DM	NS	Nuseed	1279	19.4	144	58	28.3	40
N4H161 CL	CL/DM	HO	Nuseed	1274	18.4	144	58	27.4	37.2
Experimental lines being tested/proposed for registration in Canada									
N4H134 E	ExSun/DM	HO	Nuseed	1181	17.3	140	60	28.8	40.1
N4H337 E	ExSun/DM	HO	Nuseed	1084	18.1	145	59	27.8	46.5
Badger DMR	CL/DM	Conoil	Nuseed	1301	18.5	144	59	28.1	37.8
AC2101	CL Plus	HO	RAGT Semences	1299	17.9	147	62	28.1	36.5
N4H205 E	ExSun/DM	HO	Nuseed	1478	17.3	142	58	27.6	44.4
P63HE920	ExSun	HO	Pioneer Hi-Bred	1322	18.4	145	59	27.7	41.5
Site Average				1287	18.1	144	59	28.0	--
CV%				11.65	7.39	2.59	5.58	7.43	--
Sign Diff				No	No	No	No	No	--
LSD (0.05)				--	--	--	--	--	--
Planting Date				May 10, 2024					
Desiccation Date									
Harvest Date				October 16, 2024					

[1] Physiological maturity for sunflowers is R9, where the bracts on the head are almost completely brown.
[2] Test weights are reported in lbs per Avery (Canadian) bushel.
Refer to the MCA website at www.mbcropalliance.ca for more details.

Confectionary Sunflower Variety Performance Testing

Project duration	May 2024 – September 2024
Objectives	Evaluate candidate sunflower hybrids for regional variety adaptation and performance. Collect sound, unbiased, replicated data on hybrids that will be or currently are available in the marketplace.
Collaborators	Daryl Rex – Manitoba Crop Alliance

Background:

The Manitoba Sunflower Variety Performance Trials (VPT) were organized and conducted by the Manitoba Crop Alliance (MCA) in co-ordination with Manitoba Agriculture. 2024 was the 18th year that these trials have been coordinated and serve to continue as an important tool for sunflower growers for generating 3rd party, impartial hybrid performance data within Manitoba. The trials included hybrids that are either commercially available and registered within Canada or new hybrids that are being considered for registration. In 2024, the MCA coordinated the VPTs at 4 locations within the province: Carberry, Elm Creek, Melita and Rossendale.

The 2024 growing season was dry for the majority of the growing season. The trials were all initially planted the first part of May, but due to herbicide damage at the Elm Creek location the trials were replanted on June 4. The smaller seeded oilseed hybrids seemed to germinate and emerge more evenly than the larger seeded confection hybrids, creating more plant population variability in the confection trial. Variability was noted throughout the season due to the previous crop residue and soil moisture availability. Birds did not seem to be much of an issue in the trials this year. Both the Melita and Carberry locations desiccated the trials prior to harvesting.

All the trials were harvested, but due to a high CV the confection trial data at Carberry was not published. A big “Thank-you” to all the producers, seed companies and site contractors that provided the land for the trials, seed of the hybrids being tested, and the hard work conducting the trials and generating the trial results.

SUNFLOWER HYBRID PERFORMANCE TRIALS

Carberry 2024

All sunflowers varieties listed are susceptible to sclerotinia and sunflower rust strains present in Manitoba. Genetic resistance to verticillium wilt is rated as moderately susceptible to moderately resistant for all sunflower varieties presented. Plant population and environment will contribute greatly to the final product.

NON-OILS — CARBERRY 2024

Hybrid	Genetic Trait	Company	Yield (lb/ac)	Moisture (%)	Maturity[1]	Height	2023 Seeding Sizing (%)[2]			Test Wgt[3]
							>22/64	>20/64	<20/64	(lb/bu A)
6946 DMR	DMR	Nuseed	1587	18.8	136	50	18	38	23	23.5
MCA 359239	ExSun	MCA	1686	18.6	139	45	85	12	3	23.1
MCA 359306	ExSun	MCA	1715	18.2	143	45	82	15	3	24.3
Experimental lines being tested/proposed for registration in Canada										
NJKM65823	CL/DM	Nuseed	1576	18.3	134	47	56.5	28.5	15.1	25.3
N6L377 CL	CL/DM	Nuseed	1458	17.4	143	46	66.4	23.3	10.3	25.4
Site Average			1604	18.3	139	47	--	--	--	24.3
CV %			8.23	4.67	0.92	8.14	--	--	--	6.4
Sign Diff			No	No	Yes	No	--	--	--	No
LSD (0.05)			--	--	2	--	--	--	--	--
Planting Date			May 10, 2024							
Desiccation Date			---							
Harvest Date			October 10, 2024							

1 Physiological maturity for sunflowers is R9, where the bracts on the head are almost completely brown.
2 Totals may not add to 100% due to rounding.
3 Test weights are reported in lbs per Avery (Canadian) bushel.
Refer to the MCA website at www.mbcropalliance.ca for more details.

MANITOBA CROP ALLIANCE

Sunflowers Row Spacing and Plant Population Evaluation

Project duration: April 2023 to March 2027

Objectives: To evaluate the efficacy of Manitoba-registered flax seed treatments against soil-borne diseases in two flax types (yellow and brown).

To evaluate the relationship between the seed treatment and germination, emergence, and ultimately yield in brown and yellow flax types.

Collaborators:
MCVET

MB Ag (Dennis Lange)

Lupin Platform Inc.

MPSG

Background:

This study aims to compare solid-seeded oilseed sunflowers to row-planted oilseed sunflowers over two field seasons. The experiment follows a randomized complete block design (RCBD) with four replicates in 2023 and transitioned to a split-plot design in 2024 to aid planting operations. The study evaluates different plant populations and row spacing to understand how air seeders perform compared to traditional planters.

The project tests an oil-type sunflower hybrid (P63ME80) with three target plant populations: 18,000, 22,000, and 26,000 plants per acre. Row spacing includes narrow (<12” solid seeded), mid (15”), and wide (30”) rows.

Method and Design:

For all sites:

- **Crop Rotation:** Best Management Practices (BMP)
- **Fertility:** BMP
- **Pesticides:** BMP (cutworms, weed control, grasshopper management)
- **Trial Design:** RCBD (2023), Split-Plot (2024)
- **Replications:** 4

Plot Information:

Melita Site:

- 9.5” row spacing – 18,000 ppa
- 15” row spacing – 22,000 ppa
- 30” row spacing – 26,000 ppa

Carberry Site:

- 12” row spacing
- 15” row spacing
- 30” row spacing

2024 Trial Notes:

In 2024, compaction issues led to non-uniform emergence, impacting trial performance. To mitigate this, adjustments in field preparation will be made in 2025.

Data Collection Parameters:

- Seeded Plot Area (m^2)
- Harvest Plot Area (m^2)
- Days to Flowering
- Lodging (scale 1-9)
- Disease Severity (scale 1-9)
- Plant Height (inches)
- Bird Damage (%)
- Yield (kg/plot)
- Seed Moisture (%)
- Adjusted Yield (lbs/acre @10.5% moisture)
- Bushel Weight (lbs/bushel)

- Oil Content (%)
- Quality Sample (500g per plot to MCA)

Agronomic Trial/Site Summary:

- **Field Prep:** Best practices applied
- **Seeding Date:** Site-specific
- **Seeder Type:** Drill/planter
- **Errors at Seeding:** Compaction issues in 2024
- **Fertility Applied:** BMP-based (NPKS)
- **Herbicide/Fungicide/Insecticide Applications:** As required
- **Harvest Date:** To be determined per site
- **Special Sample Dates:** To be scheduled
- **Growing Degree Days (GGD):** Actual vs. normal comparison
- **Precipitation:** Actual vs. normal (seeding to harvest)
- **Comments:** Adjustments planned for 2025 due to compaction issues in 2024.

Conclusion:

Despite challenges with soil compaction affecting emergence in 2024, the study will continue in 2025 with improved field preparation strategies. The study will provide valuable insights into optimizing row spacing and plant population for oilseed sunflower production in Manitoba.

Preparing for Climate Change with Drought Tolerant Soybean

Project duration: April 2023 – March 2028

Objectives: Agronomic studies of drought stress on seed yield and seed protein. A series of low to high protein lines will be grown in dryland and irrigated conditions to determine the role of drought stress on seed yield and seed protein.

Analysis of a MAGIC population segregating for drought tolerance and seed protein content. Two drought tolerant and two high protein lines will be inter-mated to develop a mapping population. Quantitative trait loci will be determined for tolerance to drought stress for both seed yield and protein.

Prolonged nitrogen fixation (PNF) during periodic moisture stress to enhance yield and protein accumulation in soybean. PNF is one mechanism for drought tolerance, and tools will be developed to test for PNF and to allow for its introgression in early maturity soybean.

Collaborators: Elroy Cober – AAFC – Ottawa Research and Development Centre

Malcolm Morrison – AAFC – Ottawa Research and Development Centre

Bahram Samanfar – AAFC – Ottawa Research and Development Centre

Anfu Hou – AAFC – Morden Research and Development Centre

Background:

Climate models predict that Western Canada will experience hotter temperatures and more irregular precipitation patterns, leading to an increased frequency of periodic moisture stress during critical crop growth stages. Soybeans in Western Canada generally have lower seed protein content than those grown in Eastern Canada, with water availability during seed filling playing a key role in protein accumulation.

This project builds on previous research under the CAP program and aims to develop tools and techniques for improving drought tolerance and seed protein content in early-maturing soybean varieties. By improving drought resilience, the project supports the expansion of soybean acreage beyond the 2017 peak of 3M acres in Western Canada.

Project Methodology:

- **Varieties:** 10 conventional soybean varieties
- **Locations:** 5 (Ottawa, Morden, Saskatoon, Melita; Carberry was dropped due to hilum color inconsistencies)
- **Experimental Design:** 10x3 randomized complete block, one dryland and one irrigated per location
- **Treatments:** 10 soybean varieties
- **Data Collection Parameters:**
    - Flowering date, days to maturity, plant height, lodging, yield, seed composition
    - Soil sampling: 500 mL sample, top 12” of soil, shipped to AAFC Ottawa for analysis
    - Emergence, pest pressure (if present), lodging (1-5 scale), moisture content at harvest
    - Shipping of at least 500g of harvested samples per plot to AAFC Ottawa

Trial Management:

- Pre-emergence herbicide for seedbed preparation, in-crop herbicide as required
- Start-up fertilizer applied at recommended soybean rates
- Inoculation using standard local practices
- Irrigation in irrigated trials targeting 25mm total precipitation per week (rain + irrigation)
- Dryland trials dependent on natural precipitation

2024 Results Summary:

- **Drought stress yield loss:** Ranged from 1% in Ottawa to 45% in Saskatoon.
- **Protein content:** Dryland conditions resulted in an average 1.3% reduction in seed protein content compared to irrigated conditions.

- **Nitrogen Fixation:** Evaluated using non-nodulating and nodulating iso-lines:
    - In drought-stressed environments, nitrogen fixation contributed to approximately 54 kg/ha more protein yield under irrigation.
    - The nodulated line yielded 790 kg/ha more and had a protein yield increase of 355 kg/ha compared to the non-nodulating line, even in non-drought conditions.
    - Irrigation increased protein yield by 245 kg/ha in the non-nodulating line, indicating enhanced root growth or nitrogen mineralization.
    - Irrigation provided an estimated additional 15 kg/ha of nitrogen.

Future Work:

- The N15 work is still ongoing and will be incorporated once available.
- Further analysis will continue on the MAGIC population to identify Quantitative Trait Loci (QTL) for drought tolerance.
- Prolonged Nitrogen Fixation (PNF) studies will be expanded to assess its role in moisture stress resilience.

Economic Impact:

- Addressing the Western Canadian soybean protein deficit could result in an estimated annual return of $12M.
- A 7% yield improvement through drought tolerance could increase national soybean production by 0.5M tonnes.

Conclusion: The findings from the 2024 trial reaffirm the importance of drought tolerance mechanisms in soybean production. The research highlights the role of nitrogen fixation in sustaining protein levels under drought stress and provides critical insights for breeding programs aimed at improving drought resilience in early maturing soybean varieties.

Lupin Variety Adaptation Evaluation

Project duration: April 2023 to March 2027

Objectives: To evaluate the efficacy of Manitoba-registered flax seed treatments against soil-borne diseases in two flax types (yellow and brown).

To evaluate the relationship between the seed treatment and germination, emergence, and ultimately yield in brown and yellow flax types.

Collaborators: MCVET

MB Ag (Dennis Lange)

Lupin Platform Inc.

MPSG

Background:

Lupins are a legume crop that originally came from Europe, which we are now growing in Canada. They are most commonly used for food products and as livestock feed. There are many species of lupin that are native to Europe; here the focus will be put on two different species with multiple varieties. The species Lupinus albus refers to a white, narrow-leaved lupin, while Lupinus angustifolius refers to a blue, broad-leaved lupin. While these are both species of lupin, it can be thought of as comparing wheat and oats; both are cereals but are managed differently. Both the white and blue species of lupin require high moisture (>225 mm) during the growing season, but they also have many differences. White lupins can handle slightly higher soil pH and are more susceptible to anthracnose than blue lupins. White lupins have a lower target plant population (4.5-6 plants/ft2) than blue lupins (10-11 plants/ft2). White lupins also have a larger seed size and grow taller than blue lupins (70-80 cm and 50-60 cm, respectively). Both types have good standability and are not prone to lodging, but at harvest time blue lupins are more susceptible to pod shattering under certain field conditions. There are initiatives in Manitoba and across Canada seeking to increase the efficiency of protein production. It is thought the lupins are more sustainable than field peas since they have been shown to have higher seed protein. There are other important interests in lupins as well. In addition to the high seed protein content, they also come with all the conventional benefits that legumes bring to the producer’s rotation, additional resistance and a longer rotation from Aphanomyces root rot (Boström 2005). Lupins are classified as nitrogen-fixing legumes and can be treated similarly as the other pulse crops that provide the advantage of nitrogen fixation. This trial focuses on comparing white and blue lupins to each other as well as to field peas, which farmers are more familiar with.

Methods and Materials

In Melita, the Lupin variety trial was established on Waskada Loam soil in excellent moisture on May 16th at a depth of 1-inch. Chemical burn-off was needed and was applied as Round Up Transorb (0.67 L ac-1), Rival (0.65 L ac-1), and Authority (85 mL ac-1). Granular fertilizer was sidebanded during seeding as 10-35-25-15-1 actual lbs ac-1 (N-P-K-S-Zn); the lupins were also inoculated with a peat-based lupin specific Rhizobia species. Different post-emergence herbicides were used on the peas and the lupins. The peas were sprayed with Viper (0.4 L ac-1) and UAN (0.81 L ac-1); the lupins were sprayed with Arrow (150 mL ac-1) and 0.5% v./v. X-Act. The plots were harvested on different days; the blue lupins and peas were harvested on August 17th, and the white lupins were harvested later on September 8th.

Results and Discussion

In terms of height, the white lupin variety Dieta was the tallest (73.8 cm) but was not significantly taller than any of the other white lupin varieties (Table 13). The variety Lunabor was the tallest of the blue lupins (41.0 cm) but was not significantly taller than any of the other blue lupin varieties. All the white and blue lupin varieties were significantly different ($P < 0.001$), in terms of height, compared to the field peas. Of the field peas, the variety CDC Lewochko was the tallest (76.0 cm) and was also the tallest entry of the trial. The white lupins, blue lupins, and field peas all had a significantly different ($P < 0.001$) number of days to maturity. Blue lupins were the first to mature (69-71 days), field peas were second (75-76 days), and white lupins matured last (92-95 days). Yield was also found to be significantly different ($P < 0.001$) between the white and blue lupins and field peas. AAC Carver peas had the highest yield of the entire trial (4621 Kg ha-1) but was not significantly different from the yield of AAC Chrome peas (4443 Kg ha-1). The lowest yielding entry of the trial was the blue lupin variety Probor (1666 Kg ha-1). The blue lupin variety with the highest yield was Lunabor (2323 Kg ha-1) but was not significantly higher than the yield of the blue lupin variety Boregine (2056 Kg ha-1). The white lupin variety with the highest yield was found to be Bonus (2911 Kg ha-1) but its yield was not significantly higher than any of the other white lupin varieties. Crude protein content for pea and white lupin are approximately 24% and 38%, respectively. Since lupin is significantly higher in crude protein content it is important to take this in consideration when protein is the goal in yield and profitability. For example, in this trial Chrome peas would have yielded 1066 Kg ha-1 crude protein whereas white lupin Bonus would have yielded 1047.96 Kg ha-1 crude protein, which are likely not significantly different in this perspective of crude protein.

Testing seed treatments for managing soil borne flax diseases

Project duration:	April 2023 to March 2027
Objectives:	To evaluate the efficacy of Manitoba-registered flax seed treatments against soil-borne diseases in two flax types (yellow and brown). To evaluate the relationship between the seed treatment and germination, emergence, and ultimately yield in brown and yellow flax types.
Collaborators:	MCA (Daryl Rex), Manitoba Diversification Centres (WADO, PCDF, MCDC, and PESAI)

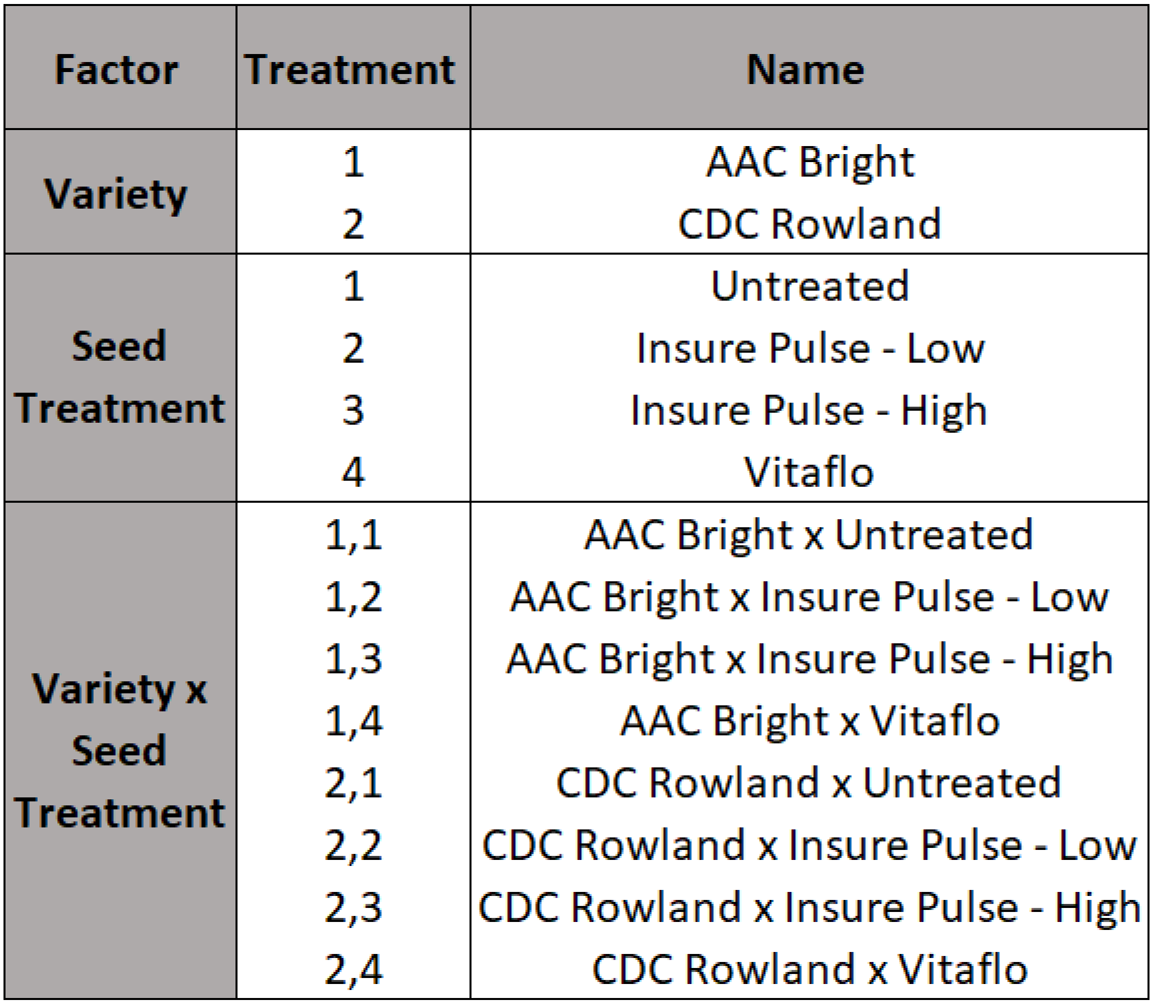
Background:

There has been little testing done recently evaluating the commercially available seed treatments for flax in Manitoba. This project will evaluate commercially available seed treatments and respective label rates in brown and yellow flax for Manitoba farmers in 2023 and 2024 growing seasons across the four Diversification Centre locations. The project will be set up as a small plot experiment, randomized complete block design with four replicates. Two flax varieties (one yellow, one brown) will be evaluated in this study. The available seed treatments for flax in Manitoba are Insure Pulse (300 mL to 600 mL/100 Kg of seed), INTEGO Solo Fungicide (13 mL to 19.6 mL/100 Kg of seed), and Vitaflo Brands (525 mL/100 Kg of seed). There will be 6 fungicide treatments applied to two flax types for a total of 12 treatments: 1) one untreated check, 2) Insure Pulse (300 mL/100 Kg of seed), 3) Insure Pulse (600 mL/100 Kg of seed), 4) INTEGO Solo Fungicide (13 mL/100 Kg of seed), 5) INTEGO Solo Fungicide (19.6 mL/100 Kg of seed), and 6) Vitaflo Brand product of choice (525 mL/100 Kg of seed). Each treatment was applied to yellow and brown flax types. The following data will be collected: observations on treatment application coverage and seed flow, seeding and harvest data, fertility data, crop emergence, disease presence and severity (Fusarium spp. and Rhizoctonia solani seed and root rots, plus seedling blight; Pythium spp. seed rot and pre-emergence damping off), late season disease development, crop yield, seed quality. Trial data collected by the Diversification Centre Specialists and Technicians is analyzed by the MCA. More information on this trial from other sites can be found by contacting Darryl Rex at the MCA.

Materials and Methods:

This flax trial evaluated two different flax varieties, one brown variety and one yellow. CDC Rowland was the brown flax variety chosen, and AAC Bright was chosen for yellow flax. The available seed treatments for flax in Manitoba include Insure Pulse and Vitaflo brands. Four different fungicide treatments were applied to each type of flax for a total of eight treatments in the trial (Table 1). These treatments were replicated four times and laid out in a randomized complete block design. The trial was established at all four of the Crop Diversification Centers located at Melita, Roblin, Carberry, and Arborg to help evaluate any differences that may be seen due to varying regional conditions.

Table 1. The varieties and fungicide seed treatments used in the Flax Seed Treatment Evaluation Trial at Melita in 2024



Factor	Treatment	Name
Variety	1	AAC Bright
	2	CDC Rowland
Seed Treatment	1	Untreated
	2	Insure Pulse - Low
	3	Insure Pulse - High
	4	Vitaflo
Variety x Seed Treatment	1,1	AAC Bright x Untreated
	1,2	AAC Bright x Insure Pulse - Low
	1,3	AAC Bright x Insure Pulse - High
	1,4	AAC Bright x Vitaflo
	2,1	CDC Rowland x Untreated
	2,2	CDC Rowland x Insure Pulse - Low
	2,3	CDC Rowland x Insure Pulse - High
	2,4	CDC Rowland x Vitaflo

The flax seed treatment trial was established on Waskada Loam soil into wheat stubble. The flax was seeded on April 30th using a Dual Knife Seedhawk Drill at 1-inch depth. Burn off was sprayed the same day before seeding as Round Up (0.5 L/ac), and Authority (100 mL/ac) and Rival (0.5 L/ac) after seeding. Fertilizer was side banded during seeding as 106-30-21-15-0.63 actual lbs/ac (N-P-K-S-Zn). In-crop herbicides were applied as Arrow (100 mL/ac) + X-act (0.75% v./v.) on May 31st, and Basagran (0.91 L/ac + 20 gal/ac water volume) on June 7th. The insecticide Pounce (0.75 mL/ac) was also applied on May 31st to protect again insect damage. All plots were desiccated using Roundup Transorb (0.67 L/ac) on August 30th. In Melita the plots were harvested on September 10th. Data Collected throughout the growing season included emergence counts, disease presence and severity ratings, flowering dates, heights, lodging rates, maturity dates, grain yield and moisture.

Results and Discussion:

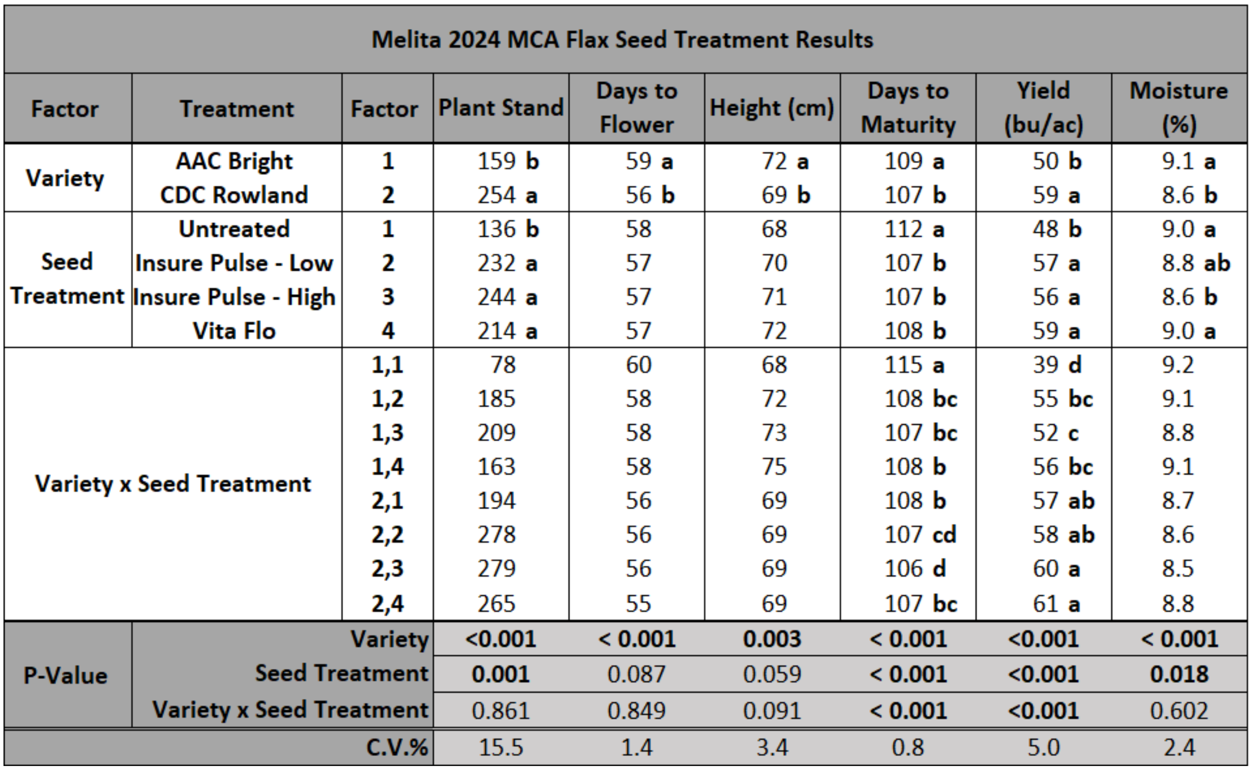
The Results from the 2024 Melita MCA Flax Seed Treatment trial can be found below in Table 2. The variety grown had a significant effect ($p < 0.001$) on the flax plant stand. CDC Rowland had higher plant stands (254 plants/m^2) and AAC Bright had lower plant stands (159 plants/m^2). The seed treatment applied to the flax seed also had a significant influence ($p = 0.001$) on the plant stands. When Insure Pulse was applied to the seed at the high rate, it produced the highest plant stands (244 plants/m^2) between seed treatments, though those stands were not significantly different than when other seed treatments were used. The flax plots that did not receive any seed treatment had the lowest plant stands (136 plants/m^2).

The number of days to flowering was found to be significantly different ($p < 0.001$) between the flax varieties at Melita. CDC Rowland took fewer days to reach flowering (56 days) than AAC Bright (59 days). The height of the flax plants was also found to be significantly different ($p = 0.003$) between the two varieties. AAC Bright plants were taller (72 cm) than CDC Rowland plants (69 cm). Variety, seed treatment, and their interaction were found to have significant effects ($p < 0.001$) on the maturity of the flax in Melita. Between varieties, CDC Rowland matured faster (107 days) than AAC Bright (109 days). When Insure Pulse was used at either the low or high rate, the flax matured the fastest (107 days) between seed treatments, though it was not significantly faster than when Vita Flo was used on the seed (108 days). The untreated flax took the longest to reach maturity (112 days). When the high rate of Insure Pulse was used on

CDC Rowland, those flax plots reached maturity faster than all the other seed treatments in the trial (106 days). When AAC Bright was grown without seed treatment, the plants took the longest to mature (115 days). Again, variety, seed treatment, and their interaction had significant effects (p < 0.001) on yield at Melita. CDC Rowland produced the highest yield (59 bu/ac), while AAC Bright produced the lowest yield (50 bu/ac).

The seed treatment that produced the highest flax yield was Vita Flo (59 bu/ac), though the yield was not significantly higher than when other seed treatments were used. The untreated flax plots produced the lowest yield (48 bu/ac). When variety and seed treatment were evaluated together, it was found that CDC Rowland treated with Vita Flo produced the highest yield (61 bu/ac), though that yield was not significantly different than any other yield produced by CDC Rowland. When AAC Bright was untreated, it produced the lowest yield in the trial at Melita (39 bu/ac). The grain moisture at harvest was also found to be significantly different (p < 0.001) between varieties grown at Melita.

Table 2. Results from the 2024 MCA Flax Seed Treatment trial at Melita.



Melita 2024 MCA Flax Seed Treatment Results

Factor	Treatment	Factor	Plant Stand	Days to Flower	Height (cm)	Days to Maturity	Yield (bu/ac)	Moisture (%)
Variety	**AAC Bright**	**1**	159 **b**	59 **a**	72 **a**	109 **a**	50 **b**	9.1 **a**
	CDC Rowland	**2**	254 **a**	56 **b**	69 **b**	107 **b**	59 **a**	8.6 **b**
Seed Treatment	**Untreated**	**1**	136 **b**	58	68	112 **a**	48 **b**	9.0 **a**
	Insure Pulse - Low	**2**	232 **a**	57	70	107 **b**	57 **a**	8.8 **ab**
	Insure Pulse - High	**3**	244 **a**	57	71	107 **b**	56 **a**	8.6 **b**
	Vita Flo	**4**	214 **a**	57	72	108 **b**	59 **a**	9.0 **a**
Variety x Seed Treatment		**1,1**	78	60	68	115 **a**	39 **d**	9.2
		1,2	185	58	72	108 **bc**	55 **bc**	9.1
		1,3	209	58	73	107 **bc**	52 **c**	8.8
		1,4	163	58	75	108 **b**	56 **bc**	9.1
		2,1	194	56	69	108 **b**	57 **ab**	8.7
		2,2	278	56	69	107 **cd**	58 **ab**	8.6
		2,3	279	56	69	106 **d**	60 **a**	8.5
		2,4	265	55	69	107 **bc**	61 **a**	8.8
P-Value		**Variety**	**<0.001**	**< 0.001**	**0.003**	**< 0.001**	**<0.001**	**< 0.001**
		Seed Treatment	**0.001**	0.087	0.059	**< 0.001**	**<0.001**	**0.018**
		Variety x Seed Treatment	0.861	0.849	0.091	**< 0.001**	**<0.001**	0.602
		C.V.%	15.5	1.4	3.4	0.8	5.0	2.4

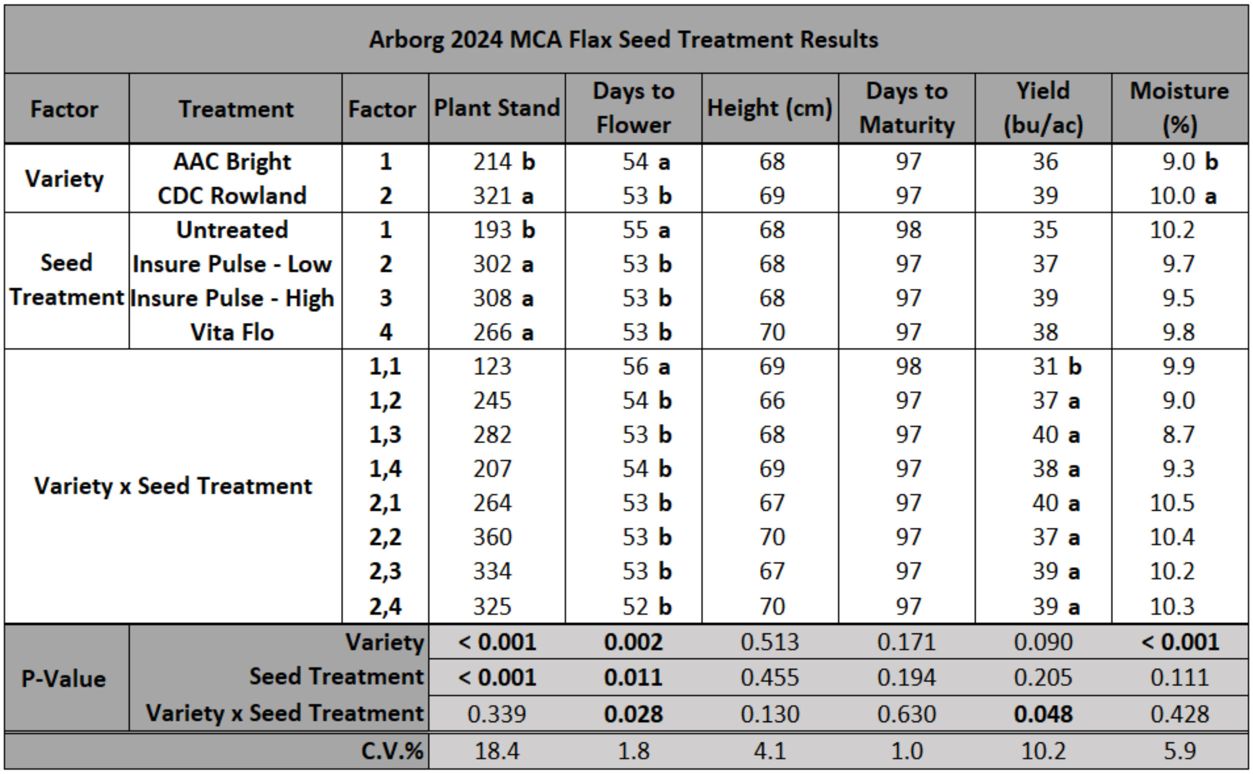
AAC Bright was harvested with the highest moisture (9.1%), while CDC Rowland was harvested with lower seed moisture (8.6%). Lastly, the seed treatment used also had a significant effect ($p = 0.018$) on grain moisture at harvest in Melita. Untreated flax and flax treated with Vita Flo has higher grain moisture at harvest (9.0%); flax treated with the high rate of Insure Pulse had the lowest grain moisture at harvest (8.6%).

The results from the 2024 Flax Seed Treatment trial in Arborg can be found below in Table 3. Variety and seed treatment had significant effects ($p < 0.001$) on plant stand at Arborg. CDC Rowland had higher plant stands (321 plants/m^2) while AAC Bright had lower plant stands (214 plants/m^2). When Insure Pulse was used at the high rate, it resulted in the highest plant stands between seed treatments (308 plants/m^2), though the stands were not significantly higher than when Insure Pulse was used at the low rate (302 plants/m^2) or Vita Flow (266 plants/m^2). The untreated plots had the lowest plant stands (193 plants/m^2). At Arborg, the variety used was found to have a significant effect ($P = 0.002$) on the number of days it took for the flax to reach flowering. CDC Rowland reached flowering earlier (53 days) than AAC Bright (54 days).

The seed treatment used had a significant effect ($P = 0.011$) on flowering date at Arborg. The plots that received seed treatment flowered earlier (53 days), while the untreated plots took longer to reach flowering (55 days). The combined effects of variety grown and seed treatment used also had a significant influence ($P = 0.028$) on flowering date Arborg. When CDC Rowland was treated with Vita Flo, the flax took the least number of days to reach flowering (52 days), though it was not found to be significantly different from the days to flowering from any other treatment in the trial except for when AAC Bright was left untreated, which took 56 days to reach flowering.

There were no significant differences found between plant height or maturity of the flax at Arborg. The combined effects of variety with seed treatment had a significant effect ($P = 0.048$) on yield at Arborg. Both AAC Bright treated with the high rate of Insure Pulse and CDC Rowland with no seed treatment produced the highest yield (40 bu/ac), though the yield was not significantly higher than any other treatment in the trial except when AAC Bright was left untreated, which produced the lowest yield (31 bu/ac). Lastly, the variety grown had a significant effect ($P < 0.001$) on grain moisture at harvest in Arborg. AAC Bright had a lower grain moisture at harvest time (9.0%), while CDC Rowland had higher grain moisture at harvest (10.0%).

Table 3. Results from the 2024 MCA Flax Seed Treatment trial at Arborg.



Arborg 2024 MCA Flax Seed Treatment Results								
Factor	**Treatment**	**Factor**	**Plant Stand**	**Days to Flower**	**Height (cm)**	**Days to Maturity**	**Yield (bu/ac)**	**Moisture (%)**
Variety	**AAC Bright**	**1**	214 **b**	54 **a**	68	97	36	9.0 **b**
	CDC Rowland	**2**	321 **a**	53 **b**	69	97	39	10.0 **a**
Seed Treatment	**Untreated**	**1**	193 **b**	55 **a**	68	98	35	10.2
	Insure Pulse - Low	**2**	302 **a**	53 **b**	68	97	37	9.7
	Insure Pulse - High	**3**	308 **a**	53 **b**	68	97	39	9.5
	Vita Flo	**4**	266 **a**	53 **b**	70	97	38	9.8
Variety x Seed Treatment		**1,1**	123	56 **a**	69	98	31 **b**	9.9
		1,2	245	54 **b**	66	97	37 **a**	9.0
		1,3	282	53 **b**	68	97	40 **a**	8.7
		1,4	207	54 **b**	69	97	38 **a**	9.3
		2,1	264	53 **b**	67	97	40 **a**	10.5
		2,2	360	53 **b**	70	97	37 **a**	10.4
		2,3	334	53 **b**	67	97	39 **a**	10.2
		2,4	325	52 **b**	70	97	39 **a**	10.3
P-Value		**Variety**	**< 0.001**	**0.002**	0.513	0.171	0.090	**< 0.001**
		Seed Treatment	**< 0.001**	**0.011**	0.455	0.194	0.205	0.111
		Variety x Seed Treatment	0.339	**0.028**	0.130	0.630	**0.048**	0.428
		C.V.%	18.4	1.8	4.1	1.0	10.2	5.9

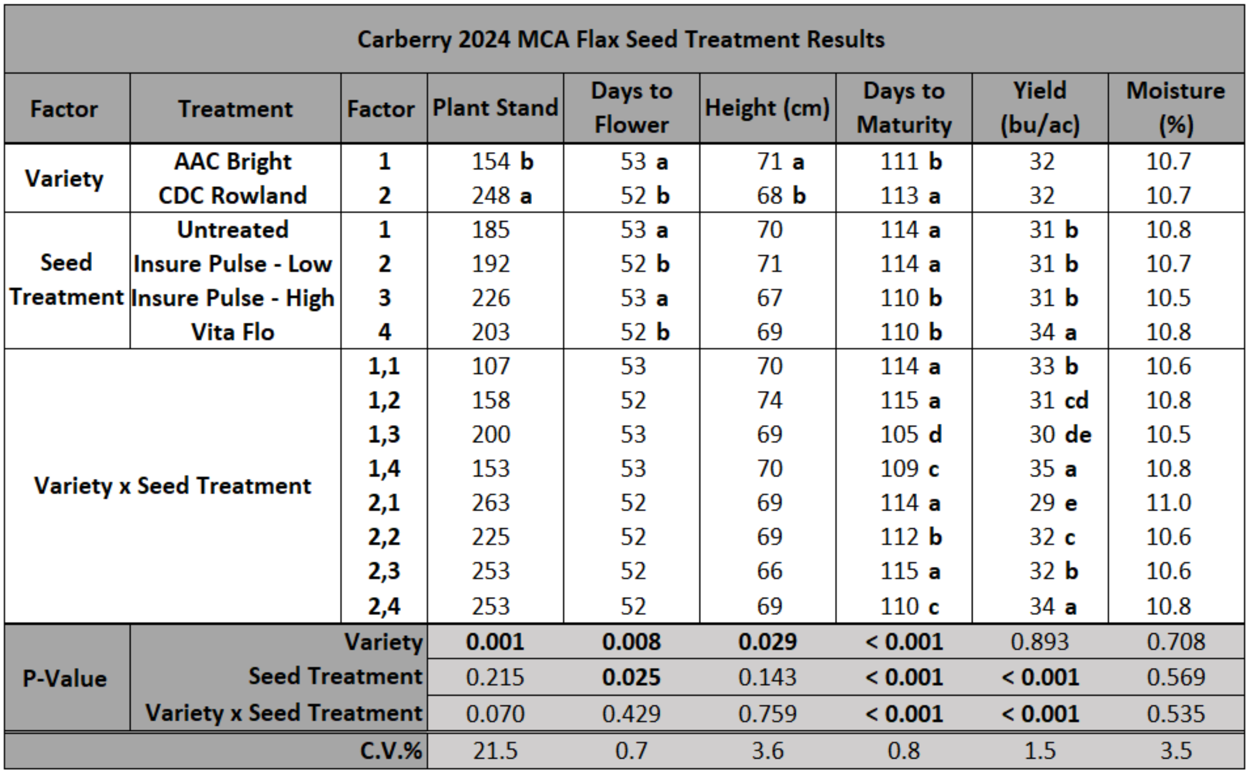
The results from the 2024 Flax Seed Treatment trial in Carberry can be found below in Table 4. Plant stands were found to be significantly different (P = 0.001) between the varieties grown at Carberry. CDC Rowland had higher plants stands (248 plants/m^2), while AAC Bright had lower plant stands (154 plants/m^2). The variety used also had significant effects (P = 0.008) on the number of days it took the flax to reach flowering. CDC Rowland reached flowering earlier (52 days) than AAC Bright (53 days).

The days to flowering were also found to be significantly different (P = 0.025) between seed treatments used. When the low rate of Insure Pulse or Vita Flo was used on flax, the plants reached flowering earlier (52 days) than when the high rate of Insure Pulse was used or when the flax was left untreated (53 days). The variety grown had a significant effect (P = 0.029) on plant heights at Carberry. The AAC Bright plants were taller (71 cm), while the CDC Rowland plants were shorter (68 cm). the variety grown, seed treatment used, and the combined effects of variety and seed treatment all were found to have significant effects (P < 0.001) on the maturity of the flax at Carberry. Between varieties, AAC Bright matured earlier (111 days), while CDC Rowland too longer to reach maturity (113 days).

When the high rate of Insure Pulse or Vita Flo was used, the flax matured earlier (110 days) than the untreated flax or when the low rate of Insure Pulse was used (114 days). When AAC Bright was treated with Vita Flo, it matured the fasted (109 days), though it was not significantly faster than when CDC Rowland was treated with Vita Flo (110 days). When AAC Bright was treated with Insure Pulse at the low rate and CDC Rowland was treated with Insure Pulse at the high rate, the flax took the longest time to reach maturity (115 days). Though the maturity of either flax variety that did not receive seed treatment was not significantly longer (114 days). The seed treatment used had a significant influence (P < 0.001) on yield at Carberry.

When flax was treated with Vita Flo, it produced the highest yield (34 bu/ac), and the remaining treatments produced lower yields (31 bu/ac). The combine effects of variety grown and seed treatment used also significantly affected (P < 0.001) the flax yield at Carberry. The highest yield was produced by AAC Bright treated with Vita Flo (35 bu/ac), though the yield was not significantly different than the yield produced by CDC Rowland treated with Vita Flo (34 bu/ac).

Table 4. Results from the 2024 MCA Flax Seed Treatment trial at Carberry.



Carberry 2024 MCA Flax Seed Treatment Results								
Factor	**Treatment**	**Factor**	**Plant Stand**	**Days to Flower**	**Height (cm)**	**Days to Maturity**	**Yield (bu/ac)**	**Moisture (%)**
Variety	**AAC Bright**	**1**	154 **b**	53 **a**	71 **a**	111 **b**	32	10.7
	CDC Rowland	**2**	248 **a**	52 **b**	68 **b**	113 **a**	32	10.7
Seed Treatment	**Untreated**	**1**	185	53 **a**	70	114 **a**	31 **b**	10.8
	Insure Pulse - Low	**2**	192	52 **b**	71	114 **a**	31 **b**	10.7
	Insure Pulse - High	**3**	226	53 **a**	67	110 **b**	31 **b**	10.5
	Vita Flo	**4**	203	52 **b**	69	110 **b**	34 **a**	10.8
Variety x Seed Treatment		**1,1**	107	53	70	114 **a**	33 **b**	10.6
		1,2	158	52	74	115 **a**	31 **cd**	10.8
		1,3	200	53	69	105 **d**	30 **de**	10.5
		1,4	153	53	70	109 **c**	35 **a**	10.8
		2,1	263	52	69	114 **a**	29 **e**	11.0
		2,2	225	52	69	112 **b**	32 **c**	10.6
		2,3	253	52	66	115 **a**	32 **b**	10.6
		2,4	253	52	69	110 **c**	34 **a**	10.8
P-Value	**Variety**		**0.001**	**0.008**	**0.029**	**< 0.001**	0.893	0.708
	Seed Treatment		0.215	**0.025**	0.143	**< 0.001**	**< 0.001**	0.569
	Variety x Seed Treatment		0.070	0.429	0.759	**< 0.001**	**< 0.001**	0.535
C.V.%			21.5	0.7	3.6	0.8	1.5	3.5

The lowest yield was produced when CDC Rowland was left untreated (29 bu/ac), though the yield was not significantly different than the yield produced by AAC Bright treated with the high rate of Insure Pulse (30 bu/ac). The grain moisture of the flax at harvest was not found to be significantly affected at Carberry.

The results from the 2024 Flax Seed Treatment Trial at Roblin can be found below in Table 15.5. The seed treatment used was found to have a significant effect (P = 0.005) on flax plant stands at Roblin. When Insure Pulse was used at the high rate, it resulted in the highest plant stands (163 plants/m^2). When the flax seed was left untreated, it resulted in the lowest plant stands (114 plants/m^2), though the stands were not significantly lower than when the low rate of Insure Pulse (135 plants/m^2) or Vita Flo was used (128 plants/m^2).

The number of days it took the flax to reach flower was found to be significantly different (P = 0.008) between the flax varieties grown at Roblin. CDC Rowland reached flowering earlier (57 days), while AAC Bright too longer to reach flowering (58 days). There were no significant influences on plant heights or maturity of the flax at Roblin. The variety grown was the only factor found to have a significant effect (P < 0.001) on flax yield at Roblin.

Table 5. Results from the 2024 MCA Flax Seed Treatment trial at Roblin.

Roblin 2024 MCA Flax Seed Treatment Results

Factor	Treatment	Factor	Plant Stand	Days to Flower	Height (cm)	Days to Maturity	Yield (bu/ac)	Moisture (%)
Variety	**AAC Bright**	**1**	131	58 **a**	72	107	38 **b**	7.3
	CDC Rowland	**2**	139	57 **b**	72	107	45 **a**	7.6
Seed Treatment	**Untreated**	**1**	114 **b**	58	72	107	39	7.7
	Insure Pulse - Low	**2**	135 **b**	58	71	107	42	7.5
	Insure Pulse - High	**3**	163 **a**	58	71	107	43	7.4
	Vita Flo	**4**	128 **b**	58	74	107	41	7.1
Variety x Seed Treatment		**1,1**	96	58	72	107	35	7.3
		1,2	144	58	71	107	39	7.8
		1,3	162	58	71	107	39	7.0
		1,4	122	58	75	107	38	7.0
		2,1	131	57	73	107	43	8.1
		2,2	126	57	71	107	46	7.2
		2,3	164	57	71	107	47	7.8
		2,4	133	57	73	107	44	7.2
P-Value	**Variety**		0.374	**0.008**	0.731	-	**< 0.001**	0.159
	Seed Treatment		**0.005**	0.412	0.149	-	0.236	0.151
	Variety x Seed Treatment		0.143	0.412	0.602	-	0.933	0.065
	C.V.%		18.0	0.3	3.9	0.0	10.2	7.5

CDC Rowland produced the higher yield flax (54 bu/ac), while AAC Bright produced the lower yielding flax (38 bu/ac).

Growing Potential of Ethnic Vegetables

Project duration:	April 2023 to March 2028
Objectives:	Evaluate the agronomic performance of ethnic vegetables under Manitoba’s climatic conditions. Understand the market potential and consumer demand for locally grown ethnic vegetables. Provide research-based recommendations for best practices in production. Support farmers in diversifying their crop portfolios to enhance profitability and sustainability. Engage students and agricultural professionals in hands-on learning and research opportunities. Promote food security and reduce reliance on imported ethnic vegetables.
Collaborators:	Assiniboine College Manitoba Agriculture

Background:

The Ethnic Vegetables Project is a collaborative initiative between the Manitoba Crop Diversification Centre (MCDC) and Assiniboine Community College (ACC), with support from Agriculture and Agri-Food Canada (AAFC). This project aims to explore the potential of ethnic vegetable production in Manitoba, addressing the growing demand for diverse and culturally significant crops. Given the increasing population of immigrant communities in the region, there is a need to assess the feasibility of growing these vegetables under local climatic conditions and to support local producers in diversifying their crop offerings. The primary objective of the Ethnic Vegetables Project is to assess the feasibility of cultivating ethnic vegetables in Manitoba and to support local producers in adopting these crops.

Ethnic vegetables play a crucial role in meeting the dietary and cultural needs of diverse communities. As Manitoba continues to see an influx of immigrants from various regions, there is a rising demand for fresh, locally grown ethnic vegetables. However, these crops are often imported, leading to higher costs, reduced freshness, and increased carbon footprints associated with transportation. By establishing local production, this project seeks to:

- Provide fresh and affordable ethnic vegetables to local communities.
- Support small-scale and commercial farmers in diversifying their crops.
- Reduce dependence on imports and strengthen food security.
- Promote sustainable agricultural practices tailored to Manitoba's climate.
- Create educational and research opportunities for students and producers.

Project Activities and Outcomes:

The Ethnic Vegetables Project has been conducted at MCDC and Assiniboine College with the primary objectives of:

1. **Assessing the Agronomic Viability:** Studying how different ethnic vegetables adapt to Manitoba's growing conditions in terms of soil, temperature, and pest resistance.
2. **Evaluating Market Potential:** Conducting surveys and engaging with local retailers, farmers' markets, and restaurants to understand demand and pricing.
3. **Engaging Farmers and Students:** Offering hands-on training and workshops for producers and agriculture students to learn about best practices in cultivation and management.
4. **Promoting Local Production:** Encouraging farmers to adopt ethnic vegetable production as an economically viable and sustainable option.

2025 Project Plans:

Building on the success of previous trials, the Ethnic Vegetables Project will be expanded in 2025 with research and production taking place at Assiniboine College. The project will incorporate both greenhouse and outdoor field trials to better understand the adaptability of ethnic vegetables under different growing conditions.

- **Greenhouse Trials:** The controlled environment will allow researchers to optimize growing conditions, extend the growing season, and study the impact of temperature and humidity on yield and quality.

- **Outdoor Trials:** Field trials will assess the feasibility of open-field production under Manitoba’s climatic conditions, helping determine best practices for soil preparation, irrigation, and pest management.

This expansion will provide valuable insights into efficient production methods, enabling growers to make informed decisions about adopting ethnic vegetable cultivation in their operations.

Conclusion

The Ethnic Vegetables Project represents an important step toward enhancing agricultural diversity and meeting the needs of Manitoba’s multicultural population. Through research, education, and farmer engagement, this initiative is fostering local food security while creating new opportunities for producers. The upcoming 2025 trials at Assiniboine College will further strengthen the project’s impact by refining production techniques and expanding the reach of ethnic vegetable farming in the region. With continued support and collaboration, this project has the potential to transform Manitoba’s agricultural landscape, offering sustainable solutions for both growers and consumers alike.

Evaluation of Hops Varieties in Manitoba

Project duration: May 2024 – September 2024

Objectives: Evaluation and Demonstrate the adaptability of hops in the Carberry region of Central Plains, Manitoba.

Collaborators: CMCDC

Background:

Hops are used as a flavoring and preserving ingredient in beer as well as for aroma. For large commercial brewers the majority of production has been centralized in Washington USA; however, the explosion of the craft brewing industry south of the border, and more recently in Canada has somewhat re-vitalized the hop industry on more of a regional scale.

Many of the resources citing characteristics used to describe hops come from work in the Pacific Northwestern USA, and therefore traits may not be expressed the same in our more northern/non-costal environment. Traits most important to Manitoba growers include: maturity firstly, followed by disease/pest resistance and of course yield. Specific characteristics related to bitterness (% alpha acid), aroma (% beta acid and volatile fatty acids), and storability (Harvest Storage Index) are also important considerations but can be dependent on marketing plans. The most important thing when acquiring rhizomes, crowns or cuttings for yard establishment is to ensure they are disease free and from a reputable source.

Hops favor well drained medium textured soil with ideal pH within the 6.2-6.5 range. On lighter textured soil drip irrigation may be required to experience full yield potential. Fertility is important, with Nitrogen and Potassium being of greatest importance followed by Phosphorus. Once established nitrogen demands during the season for biomass production can reach 150+lbs per acre, with approximately half converted by the plant into cone production. Potassium requirements at these Nitrogen levels are approximately 100lbs/acre and 25lbs/ac for Phosphorus.

As with most crops there are numerous pests that can potentially reduce yield/quality and/or significantly impact the general long-term health of the hop yard. Dominant insect pests include aphids, spider mites, and various leaf eating caterpillars such as Bertha Armyworm. Main diseases of concern are Powdery Mildew, Downy Mildew and Verticillium. Pruning of the leaves off the bottom 0.5-1m of bine to promote air-flow is one effective means of reducing the incidence of disease (Mildews). Integrated pest management techniques are encouraged regardless if the yard is organic or conventional; especially considering the long-term investment of a hop yard.

Varieties established at Carberry are listed in Table 1 with detailed descriptions in Appendix A.

Table 1: Hop varieties demonstrated at CMCDC Carberry.

Plot	Name
1	**Cascade:** A well-established American aroma hop developed by Oregon State University's breeding program in 1956 from Fuggle and Serebrianker (a Russian variety), but not released for cultivation until 1972. It has a flowery and spicy, citrus-like quality with a slight grapefruit characteristic.
2	**Golding:** A popular English aroma hops grown prior to 1790 but also widely cultivated in the USA. They tend to have a smooth, sweet flavour.
3	**Wild Miami:** A wild selection taken from Miami Manitoba in 2009 – not an official registered variety.
4	**Garden:** Used as an ornamental vine and does not produce cones.
6	**Mt Hood:** A soft American variety frequently used in styles that require only a subtle hop aroma (German/American lagers). Named for Mount Hood in Oregon.
8	**Golden:** Typically used as an ornamental vine, it is popular as a foliage accent in the garden, particularly in cool-summer regions. Golden Hops has attractive yellow foliage which emerges gold in spring. The fuzzy lobed leaves are ornamentally significant but do not develop any appreciable fall colour. The flowers are not ornamentally significant. It produces abundant clusters of yellow hop-like fruit from midsummer to mid fall.
9	**Brewers Gold:** British bittering hop developed in 1919. Both Brewer's Gold and Bullion are seedlings of BB1 (found wild in Manitoba). Many modern high alpha hops were developed from Brewer's Gold. Has a resiny, spicy aroma/flavor with hints of black currant.

10 **Fuggle:** This variety was noticed growing "wild" in the hop garden of George Stace's house at Horsmonden in Kent, England in 1861. In 1875 it was introduced by Richard Fuggle who lived in the village of Brenchley and hence it was called Fuggle. The aroma is earthier and less sweet than Goldings.

Plant Growth, Maturity and Yield Observations

Relative growth habits, vigor and cone yields were consistent. For the third straight year Brewer's Gold was the greatest producer while Fuggle produced the least suggesting that relative yield differences within maturity groups listed from other geographies most likely hold true in Manitoba as well.

Multiple harvest samples were taken though September and into October and submitted for quality testing to help identify ideal harvest timing. For each date samples of random cones were picked from each variety and dried immediately in an oven at 50 ^{o}C for three days or until dry. Once dry, samples were vacuum sealed and frozen at -20 C until shipped for analysis. Quality analysis was conducted by Alpha Analytics Inc, in Yakima, Washington USA.

Spider mites were the dominant pest.

Figure 1: Spider mite damage observed on hops at CMCDC.

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