



**WADO**

Westman Agricultural Diversification Organization  
**2015 ANNUAL REPORT**



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## 2015 Industry Partners (Alphabetical Order)

AgQuest	Manitoba Pulse and Soybean Growers Association
Agriculture and Agri-Food Canada	Mustard 21
Agrisoma	National Sunflower Association of Canada
ARDI – Agri-Food Research Development Initiative	Parkland Crop Diversification Foundation - Roblin
Avondale Seeds	Pepsico /Quaker
Barker’s Agri-Centre – Melita	Pioneer Grain
BASF	Prairie Agricultural Machinery Institute - Portage
Canada MB Crop Diversification Centre- Carberry	Prairies East Sustainable Ag Initiative – Arborg
Cargill	Prince Farm
Composites Innovation Centre	RM of Pipestone
Ducks Unlimited Canada	RM of Two Borders
Farm Credit Canada	Rural Development Institute
FP Genetics	Secan Seeds
Gowan Agro Canada	Seed Manitoba
Indian Head Agricultural Research Foundation	Southwest Regional Development Committee
MAFRI – Crops Branch and GO Teams	University of Manitoba
Manitoba Buckwheat Growers Association	University of Saskatchewan (CDC)
Manitoba Corn Growers Association	Western Feed Grains Development Cooperative
Manitoba Crop Variety Evaluation Team	

## Farmer Co-operators – 2015-2016 Trial Locations

Barkers Farm – Melita	Kirkup Farm - Melita
John Snyder – Melita	Jim Anderson Farm – Melita
Mayes Family Farms – Lyleton	Prince Farm - Waskada

## WADO Directors

WADO functions with a board of directors that assists in communications, activities and project development. The directors are from all across southwest Manitoba and they have a direct connection to farming and agriculture. The directors listed below are those that participated with WADO operations for 2016.

Gary Barker	Melita - Chairman	John Finnie	Kenton
Brooks White	Pierson	Allan McKenzie	Nesbitt
Ryan Martens	Boissevain	Patrick Johnson	Killarney
Kevin Beernaert	Hartney	Neil Galbraith	Minnedosa
Kevin Routledge	Hamiota		

MAFRI staff members located in Southwest Manitoba are also part of the WADO board: Elmer Kaskiw – Shoal Lake, Lionel Kaskiw – Souris, Murray Frank – Brandon, Amir Farooq – Hamiota, as well as & Scott Chalmers – Melita

## Introduction

The Westman Agricultural Diversification Organization Inc. (WADO) manages a wide range of value-added and diversification agriculture research and demonstration projects that are summarized in this report. WADO operates in the southwest region of Manitoba and works in conjunction whenever possible with the other Diversification Centres in Roblin (PCDF), Arborg (PESAI) and the Fed/Prov. Canada/Manitoba Diversification Centres (CMCDC) based in Carberry and Portage la Prairie. WADO owes its success to the excellent cooperation and participation we receive from the WADO Board of Directors, cooperating land owners, local producers, industry partners and cooperating research institutes. WADO acts as a facilitator and sponsor for many of the Ag Extension events held across the province in conjunction with other MAFRI staff and industry personnel. This is all part of WADO's goal of helping farmers and our rural communities do better.

WADO receives the majority of its operating funds from the Agricultural Sustainability Initiative (ASI) and other Growing Forward (GF) programs. Smaller amounts of additional funding come from the MCVET committee and other Industry Partners for the contract work that WADO is able to provide to these organizations.

## WADO Staff

Scott Chalmers P.Ag., is the Diversification Specialist for MAFRI in Southwest Manitoba. Scott is responsible for project development, general operations, summer staff management, plot management, data collection and analysis. Scott has been working with WADO since 2007.

WADO enjoyed excellent staff in 2015. They were an important reason we were able to successfully handle more than 2300 plots throughout the SW region. Liam Bambridge from Melita, Chantal Elliott of Pipestone and Jessica Mayes of Pierson were all returning summer students.

Liam has been with WADO for four summers. His employment extended into the winter to assist with fall work, shop renovations and equipment maintenance. He will be resuming his education in the fall of 2016 at ACC taking Agribusiness.



WADO Staff 2015 (right to left): Scott Chalmers, Chantal Elliott, Leanne Mayes, Jessica Mayes, Liam Bambridge

Chantal has spent three summers with WADO. She is currently working on her final year of an Environmental Science degree at the University of Manitoba. Chantal grew up on an organic farm near Pipestone, MB.

Jessica has been a summer student with WADO since 2013. She is a Grade 12 student at Pierson School. She plans to return to WADO during the summer of 2016.

Leanne Mayes joined the staff in October 2014 as full time laborer.

## Got An Idea?

The Westman Agricultural Diversification Organization continually looks for project ideas, value-added ideas, and producer production concerns. If you have any ideas, please forward them to:

Westman Agricultural Diversification Organization (WADO)  
c/o Scott Chalmers MAFRI  
Box 519  
Melita, MB R0M 1L0  
204-522-3256 (office)  
204-522-5415 (cell)  
204-522-8054 (fax)  
[scott.chalmers@gov.mb.ca](mailto:scott.chalmers@gov.mb.ca)

All WADO annual reports are posted at the provincial website:

<http://www.gov.mb.ca/agriculture/innovation-and-research/diversification-centres/index.html>

## 2015 Weather Report and Data – Melita Area

After the struggles of the past two years caused by excess moisture, we finally enjoyed a more relaxed spring. Limited snow accumulation allowed seeding to begin late April. Air and soil temperatures remained below normal for most of the spring and on May long weekend the Melita area was hit by a large storm system that dumped several inches of rain and snow. WADO crops survived this event with no losses due to frost or excess moisture. The sunflower variety trial located in Pierson experienced wind damage on two different occasions. On July 26<sup>th</sup> a tornado touched down north of the plots. Although the tornado was several miles away, the plots were still damaged by the high winds. Later in the growing season a wind storm struck the area contributing to lodging of both the oil and confectionary sunflowers. Harvest began early in August with the winter cereals and continued smoothly due to dry hot weather. Overall, WADO had a good season.

**Table 1:** Melita 2015 Season Report by Month

	April	May	June	July	August	September	October	Total
Precip (mm)	5	112	167	40	39	67	6	436
Normal Percip. 1	29	53	101	69	78	35	31	396
Temp Average Celcius	6.6	11.2	18	20.3	19	14.6	9.8	
Norm. Temp	4.6	11.59	16.8	19.49	18.52	12.69	5.58	
CHU	156	344	640	743	655	475	154	3167
GDD	75	194	390	474	435	289	85	1942

Source: [www.gov.mb.ca/climate/SeasonalReport](http://www.gov.mb.ca/climate/SeasonalReport)

**Table 2:** Season summary April 1 – October 31 2015

	<b>Actual</b>	<b>Normal</b>	<b>% of Normal</b>
Number of Days	214		
Growing Degree Days	1942	1702	114
Corn Heat Units	3167	2884	110
Total Percipitation	436	396	110

Source: [www.gov.mb.ca/climate/SeasonalReport](http://www.gov.mb.ca/climate/SeasonalReport)

To calculate growing degree days (GDD), first determine the mean temperature for the day. This is usually done by taking the maximum and minimum temperatures for the day, adding them together and dividing by 2. The base temperature (0°C for cereals, 5°C for both alfalfa and canola) is then subtracted from the mean temperature to give a daily GDD. If the daily GDD calculates to a negative number it is made equal to zero. Each daily GDD is then added up (accumulated) over the growing season.

Corn heat units (CHU) are based on a similar principle to growing degree days. CHUs are calculated on a daily basis, using the maximum and minimum temperatures; however, the equation that is used is quite different. The CHU model uses separate calculations for maximum and minimum temperatures. The maximum or daytime relationship uses 10°C as the base temperature and 30°C as the ceiling, because warm-season crops do not develop at all when daytime temperatures fall below 10°C, and develop fastest at about 30°C. The minimum or nighttime relationship uses 4.4°C as the base temperature and does not specify an optimum temperature, because nighttime minimum temperatures very seldom exceed 25°C in Canada. The nighttime relationship is considered a linear relationship, while the daytime relationship is considered non-linear because crop development peaks at 30°C and begins to decline at higher temperatures. CHU's is a more accurate crop prediction tool for crops like corn and beans that require heat for proper growth.

WADO continues to operate and draw data from several weather stations in the southwest. These stations include Melita, Hamiota and Reston. Continuous real time data recorded every 15 minutes and this can be viewed publicly at the following locations:

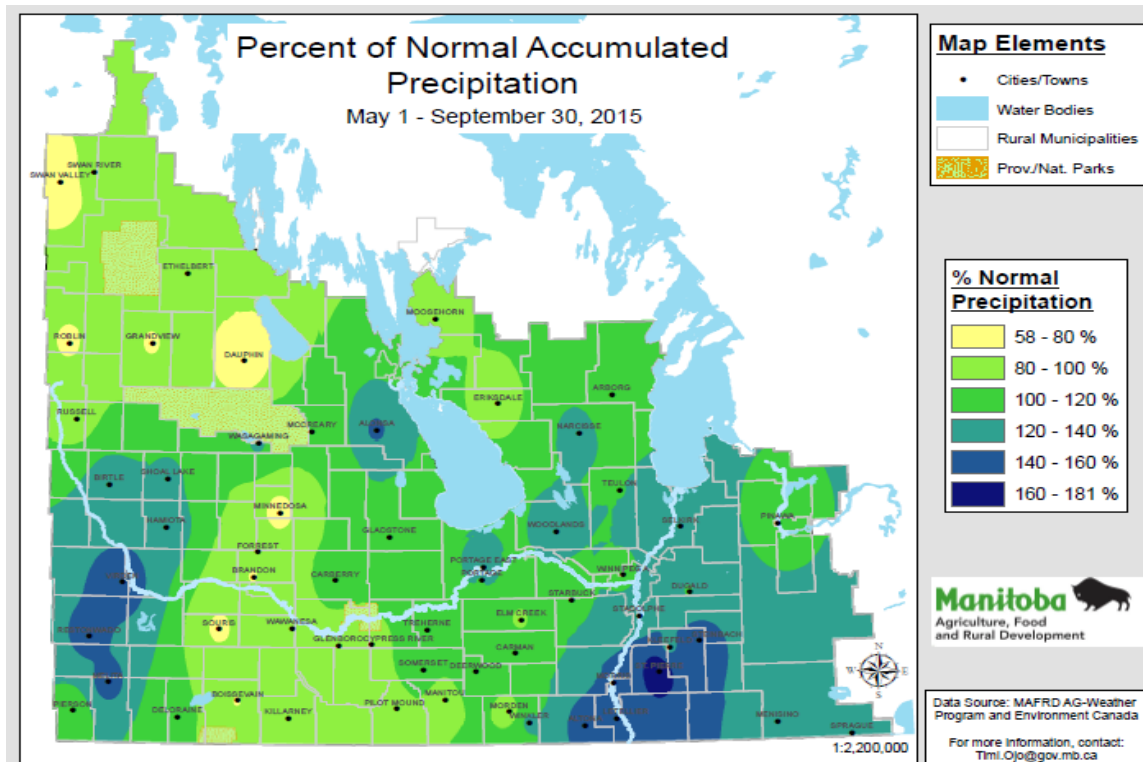
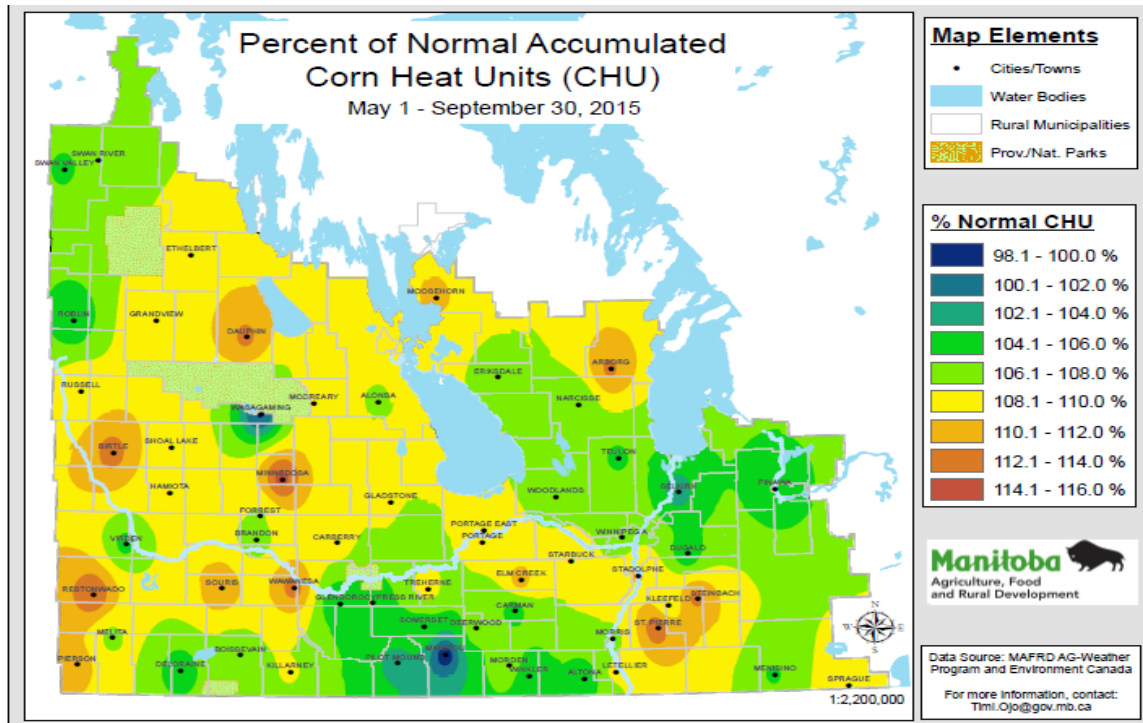
<http://tgs.gov.mb.ca/climate/DisplayImage.aspx?StationID=bede253>

<http://tgs.gov.mb.ca/climate/DisplayImage.aspx?StationID=hamiotaWADO>

<http://www.gov.mb.ca/agriculture/weather/reston-cc.html>



## 2015 Corn Heat Unit Map and Precipitation Map



Source: <http://gov.mb.ca/agriculture/weather/weather-conditions-and-reports.html>

## WADO Tours and Special Events



Ag Days, held January in Brandon, was the largest event WADO was involved in for 2015 (picture left). WADO attended the show with the rest of Manitoba's Diversification Centres featuring a booth showcasing new farming opportunities and possibilities. Over 40,000 people were in attendance.

WADO was unable to host a Field Day in 2014 due to the exceptionally wet conditions, so on July 21 we were happy to be able to present our plots at the 2015 WADO summer tour.

Approximately 75 people joined us for lunch and then toured our main plot site SW of Melita. This location showcased many of our variety trials including: winter cereals, oats, barley, soybeans, peas, narrow row beans, buckwheat, hemp, carinata, and juncea. Also at this site were several trials that were part of the University of Manitoba's research on soybeans and WADO's own research project on intercropping hairy vetch with corn and sunflowers.



Photo left: Jeff Kostuik (CMCDC) discussing our Hemp variety trial at the WADO field day.

Photo right: WADO field day participants enjoying lunch under the tent before the crop tour begins.



## Trip to France regarding Intercropping Presentations at the NLSD and BASE Network

Manitoba Agriculture, Food and Rural Initiatives Out-of-Province Travel Report

September 12-20<sup>th</sup>, 2015

Scott Chalmers, Diversification Specialist, AIA, WADO Diversification Centre

I was asked to speak at two conferences in France during the month of September. I was pleased to be able to attend the NLSD (Festival of No Till and Direct Seeding) and BASE (Biodiversity Agriculture Soil Environment) Network Meetings in France. Three formal presentations were given and I was able to tour several farms. Both organizations are similar to the MANDAK that we have in Manitoba and North Dakota. They are fairly close with France's agricultural colleges around their country and are a membership non-profit with over 2500 members/producers. No till is a concept that has just spread to the UK as well.

### *Subject (or purpose of trip):*

To provide information to field day attendees in France on intercropping research and practices generated from WADO and other parts of the prairies and to meet with researchers investigating intercropping with similar crops as Manitoba and exchange information useful for Manitoba producers.

### *Observations and Events*

#### **September 12**

Stayed in Paris, checked in at hotel and toured historical monuments, Eifel tower and river tour.

#### **September 13**

Took speed train to the town of Vitre and met up with Fredrick Thomas (former president of BASE). Toured the town and famous castle. I reviewed the presentation with Fredrick to prepare for translating during future speaking sessions. Fredrick is a local no till farmer who uses cover crops. He farms approximately 800 hectares of crops and cooperates with a sheep farmer for grazing in his system of farming. He has a no till garden, which he and I found we had in common. He was president of BASE and has plenty of contacts in the US, Canada, Australia, Brazil, and France. He spent some time in Minnesota in the 90s as part of the extension programming in agriculture. He learned his English in the US.

#### **September 14**

Fredrick taxied me to the town of Pontivy where I spoke at the Agriculture College Lycee Agricole de Pontivy (Photo 1). Approximately 60 producers, members of BASE, and several students were in attendance. Fredrick translated my presentation as I spoke for the audience. I spoke from 10-1:30, and again from 2:00-5:30. There were many questions after the presentation from the audience, including: GMOs, economics of wheat in Manitoba, and ideas for dealing with excessive moisture we are experiencing. Translation was taken over by William Collins as Fredrick had to leave to help in Lyon for the NLSD conference. William Collins is a Coop agronomist for the local area and also learned English from the US extension partnership they have. After the meeting we toured local fields with cover crop experiments. Had a nice supper at Pontivy with William, Jean Luc Lebeneziec, and a professor of the ag college; (all members of BASE). Jean Luc then took us to his home in Sarzeau.

### **September 15**

Toured the area of Sarzeau with Jean Luc and his wife. We visited the local ocean beach and a local castle Chateau de Suscinio. We travelled to Vannes city to tour that area as well, and then had lunch back a Jean Luc's. He has a no till garden; similar to myself and Fredrick. Jean Luc then took us to a friend of his who is a farmer near Rennes. Bernard was a farmer who also lived in a small castle and has been farming no till for over 30 years. Of all the fields I toured, his corn looked the healthiest which provided reassurance that no till over time provides intrinsic benefits to the soils. His earthworms appeared to be thriving based on the size and number of earthworm castings on the ground (photo 2). This farmer grows corn, wheat, buckwheat, peas, and clover. He also grows cover crop mixes as a resting crop including soybean, buckwheat, clovers, common vetch, phacelia, tillage radish, oilseed radish, mustard, sunflower (photo 3). Bernard has installed permanent, native flower field borders about 3 meters wide around the outside of the field to provide a place for pollinators and insect predators to thrive (photo 4). He has been running into issues with his radish and clovers suffering from sulfonylurea residues in the soil from long term corn, wheat and rapeseed production in the past. He grows peas before buckwheat to produce a nitrogen credit for his buckwheat and on these fields he does not spray or fertilize. He has wild boar in his area which he hunts; they cause problems in his fields rooting around.

Later that day Jean Luc had to take us to the Nantes airport. I took the plane to Lyon. Bertrand Saignant picked us up at Lyon. He is a member of BASE and is a no till cropper and no till vegetable grower near Lyon. He and his wife and father grow fresh vegetables for the roadside market five days a week. I stayed at a hostel that evening at Quincieux, a small town, near the next day's event.

### **September 16**

A one day no till conference called NLSO was held at the Ag School, Lycee de Agricole near Quincieux. This event showcased some new no till equipment, about 12 booths, and about 6 no till presenters. Presentations were basic regarding no till and essentially reviewed the benefits. A researcher from Switzerland (AgriGeneva <http://www.agrigeneve.ch/>) described the government programs they have on cover crops where producers are rewarded on their no till and cover cropping practices ranging from 150-250 Franks/ha subsidy (approximately \$190 – \$325 CDN dollars) depending on the practice including; cover crops, intercropping, no till, rotation, etc. I was the last presenter and presented from 4:30 to 6:50. There were many questions and an obvious interest in hairy vetch specifically. The theatre classroom type location had 500 people packed into a space designed to hold 400 (photo 6). Students from surrounding Ag schools rotated in schedule with presenters. Fredrick Thomas translated for me. Lunch was served in the cafeteria during presentations. I met up with Maxime Barbier who was my next day translator. I also met Sabine Lory who organized my entire trip. I met Jerome Defert a local farmer who could speak English and spent the majority of the conference with him discussing and comparing the agriculture status of our countries. After my presentation several people from various soil conservation groups introduced themselves to me. Maxime took us to our hotel that evening in Beaune.

### **September 17**

Toured the city of Beaune and the historical hospice and Caves, Patriarche Père & Fils, which is a wine cellar under the city 5 km long. We then drove to Dijon to tour that city downtown and had supper there.

### **September 18**

Maxime and I drove to the small community of Autrey les Gray where I did my presentation. Maxime translated. I spoke for about two hours in front of about 60 farmers all members of BASE. Many were interested in intercropping and some had even tried it on their farms.

During lunch, I met another person who had worked in Minnesota and had grown sunflowers and common vetch together. He said the common vetch over took the sunflowers and was too competitive. They were impressed with how well the crop looked on my presentation with sunflower and hairy vetch from Manitoba.

I listened to a unique presentation by a large farm in the area that is spraying plant derived teas on their crops in order to induce a resistance response in the crop, reducing the amount of disease in the crop and stimulating growth. They harvest whole plants of Comfrey, Horsetail, Burdock, alfalfa, and Stinging Nettle, then add water to the plants in a container and let it naturally ferment. They strain off the “tea” and spray it on their crops. Their anecdotal evidence suggests crop health improvements and greater yields. It takes about 10 kg of the plant material and 100 L of water ratio. This solution is sprayed on the crop once to several times at 4 L/ha. Some of the local farmers say it was banned by the government as an agricultural practice a decade earlier.

That evening I stayed at a local farm bed and breakfast near Poigny with Dominique Guyot. His wife cooked us a unique local feast of deer roast, various Bavarian beers, local wine, roasted potatoes and pears, and apple crisp. His farm is rather large for the area, approx 1500 acres, where he grows corn, buckwheat, wheat, peas, cover crops, rapeseed, and faba beans. He is a no tiller and a member of BASE. He also raises rabbits for meat and ferrets which are used for hunting. They store grain under sheds, have solar and wind power, and have a large assortment of fruit trees in their yard.

### **September 19**

We toured Dominique’s fields. He has a lot of topography (photo 7, 8). He has access to the public effluent which he spreads on his fields. He claims to get a response from the effluent only by the third year of grain production. He grows about 7 species in his cover crop mix then seeds into this crop with wheat. Slugs and wild rabbits are some of their major pests. He claims to not have the rapeseed disease *Aphanomyces* despite the department of agriculture noting his area to be the worst in France. He claims his cropping practices prevent the disease. He has a seed cleaner which he cleans or separates crops with for seeding. He has also rigged up a system to mix his polycrops together which is a system of augers and conveyer belts. Dominique was using mustard, oilseed radish, tillage radish, common vetch, phacelia, sunflower, forage pea and faba in his cover crops mix (photo 7 and 8).

### **General Observations:**

During my tour around France, I found about 80% of farms still use tillage on the majority of their soils. Zero tillage is a minority among most fields and is rather unfamiliar to many. Their soils are rich but shallow and have great variation in topography and great risk to erosion. Fredrick mentioned the soils in his area (Vitré and Lyons; he has two farms) have been farmed for nearly a thousand years and the soils have little to give in return anymore. This is why he is moving forward with zero till and polycropping. Farms are small in France, about 150 – 200 acres and field size is 40 to 80 acres. Their seeders are 8 feet wide and they generally don’t have GPS guidance systems. Disc seeders are more common with the no tillers there than hoe drills. The economy seems to be more locally sufficient than ours in terms of fresh



farm food like meat, eggs, and local food products. They seem to be 10 years ahead on polycropping but 20 years behind on zero tillage. Farmers attribute excessive moisture as the factor which prevents them from no tilling. However, some early pioneers there seem to be making it work with cover crops and interseeding, reducing soil moisture enough to direct seed. They like to plant clovers with their rapeseed as a relay crop. After rapeseed harvest, the clover continues to grow. I noticed their corn is short and yellow, with plenty of weeds. They cannot grow GMO Corn and they are restricted by their government in that they are only able to apply 140 kg/ha nitrogen, including the soil test N. Therefore, their corn is deficient in nitrogen. Basal weeds like Knotweed plague the corn. Field size is about 40 acres. Local crops include corn, rapeseed, wheat, buckwheat, clover. pH of the soil is 6.5. Rapeseed grows about 6 feet tall and has a stalk about 1" thick! They grow 'Alexander' or 'Kura' clover which grows much of the fall and will die from the first fall hard frost (photo 5). This practice simplifies termination without herbicides. They like to put this with rapeseed for this reason. They also don't inoculate their pulse crops; they seem to rely on natural Rhizobia in the soil. The local Ag College has fields that they help with establishment, harvest, and as an educational tool.

Their public education system is free for students to attend and no tuition is required even at the university level. At about the age of 15-18 students focus on their specific interest for education. They can choose agriculture as one of these choices of school. Schools are located in rural (country) areas even separate from local towns where the school has practical farm experience such as dairy cows, swine pens, chickens, and students can also participate in the grain farm seeding or spraying etc. The two schools I visited had a respectable amount of infrastructure given the infrastructure of the local agricultural area.

Photo 1: Agriculture College Lycee Agricole de Pontivy



Photo 2: Earthworm castings in corn field near Rennes



Photo 3: Cover crops at Bernard's Farm near Rennes.



Photo 4: Native flower borders around crops.



Photo 5: Clover



Photo 6: Ag School Lycee de Agricole near Quincieux.



Photo 7: Dominique's fields



Photo 8: Dominique's fields



## U.K. Nuffield Scholar Visits WADO – Andrew Howard

In July, Scott spent two days with Andrew Howard, an arable farmer from Kent, England who was visiting Canada as a Nuffield Scholar. Nuffield Farming Scholarship Trust is a charity which awards around 20 scholarships to farmers and people in the agricultural industry each year. These scholarships allow the scholars to travel the world to meet the most innovative people in their chosen subject. The scholars, after eight weeks of overseas travel, are expected to write a report on their findings and also go out into the industry to communicate what they have found. The Trust's motto is "Leading positive change in agriculture".

The title of Andrew's study is, "The potential for Companion Cropping in UK arable systems". The basic idea of his study is to look at growing more than one species in the field at the same time. This may be a companion crop which is not taken to harvest, intercrops where all the species are taken to harvest, living mulches and under-storey crops.

Andrew learned of WADO's research on intercropping pea and canola through an internet search. As this is a subject of particular interest to him, he contacted WADO to arrange a tour. During his time in the area Andrew toured WADO's intercropping plots of corn-hairy vetch, sunflower-hairy vetch and rye-hairy vetch. Scott and Andrew visited a farmer near Deloraine (photo right) who was intercropping sunflower and hairy vetch and another farmer in the Boissevain area who is intercropping pea with canola. Also included in the tour was an organic farm near Nesbitt which demonstrated intercropping with pea-mustard-alfalfa, mustard-alfalfa, camelina-pea and a sweet clover seed field.



If you are interested in learning more about Andrew's scholarship and research you can visit his blog at <https://andyhowardnuffield15.wordpress.com/>.

## Understanding Plot Statistics

There are two types of plots at WADO. The first type is replicated research plots and the other is demonstration plots. Demonstration plots are not used to determine statistical differences between data; they are typically used only for show and tell and observation.

Replicated plots are scientific experiments in which various treatments (ex. varieties, rates, seed treatments, etc.) are subject to a replicated assessment to determine if there are differences or similarities between them. Many designs of replicated trials include randomized complete block designs (most common), split plot design, split-split plot design and lattice designs. Since these types of trials are replicated, statistical differences can be derived from the data using statistical analysis tools.

The analysis of variance (ANOVA) is the most common of these calculations. From those calculations, we can determine several important numbers such as coefficient of variation (CV), least significant difference (LSD) and R-squared. CV indicates how well we performed the trial in the field which is a



value of trial variation; variability of the treatment average as a whole of the trial. Typically CV's greater than 15% are an indication of poor data in which a trial is usually rejected from further use. LSD is a measure of allowable significant differences between any two treatments. Ex: Consider two treatments; 1 and 2. The first treatment has a mean yield of 24 bu/ac. The second treatment has a yield of 39 bu/ac. The LSD was found to be 8 bu/ac. The difference between the treatments is 15. Since the difference was greater than the LSD value 8, these treatments are significantly different from each other. In other words, you can expect the one treatment (variety or fertilizer amount, etc.) to consistently produce yields higher than the other treatment in field conditions. If "means" (averages) do not fall within this minimal difference, they are considered not significantly different from each other. Sometimes letters of the alphabet are used to distinguish similarity (same letter in common) between varieties or differences between them (when letters are different representing them).

R-squared is the coefficient of determination and is a value of how "sound" the data really is. In regression models such as ANOVA it is determined by a value that approaches the value of 1, which represents perfect data in a straight line. In most plot research, R-squared varies between 0.80 and 0.99 indicating good data.

Grand mean is the average of the entire data set. Quite often, it helps gauge the overall yield of a site or trial location.

Sometimes 'checks' are used to reference a familiar variety to new varieties and may be highlighted in grey or simply referred to as 'check' in the results table or summary for the readers convenience.

Data in all replicated trials at WADO has been analyzed by statistical software from either Agrobase Gen II version 16.2.1 software, or Analyze-it version 2.03 software. Coefficient of variation and least significant difference at the 0.05 level of significance was used to determine trial variation and mean differences respectively. At this level of significance, there is less than 5% chance that this data is a fluke when considered significant. For differences among treatments to be significant, the p-value must be less than 0.05. A p-value of 0.001 would be considered highly significant.

## MCVET Variety Evaluation Trials

The Westman Agricultural Diversification Organization is one of many sites that are part of the Manitoba Crop Variety Evaluation Team (MCVET) which facilitates variety evaluations of many different crop types in this province.

The purpose of the MCVET variety evaluation trials is to grow both familiar (checks or reference) and new varieties side by side in a replicated manner in order to compare and contrast various variety characteristics such as yield, maturity, protein content, disease tolerance and many others. From each MCVET site across the province, yearly data is created, combined, and summarized in the "Seed Manitoba" guide. Hard copies can be found at most MAFRI and Ag Industry Offices. The suite of Seed Manitoba products — the Seed Manitoba guide and the websites [www.seedinteractive.ca](http://www.seedinteractive.ca) and [www.seedmb.ca](http://www.seedmb.ca) — provides valuable variety performance information for Manitoba farmers. Look for Seed Manitoba 2016 mailed out with the Manitoba Cooperator or on the web.

## Winter Wheat Variety Trials

### Cooperators

- Ducks Unlimited Canada
- MCVET & Seed Manitoba
- Winter Cereals Canada

### *Introduction*

Farmers select winter wheat varieties based on yield potential, disease resistance, height, standability and maturity. Another selection point that is becoming increasingly important is selecting a variety on planned end-use or marketing considerations. Is the harvested product for milling? For ethanol production? As an ingredient in feed rations? Knowing the answers to these questions will help farmers select not only a variety that will perform on their farm, but one that will also be suitable for the planned end-use.

### *Updated Long-Term Data*

To assist with variety decisions, MCVET publishes variety data in Seed Manitoba's 2016 Variety Selection & Growers Source Guide available at [www.seedmb.ca](http://www.seedmb.ca). Farmers should look at long-term data and select those varieties which perform well not only in their area, but across locations and over multiple years. Long-term data can be found in the 2016 Winter Wheat Variety Descriptions Table. The more site-years, the more dependable the data. If farmers want to choose their own check, the website [www.seedinteractive.ca](http://www.seedinteractive.ca) gives them that ability.

A new variety that was supported for registration in 2015 was 1303-132-2 (class yet to be determined by the Canadian Grains Commission). Caution must be exercised when evaluating the performance of new varieties as the data represents limited years of data.

AAC Elevate is a new variety in the CWRW class. Seed will be available in 2017.

### *Fusarium Head Blight Ratings*

A concerted effort to improve fusarium head blight (FHB) resistance in winter wheat varieties is being undertaken by breeders. In past editions of the seed guide, there has been limited data available to publish ratings for many varieties. However, official FHB evaluations have started for winter wheat entries tested in both the Central and Western winter wheat co-operative registration trials. Emerson is the only variety rated 'resistant' (R) to Fusarium Head Blight. Depending on the level of disease pressure, varieties that are rated as resistant could still be infected to some degree. If disease pressure is high, yield and/or quality loss due to FHB can still occur in R-rated varieties.

It is important to note that with future testing, more changes to the ratings may occur in order to provide the most accurate information to farmers. But the data released is a great first step and subsequently a great planning tool for farmers as FHB can be an issue in winter wheat production.

## Trial Objectives

- To evaluate yield and qualities of different varieties of winter wheat for use in food, fuel and feed markets.
- To expand the current industry for value-added processing opportunities.
- To grow winter wheat in several locations across SW Manitoba to assess the impact of climate and soil type differences among variety yields.

## Methods

This trial consisted of 9 varieties of winter wheat in plots that were 1.44 m wide by 9 m long. Varieties were organized in a randomized complete block design. Variety plots were replicated three times. Soil tests were taken prior to seeding (Table 1). A plot air seeder equipped with SeedHawk dual knife openers was used to seed plots at a depth of ½". A blend of 60-35-30-20 (NPKS) was sideband with the seed on September 15, 2014. An additional 50 lbs N was broadcast in the spring on May 5<sup>th</sup>. Herbicides Achieve at 0.2 l/ac, Mextrol 450 at 0.5 l/ac and Turbocharge at 2% were applied at 10 gal/ac water on May 4<sup>th</sup>. Plots were combined with a Hege plot combine on August 4<sup>th</sup>. Samples were measured for moisture and test weight.

**Table 1:** Site location, previous crop type and soil tests.

Site	Legal Land Location	Previous Crop	Depth	N	P	K	S	OM
				lbs/ac	ppm Olsen	ppm	lbs/ac	
Melita	SW 26-3-27 W1	Summer fallow	0-6"	40	10	360	22	3.4%
			6-24"	60			54	

## Results

There were significant differences among varieties (Table 2). 1303-132-2 and Moats were the top yielding varieties of the trial. CDC Falcon and AAC Gateway were the highest protein varieties in the trial.

**Table 2:** Varieties of winter wheat and their corresponding yield and protein content in 2015.

Variety	Class	kg/ha	Protein %
1303-132-2	CWGP	8216.4	11.0
Moats	CWRW	8015.3	12.8
CDC Chase	CWRW	7922.0	12.3
Flourish	CWRW	7002.0	12.8
Emerson	CWRW	6729.3	11.2
AAC Gateway	CWRW	6457.2	13.0
CDC Buteo	CWRW	6431.1	12.0
AAC Elevate	CWRW	6388.6	12.3
CDC Falcon	CWGP	6180.5	13.0
CV		5.0	
LSD		608.6	
Prob. Entry		0	
GRAND MEAN		7038.0	
Alpha level		0.05	
R-Square		0.8815	

CWRW – Canada Western Red Winter  
 CWGP – Canada Western General Purpose

## Spring Wheat

### Cooperators

- MCVET
- Seed Manitoba

**Research Site:** Melita, MB

**Location:** 26-3-27 W1

**Land Cooperator:** John Snyder

**Previous Crop:** Summer Fallow

**Soil Texture:** Newstead Loamy Fine Sand

**Soil Test:**

Depth	pH	N	P	K	S	Organic Matter
		lbs	ppm Olsen	ppm	lbs	%
0-6"	7.6	26	10	318	80	3.6
6-24"		66			174	

### Objective

Evaluate and demonstrate different varieties of Canada Western Red Spring, Canada Prairie Spring Red, Canada Western Extra Strong, and Canada Western Hard White wheat for yield potential and protein content. This will provide producers with information to help them select the appropriate variety in order to meet their target market's specifications whether it is the food sector, feed wheat, or ethanol industry. This variety data is used to support the province wide data set published in Manitoba's Seed Guide for 2016.

### Methods

The evaluation consisted of two trials, one with 23 varieties of Canada Western Red Spring (CWRS) and Canada Western Hard White Spring (CWHRS) varieties and the other with 13 varieties of Canada Western General Purpose (CWGP), Canada Prairie Spring Red (CPSR), Canada Western Soft White Spring (CWSWS) and Canada Western Interim Wheat (CWIW). Each trial had a CWRS check (Glenn). Plot dimensions were 1.44 m wide x 9 m long. Varieties were organized in a randomized complete block design and replicated three times. Pre-emergence weed control was accomplished with 1 l/ac Roundup and 10 ml/ac Aim. Plots were direct seeded April 29 at a depth of  $\frac{1}{2}$ " using a dual knife SeedHawk air seeder. For the Wheat 1 trial fertilizer was sideband at 134 lbs/ac nitrogen, 35 lbs/ac phosphorous, 30 lbs/ac potassium, and 20 lbs/ac sulfur. Wheat 2 fertilizer application was the same except for the nitrogen which was reduced to 77 lb/ac. Plots were maintained weed free using an application of Tundra Herbicide at a rate of 0.8 L/a on June 1st. Plots were harvested at full maturity on August 13<sup>th</sup> with a Wintersteiger plot combine. Data collected included yield and test weight. Yield and protein data are summarized.



### Results

There were significant differences among spring wheat varieties in Melita (Table 1 and 2).

**Table 1:** Wheat 1 varieties of spring wheat, wheat classes and their corresponding grain yield, bushel weight and protein content in Melita.

Variety	Identity 1	Class	Yield		Bushel Weight	Protein %
			kg/ha	bu/ac	lbs/bu	
BW487	BW487		5103	76	64.4	15.0
Carberry (Check)	BW874	CWRS	4874	72	64.5	14.0
AAC Elie	BW931	CWRS	4828	72	62.8	14.2
Glenn (Check)	BW406	CWRS	4632	69	65.3	15.0
AAC Cameron VB	BW485	CWRS	4667	69	62.9	14.0
BW483	BW483	CWRS	4677	69	64.6	12.7
CDC VR Morris	BW423	CWRS	4609	68	63.1	14.7
PT637	PT637		4591	68	63.5	12.6
AAC Brandon	BW932	CWRS	4515	67	63.4	14.4
5605HR CL	BW918	CWRS	4534	67	62.8	15.2
Coleman	PT765	CWRS	4541	67	64.3	14.6
AAC Whitefox	HW027	CWHR	4373	65	61.7	14.3
AAC Redwater	PT457	CWRS	4279	64	62.7	14.6
CDC Titanium	PT584	CWRS	4147	62	60.8	16.4
AAC W1876	BW957	CWRS	4199	62	61.8	13.1
BW479	BW479		4100	61	62.8	13.4
CDC Plentiful	PT580	CWRS	4055	60	62.9	15.1
AAC Iceberg	HW021	CWHR	4055	60	61.6	14.0
AAC Prevail	BW462	CWRS	4010	60	61.6	14.0
BW472	BW472	CWRS	4042	60	62.7	12.8
Thorsby	BW947	CWRS	3916	58	61.8	13.9
AAC Connery	PT245	CWRS	3886	58	62.0	13.2
CDC Whitewood	HW612	CWHR	3797	56	62.9	14.6
CV			5.9			
LSD			426			
Prob. Entry			0			
GRAND MEAN			4366			
R-Square			0.74			

Varieties with class not identified have been supported for registration and class is yet to be determined by the Canadian Grain Commission.

**Table 2:** Wheat 2 varieties of spring wheat, wheat classes and their corresponding grain yield, bushel weight and protein content in Melita.

Variety	Identity 1	Class	Yield		Bushel Weight	Protein %
			kg/ha	bu/ca	lbs/bu	
AAC Chiffon	SWS408	CWSWS	6168	92	59.5	11.7
Elgin ND	2014-11	CWIIW	5735	85	63.2	13.7
AAC Innova	GP047	CWGP	5507	82	57.9	11.8
WFT603	WFT603	CWGP	5489	81	61.6	12.2
Prosper	HY2016	CWIIW	5437	81	62.2	12.5
Faller		CWIIW	5354	79	60.1	13.2
AAC NRG097	GP097	CWGP	5315	79	60.0	12.1
SY087	GP087	CWGP	5121	76	59.6	14.1
AAC Foray	HY1610	CPSR	5009	74	60.7	12.5
Glenn (Check)	BW406	CWRS	4974	74	66.2	15.0
SY995	HY995	CWRS	4864	72	58.6	13.3
AAC Penhold	HY1319	CPSR	4644	69	61.7	13.2
AAC Tenacious	HY1615	CPSR	4525	67	62.7	12.8
CV			6.0			
LSD			531			
Prob. Entry			0.0001			
GRAND MEAN			5242			
R-Square			0.76			

## Oats

### Cooperators

- MCVET
- Seed Manitoba

**Research Site:** Melita, MB

**Location:** SW 26-3-27 W1

**Cooperator:** John Snyder

**Previous Crop:** Summer fallow

**Soil Texture:** Newstead Loamy Fine Sand

**Soil Test:**

Depth	pH	N	P	K	S	Organic Matter
		lbs/ac	ppm Olsen	ppm	lbs/ac	%
0-6"	7.5	31	13	401	120	3.6
6-24"		81			360	

### Objective

To evaluate and demonstrate varieties of oats for yield and protein for milling, food processing and expand the current industry for value-added processing opportunities.

### Methods

This trial consisted of 7 varieties of hulled oats in plots that were 1.44 m wide by 9 m long. Varieties were organized in a randomized complete block design and replicated three times. Plots were direct seeded May 1<sup>st</sup> at a depth of  $\frac{3}{4}$ ". Fertilizer was sideband at 102 lbs/ac nitrogen, 35 lbs/ac phosphorous, 30 lbs/ac potassium, 20 lbs/ac sulfur with liquid UAN and included a granular blend of 12-17-15-10. Plots were sprayed with Stampede herbicide and MCPA Ester 500 herbicides at rates of 1.25 lbs/ac and 0.4 L/ac, respectively, applied with a 20 gal/ac water volume on June 1<sup>st</sup>. An additional application of Mextrol 450 was applied on June 5<sup>th</sup>. Plots were harvested at full maturity August 10th. Protein samples were analyzed from composite samples of each variety. Data collected included leaf disease, height, lodging, maturity, and grain yield and bushel weight. Agronomic characteristic data can be made available upon request or from [www.seedmb.ca](http://www.seedmb.ca).

### Results

There were significant differences in oat yields among varieties (Table 1).

**Table 1:** Comparison of yield and bushel weight of oat varieties in Melita, 2015

Variety	Code	Yield		Bushel Weight
		kg/ha	bu/ac	lbs/bu
OT3066	OT3066	6529	171	35.8
CS Camden	OT4001R	6418	168	36.5
Bia	CFA00137	6039	158	36.7
AAC Justice	OT2084	5868	154	38.0
Nice	Q0.685.43	5813	152	39.0
Leggett (Check)	OT 2021	5691	149	38.3
CDC Haymaker	SA04412	4016	105	32.6
CV		6.2		
LSD		641		
Prob. Entry		0.0001		
GRAND MEAN		5768		
R-Square		0.90		



Photo (above): Oat variety trial in Melita 2015

## Durum

### Cooperators

- MCVET
- Seed Manitoba

**Research Site:** Melita, MB

**Location:** SW 26-3-27 W1

**Cooperator:** John Snyder

**Previous Crop:** Summer Fallow

**Soil Texture:** Newstead Loamy Fine Sand

**Soil Test:**

Depth	pH	N	P	K	S	Organic Matter
		ppm	ppm Olsen	ppm	lbs/ac	%
0-6"	7.9	16	6	411	72	3.4
6-24"		63			360	

### Background

Manitoba Durum production has been minimal as of late due to its higher susceptibility to Fusarium head blight (FHB) and leaf diseases linked to southern Manitoba's unique climate. FHB not only affects final yield potential by shriveling kernels, it also produces deoxynivalenol (DON) toxins. Durum is also easily downgraded because of other fungal diseases so this has limited its acreage in Manitoba.

### Objectives

To test varieties of durum registered in Canada for yield, protein and food quality characteristics.

### Methods

This trial consisted of 16 varieties (photo right shows one variety) in plots that were 1.44 m wide x 9 m long. Varieties were organized in a randomized complete block design. Variety plots were replicated three times. Plots were direct seeded April 29<sup>th</sup> at a depth of  $\frac{1}{2}$ ". Fertilizer was applied at 77 lbs/ac nitrogen, 35 lbs/ac phosphorous, 30 lbs/ac potassium, and 20 lbs/ac sulfur. Plots were maintained weed free using Tundra herbicide at 0.8 L/ac, applied June 1<sup>st</sup>. An application of Axial and Mextrol took place on June 5<sup>th</sup>. Plots were harvested at full maturity on August 12<sup>th</sup> with a Wintersteiger plot combine. A composite sample of each variety was analyzed for protein content.



### Results

There were significant differences among variety yields and bushel weights of durum in Melita (Table 1).



**Table 1:** Grain yield, protein content and bushel weight of durum in Melita, 2015.

Variety	Code	Yield		Protein %	lbs/bu
		kg/ha	bu/ac		
AAC Spitfire	DT844	5514	82	11.7	63.15
AAC Current	DT816	5395	80	12.0	64.58
AAC Cabri	DT840	5393	80	12.3	64.72
DT577	DT577	5332	79	11.7	63.63
CDC Fortitude	DT570	5312	79	12.1	63.41
Transcend	DT801	5310	79	11.6	63.91
AAC Raymore	DT818	5199	77	12.1	63.65
DT578	DT578	5132	76	12.4	63.97
AAC Marchwell VB	DT833	5099	76	12.6	63.33
Strongfield	DT712	5039	75	12.3	63.69
CDC Carbide	DT574	5035	75	12.5	62.86
DT579	DT579	5026	75	11.6	64.09
AAC Durafield	DT832	4954	74	12.6	62.69
DT856	DT856	4886	73	11.6	64.02
CDC Vivid	DT562	4847	72	11.8	64.23
CDC Desire	DT561	4644	69	11.8	63.38
CV		4.1			
LSD		350			
Prob. Entry		0.0013			
GRAND MEAN		5132			
R-Square		0.67			

## Discussion

Durum is highly susceptible to FHB and if grown in Manitoba, strict production management practices should be exercised.

These measures may include:

- Crop rotation cycles and field stubble selection
- Timely use of fungicides and seed treatments
- Attention to weather patterns, humidity and temperature

Varieties used in this trial and others found in the Manitoba Seed Guide are rated as poor or very poorly resistant to FHB, therefore these management practices are a must to follow. However, it goes without saying that these practices must also make economic sense.

The varieties AAC Marchwell VB and CDC Carbide VB are midge tolerant durum varieties registered for production in Canada. They are grown as a varietal blend to protect the Sm1 gene. Varieties AAC Raymore, CDC Fortitude, and AAC Cabri have solid stem with resistance to the wheat stem sawfly.



## Barley

### Cooperators

- MCVET
- Seed Manitoba

**Research Site:** Melita, MB

**Location:** SW 26-3-27 W1

**Land Cooperator:** John Snyder

**Previous Crop:** Summer Fallow

**Soil Texture:** Newstead Loamy Fine Sand

### Soil Test:

Site	Depth	pH	N lbs/ac	P ppm Olsen	K ppm	S lbs/ac	Organic Matter %
Melita	0-6"	7.4	13	9	340	32	2.7
	6-24"		42			150	
	0-24"		55			182	

### Objective

To assess varieties of barley for feed and malting processing and to expand the current industry for value added processing opportunities.

### Methods

This trial consisted of 10 varieties in plots that were 1.44 m wide x 9 m long. Varieties were organized in a randomized complete block design and replicated three times. Plots were direct seeded on May 1<sup>st</sup> at a depth of 3/4". Pre-emergence weed control was accomplished with 1 l/ac of Roundup and 10 ml/ac Aim. Fertilizer was sideband at 102N, 35P, 30K and 20S using 28-0-0 UAN and a granular blend of 12-17-15-10. Weeds were controlled with an herbicide application of Tundra on June 1<sup>st</sup>. Plots were harvested August 4<sup>th</sup> with a Hege 140 plot combine.

### Results

There were significant differences among variety yields and bushel weights of barley in Melita (Table 1).

**Photo:** MCVET Barley plots in Melita, July 15 2015.



**Table 1:** Varieties of barley grown in Melita illustrating their market class, yield, bushel weight and protein.

Market Class	Variety	Identity 1	Yield		Bushel Weight lbs/bu	Protein %
			kg/ha	bu/ac		
Food and Feed	TR12733	TR12733	7378	137	51.21	11.9
	TR12735	TR12735	6854	127	50.30	12.1
	Amisk	BT593	6842	127	46.03	11.9
	Canmore	TR10694	6694	124	50.81	11.6
	TR11698	TR11698	6543	121	48.89	11.3
	CDC Maverick	FB205	5990	111	53.48	13.9
Malting	TR10214	TR10214	6874	128	50.17	12.2
	TR11127	TR11127	6755	125	50.70	12.1
	CDC PlatinumStar	TR07921	6669	124	51.21	11.3
	AC Metcalfe (Check) TR 232		6136	114	52.23	12.6
	CV		3.9			
	LSD		449			
	Prob. Entry		0.0003			
	GRAND MEAN		6673			
	R-Square		0.78			

## Fall Rye

### Cooperators

- MCVET
- Seed Manitoba

**Research Site:** Melita, MB

**Location:** SW 26-3-27 W1

**Cooperator:** John Snyder

**Previous Crop:** Summer Fallow

**Soil Texture:** Newstead Loamy Fine Sand

**Soil Test:**

Depth	N	P	K	S	OM
	lbs/ac	ppm Olsen	ppm	lbs/ac	
0-6"	40	10	360	22	3.4%
6-24"	60			54	

### Objective

To evaluate and demonstrate different varieties of fall rye for yield potential in the Southwest region of Manitoba.

### Methods

The trial consisted of 4 varieties of fall rye that were in plots 1.44 m wide x 9 m long. Varieties were organized in a randomized complete block design and replicated three times. Plots were direct seeded on September 15, 2014 at a depth of ½". Fertilizer was sideband the day of seeding at 60N, 35P, 30K and 20S. Additional 50N was broadcast in the spring on May 5<sup>th</sup>. Plots were maintained weed free using an application of Achieve at 0.2 l/ac + Mextrol 450 at 0.5 l/ac and Turbocharge at 2% on May 4<sup>th</sup>. Plots

were harvested at maturity on August 4<sup>th</sup>. Data that was collected includes: height, lodging, bushel weight and grain yield.

## Results

**Table 1:** Varieties of rye grown in Melita their corresponding yield, height, lodging and bushel weight.

	Yield		Height cm	Lodging 1 to 5	Bushel Weight lbs/bu
	kg/ha	bu/acre			
Brasetto	8599.3	137.0	119	5	57
Guttino	8062.1	128.0	117	4	57
Danko	7818.4	124.0	127	1	59
Hazlet	7415.7	118.0	137	3	59
CV	6.1				
LSD	1027.3				
Prob. Entry	0.2				
GRAND MEAN	7973.9				
Alpha level	0.05				
R-Square	0.9				

Brasetto and Guttino are hybrid varieties. Seed was made available in 2015.



Photo: Fall rye variety trial in Melita July 2015.

## Lentils

### Cooperators

- WADO
- Seed Manitoba
- Manitoba Pulse Growers Association

**Research Site:** Melita

**Cooperator:** John Snyder

**Soil Texture:** Newstead Loamy Fine Sand

**Location:** SW 26-3-27 W1

**Previous Crop:** Summer Fallow

## Soil Test:

Depth	pH	N	P	K	S	Organic Matter
		lbs	ppm Olsen	ppm	lbs/ac	%
0-6"	7.5	12	7	301	94	2.9
6-24"		30			360	

## Background

Lentils are a cool season crop with a restricted root system that is only somewhat resistant to high temperatures and drought. They cannot withstand flooding, water-logging or soils with high salinity. Lentils work well in rotation with cereals such as spring and durum wheat. They have the ability to fix nitrogen from the air which can then be used by other crops in following years. Lentils are vulnerable to Ascochyta blight as well as anthracnose. To reduce the risk of these blights, lentils should be seeded in the same field only once every four years. (AAFC)

Lentil production has been limited in Manitoba due to several factors such as:

- Disease incidence
- Limited processing companies
- The limited need to grow such a specialty crop in regions better suited for other crop production such as wheat, barley, and canola.

The pulse industry in Manitoba has adopted peas, edible beans, and soybeans as pulses rather than the lentil which is more suitable for the cooler, drier brown and light brown soil zones of Saskatchewan.

Despite all these factors, large yields in certain areas are not impossible. As seen in this trial in 2009, yields were reaching near 58 bu/ac. Yields like this could be very competitive and profitable compared to a market dominated by Saskatchewan farms typically reaching 30 bu/ac on average. With new varieties and weed control options becoming available, producers in Manitoba may be able to capitalize on some serious returns.

## Methods

The trial consisted of 12 varieties in plots that were 1.44 m wide x 4 m long. Varieties were organized in a randomized complete block design and replicated three times. A pre-emergence application of Roundup 1 l/ac, Rival 0.5 l/ac and Aim 10 ml/ac was applied prior to seeding on April 29th. Plots were direct seeded at a depth of  $\frac{3}{4}$ ".

Seed was inoculated with TagTeam granular inoculant and a granular fertilizer blend of 24N, 35P, 30K, 20S (lbs/ac actual) was sideband the day of seeding. Plots were maintained weed free with Sencor 20 gal/ac water rate and Select at 120 ml/ac with 10 gal/ac water rate on June 15<sup>th</sup>. This trial was desiccated one week prior to harvest with Reglone at a rate of 0.9 l/ac and Ag90 20 gal/ac water.

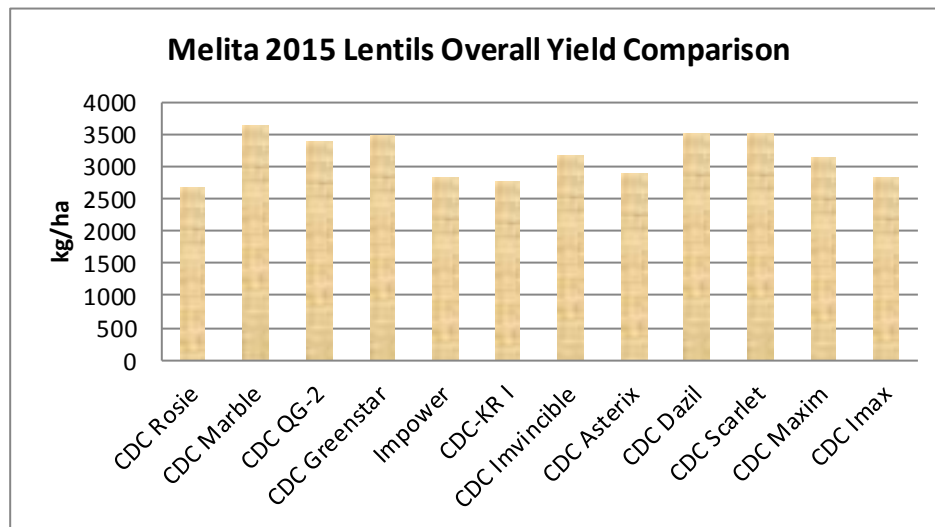
Data collected included plant emergence, height, lodging, and days to maturity. Plots were harvested for grain yield with a Hege plot combine on August 18th. Test weight, sample moisture, and total plot weight were collected.

## Results

There were significant differences in yield in Melita (Table 1).

**Table 1:** Lentil market class, variety, yields and height in Melita, 2015.

Market Class	Variety	Code	kg/ha	Height cm
Extra Small Red	CDC Rosie	3155-18	2669	42.3
French Green	CDC Marble	3494-6	3619	38.0
French Green	CDC QG-2		3382	39.3
Large Green	CDC Greenstar	3339-3	3463	40.7
Large Green	Impower	IBC-194	2834	44.3
Large Red	CDC-KR I	2275-15	2755	38.3
Small Green	CDC Invincible	IBC 112	3178	38.0
Small Green	CDC Asterix	2861-15a	2894	37.7
Small Red	CDC Dazil	IBC 289	3504	43.7
Small Red	CDC Scarlet	3160-21	3499	41.3
Small Red	CDC Maxim	3114	3122	38.3
Small Red	CDC Imax	IBC 187	2826	42.3
<b>CV</b>			8.3	
<b>LSD</b>			451	
<b>GRAND MEAN</b>			3145	
<b>Prob. Entry</b>			0.0013	



**Figure 1:** Overall yield comparison of lentil varieties grown in Melita in 2015.

**Table 2:** Variety description of lentils grown in the McVet trial in 2015.

Variety Descriptions

Market Class	Variety	Yield % Check	Site Years Tested	Maturity Rating <sup>1</sup>	Resistance Level		Seed Wt (TKW)	Cotyledon Colour	2015 Yield: % of CDC Maxim	
					Ascochyta Blight	Anthrachnose Race <sup>1</sup>			Hamiota	Melita
Small green	CDC Asterix	95	5	Early	G	F	26	Yellow	104	93
	CDC Invincible CI	78	14	Early	G	G	35	Yellow	93	102
	CDC Milestone	80	10	Early	G	VP	37	Yellow	—	—
	Eston	82	7	Early	VP	VP	33	Yellow	—	—
Medium green	CDC Imigreen CL	63	11	Medium	G	F	63	Yellow	—	—
	CDC Impress CL	68	11	Medium	G	P	52	Yellow	—	—
	CDC Richlea	76	7	Medium	VP	VP	51	Yellow	—	—
Large green	CDC Greenland	63	10	Med/Late	G	VP	64	Yellow	—	—
	CDC Greenstar	98	3	Med/Late	G	F	73	Yellow	84	111
	CDC Impower CI	67	8	Medium	G	P	74	Yellow	58	91
	CDC Improve CL	70	11	Medium	F	VP	67	Yellow	—	—
	CDC Plato	61	11	Med/Late	G	P	62	Yellow	—	—
	Lalrd	54	7	Very Late	VP	VP	67	Yellow	—	—
French green	CDC Peridot CL	78	11	Early	G	P	40	Yellow	—	—
	CDC Marble	113	5	Early/Med	F	G	32	Yellow	118	116
	CDC QG-2	85	3	Early/Med	F	G	33	Yellow	77	108
Extra small red	CDC Robin	78	10	Early	G	G	30	Red	—	—
	CDC Impala CL	81	11	Early	G	G	31	Red	—	—
	CDC Imperial CL	77	11	Early	G	G	30	Red	—	—
	CDC Redbow	84	8	Early/Med	G	G	42	Red	—	—
	CDC Rosebud	87	10	Early	G	G	29	Red	—	—
	CDC Rosie	90	5	Early/Med	G	G	30	Red	90	85
	CDC Rosetown	88	11	Early	G	G	31	Red	—	—
	CDC Ruby	92	2	Early	G	G	29	Red	—	—
Small red	CDC Dazil	99	6	Early/Med	G	F	35	Red	105	112
	CDC Imax CL	82	14	Medium	G	G	50	Red	81	91
	CDC Impact CL	78	10	Early	G	P	34	Red	—	—
	CDC Maxim CL	100	16	Early/Med	G	G	40	Red	100	100
	CDC Red Rider	83	2	Early/Med	G	F	45	Red	—	—
	CDC Redberry	97	11	Early/Med	G	G	42	Red	—	—
	CDC Redcoat	78	8	Early	G	G	40	Red	—	—
	CDC Scarlet	105	5	Early/Med	G	F	36	Red	97	112
Large red	CDC-KR I	80	11	Medium	G	G	56	Red	83	88
<b>CHECK CHARACTERISTICS</b>							<b>CDC Maxim (lb/ac)</b>		3120	2788
CDC Maxim		16	3215				CV%		11.8	8.3
		site years	lb/ac				LSD (%)		20	14
							Sign Diff		Yes	Yes
							Seeding Date		08-May	29-Apr
							Harvest Date		22-Sep	18-Aug

<sup>1</sup> Ratings determined in Saskatchewan and may not be accurate under wetter growing conditions present in Manitoba

Source: Seed Manitoba 2016

## Discussion

Lentils are not a crop typically grown in Manitoba due to the high precipitation region that our agriculture sector lies within. Normally, the plot would be infected with Ascochyta and Anthracnose fungi that typically infest lentils where rain is abundant. Stereotypically lentils are grown in regions such as the Brown and Dark Brown soil zones of Saskatchewan. The 2015 season was ideal for growing lentils in Southwest Manitoba due to the cool spring followed by a dry summer therefore incidence of disease was rather low and favored high yields among varieties.

## Buckwheat

### Cooperators

- MCVET
- Seed Manitoba
- Manitoba Buckwheat Growers Association

**Research Site:** Melita, MB

**Location:** SW 26-3-27 W1

**Cooperator:** John Snyder

**Previous Crop:** Summer Fallow

**Soil Texture:** Newstead Loamy Fine Sand

### Soil Test:

pH	N	P	K	S	Organic Matter
	lbs/ac	ppm Olsen	ppm	lbs/ac	%
7.8	13	4	347	104	2.8
	27			360	

### Background

In 2005, Manitoba was the only province in Canada producing Canadian buckwheat. Buckwheat is one of the best sources of high-quality, easily digestible proteins in the plant kingdom. Its 74% protein absorption rate makes it an excellent meat substitute. It is also very high in carbohydrates (80%), antioxidants, numerous minerals and vitamins such as: zinc, copper, and niacin. This makes buckwheat an ideal ingredient for a wide range of food products. Buckwheat starch can also act as a fat alternative in processed foods.

Production of buckwheat in Manitoba is limited to its long growing season of 100- 110 days needed for full maturity. It is also sensitive to spring and fall frosts which can cause problems for the production of it in regions that have fewer frost free days. Overall this is an attractive crop which uses lower fertility rates and is very weed competitive.

### Objective

To demonstrate and examine the yield performance of varieties of buckwheat and explore value-added potential for Manitoba producers.



### Methods

The trial consisted of 6 varieties of buckwheat in plots that were 1.44 m wide by 9 m long. Varieties were organized in randomized complete block design replicated three times. A pre-seed burnoff of Roundup was applied at a rate of 1 L/ac. Plots were direct seeded June 11<sup>st</sup> at a depth of  $\frac{3}{4}$ ". Fertilizer applied was 62 lbs N, 35 lbs P, 30 lbs K and 20 lbs S (lbs/ac actual). No in-crop herbicides were applied. Plots were swathed at physiological maturity on September 28<sup>th</sup> and harvested on October 8<sup>th</sup> with a Wintersteiger plot combine.

## Results

There were significant yield differences at all sites across Manitoba (Table 1).

**Table 1:** Variety descriptions from all sites.

Variety	Yield %	Site Years	Days to 50% Bloom	Height	2015 Average	2015 Yield: % of Koma		
	Check	Tested	+/- Check	+/- Check	Yield	Dauphin	Melita	Roblin
AC Manisoba	115	21	-3	-2	123	135	107	124
AC Springfield	115	21	-1	-5	119	122	108	127
Horizon	126	12	—	—	122	124	107	138
Koma	100	21	0	0	100	100	100	100
Koto	120	21	-2	-3	119	135	83	139
Mancan	108	21	-2	-6	117	122	98	133
Manor	111	4	—	—	—	—	—	—
<b>CHECK CHARACTERISTICS</b>								
Koma	1608	21	47	45	CV%	2442	1676	1848
	lb/acre	site years	days	inches	LSD%	8.1	10.6	7.5
					Sign Diff	15	—	14
						Yes	No	Yes
					Seeding Date	04-Jun	11-Jun	29-May
					Harvest Date	09-Oct	08-Oct	15-Oct

Source: Seed Manitoba 2016

**Table 2:** Yield comparison of buckwheat varieties grown in Melita in 2015.

Variety	Yield kg/ha	Bushel Weight lbs/bushel
AC Springfield	2025	40
Horizon	2011	41
AC Manisoba	1998	41
Koma (Check)	1871	40
Mancan	1828	40
Koto	1559	40
CV	10.6	
LSD	387	
Prob. Entry	0.16	
GRAND MEAN	1882	

## Narrow Row Beans

### Cooperators

- MCVET
- Seed Manitoba
- Manitoba Pulse Growers Association

**Research Site:** Melita, MB

**Location:** SW 26-3-27 W1

**Cooperator:** John Snyder

**Previous Crop:** Summer Fallow

**Soil Texture:** Newstead Loamy Fine Sand

**Soil Test:**

pH	N	P	K	S	Organic Matter
	lbs/ac	ppm Olsen	ppm	lbs/ac	%
7.8	13	4	347	104	2.8
	27			360	



## Background

Dry bean production in Southwest Manitoba is limited to the amount of frost free days, moisture, and accumulated heat units over the growing season. Typically dry beans require 90 to 110 days to reach full maturity. Given a late seeding date (normally seeded in late May), this requires a season finish by late August. The growing season of the dry bean also requires a 24°C optimum temperature and a cool flowering period under 30°C to prevent bloom blasting. If any of these factors are lacking or are in abundance, the dry bean production will suffer. With careful production practices many varieties and types of dry bean can be produced in many southern areas of the province including the Southwest regions. The 2015 growing season would be considered slightly above average year for dry bean production due to the excess of accumulated heat units.

## Objective

To evaluate and demonstrate varieties of dry beans including Pinto, Black, and Navy types for yield in the Southwest region of Manitoba.

## Methods

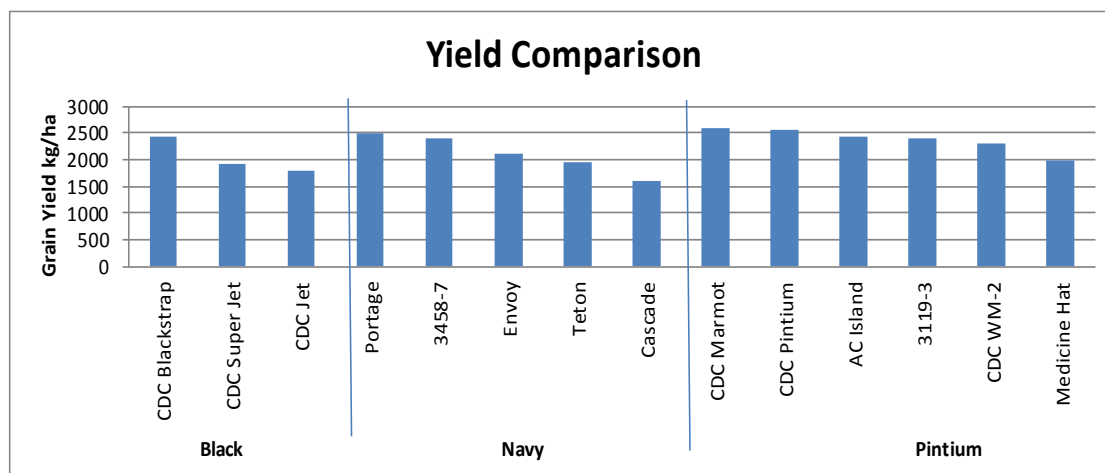
Trials consisted of 14 varieties of narrow row dry beans in plots that were 1.44 m wide by 9 m long. Varieties were organized in a randomized complete block design and replicated three times. Plots were direct seeded May 25 at a depth of  $\frac{3}{4}$ ". Fertilizer was sideband at 66 lbs/ac nitrogen, 35 lbs/ac phosphorous, 30 lbs/ac potassium and 20 lbs/ac sulfur. Plots were controlled for weeds with Basagran Forte and Select herbicides sprayed June 15<sup>th</sup> at 20 gal/ac water volume. Plots were harvested September 3<sup>rd</sup> with the Hege 140 plot combine.

## Results

There were significant differences in final yield among varieties (Table 1).

**Table 1:** Varieties of black, navy, and pinto beans in Melita, 2015.

Class	Variety	kgha
Black	CDC Blackstrap	2426
Black	CDC Super Jet	1926
Black	CDC Jet	1798
Navy	Portage	2491
Navy	3458-7	2386
Navy	Envoy	2115
Navy	Teton	1938
Navy	Cascade	1612
Pinto	CDC Marmot	2585
Pinto	CDC Pintium	2567
Pinto	AC Island	2430
Pinto	3119-3	2392
Pinto	CDC WM-2	2296
Pinto	Medicine Hat	1968
	CV	6.3
	LSD	234
	GRAND MEAN	2209
	Prob. Entry	0
	R-Square	0.88



**Chart 1:** Dry Bean Yield of Black, Navy and Pinto Beans

## Western Manitoba Soybean Adaptation Trial

### Cooperators

- Manitoba Pulse Growers Association
- Seed Manitoba
- MCVET

**Research Site:** Melita, MB

**Location:** SW 26-3-27W1

**Cooperator:** John Snyder

**Previous Crop:** Summer Fallow

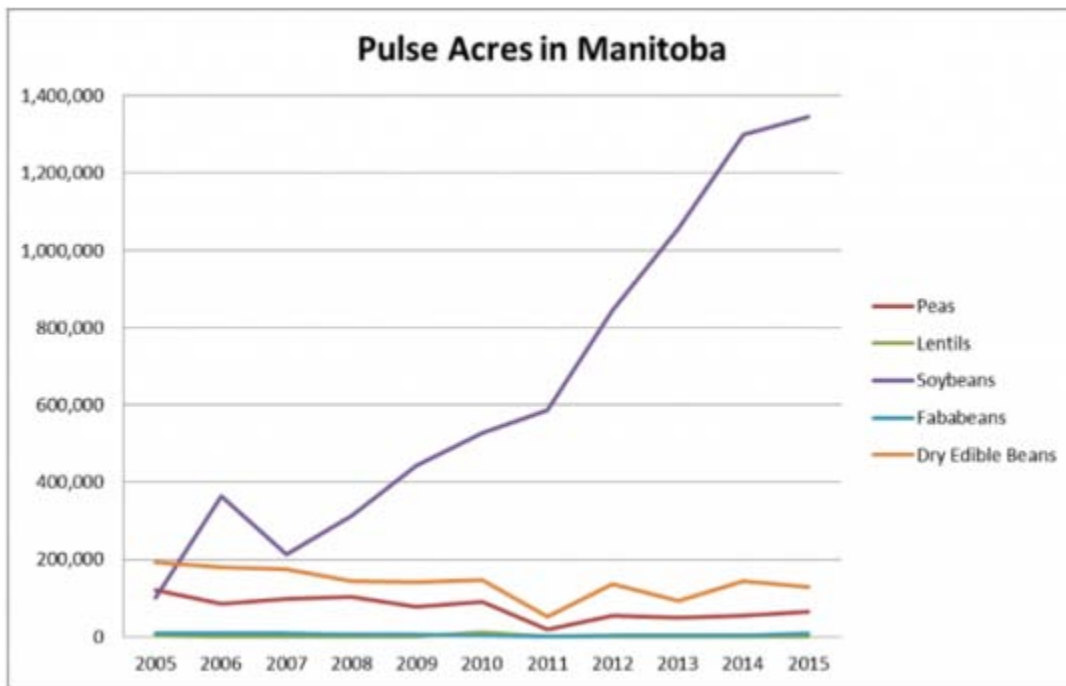
**Soil Texture:** Newstead Loamy Fine Sand

### Soil Test:

Site	Depth	pH	N	P	K	S	Organic Matter
			lbs/ac	ppm Olsen	ppm	lbs/ac	%
Melita	0-6"	7.7	10	8	405	120	3.2
	6-24"		60			360	
	0-24"		70			482	

## Background

Over the last several years, soybean acres have climbed to record highs in Manitoba. In 2013, harvested area was reported at 1,056,652 acres (Chart 1), up 20% from 2012 in Manitoba. In 2015, there was a record 1.3 million acres, a 6% increase since 2014. Yield also increased, from 38.3 in 2013 to 39 bu/ac in 2015 in Manitoba (Yield Manitoba, MMPP). Reasons for this increase may include; new varieties of soybean with improved earliness to maturity, new genetic yield potential that are more competitive to canola yields and cost of production.



**Chart 1:** Pulse Acres in Manitoba (Source: Manitoba Pulse Growers Association, 2015.)

Melita has been testing varieties of soybean for some time. The increase number of entries in the trials over the years is a good indicator of an expansion of a crop in the area as well. It is also important to note that soybeans are now an insured crop in western Manitoba.

## Methods

Trials consisted of 35 varieties of glyphosate tolerant varieties arranged in a 5x7 rectangular lattice design and replicated three times. Seed was inoculated with granular inoculant (Becker Underwood) just prior to planting. Plots were solid seeded at a depth of  $\frac{3}{4}$ " with a SeedHawk dual knife opener air drill. Plots were 1.44 m wide by 9 m long with six rows at 9.5" spacing. Agronomic parameters for establishment and growing season are summarized in the table below.

**Table 1:** Agronomy Information for Soybean Trial soybeans

Preseed Burnoff	Seed Date	Seed Depth	Fertilizer Applied (lbs/ac)	Herbicides	App. Date	Harvest
1 l/ac Round-up	15-May	3/4"	24N 35P 30K 20S	Roundup applied @ 0.33 L/ac	15-Jun	Sept. 30

Data collected included height, maturity date, and test weight. Plots were harvested with a Hege plot combine at full maturity.

**Table 2:** Western Canada soybean variety yields, maturities, and crop heights, in Melita in 2016

Name	Identity 1	Yield kg/ha	Days to Maturity	Height cm
TH 35002R2Y	TH 35002R2Y	3302	114	68.5
S007-Y4	AR1111955/S007-Y4	3257	115	68.0
Hero R2	SC2380 R2	3248	117	82.5
NSC GLADSTONE RR2Y	NSC GLADSTONE RR2Y	3185	116	87.0
HS 006RYS24	EXP006RY24	3142	117	71.0
LS002R24N	LS002R24N	3081	117	94.0
TH 32004R2Y	32004	3072	114	79.5
TH 33005R2Y	TH 33005R2Y	3049	114	72.0
Notus R2	AURA R2	2996	113	60.0
P006T78R	PH 14002	2992	112	63.5
NSC TILSTON RR2Y	G10 R2; NSMR2-EXP G10	2969	116	88.5
Mahony R2		2942	114	71.5
TH 33003R2Y	QG 2475R2Y	2936	117	89.0
PRO 2525R2	PRO 2525R2	2934	121	88.5
PS 0035 R2	EXP00313R2	2926	119	76.0
Akras R2	CFS12.3.02	2902	110	69.5
MCLEOD R2	SC2375R2	2893	117	75.0
LS 003R24N	CFS13.2.02 R2	2867	118	101.0
CFS13.2.01 R2	CFS13.2.01 R2	2861	113	81.0
22-60RY	MKZ913A4	2858	112	65.0
NSC RESTON RR2Y	NSM EXP 1225 R2	2854	111	76.0
NSC Anola RR2Y	NSMR2-EXP 190	2854	116	66.0
23-10RY	23-10RY	2851	112	63.5
S0009-M2	AR1215521	2821	109	82.0
23-60RY	FLZ612A4	2794	113	76.0
Vito R2	PR1182713R2	2768	115	98.0
Pekko R2	CFS11.1.01R2	2763	112	76.5
23-11RY	MKZ613A3	2733	112	80.0
FILL		2712	111	89.5
LS NorthWester	LS NorthWester	2600	112	90.5
Bishop R2	SC-1001RR	2587	117	81.5
900Y61	PH10001	2512	120	66.5
NSC MOOSOMIN RR2Y	NSC MOOSOMIN RR2Y	2459	114	62.0
P002T04R	P002T04R	2425	113	78.5
NSC Watson RR2Y	GS00096	2417	107	74.5
P001T34R	PH 12004	2333	108	61.0
CV		4.0		
LSD		185		
GRAND MEAN		2858		
Prob. Entry		0.000		
RE-RCBD		678		
R-Square		0.87		



**Photo:** Western Manitoba Soybean Adaptation Trial, Melita 2015.

## Peas

### Cooperators

- MCVET
- Seed Manitoba

**Research Site:** Melita, MB

**Location:** SW 26-3-27 W1

**Land Cooperator:** John Snyder

**Previous Crop:** Summer Fallow

**Soil Texture:** Newstead Loamy Fine Sand

### Soil Test:

Site	Depth	pH	N lbs/ac	P ppm Olsen	K ppm	S lbs/ac	Organic Matter %
Melita	0-6"	7.5	8	7	259	52	2.9
	6-24"		51			360	
	0-24"		59			412	

### Objective

To assess varieties of yellow and green peas for yield potential in the southwest region of Manitoba.

### Methods

The trial consisted of 6 varieties of green and 10 varieties of yellow peas in plots that were 1.44 m x 9 meters long. Varieties were arranged in a randomized complete block design and replicated three times. A pre-seed burn-off of Roundup 1 l/ac, Rival 0.5 l/ac and Aim at 10 ml/ac was applied prior to seeding. Plots were direct seeded into wheat stubble at a depth of  $\frac{3}{4}$ " on April 29<sup>th</sup>. Seed was inoculated with TagTeam pea and granular inoculant. Granular fertilizer was applied at a rate of 24N, 35P, 30K and 20S (lbs/ac actual). Weed control was maintained with a tank mix of Odyssey, Equinox and Merge on June 4<sup>th</sup>. Plots did not require desiccation and were harvested at full maturity on August 10<sup>th</sup> with a Hege plot combine. Test weight, sample moisture and total plot weight data was collected.

### Results

There were significant differences in yield among varieties of peas (Table 1).

**Photo (right):** Pea variety trial, photo taken July 2015.



**Table 1:** Varieties of peas, type and corresponding grain yield.

Type	Variety	Yield	
		kg/ha	bu/ac
Green	AAC Royce	5325	79
	CDC Greenwater	4755	71
	CDC Limerick	4747	71
	CDC Striker	4582	68
	CDC Patrick	4207	62
	AAC Radius	4062	60
Yellow	CDC Amarillo	5469	81
	Abarth	5191	77
	CDC Saffron	4893	73
	CDC Inca	4870	72
	CDC Meadow	4764	71
	AAC Ardill	4748	70
	Agassiz	4701	70
	AC Earlystar	4494	67
	CDC Golden	4330	64
	AAC Lacombe	4197	62
	CV	8.6	
	LSD	675	
	Prob. Entry	0.0074	
	GRAND MEAN	4708	

## Canola

**Research Site:** Melita, MB

**Location:** NE 10-4-26 WI

**Cooperator:** Barker Farms

**Previous Crops:** Wheat, Wheat

**Soil Texture** Stanton Loamy Fine Sand

**Soil Test:**

pH	N lbs/ac	P ppm Olsen	K ppm	S lbs/ac	Organic Matter %
8.1	3	8	165	102	2
	18			210	

## Background

Varieties with a resistant (R) or moderately resistant (MR) rating for Blackleg are varieties that have shown the greatest ability to suppress blackleg incidence and severity. These varieties can still develop some lesions or cankers. In fields with high levels of blackleg or a history of short rotations with canola, longer rotations can be used to control Blackleg.

Clubroot has been found at very low concentrations in Manitoba fields. There are three varieties available for planting that are resistant but not immune to Clubroot disease: Brett Young 6074RR, Canterra Seeds CS2000, and Cargill Victory Hybrid V12-3. Another variety, Syngenta 14H1176, has been supported for registration and is also rated as Clubroot resistant. Good agronomy practices and proper crop rotation are important tools to manage the risk of Clubroot.

## Objective

To evaluate and demonstrate different varieties of canola for yield in the Southwest region of Manitoba.

## Method

This trial consisted of 24 varieties of canola in plots that were 1.44 m wide by 9 m long. Varieties were organized in a randomized complete block design. Variety plots were replicated three times and blocked according to their herbicide system. A plot air seeder equipped with SeedHawk dual knife openers was used to seed plots at a depth of 3/8". Fertilizer was sideband on the day of seeding at a rate of 95N, 35P, 30K and 20S (actual lbs/ac). Plots were kept weed free by spraying either:

- Liberty Link Lines – Liberty – 1.35L/ac or 3.33L/ha. Tank mix Centurion – 25.5ml/ac or 63ml/ha plus 0.5% (v/v) Amigo: Water volume – 45 L/ac
- Clearfield Lines – Odyssey 17.3 g/ac plus Equinox @ 67 to 101 ml/ac plus Merge @0.5 L in 100L of spray solution. Water volume – 40 L/ac.
- Roundup Ready Lines – please see chart below. Water volume – 45 L/ac.

All herbicide applications were applied on June 3 at the 2-4 leaf stage. All plots were sprayed with Matador @ 34 ml/ac at the two leaf stage due to flea beetle pressure. Plots were swathed at full maturity on August 5 and harvested on August 14 with a Hege plot combine. Data collected included height, days to maturity, sample moisture, seed weight and yield.

## Results

Variety Description

Distributor	Variety (B.napus)	LONG Season Zone (8 trials)				MID Season Zone (16 trials)				Disease <sup>1</sup> Tolerance
		Yield 5440%	Maturity (days)	Lodging (1-5)	Height (inches)	Yield 5440%	Maturity (days)	Lodging (1-5)	Height (inches)	
Clearfield										
BrettYoung CANTERRA SEEDS	5525 CL	98	92	2.3	50	91	96	2.0	48	BL
	CS2200CL	94	93	2.5	50	93	97	2.3	47	BL
	LSD (%)	13				17				
Liberty										
Bayer CropScience	5440	100	92.6	1.8	50.6	100	96	1.4	49	BL
Bayer CropScience	L252	117	93.4	2.3	49.1	106	97	2.2	47	BL
Bayer CropScience	L261	108	94.2	2.5	53.8	104	98	1.8	52	BL
Bayer CropScience	L140P	107	91.8	3.5	49.0	99	95	2.8	48	BL
	LSD (%)	10				10				
Roundup										
CANTERRA SEEDS	1990	100	91.9	3.0	46.4	94	96	2.8	46	BL
BrettYoung	6074RR	105	94.8	2.7	49.2	102	98	2.1	47	BL/CR
BrettYoung	6056CR	97	94.6	2.4	49.5	93	98	2.1	47	BL
BrettYoung	6080RR	98	92.6	2.4	47.7	97	97	1.9	48	BL
CANTERRA SEEDS	CS2000	102	93.8	2.4	51.7	99	97	2.6	50	BL/CR
CANTERRA SEEDS	CS2100	102	93.7	2.5	48.4					BL
Syngenta	SY4166	101	92.1	3.0	51.0	98	96	2.9	48	BL
Syngenta	SY4157	105	94.3	2.3	52.2	102	98	2.3	49	BL
Cargill - VICTORY Hybrid	V12-1 *	100	93.4	2.3	50.2	93	96	2.7	47	BL
Cargill - VICTORY Hybrid	V12-3 *	102	93.4	2.7	49.8	99	97	2.9	47	BL/CR
Varieties that have been supported for registration										
DL Seeds	14DL30209	95	92.0	2.8	49.2	93	97	2.8	48	BL
Syngenta	14H1176	108	95.6	2.4	53.2	102	99	2.0	50	BL/CR
Proven Seed / CPS	PS-SY 13-1579	107	94.3	2.0	51.0	100	98	1.6	49	BL
Proven Seed / CPS	PS-SY 13-1651	102	92.3	2.0	47.9	94	96	2.0	46	BL
	LSD (%)	8				9				
CHECK MEAN 5440 (bu/ac)		58				62				

\* Indicates varieties with Specialty oil profiles and premiums associated with pricing. Visit [www.canolaperformancetrials.ca](http://www.canolaperformancetrials.ca) for more details

<sup>1</sup> Indicates genetic resistance with a "R" or resistant rating to BL=Blackleg; CR=Clubroot

Source: Seed Manitoba 2016



## CANOLA PERFORMANCE TRIAL — Long and Mid Season Zone Plot Location Data

	LONG SEASON ZONE 2015 YIELD (%5440)								MID SEASON ZONE 2015 YIELD (%5440)											
Variety (B.napus)	Beausejour, MB	Elm Creek, MB	Melita, MB	Outlook, SK	Portage la Prairie, MB	Souris, MB	Stonewall, MB	Thornhill, MB	Aberdeen, SK	Arborg, MB	Dauphin, MB	Elstow, SK	Foam Lake, SK	Melfort 1, SK	Nipawin, SK	North Battleford, SK	Saskatoon 1, SK	Saskatoon 2, SK	Vanscoy, SK	Yokton, SK
Clearfield																				
5525 CL	104	108	109	95	83	98	88	99	90	80	95	81	85	92	93	91	90	94	98	98
CS2200CL	102	106	98	82	84	97	83	102	94	80	96	89	85	94	94	90	91	103	96	98
LSD (%)	28	12	9	20	11	21	5	2	15	1	8	33	15	6	14	8	12	27	27	4
Liberty																				
5440	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
L252	141	135	114	112	105	105	108	116	114	108	116	93	109	109	100	105	111	116	98	111
L261	121	114	117	103	95	103	105	103	89	103	109	94	102	111	97	103	111	101	96	116
L140P	129	111	104	102	94	114	97	105	93	97	110	92	94	102	101	100	102	77	91	108
LSD (%)	21	11	15	13	9	6	5	4	9	19	13	17	8	6	14	6	7	14	17	4
Roundup																				
1990	94	103	110	103	91	111	97	95	98	81	111	89	85	100	96	99	99	75	82	97
6074RR	106	126	108	101	87	111	100	102	111	81	122	82	101	107	101	96	99	116	102	108
6056CR	108	108	102	95	82	100	88	93	91	65	108	98	88	94	97	90	95	76	93	99
6080RR	86	118	105	94	91	108	95	91	98	80	115	89	93	101	98	97	95	92	89	108
CS2000	103	115	102	97	88	99	100	112	114	91	117	85	96	102	99	104	92	88	92	106
CS2100	104	114	97	96	93	109	94	109	—	—	—	—	—	—	—	—	—	—	—	—
SY4166	123	111	102	83	89	107	91	103	104	93	112	96	93	88	89	99	106	80	87	104
SY4157	109	124	111	100	91	104	96	108	107	109	108	88	98	100	92	100	97	99	100	98
V12-1 *	100	118	104	88	86	109	93	103	97	87	106	98	91	93	94	94	94	82	79	93
V12-3 *	125	115	103	94	83	103	92	101	103	90	108	97	92	93	94	99	98	91	90	95
Varieties that have been supported for registration																				
14DL30209	100	101	97	87	89	98	87	100	98	83	99	88	91	95	99	89	93	67	88	103
14H1176	130	124	109	98	87	109	95	110	108	99	110	92	91	94	96	100	96	104	100	107
PS-SY 13-1579	132	131	108	95	92	93	96	108	104	109	116	89	95	92	100	96	98	97	89	101
PS-SY 13-1651	118	117	104	87	89	99	92	108	102	91	105	98	91	93	104	93	92	74	72	104
LSD (%)	18	8	9	11	7	7	5	10	9	16	8	12	8	5	10	7	7	12	17	8
CHECK MEAN 5440 (bu/ac)	31	35	53	82	69	65	79	48	41	43	59	65	82	71	61	66	97	47	36	70
GRAND MEAN (bu/ac)	35	41	56	79	62	67	74	49	41	39	64	59	77	69	59	64	95	43	33	72
CV%	13.1	9.1	6.6	7.8	5.7	6.6	3.3	6.3	7.1	9.1	6.9	10.1	5.6	3.8	8.6	4.8	5.0	10.2	13.4	5.5

\* Indicates varieties with Specialty oil profiles and premiums associated with pricing. Visit [www.canolaperformancetrials.ca](http://www.canolaperformancetrials.ca) for more details

Source: Seed Manitoba 2016

## Sunflower Variety Trial

### Cooperators

- National Sunflower Association of Canada
- Seed Manitoba
- MCVET

### Introduction

As part of WADO's support for special crops, WADO partnered up with the National Sunflower Association of Canada to test Sunflower varieties in Western Manitoba. A site was established a mile northwest of Pierson MB in a producers' field of confectionary sunflowers. The plot was set up to determine the various aspects of weight, oil content, screen seed size distribution and final yield.



## Methods

Test design:	Randomized complete block design for each type
Treatments:	9 oil types, 12 confection types
Replications:	3
Plot size:	3.048 m x 7 m
Row Spacing:	30" x 4 rows/plot
Plant Spacing:	Planted with a Wintersteiger Vacuum Planter @ 8" for oilseed types and 10" for confectionary types between plants in row
Seeding date:	June 1, 2015
Fertilizer applied:	73-34-10-0-1 zinc (NPKS-Zn lbs/ac actual) applied preplant with Seedhawk drill
Herbicide applied:	Authority at 100 mL/ac, and Glyphosate (Credit) at 1 L/ac as a preseed application in mid-May; Roundup and Aim applied preseed June 1; Assure II applied June 19 at 0.2 L/ac
Insecticide:	Lorsban applied for Cutworms applied June 17 (stage V2) at a rate of 500 ml/ac
Harvest date:	October 19, 2015
Harvester:	Wintersteiger Classic plot combine
Product handling:	Each plot was harvested with only the two middle rows of the four being used. Plot samples were weighed and moisture was determined
Data Collected:	Height, disease rating, lodging, maturity (R9), oil content, seed size, screen seed size distribution, test weight, final yield

## Results

### Oilseeds

There were significant differences in maturity, crop height, test weight, and yield. There were no differences in sunflower rust incidence and lodging. Variety 'Honeycomb NS' was exceptionally early maturing in only 104 days.

**Table 1:** Oilseed Sunflower

Variety	Maturity days	Rust 1-10 (10=covered)	Lodge 1-10; 1=erect	Height cm	Test Weight lbs/bu	Yield kg/ha
8N270CLDM	110.7	0.7	1.3	172.7	27.7	3299
Cobalt II	117.0	1.3	1.3	180.0	28.9	2731
E84131CLDM	109.0	2.0	2.0	168.7	27.0	3393
Honeycomb HO	114.0	1.7	5.3	176.3	28.3	2792
Honeycomb NS	104.0	1.3	1.7	173.0	27.7	3647
P63ME70	115.0	1.7	4.0	189.3	30.4	3393
P63ME80	117.0	1.3	1.0	177.0	28.4	3486
Talon	115.3	2.0	2.0	178.0	28.5	3891
Wishbone	116.0	1.3	2.3	200.0	32.1	2740
CV%	1.3	73.6	68.7	4.3	2.4	13.1
LSD	2.5	1.9	2.8	13.3	2.1	739
P value	<0.0001	0.887	0.068	0.004	<0.0001	0.034
R-squared	0.93	0.29	0.58	0.72	0.80	0.62
Grand Mean	113.1	1.5	2.3	179.4	28.8	3264

### Confects

There were significant differences in days to maturity, sunflower rust incidence, crop lodging, and test weight. There were no differences in crop height, and final grain yield. Two varieties were excluded from the trial due to severe lodging including varieties EX 2755 and EX 9255. These two varieties were nearly completely lodged due to the inability of the roots to properly anchor the plant.

**Photo:** Variety above blue meter stick is EX 9255 which had fallen from poor root structure while the variety below the blue meter stick 14EXP02 did not lodge and had a more prolific rooting structure.



**Table 2:** Confectionary Sunflower results

Variety	Maturity days	Rust 1-10 (10=covered)	Height cm	Lodge 1-10; 1=erect	Test Weight lbs/bu	Yield kg/ha
14EXP02	115.0	2.3	210.7	1.0	24.2	3498
15EXP01	122.7	4.7	174.3	2.3	20.6	3843
15EXP02	123.0	0.0	194.3	2.7	23.2	3070
15EXP03	118.3	5.0	191.7	1.0	22.9	3414
6946 DMR	117.0	3.0	182.5	4.7	26.1	2817
9180 DMR	117.3	3.3	182.0	5.7	24.6	3161
E94305	119.7	3.3	189.7	5.7	23.9	2637
Jaguar DMR	113.7	6.7	184.0	4.0	25.0	3052
Panther DMR	110.0	5.7	163.3	4.7	27.3	3832
RH1130EX	123.0	2.7	185.3	2.3	23.0	3374
CV%	2.3	38.7	7.9	20.6	4.2	13.7
LSD	4.6	2.4	NS	1.4	1.7	NS
P value	<0.0001	0.001	0.072	<0.0001	<0.0001	0.250
R-squared	0.8	0.7	0.5	0.9	0.8	0.63
Grand Mean	118.0	3.7	185.9	4.1	149.5	3269.8

### Discussion

With help and funding from the Manitoba Corn Growers Association and the Western Grains Research Foundation, WADO now has a small plot Wintersteiger vacuum corn planter (photo below) that has the ability to precisely plant plots with RTK guidance, insuring greater accuracy of data though better establishment of each plant. Traditionally WADO used to over-seed the plot with an air drill then thin back the stand by pulling each plant which tends to lead to uneven populations and selective picking during thinning (of healthy plants).



# Effect of Seeding Rate, Seed Treatment and Fertility on the Performance of Winter Wheat

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**Principal Investigators:** Ducks Unlimited Canada.

**Co-Investigators:** Canada-Manitoba Crop Diversification Centre (CMCDC)  
Westman Agriculture Diversification Organization (WADO)  
Parkland Crop Diversification Foundation (PCDF)

**Support:** Ducks Unlimited Canada; Growing Forward 2

**Duration:** 2014-2015

## *Objective*

- Evaluate the effect of inputs on winter wheat variety performance in western Manitoba.
- Yield potential of new winter wheat varieties possibly higher with greater rates of nitrogen under good growing conditions.
- Seed treatment may improve winter survival of winter wheat.

## *Introduction*

Winter wheat is a crop with one of the highest potential returns to growers in Manitoba due to typically high yields and relatively low inputs. Planting winter wheat also spreads out labor during the fall and reduces planting requirements during the spring. Despite the prospect of high returns, made even more likely by new high yielding genetics, producers in Manitoba tend to plant winter wheat on their lower quality land and/or restrict input levels relative to other crops.

There are a number of agronomic approaches to improving yields in winter wheat along with variety selection. Fall establishment is important for ensuring the crop has a high probability of surviving winter and to ensure a suitable plant stand come spring. The use of seed treatments and an increase in seeding rate have been two approaches to improve the likelihood of a healthy stand. Nitrogen fertility is another factor to consider and recommendations can be slightly different depending on the source.

Nitrogen recommendations in Manitoba are 80-120 lbs/ac<sup>(1)</sup> to ensure yield potential is met and protein levels are sustained. However, questions have been raised about new varieties possibly extending these levels higher and providing Manitoba growers with even more potential yield provided enough nutrients are provided.

This study was conducted in 2014 and 2015 to investigate the contribution of higher seeding rates, seed treatment, and increased nitrogen rates on the latest variety of winter wheat under western Manitoba conditions.

## Material and Methods

This trial looks at three agronomic components for achieving high winter wheat yield: Planting rate, seed treatment and fertility. The trial was conducted at Carberry, Hamiota and Roblin Manitoba; however, Roblin experienced complete winterkill on all winter cereal trials in 2014. Table 1 below outlines the factors of the experiment as well as agronomic operations. Data collected included fall and spring stand establishment, crop height, SPAD, maturity, and grain yield. Data on Fusarium damage kernels was also collected at Carberry. Data analysis consisted of Analysis of Variance (ANOVA) for individual sites as well as Mixed Models (REML) analysis for combined grain yield.

**Table 1:** Field operations for 2014 & 2015 high yielding winter wheat in Western Manitoba.

Operation	Date/Rate
Variety	Flourish
Seeding Rates	Target: 250plants/m <sup>2</sup> & Target 450pl/m <sup>2</sup>
Seeding Dates (stubble):	
Carberry	September 17, 2013 (canola) & September 26, 2015 (canola)
Hamiota	September 20, 2013 (wheat) & September 5, 2014 (fallow)
Roblin	September 15, 2014 (canola)
Harvest Dates	
Carberry	August 28, 2014 & August 13, 2015
Hamiota	September 12, 2014, July 30, 2015
Roblin	August 18, 2015
Fertility Treatments	
<b>Carberry</b>	Nitrogen 2014
2014	LOW: 36lbs/ac Mid Row Banded UREA at seeding; 24lbs/ac spring broadcast. Total Available N: 86lbs/ac
Avail N (fall 0-12"): 26 lbs/ac	MED: 48lbs Mid Row Banded UREA at seeding; 53lbs/ac Spring broadcast. Total Available N: 127lbs/ac
Phosphorus with seed:	HIGH: 58lbs/ac mid row banded UREA at seeding; 66lbs/ac Total Available N: 151lbs/ac
2015	Nitrogen 2015
Avail N (fall 0-12"): 19 lbs/ac	LOW: 63lbs/ac Mid Row Banded UREA at seeding; Total Available N: 82lbs/ac
Phosphorus with seed:	MED: 153lbs Mid Row Banded UREA at seeding; Total Available N: 172lbs/ac
30lbs/ac	HIGH: 206lbs/ac mid row banded UREA at seeding; Total Available N: 225lbs/ac
<b>Hamiota</b>	Nitrogen 2014
2014	LOW: 65lbs/ac Mid Row Banded UAN at seeding; 0lbs/ac spring broadcast. Total Available N: 113lbs/ac
Avail N (fall 0-24"): 48 lbs/ac	MED: 65lbs Mid Row Banded UAN at seeding; 20lbs/ac Spring broadcast. Total Available N: 133lbs/ac
Phosphorus with seed:	HIGH: 65lbs/ac mid row banded UAN at seeding; 40lbs/ac spring broadcast. Total Available N: 173lbs/ac
30lbs	

2015 Avail N (fall 0-12"): 100 lbs/ac  Phosphorus with seed: 34lbs/ac	Nitrogen 2015 LOW: 24lbs/ac with seed; 37lbs/ac Mid Row Banded UAN at seeding; Total Available N: 161lbs/ac MED: 24lbs/ac with seed; 37lbs/ac Mid Row Banded UAN at seeding; 20lbs/ac UREA spring broadcast Total Available N: 181lbs/ac HIGH: 24lbs/ac with seed; 37lbs/ac Mid Row Banded UAN at seeding; 40lbs/ac UREA spring broadcast Total Available N: 201lbs/ac
<b>Roblin</b>  2015 Avail N (fall 0-12"): 37 lbs/ac  Phosphorus with seed: 36 lbs/ac	Nitrogen 2015 LOW: 77lbs/ac Mid Row Banded at seeding; Total Available N: 114lbs/ac MED: 120lbs Mid Row Banded at seeding; Total Available N: 157lbs/ac HIGH: 164lbs/ac mid row banded at seeding; Total Available N: 201lbs/ac

#### Weed Control

<b>Carberry</b>	2014/2015 0.33L/ac Infinity (L pyrasulfotole & L bromoxynil) tank mixed with 412ml/ac Puma (fenoxaprop-p-ethyl).
<b>Hamiota</b>	2014 1L/ac Glyphosate + 20g/ac Heat 200ml/ac Achieve & 0.9L/ac Basagran
<b>Roblin</b>	2015 0.5L/ac Mextrol 450, 0.2L/ac Achieve + Turbocharge Pre-Emergence Roundup 400ml/ac Buctril M

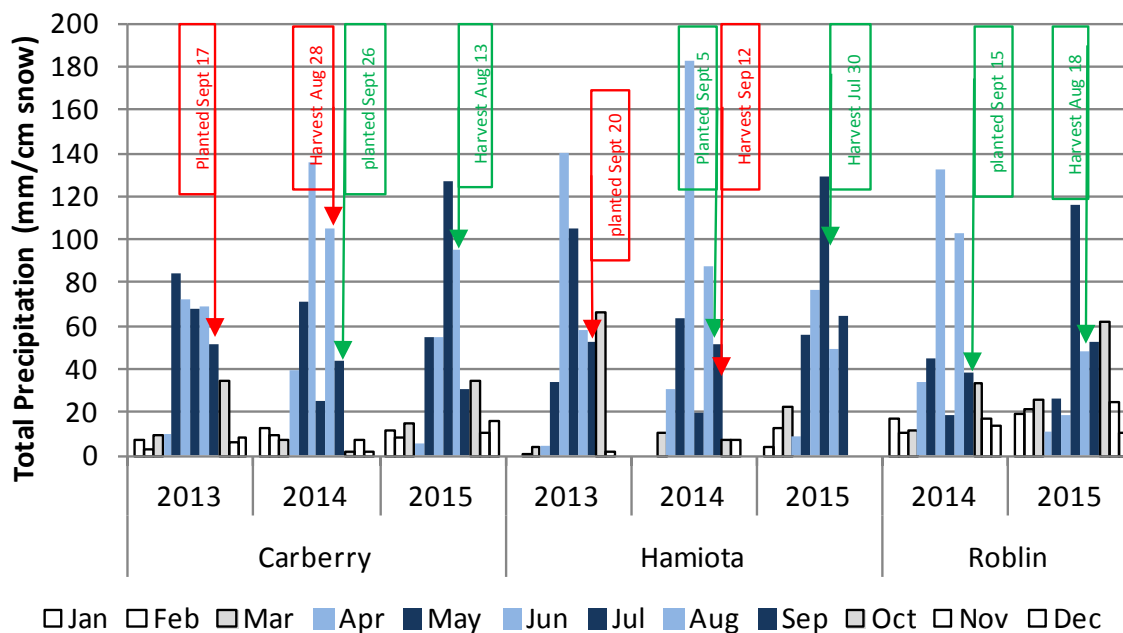
#### Fungicide

<b>Carberry</b>	2014 324ml/ac Prosaro 250 EC (Prothioconazole & Tebuconazole) at heading
	2015 324ml/ac Prosaro 250 EC (Prothioconazole & Tebuconazole) at early flower & heading
<b>Hamiota</b>	None
<b>Roblin</b>	2015 200ml/ac Folicur 250 EW at flowering

## Growing Conditions

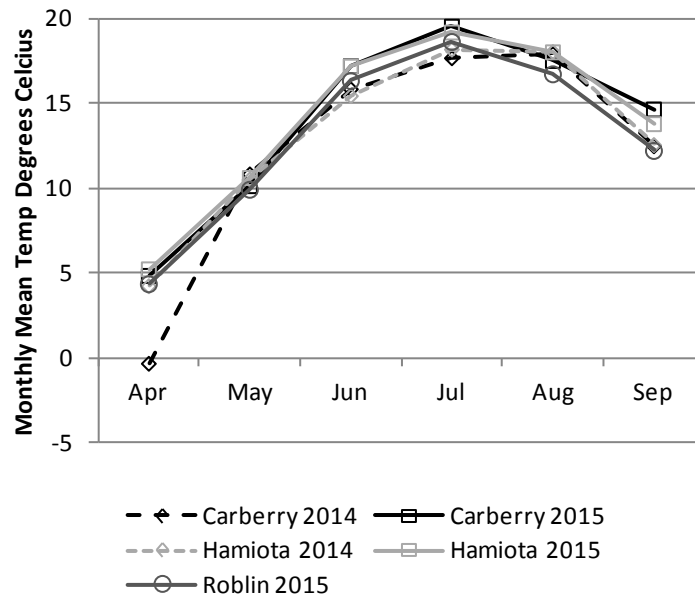
Growing conditions during the 2014 and 2015 seasons were different at each location. Precipitation and mean temperature are shown in Figures 1 & 2, respectively. At Carberry, reasonable snow cover permitted excellent winter survival for both seasons; however, 2015 had 40mm less rain than 2014 and rain distribution was different from one season (April-August) to the next. In 2014 65% of the seasons moisture fell in from April-June followed by a dry July (7% season moisture) and then a relatively wet August (28% of seasons moisture). In contrast, precipitation during 2015 in Carberry was weighted more towards the end of the season with only 34% falling from April-June, followed by a wet July & August where 38% and 28% of the rain fell, respectively. Hamiota also had adequate snow cover and showed similar trends with regards to differences in rain distribution through the season between 2014 and 2015; however the total moisture deficit from one year to the other was greater at Hamiota versus Carberry at 64mm. The distribution pattern was also more extreme in Hamiota; 2014 was wetter in the spring (72% April-June) and drier in both July (5%) and August (23%) In 2015 spring moisture in Hamiota accounted for 44% of seasonal rain with July and August representing 40% & 15%, respectively. Roblin in 2015 was characterized mainly by drought where 114mm less seasonal moisture fell relative to the year prior, of which the least amount of rain fell between April and June (26%) followed by late season moisture in July (53%) and August (22%).

Temperature differences among seasons at the locations can be summarized as a cool 2014 and warm 2015. Differences were the greatest at Carberry where April 2014 was exceptionally cooler relative to the other sites as was June and July.



**Figure 1:** Precipitation summary for Carberry (2013-2015); Hamiota (2013-2015); and Roblin (2014-2015).





**Figure 2:** Mean Monthly Temperature ( $^{\circ}\text{C}$ ) during growing season for Carberry (2014, 2015); Hamiota (2014-2015); and Roblin (2015).

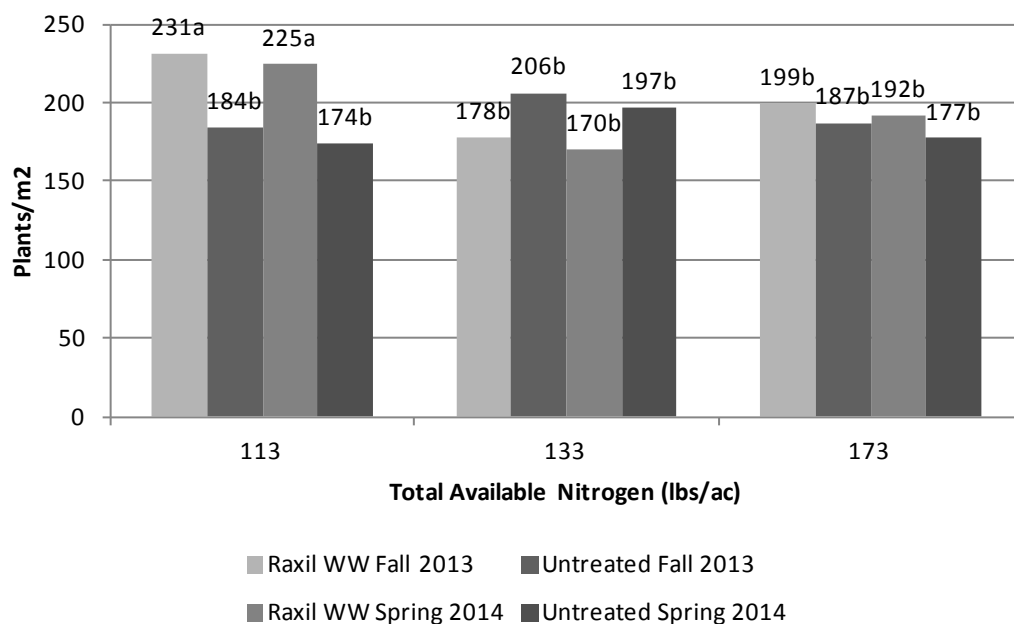
## Results/Discussion

### Establishment

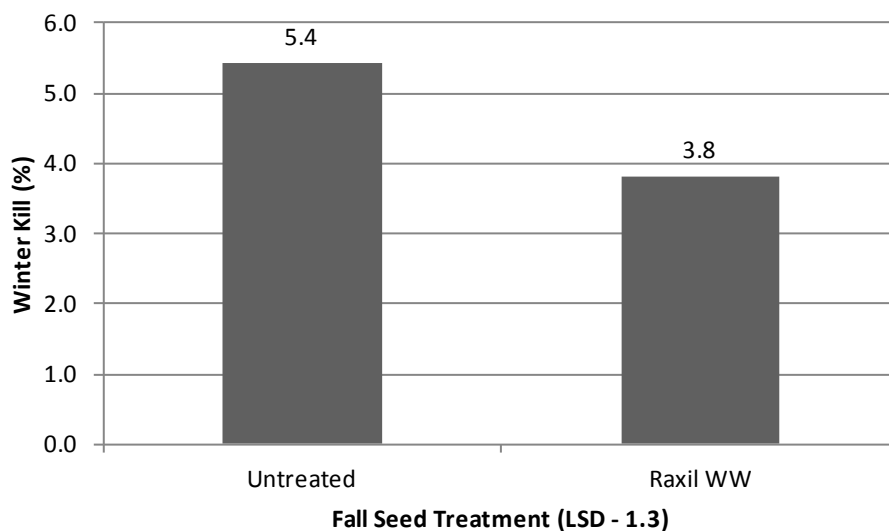
Winter wheat establishment was fair overall at all locations except in 2014 at Roblin where all winter wheat trials were destroyed due to extensive winter kill. Average plants/m<sup>2</sup> ranged from 178-203 (17-25 plants/ft), which is below the targeted recommended density of 320 plants/m<sup>2</sup>. There was some winter kill at Hamiota in 2014 & 2015, although variability was high and overall levels were relatively low at 5% & 13%, respectively. Winterkill levels were significant in 2014 but despite the higher rates in 2015, there were no significant differences among treatments.

The greater seeding rate in most cases resulted in significantly higher plant stands but the increase in stand was at the price of greater seedling mortality with improvements ranging from 9-30%. At two sites (Roblin, 2015 & Hamiota, 2015), despite numerical increase in stand, increases were not statistically significant.

Hamiota was the only site where a significant effect for seed treatment was detected in 2014 & 2015, although results were conflicting. In 2014 seed treatment had a significantly positive effect on stand at only the low fertility treatment relative to the control (Figure 3), an effect that was also detected in the spring which translated into a significant positive effect for seed treatment on winterkill (Figure 4). Significant seed treatment effects on fall stand counts detected in the 2015 trial did not carry over into the spring counts where greater variability and overall winterkill was observed, possibly skewing results.



**Figure 3:** Fall and spring winter wheat plant density at three different Nitrogen fertility regimes at Hamiota in 2013/2014 growing season.



**Figure 4:** Effect of Raxil WW seed treatment on overall winterkill at Hamiota, 2014.

### Disease

Due to the cool, wet spring Fusarium (*Fusarium graminearum*) infection was very high in winter wheat throughout Manitoba in 2014<sup>(2)</sup>. Grade results for samples at Carberry revealed levels of Fusarium damaged kernels ranging between 9-15% (Table 2) for which yield was most likely compromised. The

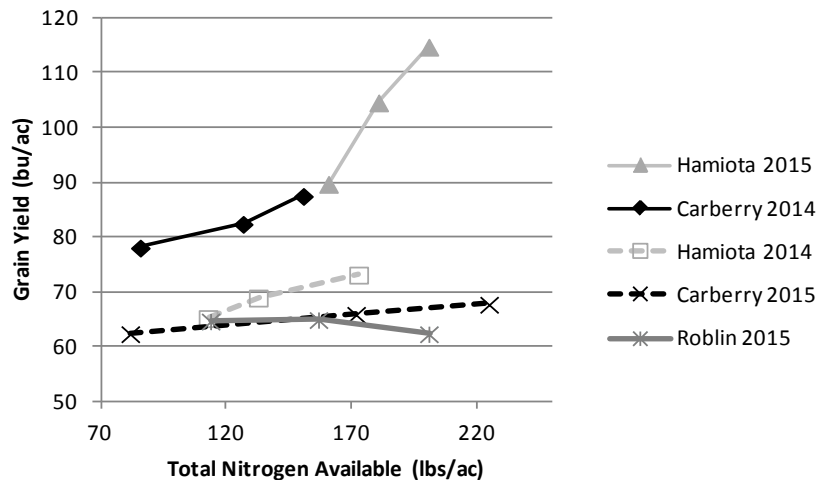
lower seeding rate had higher rates of FDK than the higher seeding (sig T-Test  $p < 0.1$ ). This is possibly related to a slightly reduced flowering period that has been shown to be associated with higher planting rates in Ontario<sup>(3)</sup>. Seed treatment was also significant ( $p = 0.1$ ) in showing reductions in FDK, although levels were still very high. Studies in Guelph have shown both an increase and a decrease<sup>(4)</sup> in FHB levels relative to the use of seed treatment so very possibly a coincidence in this case.

**Table 2:** Test weight, Percent Fusarium Damaged Kernels (FDK) and vomitoxin (VOM) in parts per million (ppm) of composite samples taken from high yield winter wheat trial at CMCDC, Carberry 2014.

Seeding Rate	Seed Treatment	Fertility	TW (g/0.5l)	FDK (%)	VOM (ppm)
250 pl/m <sup>2</sup>	Raxil WW	HIGH	364	12.8	6.0
250 pl/m <sup>2</sup>	Raxil WW	LOW	361	11.7	10.5
250 pl/m <sup>2</sup>	Raxil WW	MEDIUM	364	13.0	10.0
250 pl/m <sup>2</sup>	Untreated	HIGH	363	13.8	7.0
250 pl/m <sup>2</sup>	Untreated	LOW	362	10.0	7.0
250 pl/m <sup>2</sup>	Untreated	MEDIUM	362	15.6	13.0
450 pl/m <sup>2</sup>	Raxil WW	HIGH	362	10.2	6.0
450 pl/m <sup>2</sup>	Raxil WW	LOW	364	10.8	7.5
450 pl/m <sup>2</sup>	Raxil WW	MEDIUM	364	7.5	5.0
450 pl/m <sup>2</sup>	Untreated	HIGH	365	12.6	5.0
450 pl/m <sup>2</sup>	Untreated	LOW	364	9.8	9.0
450 pl/m <sup>2</sup>	Untreated	MEDIUM	363	14.5	6.0

### **Grain Yield**

Given that stand establishment response to increased seeding rate and seed treatment was minimal in this study, it was no surprise that fertilizer was the only factor that significantly increased grain yield (Figure 5). The greatest yield response was at the site with the greatest yield: Hamiota, 2015. Carberry in 2015 and Roblin 2015, where moisture stress was the greatest, had the lowest overall yield and as a result no significant yield response to increased fertility. When combining data from all locations nitrogen rate was significant for grain yield at the 0.1 alpha level ( $p = 0.06$ ). Combining data across only nitrogen responsive sites however resulted in a highly significant effect of nitrogen rate on grain yield at 0.05 level ( $p < 0.001$ ). Including only the responsive sites, additional fertilizer translated into approx. 6.2bu/ac for every 20lbs/ac of actual N added. The positive yield response to fertility at Hamiota was also supported by a positive response of height and leaf nitrogen content (data not shown).



**Figure 5:** Winter Wheat grain yield in 2014 & 2015 at Carberry, Hamiota and Roblin in response to total Nitrogen available at planting.

## Conclusions

A yield response to additional nitrogen fertility was observed at three out of five sites, a relationship that got stronger as the overall site yield increased. This suggests that fertility recommendations for new varieties of winter wheat may be too conservative, especially when growing conditions are adequate. However, producers still need to balance their investment/production risk tolerance relative to their historic yields. Seed treatment did not affect stand establishment overall in this study; however, establishment conditions were ideal in most cases. Where mortality was observed seed treatment may have aided in the establishment and overwintering of plants at lower fertility levels but more study, under harsher establishment conditions is required to confirm. Likewise, under good establishment conditions the increase in seeding rate, although equating to denser stands in most cases, did not result in increased yield in this study. More investigation is required under stressful fall establishment conditions to better gauge the relative importance of seed treatment and seeding rate on successful fall establishment and yield in winter wheat.

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# Comparison of Hybrid Winter Rye and Conventional Open Pollinated Winter Rye Response to Nitrogen Rate and Seeding Rates

**Cooperators:** FP Genetics  
Ducks Unlimited Canada

## *Introduction*

Rye grown on the Canadian prairies is typically grown for milling, distilling and feed purposes, with some production now being used in the cover crop industry. Rye is an open (cross) pollinated crop and for this reason has not had a lot of breeding focus in previous years. Open pollination generally results in a variety that has variable characteristics such as vigor, height, and maturity to name a few. Rye is typically grown in poor soils under low input (fertility, herbicide, fungicide) conditions and often organic systems when most other crops would fail due to its resilience with drought and winter hardiness and its intrinsic competitive and allelopathic<sup>3</sup> (weed seed suppressing) and nutrient scavenging abilities.

Hybrid rye, typically grown in northern and Eastern Europe, is now becoming popular in Canadian fields with the development of some new winter hardy varieties like 'Brassetto' distributed by FP Genetics. Hybrid rye varieties generally have a higher falling number than open pollinated types leading to improved marketing capabilities for more lucrative milling markets. In addition hybrid ryes have improved lodging resistance, higher yields, and even crop heights superior to open pollinated varieties<sup>1</sup>. Generally hybrids require lower seeding rates due to improved seedling and plant vigor, reducing the amount of seed necessary for crop establishment, consequently reducing input costs for seed. There is little information available on the optimal seeding rate for hybrid rye compared to conventional rye. FP Genetics<sup>2</sup> recommends a target seeding rate for hybrid rye to be 18.5 plants per square foot, whereas the Manitoba Agriculture Food and Rural Development<sup>4</sup> recommends open pollinated rye to be seeded at 24 plants per square foot, a 23% difference in seedling establishment between breeding systems.

Hybrids that have higher grain yields than open pollinated varieties generally require more resources such as nitrogen. There is little to no literature available comparing open pollinated varieties to hybrid varieties. Hybrid rye can out yield a conventional rye by as 20-30%.<sup>1</sup> However with greater yield, demand for inputs such as nitrogen inflate, therefore cost of production can be out of sync between hybrid and open pollinated cropping systems leading to differences in net income at the farm gate. This research project consists of a nitrogen trial and a seeding rate trial. Trials were separate to reduce the number of treatments. These trials shared the same objectives.

## *Objectives*

- To compare nitrogen rate and seeding rate response of hybrid rye to open pollinated rye with regards to winter survivability, in season agronomic development, and final yield characteristics; assess for interaction between nitrogen rates and variety use.
- Assess and compare economic potential of various nitrogen rates and seeding rates in hybrid and open pollinated rye production; assess for interaction between seeding rates and variety use.

## *Methods*

**Location:** SW 26-3-27 W1 RM of Two Borders, Melita MB

**Soil Type:** Newstead Loamy Sand

**Previous Crops:** 2014 – canola, 2015 – summer fallow

### Soil Test:

Depth	pH	N lbs/ac	P ppm Olsen	K ppm	S lbs/ac	Organic Matter %
0-6"	7.6	40	10	360	22	3.4
6-24"		60			54	

Plot area was sprayed with glyphosate at a rate of 1 L/ac prior to seeding. Plots were seeded with a Seedhawk dual knife air drill on September 5, 2014 at a depth of 3/8". Plots were 1.44 m wide by about 9 meters long. Plant counts were taken October 10 for fall and April 10, 2015 for spring counts to determine winter survivability and final plant stand. Two – one meter lengths of row were counted. The same location was used for both counting dates.

All plots were fertilized with a sideband blend of 60-35-30-20 (N-P-K-S lbs/ac) actual. Plots were sprayed with a tank mix of Mextrol 450 and Achieve applied at a rate of 0.4 L/ac and 0.2 L/ac, respectively, applied May 5, 2015. The seeding rate trial was topdressed with granular urea (46-0-0) at a rate of 50 lbs/ac actual nitrogen on May 5. The nitrogen trial was also topdressed but with the specific nitrogen treatment requirement using urea as well.

SPAD meter readings were taken June 15 at the flower stage. Ten readings per plot were taken and the flag leaf was used to measure the value. Crop height, lodging, leaf disease, test weight, grain yield and grain moisture were recorded. Grain yield was corrected to 14% moisture. Plots were harvested September 3, 2015 with a Wintersteiger Classic plot combine. Data was analyzed with an analysis of variance (ANOVA) using Agrobase Gen II statistical software. Coefficient of variation, grand mean and least significant differences (Fisher's unprotected) were determined.

### *Seeding Rate Trial*

Plot treatments were arranged in a randomized complete block design and replicated three times. The conventional rye variety 'Danko' and hybrid variety 'Brassetto' were used and treated as main plot factors. Target seeding rates were 150, 250, 350 and 450 plants/m<sup>2</sup> and were treated as subplots.

### *Results*

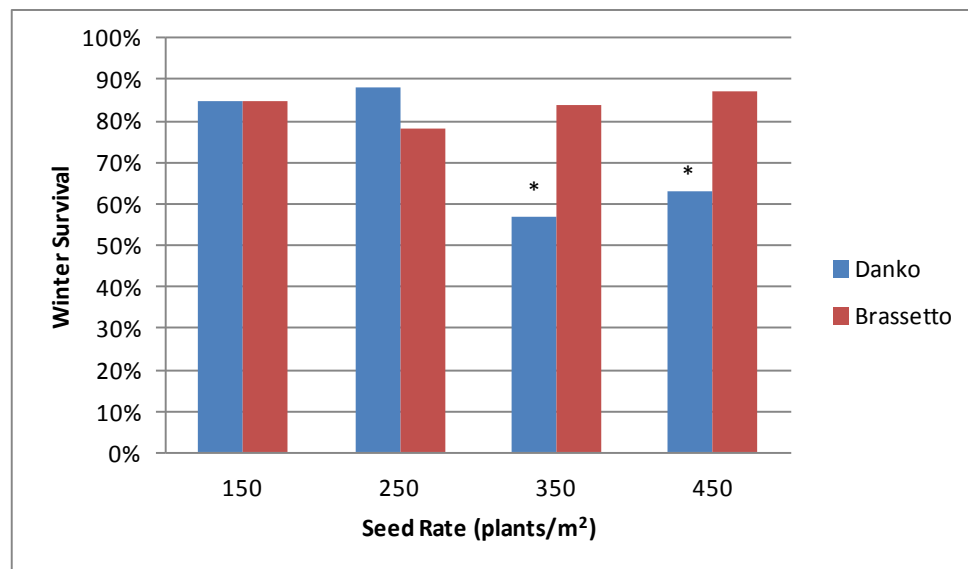
There were significant differences in winter survivability, plant height, test weight and yield between varieties 'Danko' and 'Brassetto' exclusively (Table 1). The hybrid variety 'Brassetto' resulted in greater survivability, shorter plant height, smaller test weight, and greater grain yield.

Seeding rate independently did not influence any factors measured. However, there was a significant negative interaction by increasing seeding rates of the conventional rye variety 'Danko' reducing winter survivability, but not in hybrid rye 'Brassetto' (Figure 1).



**Table 1:** Effects of Conventional rye variety ‘Danko’ and hybrid rye variety ‘Brassetto’ to seeding rate relating to winter survivability, plant height, leaf disease, grain test weight and grain yield near Melita, MB in 2015.

Variety	Seeding Rate plants/m <sup>2</sup>	Winter Survival %	Plant Height cm	Leaf Disease 1-11 (1-nil; 11- 100%)	Test Weight kg/hL	Yield kg/ha
Danko		73%	138	9	70	7450
Brassetto		83%	125	8	64	8432
	150	85%	136	8	67	8016
	250	83%	133	9	68	7788
	350	71%	127	9	67	8034
	450	75%	131	9	67	7926
Danko	150	85%	143	8	70	7377
	250	88%	138	9	71	7391
	350	57%	136	9	70	7345
	450	63%	136	9	70	7686
Brassetto	150	85%	129	8	65	8655
	250	78%	128	8	65	8186
	350	84%	118	8	64	8722
	450	87%	125	8	64	8165
LSD	Variety	9%	6	NS	0.7	429
	Seed Rate	NS	NS	NS	NS	NS
	Var x Seed Rate	17%	NS	NS	NS	NS
Prob. Entry	Variety	<b>0.025</b>	<b>&lt;0.001</b>	0.088	<b>&lt;0.001</b>	<b>&lt;0.001</b>
	Seed Rate	0.076	0.161	0.260	0.163	0.815
	Var x Seed Rate	<b>0.013</b>	0.777	0.774	0.340	0.380
Grand Mean		78%	132	8	67	7941
CV%		12.4	5.4	8.0	1.1	6.2



**Figure 1:** Interaction between conventional rye variety ‘Danko’ and hybrid rye variety ‘Brassetto’ to seeding rate and the corresponding winter survivability near Melita, MB in the spring of 2015.

## *Nitrogen Rate Trial*

Plot treatments were arranged in a randomized complete block design and replicated three times. The conventional rye variety 'Danko' and hybrid variety 'Brassetto' were used and treated as main plot factors. Target applied nitrogen rates were 60, 90 and 120 lbs/ac and were treated as subplots. Since soil tests were high, the 60 lbs/ac rate was set as a base rate after sidebanding in the fall. Spring topdressing treatments applied May 5 topped up the 90 and 120 lbs/ac treatments with 30 and 60 lbs/ac respectively, with granular urea. Therefore applied nitrogen combined with soil test nitrogen treatments would be total available nitrogen as follows:

### *Total Available Nitrogen = Fall Soil Test + Banded Fall + Spring Topdress*

1. 100 lbs/ac N soil test + 60 lbs/ac + 0 lbs/ac =160 lbs/ac N
2. 100 lbs/ac N soil test + 60 lbs/ac + 30 lbs/ac =190 lbs/ac N
3. 100 lbs/ac N soil test + 60 lbs/ac + 60 lbs/ac =220 lbs/ac N

A significant rain event just after topdressing (May 6 to May 15 – 110mm) followed by cool temperatures allowed for translocation of urea into the soil reducing the amount of volatilization losses. Leaching of banded and soil test nitrogen may have also occurred with spring snow melt combined with the large rain fall event in May depressing available soil nitrogen.

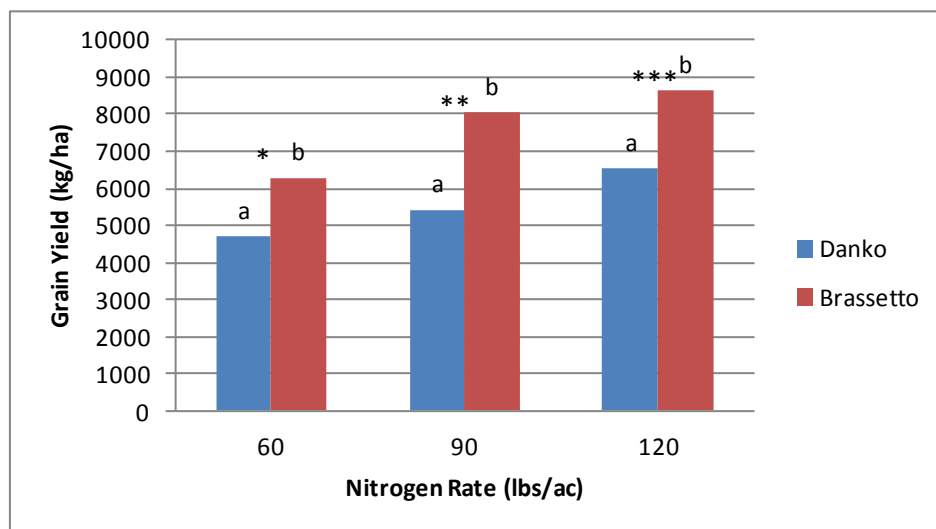
## *Results*

There were significant differences in crop height, leaf disease, SPAD meter reading, grain test weight, and grain yield between varieties 'Danko' and 'Brassetto' (Table 2). Brassetto rye crop height was shorter, had less leaf disease, lighter test weight, and greater yield than Danko. There was no difference in winter survivability between varieties.

Nitrogen rate caused significant difference only in grain yield in general for both varieties but no one variety performed better than the other in terms of an individual response. This is likely due to high fall soil test values causing an equal response over individual variety response. There was no significant interaction between varieties or nitrogen rate. However, as a trend both responded to nitrogen application and those responses were similar in magnitude, however this was not significant.

**Table 2:** Effects of Conventional rye variety ‘Danko’ and hybrid rye variety ‘Brassetto’ to applied nitrogen rate relating to winter survivability, plant height, leaf disease, SPAD meter reading, grain test weight and grain yield near Melita, MB in 2015.

Variety	N Rate (lbs/ac)	Winter Survival %	Height cm	Leaf Disease 1-11 (11-100% Covered)	SPAD	Test Weight kg/hL	Yield kg/ha
Danko		90%	136	10	36.6	74	5499
Brassetto		92%	124	9	41.7	71	7643
	60	90%	128	10	37.1	73	5489
	90	92%	132	9	39.7	72	6570
	120	92%	131	10	40.7	72	7653
Danko	60	89%	131	10	34.7	74	4697
	90	91%	139	10	37.1	74	5414
	120	91%	137	10	37.9	73	6519
Brassetto	60	91%	124	9	39.5	72	6281
	90	92%	124	9	42.2	71	8030
	120	93%	124	9	43.4	71	8616
P value	Variety	0.356	<b>0.004</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>
	N Rate	0.628	0.571	0.449	0.062	0.095	<b>0.002</b>
	Var x N Rate	0.954	0.586	0.449	0.966	0.850	0.309
LSD (p<0.05)	Variety	NS	7	0.5	2.4	0.899	721
	N Rate	NS	NS	NS	NS	NS	883
	Var x N Rate	NS	NS	NS	NS	NS	NS
Grand Mean		0.9111	130	10	39.2	73	6571
CV%		4.2728	5.2	5.3	5.9	1.2	10.1



**Figure 2:** Effects of applied nitrogen of Conventional rye variety ‘Danko’ and hybrid rye variety ‘Brassetto’ on grain yield near Melita, MB in 2015. Stars indicate nitrogen response overall was significant, letters indicate variety significance.



Photo: Hybrid rye variety 'Brassetto' (left) is shorter than conventional rye variety 'Danko' right. Photo taken July 10, 2015 at the Melita plot location.

### *Discussion*

A large crop of conventional rye can be a cumbersome crop to harvest. Hybrid rye may offer some ease when harvesting due to shorter less robust stands, while providing greater yield potential. Hybrid rye can be seeded at lower than recommended rates compared to conventional rye. This was illustrated by a winter survivability penalty with increased seeding rate, likely due to seedling diseases inflated by high plant to plant contact. Both systems responded to applied nitrogen despite the high fall soil test nutrient values, and these results suggest that higher rates may have even been warranted, however economics and crop response may limit net incomes at those inflated rates.

### *References*

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# High Yield Wheat and Protein Project

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## *Background*

The recent introduction of very high yielding wheat has brought challenges:

- Our provincial guidelines provide N recommendations for yields of 65 bu/ac
- These high yielding wheat types are often producing low protein
- The standard suggestion of 2.5 lb N/bu indicates that rates of 200 soil & fertilizer N are required for 80 bu/ac crops – a very high N rate.

The 4R approach is suggested in meeting these yield and protein requirements:

- Rates
- Timing/placement/source, especially for top-up strategies
- Development of decision tools for protein sufficiency

## *Method*

Sites were selected at MAFRD research stations (Arborg, Beausejour, Melita and Roblin), CMCDC research stations (Carberry and Portage), Richardson Pioneer research station (St Adolphe) and a producer field at Sperling (Silverwinds). Pre-plant soil sampling to 24" was done at each site in late April and early May, with several sites having very high nitrate N levels (Table 1). Soils were analyzed at Farmers Edge Laboratories.

Two experiments were conducted at each site (except at Sperling with Experiment B only).

### **Experiment A:** Wheat variety response to N.

Two popular high yielding wheat varieties were selected: AAC Brandon (CWRS) and Prosper (new Canada Northern Dark Red class) from NDSU. Nitrogen rates were added to base soil nitrate to produce 6 total N supplies: check (soil N only), 100, 130, 160, 190 and 220 lb N/ac. Base soil N at Arborg (157 lb N/ac) exceeded the lower levels so the first 4 rates (soil to 160) consisted of soil N only. Plots were seeded in a Split plot design with Main plots of N supply and sub plots as variety.

Nitrogen was applied as urea in subsurface bands during seeding at all sites except Portage and St Adolphe, where they were topdressed after seeding as urea treated with Agrotain Ultra.

**Table 1:** Site and activity descriptions

	Arborg	Beausejour	Carberry	Melita A	Melita B	Portage	Roblin	St Adolphe	Sperling
Site soil characteristics									
Soil series	Arborg C	Marquette C	Ramada CL	Newstead LFS		Dugas C	Erikson CL	St Norbert C	Osborne C
Soil N lb nitrate-N/ac	157 (203)	58	67	51 (fallow in 2014)		97	64	75	25 & 150 applied
OM	9.7%	4.9%	5.5%	3.1%		5.1%	5.6%	6.5%	5.6%
P ppm	23	32	10	7		19	12	27	5
K ppm	583	275	248	470		323	205	606	573
CEC	39	25	21	20		40	22	39	71
2015 Growing Season Weather									
Initial gravimetric soil moisture to 4'	26.7%	26.5%	18.8%	21.0%			18.6%		nd
May-Aug rain mm	310	378	331	360		371	214	382	331
May-Aug GDD	1365	1387	1370	1405		1512	1284	1535	1431
Field operations									
Seeded	May 25	May 25	May 5	May 5	May 25	May 26	May 12	May 11	
Base N appln	seeding	seeding	seeding	seeding	seeding	May 26 (11)	At seeding	May 27 (1)	Preplant
Harvest	Sept 23	Sept 24		Aug 14	Sept 1	Sept 1	Sept 1	Aug 19	Aug 12
Experiment B Supplemental N applications (days to rainfall)									
T1 = Stem Elong N appln	June 19 (8)	June 20(4)	June 19 (5)		June 18 (5)	June 19 (15)	June 10 (10)	June 5 (1)	June 5 (1)
T2 = Flagleaf N appln	July 2 (2)	July 4 (0)	July 2 (2)		July 10 (26)	July 6 (8)	June 28 (13)	June 17 (5)	June 17 (3)
PAN appln	July 28 (2)	July 28 (9)	July 19 (9)		July 21 (29)	July 22 (9)	July 19 (4)	July 13 (10)	July 11 (1)
Max temp at PAN (C °)	27	27	26		26	27.5	22	31	29

\* note values in brackets are the days between N application and rainfall amounting to ½ » or 12 mm.



## **Experiment B: Wheat response to in-season timings of N**

Prosper wheat was seeded with a base rate of 130N (soil & fertilizer N). Supplemental N was applied as Agrotain treated urea at 30 and 60 lb N/ac at late tillering-stem elongation (T1) or full flag leaf emergence-boot stage (T2) and a post anthesis (PAN) foliar application of 30 lb N as UAN, diluted 50:50 with water.

Observations: A number of observations of productivity and N sufficiency were conducted at each site as able. Agronomic measures included grain yield, protein, test weight, height and lodging. Nitrogen sufficiency measures included SPAD chlorophyll of flag leaf, GreenSeeker biomass at T1 and T2 and flag leaf N content at T2. The PAN treatment was assessed for % leaf burn within 1 week of application. Post harvest soil nitrate was determined at Roblin, Melita and St Adolphe (not yet analysed).

Weather conditions: Starting profile soil moisture was determined at all sites (not reported). In-season soil moisture was generally sufficient for high yield potential, except at Roblin (Table 1) where yields were curtailed.

Early seeding for high yield potential was intended but wet soils delayed seeding at Portage, Arborg and Beausejour and forced replanting of experiment B at Melita.

Results: Results are reported by location.

## Arborg

**Table 2:** N supply by Variety at Arborg

N Supply (lb/ac)	Yield Kg/ha	Yield Bu/ac	Protein %	Test Wt g/hl	SPAD	Flag leaf N%	GS T1	GS T2
Check*	3721	55.2	14.40	371	40.8	4.20	0.32	0.87
100N*	3688	54.7	14.41	369	39.7	4.08	0.33	0.87
130N*	3667	54.4	14.41	370	39.4	4.02	0.32	0.87
160N*	3599	53.4	14.45	367	39.5	4.21	0.31	0.86
190N	3603	53.4	14.41	368	40.5	4.15	0.31	0.87
220N	3666	54.4	14.31	368	40.1	4.20	0.32	0.87
Brandon	3171	47.0	15.09	368	39.7	4.11	0.36	0.86
Prosper	4144	61.5	13.71	369	40.3	4.18	0.28	0.87
CV	4.8		2.1	1.4	8.0	3.8	7.1	1.4
N rate								
Pr>F	0.476	0.476	0.966	0.574	0.572	0.585	0.942	0.945
LSD (0.05)	ns	ns	ns	ns	ns	ns	ns	ns
Variety								
Pr>F	0.00001	0.00001	0.00001	0.478	0.601	0.325	0.00001	0.005
LSD (0.05)	105.5	1.6	0.182	ns	ns	ns	0.014	0.007
Variety x N rate								
Pr>F	0.837	0.837	0.141	0.75	0.963	0.613	0.667	0.726
LSD (0.05)	ns	ns	ns	ns	ns	ns	ns	ns

At this site soil N was very high and supply rates check to 160N are equal (\*). Lodging and height were not recorded.

1. There was no impact of N supply on any growth factors.
2. Several varietal differences were significant. Prosper yielded 4.5 bu/ac more, had 1.4% lower protein, lower biomass at T1 and higher at T2 than Brandon.
3. There were no interactions between N supply and variety.

**Table 3: N supplementation at Arborg**

N Supply (lb/ac)	Yield Kg/ha	Yield Bu/ac	Protein %	Test Wt g/hl	SPAD	GS T1	GS T2	Flag leaf N%
130N*	4249	63.0	13.45	373	40.1	0.0	0.85	4.23
& 30N @ T1	4101	60.8	13.63	366	40.8	0.0	0.84	4.2
& 60N @ T1	4142	61.4	13.68	368	40.7	0.1	0.85	4.17
& 30N @ T2	4208	62.4	13.53	373	40.9	0.0	0.85	
& 60N @ T2	4160	61.7	13.60	369	41.3	0.0	0.85	
& 30N PAN	3911	58.0	14.28	363	41.8	0.1	0.85	
CV	3.8	3.8	1.0	1.2	2.9	247.5	1.7	0.4239
Pr>F	0.0957	0.0957	0.0000	0.0624	0.7659	0.1988	0.8958	0.1301
LSD (0.05)	235	3.5	0.2065	6.8424	ns	ns	ns	ns

\* Base rate was residual soil nitrate-N of 157 lb N/ac.

Lodging, height and leaf burn were not measured.

The base N rate at this site was the original soil nitrate-N level of 157 lb N/ac.

1. The lowest yield resulted from the PAN treatment. There were no yield differences among other treatments.
2. PAN increased protein more than all other treatments. N applications at T1 generally increased protein.
3. Test weight was lower than the check in the PAN treatment and 30N T1 applications.

## Beausejour

**Table 4:** N supply by Variety at Beausejour.

N Supply (lb/ac)	Yield Kg/ha	Yield Bu/ac	Protein %	Test Wt g/hl	SPAD	Flag leaf N%	GS T1	GS T2
Check	3843	57.0	14.1	360	31.6	3.39	0.23	0.84
100N	4017	59.6	14.2	358	31.6	3.46	0.24	0.85
130N	3869	57.4	14.5	354	31.9	3.61	0.24	0.87
160N	3799	56.3	14.7	353	32.7	3.75	0.23	0.88
190N	3687	54.7	14.9	352	33.4	3.88	0.22	0.88
220N	3675	54.5	15.0	352	33.0	3.93	0.22	0.89
Brandon	3336	49.5	15.2	353	31.1	3.72	0.25	0.88
Prosper	4294	63.7	13.9	356	33.6	3.61	0.20	0.86
CV	5.1		1.5	1.3	3.5	1.5	11.6	1.6
N rate								
Pr>F	0.224	0.224	0.0049	0.0166	0.512	0.023	0.714	0.0001
LSD (0.05)	ns	ns	0.49	5.2	ns	0.3	ns	0.01
Variety								
Pr>F	0.00001	0.00001	0.00001	0.0268	0.002	0.0025	0.00001	0.0001
LSD (0.05)	119	1.8	0.132	2.76	1.14	0.054	0.016	0.008
Variety x N rate								
Pr>F	0.548	0.548	0.714	0.57	0.406	0.214	0.383	0.272
LSD (0.05)	ns	ns	ns	ns	ns	ns	ns	ns

Lodging and height were not recorded.

1. Increasing N rate did not impact yield, but increased protein, flag leaf N, and biomass at T2 and reduced test weight.
2. Several varietal differences were significant. Prosper yielded 4.2 bu/ac more, had 1.3% lower protein, lower biomass at T2, higher SPAD and lower flag leaf N than Brandon.
3. There were no interactions between N supply and variety.

**Table 5:** N supplementation at Beausejour.

N Supply (lb/ac)	Yield Kg/ha	Yield Bu/ac	Protein %	Test Wt g/hl	SPAD	GS T2	Flag leaf N%
130N	4440	65.9	13.6	363	34.2	0.83	3.61
& 30N @ T1	4182	62.0	14.3	355	33.9	0.85	3.61
& 60N @ T1	4155	61.6	14.2	355	34.2	0.86	3.73
& 30N @ T2	4524	67.1	14.1	360	33.4	0.84	
& 60N @ T2	4415	65.5	14.1	357	32.7	0.85	
& 30N PAN	4246	63.0	14.2	355	33.8	0.84	
CV	3.7	3.7	4.2	1.1	2.6	1.5	3.29
Pr>F	0.0242	0.0242	0.3884	0.05	0.5498	0.0201	0.5906
LSD (0.05)	242	3.6	ns	5.8	ns	0.019	ns

Lodging, height and leaf burn were not measured.

1. Yields were reduced with N applications at T1 compared to the base treatment.
2. There was no significant impact on wheat protein
3. Test weight was lower than the check in the PAN treatment and T1 applications.
4. T1 applications tended to have great early season biomass (T1) than base N rate alone.

### **Carberry**

**Table 6:** N supply by variety at Carberry.

N Supply (lb/ac)	Yield Kg/ha	Yield Bu/ac	Protein %	Test Wt g/hl	GS T2	Ht cm
Check	5108	75.8	13.68	385	0.47	80
100N	5080	75.4	14.11	386	0.48	77
130N	5005	74.2	14.29	384	0.48	75
160N	5001	74.2	14.54	382	0.46	77
190N	4842	71.8	14.51	383	0.50	75
220N	5088	75.5	14.81	380	0.46	73
Brandon	4913	72.9	14.58	384	0.50	76
Prosper	5129	76.1	14.07	382	0.44	76
CV	11.90%	11.90%	3.39%	0.93%	21%	6.00%
N rate						
Pr>F	0.994	0.994	0.0001	0.7	0.79	0.51
LSD (0.05)	ns	ns	0.29	ns	ns	ns
Variety						
Pr>F	0.226	0.226	0.0018	0.12	0.04	0.93
LSD (0.05)	ns	ns	0.29	ns	0.06	ns
Variety x N rate						
Pr>F	0.422	0.422	0.265	0.06	0.92	0.25
LSD (0.05)	ns	ns	ns	ns	ns	ns

Planter problems altered plot size so several measurements were no longer collected (SPAD, flag leaf N, lodging).

1. Increasing N rate did not impact yield possibly due to seeding problems. However protein increased significantly with increasing N supply.
2. Several varietal differences were significant. Brandon had 0.5% higher protein and greater I biomass at T2 than Prosper.
3. There were no interactions between N supply and variety

**Table 7:** N supplementation at Carberry.

N Supply (lb/ac)	Yield Kg/ha	Yield Bu/ac	Protein %	Test Wt g/hl	Ht cm
130N	5906	87.6	14.00	385	81
& 30N @ T1	5616	83.3	14.35	385	81
& 60N @ T1	5912	87.7	14.65	384	79
& 30N @ T2	5797	86.0	14.18	386	81
& 60N @ T2	6306	93.5	14.00	386	79
& 30N PAN	5514	81.8	14.78	383	76
CV	14.60%	14.60%	1.20%	0.95%	5.50%
Pr>F	0.82	0.82	0.0001	0.87	0.63
LSD (0.05)	1284	ns	0.26	ns	ns

SPAD, flag leaf N, leaf burn and lodging were not reported.

1. Yields were not affected by N applications.
2. Protein increase was highest with PAN treatment, followed by T1 applications. T2 applications had no affect on protein.



## Melita

**Table 8:** N supply by variety at Melita.

N Supply (lb/ac)	Yield Kg/ha	Yield Bu/ac	Protein %	Test Wt g/hl	SPAD	Flag leaf N%	GS T2	Ht cm
Check	6048	89.7	12.85	402	40.7	3.73	0.78	95
100N	5990	88.9	13.0	400	40.1	3.78	0.79	98
130N	5920	87.8	12.58	400	40.8	3.80	0.82	95
160N	5796	86.0	13.22	399	43.3	3.84	0.81	94
190N	6097	90.4	13.75	393	43.2	3.97	0.81	98
220N	6135	91.0	13.63	399	42.2	3.96	0.78	95
Brandon	5746	85.2	14.0	401	39.3	3.83	0.79	92
Prosper	6249	92.7	12.34	397	44.2	3.86	0.81	99
CV	4.1		2.08	0.8	2.8	1.9	4.4	2.4
N rate								
Pr>F	0.681	0.681	0.001	0.178	0.0041	0.101	0.152	0.593
LSD (0.05)	ns	ns	0.441	ns	1.6	ns	ns	ns
Variety								
Pr>F	0.00001	0.00001	0.00001	0.034	0.00001	0.258	0.04	0.00001
LSD (0.05)	177	2.6	0.39	3.36	0.86	ns	0.025	1.64
Variety x N rate								
Pr>F	0.0518	0.0518	0.746	0.358	0.0109	0.768	0.544	0.544
LSD (0.05)	432	6.4	ns	ns	2.11	ns	ns	ns

1. Increasing N rate did not impact yield of Brandon, but unexpectedly led to lower yields of Prosper at the 130 and 160 N rates.
2. Higher N rates increased protein and SPAD values. Flag leaf N increased with N rates but were not significant.
3. Several varietal differences were significant. Prosper yielded 7.5 bu/ac more, had 1.65% lower protein, lower test weight but higher SPAD values, biomass and height than Brandon.
4. There was a variety x N interaction in SPAD values. N rate did not affect SPAD values of Brandon, but in Prosper produced higher values at 160 and 190 and lowest at 100N.
5. There tended to be a variety x N rate interaction on yield. Brandon yield was not affected, but Prosper yield at 160N was less than base, 100, 190 and 220 rates.
6. There was no lodging in any plots.

**Table 9:** N supplementation at Melita.

N Supply (lb/ac)	Yield Kg/ha	Yield Bu/ac	Protein %	Test Wt g/hl	GS T2	Ht cm
130N	4188	62.1	13.03	382	0.80	96
& 30N @ T1	4210	62.5	13.73	381	0.81	94
& 60N @ T1	4309	63.9	14.40	378	0.83	96
& 30N @ T2	4395	65.2	13.50	385	0.79	94
& 60N @ T2	4440	65.9	13.83	383	0.80	94
& 30N PAN	4100	60.8	13.30	379	0.80	95
CV	2.9223	2.9223	4.2391	1.1074	1.568	2.0538
Pr>F	0.0521	0.0521	0.1604	0.6882	0.0583	0.5923
LSD (0.05)	227	3.4	ns	ns	0.0229	ns

Leaf burn and Flag leaf N were not measured.

1. The original planted plots were flooded and replanted. The Prosper plots in Experiment A seeded 20 days earlier yielded 30 bu/ac more.
2. The PAN treatment yielded less than supplemental N at T2 or 60 N at T1.
3. The 60N treatment at T1 had greater biomass than the base N or any later N applications.

### **Portage**

**Table 10:** N supply by variety at Portage.

N Supply (lb/ac)	Yield Kg/ha	Yield Bu/ac	Protein %	Test Wt g/hl	SPAD	Flag leaf N%	GS T1	GS T2	Ht cm
Check	2800	41.5	13.13	380	36.4	3.88	0.27	0.66	69.3
100N	3083	45.7	13.10	379	36.4	3.80	0.27	0.65	71.8
130N	3200	47.5	12.95	378	37.0	3.72	0.31	0.72	74.2
160N	3430	50.9	13.40	381	37.1	3.83	0.32	0.74	75.9
190N	3556	52.7	13.36	379	35.0	4.10	0.34	0.76	76.3
220N	3799	56.4	13.55	380	35.9	3.94	0.33	0.79	80.2
Brandon	3176	47.1	13.72	381	37.1	3.88	0.33	0.74	72.9
Prosper	3447	51.1	12.78	378	35.5	3.88	0.27	0.70	76.3
CV	9.6		2.3	0.6	2.8	4.1	15.3	8.4	4.2
N rate									
Pr>F	0.0212	0.0212	0.232	0.53	0.089	0.277	0.045	0.0072	0.0104
LSD (0.05)	556	8.2	ns	ns	1.5	ns	0.051	0.075	5.3758
Variety									
Pr>F	0.0087	0.0087	0.00001	0.0003	0.007	0.971	0.0002	0.0369	0.05
LSD (0.05)	194	2.9	0.183	1.41	1.01	ns	0.028	0.037	3.4
Variety x N rate									
Pr>F	0.489	0.489	0.895	0.04	0.365	0.216	0.26	0.415	0.889
LSD (0.05)	ns	ns	ns	3.46	ns	ns	ns	ns	ns

1. N rate significantly increased yield, biomass at T1 and T2 and plant height. The 190N rate tended to have lower SPAD values than lower application rates.
2. Several varietal differences were significant. Prosper yielded 4 bu/ac more, had 1% lower protein, lower test weight, lower SPAD, lower biomass at T1 and T2, but was taller than Brandon.
3. There was a significant but minor interaction in test weight. At the 190 N rate Brandon had lowest test weight but Prosper had its highest test weight.
4. There was no lodging of plots.

**Table 11:** N supplementation at Portage.

N Supply (lb/ac)	Yield Kg/ha	Yield Bu/ac	Protein %	Test Wt g/hl	SPAD	GS T2	Ht cm	Flag leaf N%
130N	3278	48.6	12.50	378	34.6	0.71	76	3.63
& 30N @ T1	3665	54.4	12.68	379	36.0	0.70	79	3.93
& 60N @ T1	4131	61.3	13.05	380	37.0	0.75	82	4.08
& 30N @ T2	3313	49.1	12.28	379	32.4	0.65	78	
& 60N @ T2	3250	48.2	12.23	379	35.4	0.66	77	
& 30N PAN	3313	49.1	13.20	382	36.2	0.70	78	
CV	9.7275	9.7275	3.6336	0.7632	6.9584	9.2031	4.5444	2.8511
Pr>F	0.0136	0.0136	0.0426	0.4055	0.5596	0.332	0.2355	0.1025
LSD (0.05)	512	7.6	0.69	ns	ns	ns	ns	ns

1. There was no lodging in plots. The PAN treatment caused leaf burn of 25%.
2. There was a significant yield increase with the 60 N rate applied at T1, which is surprising since little rain was received for 15 days following application (Table 1).
3. The lowest protein resulted from T2 applications, with PAN being significantly higher than these applications and the base N.
4. The flag leaf N content tended to rise with applied N

## Roblin

<b>Table 12:</b> N supply by variety at Roblin. N Supply (lb/ac)	Yield Kg/ha	Yield Bu/ac	Protein %	Test Wt g/hl	Ht T1 cm	Ht T2 cm	GS T1	GS T2	Flag leaf N%
Check	4086	60.6	15.03	383.8	21.6	55.3	0.29	0.49	4.37
100N	4094	60.7	15.46	376.1	21.3	54.3	0.26	0.48	4.42
130N	4156	61.7	15.64	379.0	21.7	55.1	0.28	0.50	4.45
160N	4262	63.2	15.23	376.5	22.2	54.7	0.28	0.51	4.53
190N	4235	62.8	15.94	378.2	22.3	54.4	0.28	0.49	4.48
220N	4055	60.1	15.91	371.6	22.3	53.2	0.29	0.47	4.36
Brandon	4006	59	15.4	383	22.7	55.30	0.30	0.51	4.57
Prosper	4290	64	14.4	371	21.1	53.70	0.26	0.47	4.30
CV	3.1502	3.1502	1.74	1.1	4.0	2.8	10.3	3.2	1.6
N rate									
Pr>F	0.3922	0.3922	0.0547	0.0549	0.4918	0.5721	0.6372	0.5146	0.4287
LSD (0.05)	ns	ns	0.66	7.2	ns	ns	ns	ns	ns
Variety									
Pr>F	0.0001	0.0001	0.0001	0.0001	0.0001	0.0027	0.0004	0.0001	0.0001
LSD (0.05)	277	4.1	0.17	2.55	0.532	0.93	0.017	0.0094	0.07
Variety x N rate									
Pr>F	0.5434	0.5434	0.4109	0.4863	0.3973	0.8373	0.2029	0.1224	0.0684
LSD (0.05)	ns	ns	ns	ns	ns	ns	ns	ns	0.174

Low growing season rainfall reduced yields at Roblin (Table 1). There was no lodging.

1. Nitrogen tended to increase protein and reduce test weight. Nitrogen had no impact on yield, protein or other parameters.
2. All measured parameters were different between Prosper and Brandon. Prosper yielded 5 bu/ac more, was 1% lower protein, had lower test wt, height and biomass and flag leaf N than Brandon.

**Table 13:** N supplementation at Roblin.

N Supply (lb/ac)	Yield Kg/ha	Yield Bu/ac	Protein %	Test Wt g/hl	GS T1	GS T2	Ht T1 cm	Ht T2 cm	Flag leaf N%
130N	4465	66.2	15.35	354.0	0.25	0.47	22	54.9	4.38
& 30N @ T1	4314	64.0	15.33	343.0	0.27	0.45	21.3	53	4.34
& 60N @ T1	4538	67.3	15.33	350.0	0.25	0.48	20.4	53.2	4.26
& 30N @ T2	4396	65.2	15.30	348.0	0.26	0.46	21.3	53.7	
& 60N @ T2	4526	67.1	15.45	351.0	0.26	0.46	21.6	53.1	
& 30N PAN	4141	61.4	15.50	348.0	0.27	0.46	21.5	53.5	
CV	5.0	5.0	0.8397	1.7372	7.6698	4.8468	5.7497	3.1697	1.9823
Pr>F	0.3066	0.3066	0.2309	0.4014	0.6721	0.4973	0.5644	0.6179	0.514
LSD (0.05)	ns	ns	ns	ns	ns	ns	ns	ns	ns

1. There was no lodging. The PAN treatment caused leaf burn of 33%.
2. There was no impact of treatments on measured parameters.

**St Adolphe****Table 14:** N supply by variety at St Adolphe.

N Supply (lb/ac)	Yield Kg/ha	Yield Bu/ac	Protein %	Test Wt g/hl	GS T1	GS T2	Ht cm	Lodging (1-9)
Check	6052	89.8	13.91	389	0.34	0.82	82	1.13
100N	5881	87.2	13.89	387	0.36	0.83	83	1.25
130N	5949	88.2	13.71	387	0.34	0.86	83	1.63
160N	6253	92.7	14.05	385	0.33	0.86	82	2.13
190N	5992	88.9	14.75	383	0.32	0.87	83	3.25
220N	5861	86.9	14.86	382	0.33	0.87	81	3.63
Brandon	5539	82.2	14.68	384	0.37	0.86	81	1.54
Prosper	6457	95.8	13.71	387	0.30	0.85	84	2.79
CV	11.1	11.1	1.8	1.4	10.3	3.0	2.1	37.7
N rate								
Pr>F	0.855	0.855	0.0002	0.095	0.804	0.0002	0.0124	0.00001
LSD (0.05)	ns	ns	0.454	4.8	ns	0.02	1.61	0.711
Variety								
Pr>F	0.0002	0.0002	0.00001	0.102	0.00001	0.0886	0.00001	0.00001
LSD (0.05)	404	6.0	0.151	3.2	0.021	0.02	1.04	0.495
Variety x N rate								
Pr>F	0.271	0.271	0.164	0.715	0.344	0.41	0.331	0.0054
LSD (0.05)	ns	ns	ns	ns	ns	ns	ns	1.21

Due to biosecurity protocols, leaf N samples were not collected for N analysis. SPAD measurements were not done.

1. N rate did not influence yield but increased protein at the highest 2 rates, and increased biomass at T2 stage. Applied N increased lodging and reduced test weight. The shortest wheat was at the highest rate and was less than 3 other N treatments.
2. Most measurements between varieties were significant. Prosper had 13.6 bu/ac higher yield, 1% lower protein, lower biomass at T1 and T2, was taller and had more lodging than Brandon.
3. There was a significant in lodging. N rate caused significant lodging in Brandon at only the highest N rate, whereas lodging of Prosper occurred at all rates over 130N.

**Table 15:** N supplementation at St Adolphe.

N Supply (lb/ac)	Yield Kg/ha	Yield Bu/ac	Protein %	Test Wt g/hl	GS T1	GS T2	Ht cm	Lodging 1-9
130N	6452	95.7	13.40	389	0.32	0.84	84	1.50
& 30N @ T1	6505	96.5	13.58	387	0.31	0.85	83	3.25
& 60N @ T1	6108	90.6	13.75	383	0.33	0.86	83	3.50
& 30N @ T2	6765	100.4	13.63	391	0.32	0.83	84	1.75
& 60N @ T2	6683	99.1	14.00	387	0.35	0.86	84	2.00
& 30N PAN	6335	94.0	14.15	387	0.35	0.85	84	1.75
CV	3.5	3.5	2.4	0.7	7.7	1.5	2.5	29.4
Pr>F	0.0114	0.0114	0.0552	0.0139	0.2209	0.0196	0.9462	0.0021
LSD (0.05)	342	5.1	0.50	3.9	ns	0.0196	ns	1.01

Due to biosecurity protocols, leaf N samples were not collected for N analysis. SPAD measurements were not done.

1. The PAN treatment caused leaf burn of 36%.
2. N applications at T2 produced the highest yields and were significantly greater than PAN and 60 at T1.
3. The 60 N treatment at T1 had the lowest yield, lowest test weight and greatest lodging. T1 applications caused the highest lodging.
4. Protein tended to increase with N rate and was greatest with 60N at T2 and PAN.
5. Flag leaf biomass was greater than the base N rate with 60N at T1 and T2.

## Sperling

**Table 16:** N supplementation at Sperling.

N Supply (lb/ac)	Yield Kg/ha	Yield Bu/ac	Protein %	Test Wt g/hl	GS T1	GS T2	SPAD	Flag leaf N%
130N	3713.8	55.1	14.15	385.0	0.49	0.84	34.8	3.76
& 30N @ T1	4327.5	64.2	14.08	386.0	0.49	0.83	33.2	3.87
& 60N @ T1	3757.5	55.7	14.6	384.0	0.47	0.82	33.9	3.91
& 30N @ T2	3818.8	56.6	14.7	384.3	0.47	0.84		
& 60N @ T2	4000.0	59.3	14.48	384.5	0.44	0.83		
& 30N PAN	3740.0	55.5	14.98	385.0	0.48	0.83		
CV		10.1	2.45	1.2	10.3	2.6	5.0	2.8
Pr>F		0.2709	0.0228	0.992	0.6604	0.7563	0.6917	0.5052
LSD (0.05)		ns	0.54	ns	ns	ns	ns	ns

Lodging was severe at this site but was not rated and height was not measured.

The base N rate in this producer field was 196 lb N/ac (28 soil N, 150 fall NH<sub>3</sub> and 18 starter).

1. Some protein treatments had greater levels than the base N rate. Protein was increased with 30 N at T2 and PAN.
2. No other treatments were significant.

## Discussion

A summary of significant effects are reported in the following tables.

### A) N Rates

- Generally the base N rates or soil N was sufficient for high yield.
- Grain protein was increased in all cases (excluding the yield responsive Portage site and the very high soil N Arborg site)
- Applied N often increased N status values of SPAD chlorophyll, Flag leaf N and biomass (GS or GreenSeeker).
- Plant height and lodging was occasionally increased with applied N.

**Table 17:** The influence of N rate on growth, quality and N status values.

Parameter	Arborg	Bsj	Carb	Melita	Port	Roblin	SA	Prob of increase	Prob of decrease
Yield	=	=	=	=	+	=	=	1/7	
Protein	=	+	+	+	=	+	+	5/7	
Test Wt	=	-	=	=	=	-	-		3/7
SPAD	=	=		+	=			1/4	
GS	=	+	=	=	+	=	+	3/7	
Leaf N	=	+		=	=	=		1/5	
Ht			=	=	+	=	=	1/5	
Lodging				=	=	=	+	1/4	

= no change, + increase, - decrease at Pr<0.05.



## B) Varieties – Prosper vs Brandon

Prosper yielded 8.8 bu/ac more and had 0.9 % lower protein than Brandon.

**Table 18:** Yield and protein of Prosper and Brandon.

	Yield bu/ac Average (range)	Protein % Average (range)
Brandon	63.3 (47-85)	14.7 (13.7-15.4)
Prosper	72.1 (51-93)	13.6 (12.3 – 14.4)

Prosper also tended to be taller and have more lodging. N status parameters varied by site.

**Table 19:** The influence of variety on growth, quality and N status values. (Reported are significant differences between Prosper and Brandon).

Parameter	Arborg	Bsj	Carb	Melita	Port	Roblin	SA	Prob of P>B	Prob of P<B
Yield	+	+	=	+	+	+	+	6/7	
Protein	-	-	-	-	-	-	-		7/7
Test Wt	=	+	=	-	-	=	=	1/7	2/7
SPAD	=	+		+	-			1/4	2/4
GS	+	-	-	+	-	-	-	2/7	5/7
Leaf N	=	-		=	=	-			2/5
Ht			=	+	+	=	+	3/5	
Lodging				=	=	=	+	1/4	

P = Prosper, B = Brandon, = no change, + increase, - decrease at Pr<0.05.

There were few interactions between applied N and variety. The most notable interaction was at St Adolphe where Prosper lodged more than Brandon with increasing N rates.

## C) N Timing

The following tables summarize the effect of N timing (and placement) on growth, quality and N status values.

**Table 20:** The impact of additional 30 & 60 N at Stem elongation (T1). T1 vs Base N

Parameter	Arborg	Bsj	Carb	Melita	Port	Roblin	SA	SP	Prob of increase	Prob of decrease
Yield	=	-	=	=	+	=	-	=	1/8	2/8
Protein	+	+	+	=	=	=	=	=	3/8	
Test Wt	-	-	=	=	=	=	=	=	2/8	
SPAD	=	=			=			=		
GS	=	+	+		=	=	+	=	3/7	
Leaf N	=	=			=	=		=		
Ht			=	=	=	=				
Lodging					=	=	+		1/3	

N only increased yield at the responsive Portage site. Yield was reduced twice, in particular at St Adolphe due to increased lodging.

Protein was increased at 3/8 sites. T1 applications increased biomass (GS) at 3 sites, but not SPAD or leaf N at the flag leaf –boot stage.

**Table 21:** The impact of additional 30 & 60 N at Flag leaf –Boot stage (T2). T2 vs Base N

Parameter	Arborg	Bsj	Carb	Melita	Port	Roblin	SA	SP	Prob of increase
Yield	=	=	=	+	=	=	=	=	1/8
Protein	=	+	=	=	=	=	+	=	2/8
Test Wt	=	=	=	=	=	=	=	=	
Ht			=		=	=	=		
Lodging					=	=	=		

At Melita, the 60N rate increase yield over the Base N rate.

Protein was increased at 2/8 sites.

**Table 22:** The impact of additional 30N at post anthesis stage (PAN). PAN vs Base N

Parameter	Arborg	Bsj	Carb	Melita	Port	Roblin	SA	SP	Prob of increase	Prob of decrease
Yield	-	=	=	=	=	=	=	=		1/8
Protein	+	+	+	=	+	=	+	+	6/7	
Test Wt	-	-	=	=	=	=	=	=		2/8
Ht					=	=	=			
Lodging					=	=	=			

Yield was significantly reduced at only 1 site. Protein was increased at 6/7 sites. Test weight was reduced slightly at 2 sites.

## Pepsico (Quaker) Oats Variety Trial

### Cooperators

- PepsiCo-Fritolay-Quaker-Gatorade Company

### *Background (taken from Wikipedia)*

Oat bran is the outer casing of the oat. Its consumption is believed to lower LDL ("bad") cholesterol, and possibly to reduce the risk of heart disease. Oats contain more soluble fibre than any other grain. One type of soluble fibre, *beta-glucans*, has proven to help lower cholesterol.

After reports of research finding that dietary oats can help lower cholesterol, an "oat bran craze" swept the U.S. in the late 1980s, peaking in 1989, when potato chips with added oat bran were marketed. The food fad was short-lived and faded by the early 1990s. The popularity of oatmeal and other oat products again increased after a January 1998 decision by the Food and Drug Administration (FDA), when it issued a final rule that allows food companies to make health claims on food labels of foods that contain soluble fibre from whole oats (oat bran, oat flour and rolled oats), noting that 3.0 grams of soluble fibre daily from these foods may reduce the risk of heart disease. To qualify for the health claim, the whole oat-containing food must provide at least 0.75 grams of soluble fibre per serving. A class of polysaccharides known as beta-D-glucans comprise the soluble fibre in whole oats.

Beta-D-glucans, usually referred to as beta-glucans, comprise a class of indigestible polysaccharides widely found in nature in sources such as grains, barley, yeast, bacteria, algae and mushrooms. In oats, barley and other cereal grains, they are located primarily in the endosperm cell wall.

Oat beta-glucan is a soluble fibre. In comparison, the indigestible polysaccharide cellulose is also a beta-glucan, but is not soluble. The percentages of beta-glucan in the various whole oat products are: oat bran, greater than 5.5% and up to 23.0%; rolled oats, about 4%; and whole oat flour about 4%.

The food and beverage company PepsiCo has partnered with Secan Seeds to evaluate varieties of oats keeping these beta-glucans in mind, while evaluating growth characteristics, yield and milling quality. The purpose being to find the best milling oat, with the best marketable beta-glucan content, that farmers will want to grow.

Trials were set up around the Prairies by Secan and Pepsico with cooperation of research groups like WADO, to evaluate some classic and some new varieties of oats available, and assess the geographical/environmental parameters that affect the quality and quantity of the oats being grown. One of these trial sites was grown in Melita by WADO. This was year four of this partnership.

## Methods

Twenty-one varieties were arranged in a randomized complete block design and replicated three times. The trial area was treated with 1 l/ac Roundup for pre-emergent weed control prior to seeding. Plots were direct seeded into Summer Fallow at a depth of ½" on May 1<sup>st</sup> using a SeedHawk dual knife opener. Fertilizer was sideband at a rate of 129 kg/ha actual nitrogen using 28-0-0 UAN including a granular blend of 12-17-15-10 applied at a rate of 177 lbs/ac. Plots were kept weed free by spraying in crop with Stampede EDF herbicide, tank mixed with MCPA Ester 500 at a rate of 1.25 lbs/ac and 0.5 L/ac, respectively. Herbicides were tank mixed and applied June 1<sup>st</sup> with a water volume of 20 gal/ac. Plots were not sprayed with fungicide.

### Spring Soil Test:

Legal Land Location	Depth	pH	N ppm	P ppm Olsen	K ppm	S lbs/ac	Organic Matter %
SW 26-3-27 W1	0-6"	7.7	10	8	405	120	3.2
	6-24"		60			362	

Plots did not require desiccation prior to harvest on August 11<sup>th</sup>. Plots were harvested with a Wintersteiger Classic plot combine. Data collected throughout the season included heading date, days to maturity, crop height, lodging, test weight, sample moisture, seed weight and grain yield. Plot samples were combined by variety and sent to PepsiCo for milling and beta-glucan content analysis (results confidential).

Data was analyzed with a two-way analysis of variance (ANOVA) using Agrobase Gen. II statistical software (Microsoft). Coefficient of variation (CV), least significant difference (unprotected), grand mean, and R-squared were calculated.

## Results

There were significant differences among all characteristics measured (Table 1).

**Table 1:** Test weight, maturity, heading, lodging, height, disease, and grain yield of various oat varieties grown in Melita in 2015.

Variety No.	Days to Heading	Height cm	Lodge 1-9; 9=flat	Days to Maturity days	Crown Rust Severity 1-9; 9= 100% covered	Bushel Weight lbs/Avery Bu	Grain Yield bu/ac
1	60.7	106.5	2.0	88.0	1.7	37.8	125.7
2	61.0	114.5	6.7	92.7	2.0	37.8	146.6
3	62.0	119.5	5.7	89.7	3.7	38.9	154.1
4	63.0	116.0	4.0	89.0	4.7	37.2	133.2
5	63.3	114.5	5.0	94.7	6.0	35.6	143.3
6	62.0	108.5	6.0	90.3	3.0	32.2	161.7
7	65.0	107.0	4.3	90.3	2.7	36.3	141.9
8	60.3	110.5	3.7	89.3	1.3	34.0	168.8
9	63.7	113.0	3.3	92.0	2.0	40.1	137.9
10	60.7	116.5	7.7	90.0	3.3	36.2	150.7
11	62.3	111.5	4.0	93.0	4.0	36.2	154.6
12	61.7	111.5	3.7	88.7	4.7	39.1	126.7
13	62.3	114.0	4.0	88.7	2.3	36.5	144.7
14	63.0	113.0	6.0	89.0	0.7	37.9	127.5
15	59.3	122.0	7.0	90.0	2.7	37.3	154.6
16	62.7	117.5	2.3	92.0	3.3	38.1	135.8
17	61.3	115.5	4.3	93.0	3.0	37.6	147.8
18	64.7	114.0	4.0	93.7	2.7	35.0	141.7
19	61.3	106.0	3.7	89.3	4.7	37.4	154.0
20	61.3	121.0	1.3	93.0	1.3	40.7	147.4
21	60.7	110.5	5.0	90.0	6.0	36.2	169.9
CV%	1.1	3.5	42.1	2.0	55.3	3.3	10.4
LSD (p<0.05)	1.1	8.3	3.1	3.1	2.9	2.0	25.1
P value	<b>&lt;0.0001</b>	<b>0.0219</b>	<b>0.0144</b>	<b>0.0006</b>	<b>0.0186</b>	<b>&lt;0.0001</b>	<b>0.0277</b>
R-squared	0.89	0.72	0.66	0.78	0.59	0.84	0.57
Grand Mean	62.0	113.5	4.5	90.8	3.1	37.1	146.1

## Discussion

Testing varieties of oats over many locations over several years can be beneficial not only for the producer but for the processors. Processors could choose varieties that are outstanding in a certain region and also choose varieties with exceptional quality parameters such as high beta-glucan. PepsiCo-Quaker plans to use the composite samples to assess milling quality and beta-glucan content. The processor would then be in a position to advise producers what varieties would be valuable to grow and market in their region.

## AAFC Malt and Forage Barley

**Cooperators:** Agriculture and Agri-Food Canada – Dr. Ana Badea, Brandon MB

**Research Site:** Melita, MB

**Location:** 26-3-27 W1

**Land Cooperator:** John Snyder

**Previous Crop:** Summer Fallow

**Soil Texture:** Newstead Loamy Fine Sand

**Soil Test:**

Depth	pH	N	P	K	S	Organic Matter
		lbs	ppm Olsen	ppm	lbs	%
0-6"	7.4	13	9	340	32	2.7
6-24"		42			150	

## Forage Barley

### *Objective*

To evaluate and compare varieties of forage barley for yield.

### *Methods*

Sixteen varieties were seeded into plots arranged in a randomized complete block design and replicated three times. A pre-seeding burnoff was applied at a rate of 1 l/ac Roundup and 10 ml/ac Aim on May 4<sup>th</sup>. Plots were seeded on May 5<sup>th</sup> with a Seedhawk Dual Knife Opener at a depth of ½". Fertilizer was sideband the day of seeding at 115N 35P 30K and 20S. The plots received an application of Tundra at 0.8 L/ac on June 1<sup>st</sup>. At the time of this herbicide application, plots were at the 5 leaf stage. Plots were harvested for seed yield on August 11<sup>th</sup> with a Hege plot combine. Data collected included: days to heading (DTH), days to maturity (DTM), plant height, leaf disease, lodging, grain yield, seed moisture content and seed weight.

Data was analyzed with a two-way analysis of variance (ANOVA) using Analyze-it 2.03 statistical software (Microsoft). Coefficient of variation (CV), least significant difference (Fisher's unprotected), grand mean, and R-squared were calculated.

### *Results*

There were significant differences in days to heading, and height. There were no differences in days to maturity, leaf disease, lodging and grain yield (Table 1).

**Table 1:** Days to head, days to maturity, lodging, height, and leaf disease rating of forage barley varieties grown in Melita in 2015.

Variety	Days To Heading Days	Days To Maturity Days	Height cm	Leaf Disease (1-9) 9 = 100%	Lodge 1-9; 9=flat	Yield kg/ha
EX828-30	55.3	88.7	109.3	4.3	7.7	6808.5
EX828-49	55.7	86.7	112.0	5.3	7.0	6807.7
EX827-32	55.0	87.7	123.7	4.7	8.3	6672.8
EX828-29	53.0	87.7	102.3	5.7	3.7	6641.3
Vivar	54.3	88.0	104.0	4.7	7.0	6506.1
EX828-31	56.0	86.7	112.7	5.0	6.7	6473.4
EX826-39	52.0	87.0	119.0	5.7	6.7	6389.9
EX827-30	54.0	86.7	111.7	4.7	7.0	6351.0
AC Ranger	54.7	87.0	104.0	4.7	4.3	6321.0
EX827-28	53.0	88.3	115.7	5.3	6.7	6287.4
EX828-46	55.3	88.7	111.7	5.3	5.0	6244.5
EX828-37	52.0	87.0	117.3	4.7	6.7	6171.0
EX827-21	53.7	85.3	121.7	5.7	4.7	6086.6
EX828-20	56.0	88.3	102.7	5.0	5.3	6085.0
EX827-18	52.0	86.3	115.0	5.3	3.0	5824.7
EX828-32	52.0	87.7	116.7	4.7	6.7	5721.9
CV%	1.7	1.6	4.3	15.5	40.5	7.4
LSD (p<0.05)	1.6	2.3	8.1	1.3	4.1	784.9
P value	<b>&lt;0.0001</b>	0.231	<b>&lt;0.0001</b>	0.536	0.367	0.230
R squared	0.799	0.614	0.747	0.345	0.391	0.448
Grand Mean	54.0	87.4	112.5	5.0	6.0	6337.0



Photo: Melita AAFC Forage Barley Trial 2015



## Malt Barley

### Objective

To evaluate and compare varieties of malt barley for yield.

### Methods

Sixteen varieties were seeded into plots arranged in a randomized complete block design and replicated three times. A pre-seeding burnoff was applied at a rate of 1 l/ac Roundup and 10 ml/ac Aim on May 4<sup>th</sup>. Plots were seeded on May 5<sup>th</sup> with a Seedhawk Dual Knife Opener at a depth of ½". Fertilizer was sideband the day of seeding at 115N 35P 30K and 20S. The plots received an application of Tundra at 0.8 l/ac on June 1<sup>st</sup>. At the time of this herbicide application, plots were at the 5 leaf stage. Plots were harvested for seed yield on August 10<sup>th</sup> with a Hege plot combine. Data collected included: days to heading (DTH), days to maturity (DTM), plant height, leaf disease, lodging, grain yield, seed moisture content and seed weight.

Data was analyzed with a two-way analysis of variance (ANOVA) using Analyze-it 2.03 statistical software (Microsoft). Coefficient of variation (CV), least significant difference (Fisher's unprotected), grand mean, and R-squared were calculated.

### Results

There were significant differences in days to head, crop height, leaf disease and test weight. There were no significant differences in days to maturity, lodging and grain yield.

**Table 1:** Days to head, days to maturity, lodging, height, and leaf disease rating of malt barley varieties grown in Melita in 2015.

Variety	Days To Heading Days	Days To Maturity Days	Height cm	Leaf Disease (1-9) 9 = 100% disease	Lodge 1-9; 9=flat	Test Weight g/0.5L	Yield kg/ha
AC Ranger	54.7	87.7	106.7	4.7	5	285.1	7095
SM131581	51.3	87.0	97.7	4.7	7	295.1	6756
Vivar	53.3	87.3	98.7	4.7	8	282.2	6631
SM131604	51.3	86.7	97.7	5.7	6	304.5	6615
CDC Mayfair	51.3	87.0	102.7	6.7	5	292.1	6611
A513-20	51.7	87.0	104.7	5.3	7	292.9	6575
SM131576	51.7	86.7	94.0	5.3	5	287.8	6571
SM131569	52.0	87.7	96.0	4.3	6	295.1	6562
Tradition	50.7	87.0	100.7	6.0	8	304.3	6423
A515-8	50.0	86.3	102.0	6.3	6	295.5	6261
Celebration	52.0	86.7	98.0	4.7	7	303.2	6255
SM131591	52.0	87.0	98.3	5.0	8	298.6	6244
A514-58	50.3	88.0	106.0	4.7	8	316.3	6221
SM131578	52.0	87.3	95.0	4.3	4	292.1	6151
A512-1	50.3	87.7	95.0	7.0	6	286.6	6142
SM131557	53.7	87.3	97.7	4.0	7	303.2	5712
CV%	0.9	1.0	3.6	12.1	26.6	1.5	8.5
LSD (p<0.05)	0.8	1.5	5.9	1.0	3	7.6	914
P value	<0.0001	0.672	0.001	<0.0001	0.178	<0.0001	0.465
R squared	0.92	0.51	0.77	0.75	0.46	0.87	0.41
Grand Mean	52	87	99	5	6	296	6427

# Western Feed Grains Development Cooperative Variety Trial

## Cooperators

- Westman Agricultural Diversification Organization – Melita
- Prairies East Sustainable Agriculture Initiative – Arborg, MB
- Parkland Crop Diversification Foundation – Roblin, MB
- Ag-Quest Inc. – Minto MB – Matthew Yau, Dana Rourke

## Introduction (Taken from the WFGDC website: <http://www.wfgd.ca>)

The Western Feed Grain Development Co-op Ltd. is a farmer directed breeding program established in December 2005; created by farmers, for farmers, to benefit farms, livestock production operations, ethanol facilities, and local communities across Western Canada. Since the initiation of the Co-op there have been many significant changes that have occurred within Canadian agriculture including changes to grain classes and requirements, grain marketing, changes in priorities for federal funding, etc. The WFGD Co-op has continued to operate the farmer directed spring wheat breeding program to meet the changing needs of Western Canadian grain producers, the livestock industry as well as the ethanol industry. This small, dedicated organization was formed by three founding Directors with a dream to develop “feed wheat” varieties that they could use on their own farms for livestock feed instead of relying on “feed wheat” by default due to negative impacts of disease and weather.

WFGD Co-op is a unique concept in that farmers can invest and participate in the development of varieties that they can use on their own farm. Grain produced from WFGD seed can be utilized to feed livestock on farm or market to a variety of different markets. The Coop is focused on developing general purpose class wheat that can be utilized in many markets providing many marketing options for farmers.

The Co-op is incorporated in Manitoba and is also registered in Saskatchewan and Alberta. The Co-op is governed by a Board of Directors consisting of six grain and livestock producers representing Manitoba, Saskatchewan, and Alberta.

## Research & Development

The Co-op is focusing on two areas, quality varieties and a dependable feed stock for end users. WFGDC is not only trying to develop varieties that are beneficial for farmers by having disease resistance and high yield to achieve higher returns on farm, the program is also focused on providing end users with a dependable feed stock. Very few breeding programs/companies are focused on primary producers as well as domestic feed end users but WFGDC believes that it is important to address the concerns of both parties and attempt to breed lines that meet their needs.

The size of this breeding program allows for the flexibility of realigning priorities as the needs of primary producers and end users change. WFGDC feels that this is another characteristic that provides an advantage over larger competing breeding programs as modifications to the breeding activities can be made in a timely manner to adapt to the needs of the industries. The

Co-op program is unlike other wheat breeding programs as it is not limited by class and quality. The Co-op is combining materials that “class-specific breeders” would not consider as parents and is conducting germplasm development in a traditional, cost effective manner. The advantage to the traditional approach taken by the Co-op is that funds are spent on large nurseries instead of spending dollars on expensive technologies such as double haploid thus creating a greater chance of finding unique individuals within the nurseries.

WFGD Co-op has recently assessed the breeding objectives of the program and has concluded that a breeding program focused on a short term objective of developing high yielding (40% higher than the best Hard Red Spring varieties), fusarium head blight resistant general purpose wheat varieties is still needed in Western Canada to compete with corn, as a lower risk, lower production cost alternative for feed in the Canadian Prairies. The long term objective of the Co-op is to increase yield to 10 MT/hectare by 2020. This objective will be achieved through breeding and the addition of agronomic optimization trials which will test agronomic interactions of advanced lines by various fertilizer rates, seeding rates, seeding dates, and fungicide applications.

Small adjustments to the program have been made, increasing the emphasis on yield, while still emphasizing disease resistance levels required by the PGDC for variety registration. The program’s emphasis shifts from stringent disease screening to screening for yield and disease equally, meeting the requirement for registration for disease with an optimum yield on new varieties. The WFGD Co-op is also screening lines in numerous trial locations throughout the Prairies to gain agronomic data to assist the Co-op in selecting wheat lines adapted to specific areas. This will allow WFGDC to identify varieties that are high yield in different environments, with different maturity levels, to provide varieties to more farmers. Starch content will also be screened for. Combining this approach could result in high starch wheat lines that can be grown in the areas around ethanol production facilities, as starch content is an important factor in ethanol production and would be attractive for contracting by ethanol production facilities.

The WFGD Co-op is developing general purpose spring wheat lines to directly benefit Western Canadian Grain Producers and the Canadian Grain and Feed Industries. The Co-op has made significant gains to yield and disease resistance in the past eight years and will continue to in the future.

What sets the Co-op apart from other breeding programs is that the WFGDC has been able to achieve their objectives in genetic advancement on a very modest budget by optimizing resources much like our farmer members. The Co-op’s breeding program may be a small program in size but their accomplishments to date can match some larger competing companies in that support from the PRCWRT was received on one general purpose wheat class variety in February 2013. WFT 603 Breeder seed was available for distribution to seed growers in 2014 and was accessible for commercial distribution in the spring of 2015. The WFGD Coop has two more advanced lines; WFT 736 and WFT 805 that are in the second year General Coop Testing trials and a request for support that were submitted to the PRCWRT in February 2015. Seed was distributed to growers in 2015 and commercial distribution will be in the spring of 2016.

The research and development for this project will be conducted by Ag-Quest Inc. ([www.agquest.com](http://www.agquest.com)). Ag-Quest Inc., a contract agricultural research company, will be hired to conduct all research for this wheat breeding project. Ag-Quest will be subcontracted to lower costs, eliminating the need for full-time R&D employees and purchasing specialized equipment

for this project. Ag-Quest has completed all research and development to date for WFGD Co-op, and their experience and expertise will prove to be beneficial throughout this project. Ag-Quest has four research stations across Canada; Minto and Elm Creek Manitoba, Saskatoon, Saskatchewan and Taber, Alberta. Research trials can be conducted at these four locations with additional sites locally at each station. Ag-Quest is contracted by the WFGDC Board of Directors. No long term contract exists between WFGD Co-op and Ag-Quest and it is at the Board's discretion how best to conduct the research in the most cost-effective manner.

A partnership has been underway for several years between the Co-op and the Manitoba Diversification Centres. Regional variety trials have offered insight into variety strengths and weaknesses over a variety of years, sites, climatic conditions, and soil types.

**Photo:** WFGDC plots in Melita 2015



### *Methods*

Plots were arranged in a randomized complete block design replicated three times. This report is concerned with the Melita sites specifically. The Melita site was planted at a depth of 0.5" in a Newstead Loamy Fine Sand that was Summer Fallowed in 2014. The soil contained sufficient moisture at the time of seeding.

**Table 1:** Seeding date, fertility regime, herbicide use and harvest for Melita.

Location	Seed Date	Fertilizer Applied (lbs/ac)	Herbicides	Harvest Date
Melita	29-Apr	84 lbs/ac from 28-0-0 UAN 35 lbs/ac from 11-52-0 MAP 30 lbs/ac from 0-0-60 20 lbs/ac from 21-0-0-24	Tundra, incrop @0.8 L/ac	12-Aug

Soil tests were taken prior to seeding (Table 2).

**Table 2:** Soil fertility levels prior to seeding the trial at Melita.

Parameter	pH	N	P	K	S	Organic Matter
Depth		ppm	ppm Olsen	ppm	lbs/ac	%
0-6"	7.4	13	9	340	32	2.7
6-24"		27			150	
0-24"		40			182	

Data collected included, plant stand, heading dates, lodging, plant height, leaf disease, test weight, maturity, grain yield and moisture. Data was analyzed with an analysis of variance using Agrobase Gen II statistical software at the 0.05 level of significance. Weather conditions for the growing season can be found in the introduction section of this report.

## Results

There were significant differences among variety days to head, crop height, leaf disease severity, test weight and final grain yield (Table 3).

**Table 3:** Mean disease incidence, days to maturity, height (HT), test weight, and yield of each variety in Melita. Variety yield was average and is listed from greatest to least yield.

Variety	Days To Head days	Height cm	Leaf Disease (scale 1-9) (9=100% Disease)	Test Weight g/0.5L	Yield kg/ha
WFT 921	59	93	7.3	381.6	5725
WFT 1111	60	82	5.7	391.2	5644
WFT 1101	62	95	5.0	388.5	5560
WFT 1018	58	88	5.7	399.8	5523
Pasteur	62	95	5.3	397.1	5449
WFT 1112	60	84	6.0	381.7	5403
WFT 1110	59	86	7.3	383.1	5376
WFT 603RS	60	95	5.7	393.4	5349
WFT 1014	58	88	6.7	393.5	5341
AC Andrew	61	85	6.3	383.9	5299
WFT 1001	59	90	6.7	376.5	5296
WFT 1109	59	88	6.3	376.6	5284
WFT 1015	61	81	6.7	390.9	5277
WFT 1006	58	75	6.7	394.9	5218
WFT 1107	58	83	7.0	387.7	5183
WFT 1108	60	91	6.7	394.5	5181
WFT 1019	60	88	6.3	381.5	5180
WFT 1106	58	90	7.0	386.9	5170
WFT 1113	58	78	6.3	395.7	5114
WFT 1012	60	85	7.0	388.6	5053
WFT 1104	61	93	5.0	389.1	5046
WFT 603	58	97	7.3	393.7	5041
WFT 1115	61	86	6.3	382.7	5013
WFT 1114	60	83	8.0	381.2	5003
WFT 1105	59	95	7.0	383.8	4881
Sadash	61	92	7.0	390.8	4865
WFT 1103	62	90	7.0	383.3	4750
5702 PR	58	90	7.7	370.9	4638
WFT 1102	58	93	7.7	367.1	4248
WFT 914	61	118	10.0	379.8	3738
CV%	1.0	5.5	10.4	1.5	7.8
LSD (p<0.05)	1.0	8.1	1.1	9.3	656
P Value	<0.0001	<0.0001	<0.0001	<0.0001	0.0002
R-squared	0.88	0.79	0.76	0.74	0.72
Grand Mean	60	89	7	386	5128

## *Comments*

Producers interested in participating in the coop are encouraged to contact the cooperative headquarters directly at:

Ag Quest  
c/o: Haylee Hargreaves  
Box 144 Minto, Manitoba R0K 1M0

Phone: 204-776-5558  
Toll Free: 1-877-250-1552  
Fax: 204-776-2250  
Email: [info@wfgd.ca](mailto:info@wfgd.ca)  
Website: <http://www.wfgd.ca>

## **Phosphorus Fertilization Beneficial Management Practices for Soybeans in Manitoba**

**Duration of Project:** 2013-2015

### Project Leaders:

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## *Introduction*

Soybean acreage in Manitoba has increased dramatically during the last decade, bringing along many questions about nutrient management, including phosphorus, in soybean cropping systems. In response to these questions, a collaborative study was conducted over 28 site years, from 2013 to 2015, to assess soybean yield response to P fertilizer and the risk of reduced plant stand and seed yield due to seed placed fertilizer.

## *Project Overview and Objectives*

This experiment will refine the 4Rs nutrient management concept (right source, right rate, right place and right time) to help Manitoba soybean producers optimize phosphorus fertilization, using field plot research trials located throughout rural southern Manitoba. The objectives of this trial are:

1. Determine soybean yield response to added P
2. Assess seed safety and risk of stand reduction
3. Assess methods to provide soybean P fertility maintenance

## *Materials and Methods*

Two versions of the project are offered to participants; a BASIC plan with a core set of treatments and agronomic measurements; and an INTENSIVE plan with more treatments and more detailed observations (locations for each version listed below the treatment list).

The following parameters were consistent across all locations:

- Fields in this study were selected carefully to ensure the following:
  - Soil tests should indicate low levels of nitrogen < 50 lb soil nitrate-N/ac
  - Plots selected for this trial should have good drainage and not prone to flooding.
- Granular inoculant will be used at a rate of 20 lbs/acre
- Plant population targeted 210,000 plants/acre
- Seed source will be Monsanto-Dekalb 24-10RY treated with Acceleron and liquid inoculant seed treatment.
- Seed planted in moisture  $\frac{3}{4}$  inch to 1  $\frac{1}{4}$  deep, depending on soil conditions.
- Weed control in crop: glyphosate sprayed at early stage first trifoliate; 2nd application at 3rd trifoliate as deemed necessary by the contractor to keep the plots clean.
- Production practices are to be consistent with other ongoing soybean production studies underway by the participant. Tillage, row width and seeding equipment are determined by the participant. Ideally sites will have L-M soil P levels and should have < 50 lb soil nitrate-N/ac. Target planting date is mid-May to June 1.

Treatments included different P fertilizer rates (20, 40 and 80 lb  $P_2O_5$ /ac) applied in side band, seed-placed or broadcast, plus a control which did not receive P fertilizer. Sites varied in soil texture and seeding equipment, which are important factors that can affect the risk of fertilizer toxicity. Also, 50% of the sites had soil P test in the very low – low range of sufficiency (0 -10 ppm Olsen P), in which many crops would have high probability of response to P fertilizer (Table 1).

**Table 1: Site characterization according to soil test P, soil texture and equipment features across all sites tested from 2013 to 2015.**

Site	Olsen P (ppm)			Soil Texture	Row Spacing	Seeder Opener
---	2013	2014	2015	----	Inches	Type
Roseisle	N/A	4 (VL)	4 (VL)	Sandy Loam	8	Knife
Melita	3 (VL)	5 (L)	7 (L)	Sandy Loam	9.5	Knife
Brandon	5 (L)	6 (L)	5 (L)	Clay Loam	8	Knife
Carman	N/A	15 (H)	7 (L)	Sandy Clay Loam	8	Knife
Roblin	7 (L)	22 (VH)	8 (L)	Clay Loam	9	Knife
Beausejour	8 (L)	13 (M)	7 (L)	Heavy Clay	9	Disc
Arborg	14 (M)	22 (VH)	14 (M)	Silty Clay	9	Disc
St Adolphe	23 (VH)	25 (VH)	71 (VH)	Heavy Clay	7.3	Knife
Portage	34 (VH)	18 (H)	10 (L)	Clay Loam	12	Disc
Carberry	44 (VH)	11 (M)	15 (H)	Clay Loam	12	Disc

**Treatments:**

1. No P check
2. 20 lb P<sub>2</sub>O<sub>5</sub>/ac – seed placed
3. 20 lb P<sub>2</sub>O<sub>5</sub>/ac – broadcast
4. 40 lb P<sub>2</sub>O<sub>5</sub>/ac – seed placed
5. 40 lb P<sub>2</sub>O<sub>5</sub>/ac – broadcast
6. 80 lb P<sub>2</sub>O<sub>5</sub>/ac – seed placed
7. 80 lb P<sub>2</sub>O<sub>5</sub>/ac – broadcast
8. 20 lb P<sub>2</sub>O<sub>5</sub>/ac – banded – sideband (*intensive sites only*)
9. 40 lb P<sub>2</sub>O<sub>5</sub>/ac – banded – sideband (*intensive sites only*)
10. 80 lb P<sub>2</sub>O<sub>5</sub>/ac – banded – sideband (*intensive sites only*)

Core or BASIC treatments are 1-7 including a check, 3 application rates and 2 application methods.

The *INTENSIVE* plan treatments are 1-10 and include *side or midrow band application*. Plot treatments will be replicated 4 times in a randomized complete block design.

**Intensive Study Sites (locations & managers):**

University of Manitoba - Carman (Gustavo Bardella, Don Flaten, Alvin Iverson)  
 Roseisle - low P site (Gustavo Bardella, Don Flaten and John Heard)  
 AAFC - Brandon (Cindy Grant, Mike Svistovski and Ramona Mohr)  
 CMCDC - Carberry (Craig Linde)  
 MAFRD-AFIA Arbrog & Beausejour (Roger Burak and Jordan Pawluk)  
 Westman Agricultural Diversification Org. - Melita (Scott Chalmers)  
 Parkland Crop Diversification Foundation - Roblin (Jeff Kostuik)

**Sites for Basic Treatments and Agronomic Evaluation:**

AAFC - Portage (Curtis Cavers)  
 Richardson Pioneer Kelburn Farm (Brian Hellegards)



### Phosphorous Application Parameters

1. Broadcast is to be done prior to seeding with incorporation either by pre-seeding tillage and/or the seeding operation. If pre-seeding tillage is used, all treatments will receive the tillage treatment because the tillage may affect soil moisture, seedbed quality and other factors.
2. Banded treatments are based on the available equipment of the participant: either side-banded or mid-row banded. Pre-plant banding is avoided in order to preserve uniform seedbed conditions.
3. Fertilizer P will be applied as monoammonium phosphate (11-52-0) and the nitrogen contribution will not be balanced in other plots.

Results in this report are a summary of the 2015 Melita location. Please contact one of the project leaders listed previously for more results from previous locations and years.

### Melita Location Parameters

**Location:** SW 26-3-27 W1 **Soil Type:** Newstead Clay Loam

**Previous Crops:** 2013 Winter Wheat, 2014 Flax

**Soil Test:**

Legal	Depth	pH	N lbs/ac	P ppm Olsen	K ppm	S lbs/ac	Organic Matter %
SW 26-3-27 W1	0-6"	7.7	29	6.5	381	20	3.5
	6-24"		39			72	

Pre-emerg: Roundup Transorb at 1 L/ac and Aim at 10 ml/ac applied May 11 before seeding

Seed Date: May 11, 2015, rolled for rocks the next day

Seeding Depth:  $\frac{3}{4}$ "

Seeding Equipment: Seedhawk Dual Knife Air Seeder, 9.5" row spacing

In crop Herbicide Application: 0.33 L/ac Roundup Transorb applied June 3

Biomass sample date (R3 stage): July 22 (2 samples x 1 m of seed row)

Harvest Date: September 30, 2015

### *Results and Discussion Melita 2015*

At the Melita site, there were no significant differences at the 0.05 level of significance for plant stand, biomass and seed yield (Table 1).

Table 1: Effects of phosphorous (MAP) fertilizer applied as various method of placement including seed placed, side band and surface broadcast at various rates of application on soybean stand, midseason biomass and seed yield in Melita, during the growing season of 2015.

Placement	Rate	Plant Stand	Mid-season Biomass	Seed Yield
	lb.ac <sup>-1</sup>	1000.ac <sup>-1</sup>	lb.ac <sup>-1</sup>	bu.ac <sup>-1</sup>
-	0	131	3402	47
Seed Placed	20	153	3917	52
	40	166	3254	49
	80	131	3614	50
Side Band	20	141	3734	50
	40	157	3143	48
	80	129	3020	52
Broadcast	20	132	4238	49
	40	157	4159	50
	80	129	3240	49
Mean		143	3572	50
ANOVA			p > F	
Rate		0.0603	0.0827	0.305
Placement		0.513	0.159	0.229
Rate*Placement		0.908	0.519	0.0635
CV%		17.34	21.08	5.43

### Overall Sites

Four weeks after planting, plant stands were reduced by seed placed P at 6 of 28 site-years, but usually only at a rate of 80 lb P<sub>2</sub>O<sub>5</sub>/ac (Table 2). Seed placed P at rates of 20 and 40 lb P<sub>2</sub>O<sub>5</sub>/ac reduced emergence at 1 and 2 site years, respectively. At maturity, seed yield was decreased in only 2 site years. In both cases, fertilizer had been applied at 80 lb P<sub>2</sub>O<sub>5</sub>/ac seed placed and the plant stand was reduced below 100 thousand plants per acre (replant threshold). Seed yield was not increased by the fertilizer applied at any site in any year, regardless of rate, placement or soil test P (Table 3).

**Table 3: Frequency and intensity of plant stand reduction caused by fertilizer toxicity across all sites from 2013 to 2015.**

	2013	2014	2015
# Sites	8	10	10
Plant Stand for Control ('000 plants/ac)	83 - 261	116 - 258	70 - 302
# Sites with Plant Stand Reduction @ 20 lb SP	0	1 <sup>a</sup>	0
# Sites with Plant Stand Reduction @ 40 lb SP	0	2 <sup>a,d</sup>	1 <sup>b</sup>
# Sites with Plant Stand Reduction @ 80 lb SP	2 <sup>c</sup>	2 <sup>a,d</sup>	1 <sup>c</sup>

<sup>a</sup> At Portage in 2014, seed row placement of P fertilizer reduced seedling emergence for all rates of P, compared to the control, at 5% level of probability.

<sup>b</sup> At Roseisle in 2015, seed row placement of P fertilizer reduced seedling emergence at a rate of 40 lb P<sub>2</sub>O<sub>5</sub> per acre, but not at 80 lb per acre. Therefore, this reduced emergence may have been random error.

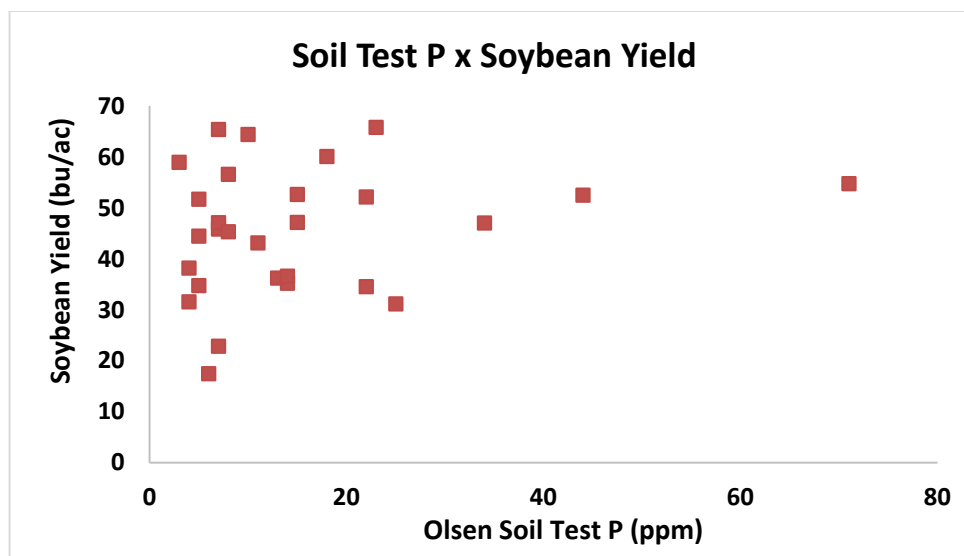
<sup>c</sup> At Melita and Carberry in 2013, and Roblin in 2015 seedling emergence was reduced only by seed row P fertilizer applied at a rate of 80 lb P<sub>2</sub>O<sub>5</sub> per acre.

<sup>d</sup> At Carberry in 2014, seedling emergence was reduced by seed placed fertilizer at 40 and 80 lb P<sub>2</sub>O<sub>5</sub> per acre.

**Table4: Soybean seed yield response to P fertilizer across all locations from 2013 to 2015.**

	2013	2014	2015
# Sites	8	10	10
Mean Seed Yield (bu/ac)	46	42	51
Seed Yield for Control (bu/ac)	23 - 66	18 - 60	37 - 65
# Sites with Yield <u>Increase</u>	0	0	0
# Sites with Yield <u>Decrease</u>	2*	0	0
% Yield Decrease*	29 - 36	0	0

\* At Melita and Carberry in 2013, only the 80 lb P<sub>2</sub>O<sub>5</sub>/ac seed-placed treatment reduced seed yields compared to the control, at 5% level of probability.



**Figure 1: Poor relationship between soybean seed yield from control plots (no P fertilizer applied) and soil test P.**

Despite the nil response of soybean to phosphorous applications, producers should still apply phosphorus to soils to maintain nutrient levels for future rotations. A soybean harvest can significantly reduce soil phosphorous levels by removing 0.85 lb P<sub>2</sub>O<sub>5</sub>/bushel, therefore a 35 bushel per acre yield will remove approximately 30 lbs/ac phosphorous from the soil.

Complementary to the study on P rates and placements, another project looking at the soybean yield response to soil P instead of P fertilizer was conducted over seven site-years. Results reinforced the findings of the previous study, with no yield increase to higher soil test P or starter fertilizer spring applied as side band.

Considering the findings of this study, the recommendation for the maximum safe rate of P<sub>2</sub>O<sub>5</sub> applied in seed row according to the Manitoba Soil Fertility Guide (10 lb P<sub>2</sub>O<sub>5</sub> /ac) probably underestimates the soybean's tolerance to seed placed fertilizer in most situations. However, it is difficult to define a new value for the maximum safe rate since there are many factors that can increase the risk of fertilizer toxicity and should be considered when determining the rate of P applied in the seed row, such as:

- Soil moisture (drier soils can increase the risk)
- Soil texture (medium to coarse soils have lower water holding capacity)
- Seeder opener type (disc openers spread fertilizer and seed less than knife or shovel openers, increasing the fertilizer concentration close to the seeds)
- Row spacing (wide spacings between seed row increase the fertilizer concentration in each seed row)
- Fertilizer rate (higher rates are more risky)

Over the long term, P fertilizer or manure must be applied to replace what is being removed by the crop based on historic yields. If applying the fertilizer in the soybean year of the rotation, the

best placement would be side banding since it minimizes the risk of fertilizer toxicity and applies the fertilizer concentrated close to the root zone and below the soil surface, preventing losses through soil erosion and run off.

Since there were no positive responses to P fertilizer in this study, another option for maintaining P fertility would be to apply larger than usual rates of P to other crops in the crop rotation, in a strategy called rotational fertilization. For instance, when banding fertilizer for cereals, apply extra fertilizer to account for the P removed by soybeans in other years. This strategy also enables non-legume crops to make the most use of the N that comes with most P fertilizers.

Another option is to fall band P fertilizer prior to a cereal crop or canola in the rotation, by attaching an air cart or fertilizer tank to a cultivator, and applying fertilizer during the fall or spring tillage operation. Banding the P under the soil surface is the best placement for maximizing crop uptake and reducing the risk of runoff losses.

We strongly recommend the use of the P balance worksheet posted on the MPSG website in order to check the P balance in your specific crop rotation (link below). This will indicate whether there is a surplus or a deficit of P in your rotation. That worksheet, along with a more detailed factsheet on P fertilization strategies for Manitoba cropping systems can be found at <http://www.manitobapulse.ca/production-resources/phosphorus-fertilization-strategies/>.

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## Soybean Inoculant Strategies

Cooperators:

- Manitoba Pulse and Soybean Growers Association – Kristen Podolsky  
[www.manitobapulse.ca/](http://www.manitobapulse.ca/)
- University of Manitoba – Dr. Yvonne Lawley

### *Introduction*

Choosing an inoculant for your soybeans can be overwhelming, considering the product, formulation, rate and combination options. In complement to the On-Farm Network Inoculant Trial (MPSG website), MPSG also invested in small-plot research trials to evaluate many inoculant strategies simultaneously in Manitoba.

The complete list of inoculant strategies tested, listed in Table 1, were selected to address four specific objectives: is there any additional yield benefit to 1) using in-furrow granular (instead of seed-applied liquid inoculant) 2) double inoculating (seed-applied liquid + granular in-furrow), 3) increasing the rate of inoculant (from 1X to 2X) or 4) using “enhanced” inoculant products?

#### What are ‘enhanced’ inoculants?

All inoculant products used in this trial contain *Bradyrhizobium japonicum* - the soybean-specific bacteria which causes nodule development on roots and biologically fixes nitrogen (N) within the nodules. In this trial, treatments termed ‘enhanced’ are those formulated with additional molecules or living organisms which claim to improve nodulation, early crop development or plant nutrition.

Both the Jumpstart (+ liquid Cell Tech) and the granular TagTeam treatments contained a phosphate-solubilizing rhizospheric fungus, *Penicillium bilaii* in addition to the *B. japonicum* bacteria. *P. bilaii* lives in the rhizosphere (soil immediately surrounding the root) and may increase soil phosphorus (P) solubility and hence, plant uptake, by secreting organic acids that acidify the soil or chelate P molecules, protecting P from precipitation or adsorption to soil. Nodulator N/T is formulated with *Bacillus subtilis*: a plant growth promoting rhizobacteria which may increase soybean growth and nodule formation resulting from co-inoculation with *B. japonicum*.

Optimize is formulated with the lipo-chitooligosaccharide (LCO) molecule. Nodulation requires both the plant root and *B. japonicum* bacteria to send and receive signals for the process to initiate. The bacteria migrate towards roots, attracted by root exudate (root to bacteria signals); these exudates cause the bacteria to produce proteins called Nod factors (LCOs). The LCO molecules (bacteria to plant signals) in Optimize may hasten the process of nodule development.

#### *Preliminary Trial Results*

Field sites selected for this trial at Melita (2014 and 2015), Roblin (2015), Carberry (2015), had no history of soybeans, while the field site at Carman (2015) last had soybeans planted in 2007. Inoculant treatments were applied to NSC Reston seed (without seed treatment) and seeded at 210,000 seeds/ac on narrow row spacing (7.5-12 inches) into cereal or flax stubble. Liquid inoculants were seed-applied and granular inoculants were applied in-furrow.

Due to the limited history of soybeans in rotation at selected field sites, we expected to see a yield response to inoculants at all site years; therefore, data from all five site years was combined for statistical analysis. Unsurprisingly, inoculant treatments increased soybean yield by 10.5 bu/ac, on average, compared to the non-inoculated soybeans (Table 2).

There was, however, no statistical difference in seed yield between individual inoculant strategies (Table 2). For example, there was no difference in seed yield between in-furrow granular inoculant compared to seed-applied liquid inoculant, nor was there a difference between single versus double inoculation treatments (Table 2). Similarly, there was no yield difference between 1X and 2X rates of liquid or granular inoculant (Table 2). In addition,

‘enhanced’ inoculant treatments did not result in higher yields compared to the standard *B. rhizobium* inoculant of equivalent formulation (Table 2).

Although there was no benefit to double inoculation in this trial (in-furrow granular inoculant in addition to a seed-applied liquid inoculant), MPSG still recommends double inoculating soybeans when grown on fields with two or less soybean crops grown previously. There are several possible explanations for the lack of response to double inoculation in this trial which cannot always be guaranteed under field conditions:

- 1) **Soybeans were seeded into ideal soil conditions.** These trials were all seeded in late May/early June, when soil conditions were relatively favourable for crop emergence and inoculum survival. Unfavourable soil conditions, i.e. cooler and wetter soil, often encountered with earlier seeding dates may reduce the viability of your inoculant; therefore, using a granular inoculant in addition to the seed applied inoculant may ensure adequate rhizobium populations are present.
- 2) **Inoculants were properly stored, handled and applied.** Inoculants should always been kept in a cool, dry environment, should not be frozen, used before the expiration date and opened only just before using. Ideally, seed treated with liquid inoculant should be planted within the same day as inoculant application (although planting windows for seed-applied inoculants vary - read individual product labels).
- 3) **No compatibility issue with seed treatment.** Fungicide and/or insecticide seed treatments may affect the effectiveness of seed-applied liquid inoculant (check product compatibility for various product combinations); however, in this experiment seed treatment was not applied in an effort to standardized inoculant application and avoid potential differences in treatment compatibility.

#### *How many nodules should a soybean have?*

Regardless of your chosen inoculant strategy, you should assess the success of your inoculant on every field every year to not only evaluate inoculant effectiveness but also ensure your crop will have adequate N during critical growth stages to maximize yield. Count the number of nodules per plant on at least 10 plants from representative areas in the field when soybeans are at the R-1 to R-4 stage. At R-4 to R-5, N fixation and N requirements for soybean have reached a maximum. Results from all sites in this inoculant trial showed that at least five nodules per plant were required to reach the average yield at each site (average yield ranged from 35 to 49 bu/ac) (Figure 1).

This trial will be repeated in 2016. MPSG thanks collaborators from WADO (Melita), CMCDC (Carberry), PCDF (Roblin) and the U of M (Carman).

**Table 1:** Soybean yield (bu/ac) of each inoculant treatment, averaged across all five site years.

Treatment	Yield (bu/ac)
Untreated	31.7
Liquid Cell Tech	43.2
2X Liquid Cell Tech	45.4
Liquid + Granular Cell Tech	41.3
Granular Cell Tech	42.7
2X Granular Cell Tech	42.1
Liquid Cell Tech + Jumpstart	35.9
Liquid Optimize	43.1
Granular TagTeam	39.9
Granular Nodulator	42.2
2X Granular Nodulator	43.6
Liquid Nodulator N/T	42.4
2X Liquid Nodulator N/T	41.3
Liquid + Granular Nodulator	43.7
F value	2.46
P>F	0.0124
Mean	41.6
CV %	20.6

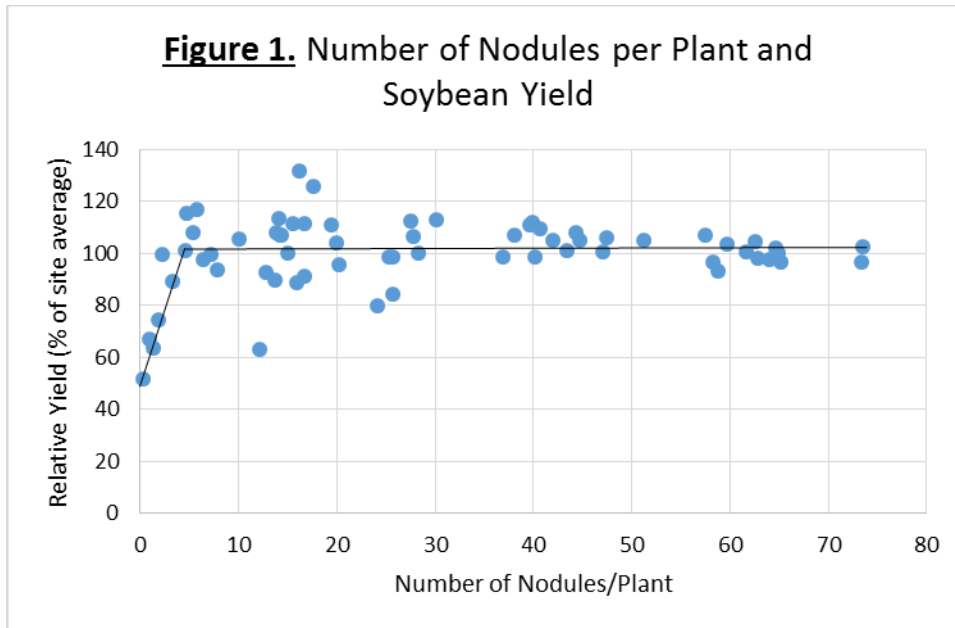
**Table 2:** Difference in soybean yield (bu/ac) between select inoculant strategies, averaged across all five site years.

Treatment Contrasts			
Treatment 1	Treatment 2	Difference between Treatment 1 - Treatment 2	
All Inoculant Treatments	Untreated	10.5	*
Liquid Cell Tech	2X Liquid Cell Tech	-2.2	NS
Liquid Cell Tech	Granular Cell Tech	0.5	NS
Liquid Cell Tech	Liquid + Granular Cell Tech	1.9	NS
Granular Cell Tech	2X Granular Cell Tech	0.5	NS
2X Granular Cell Tech	Liquid + Granular Cell Tech	0.8	NS
Liquid Cell Tech	Liquid Optimize	0.1	NS
Liquid Cell Tech	Liquid Cell Tech + Jumpstart	5.2	NS
Granular Cell Tech	Granular TagTeam	2.8	NS
Liquid Cell Tech	Liquid Nodulator N/T	0.8	NS
Liquid Nodulator N/T	2X Liquid Nodulator N/T	1.2	NS
Liquid Nodulator N/T	Liquid + Granular Nodulator	-1.3	NS
Granular Nodulator	2X Granular Nodulator	-1.3	NS

\* Difference between treatment means is statistically significant at  $P < 0.0001$

NS Difference between treatment means is not statistically significant





## Secan Soybean Variety Trial

### Cooperators

- Secan Seeds – Brad Pinkerton

### Objective

To grow and compare varieties of soybeans in prospect for distribution by Secan Seeds against industry standard varieties.

### Introduction

The success of soybean varieties during their northwesterly expansion on the prairies is depended on early maturity, and most importantly, yield potential. This trial focused on maturity and yield potential in comparison to other varieties currently on the market suited for the region. Secan brought several varieties to the trial that were not available in the traditional MCVET trials.

### Methods

Soil tests were taken prior to seeding the plots to determine background nutrient profiles. On May 15th trials were solid seeded at a depth of  $\frac{3}{4}$ " into Newstead loamy fine sand which had been Summer Fallowed in 2014.

## Soil Test Melita SW 26-3-27 W1

Depth	pH	N	P	K	S	Organic Matter
		ppm	Olsen ppm	ppm	#/ac	%
0-6"	7.7	10	8	405	120	3.2
6-24"		60			360	

Seven glyphosate tolerant soybean varieties were seeded into plots arranged in a randomized complete block design and replicated three times. A pre-seeding burnoff was applied at a rate of 1 l/ac Roundup and 10 ml/ac Aim. Final plot dimension was 1.44 m wide by 9 m long. Seed was inoculated with TagTeam granular soybean inoculant. A granular fertilizer blend of 24-35-30-20 (lbs/ac actual) was sideband the day of seeding. Soybean plots were rolled with a land roller just after seeding. The plots received an application of Roundup Transorb @.33 L/ac at 10 gal/ac water, on June 15<sup>th</sup>. Plots were harvested for seed yield on September 30<sup>th</sup>. Data collected included days to maturity, plant height, pod height, seed yield, seed moisture content and seed weight. Data was analyzed with a two-way analysis of variance (ANOVA) Microsoft Analyze-it v2.03 statistical software with using a Fishers unprotected LSD.

## Results

There were significant differences in days to maturity, and seed weight in Melita at the 0.05 level of significance (Table 1). There were significant differences in grain yield at the 0.1 level of significance. There were no differences in green seed as most varieties were able to mature before the first hard fall frost on October 4<sup>th</sup>.

**Table 1:** Varieties of soybean days to maturity (DTM), final yield, plant height, pod height, and seed weight, in Melita, MB.

Variety	Plant Height (cm)	Days to Maturity (95% BP)	Mean Pod Height (cm)	Grain Yield @ 10% moisture (kg/ha)	Seed Wt g/100 seed
Hero	88	118.3	7.0	3329	16
Mahony	79	117.0	7.3	3159	16
Gray	82	119.7	6.7	3130	16
23-60RY	92	113.7	7.7	3114	15
Chadburn	79	119.3	9.4	3074	17
Mcleod	84	118.0	8.0	2992	17
Bishop	90	117.3	5.7	2607	15
CV%	6.6	0.9	15.7	6.0	4.6
LSD (p<0.05)	NS	2.0	NS	325	1.3
LSD (P<0.10)	8	-	1.46	-	-
P value	0.06	<b>0.0005</b>	0.051	<b>0.013</b>	<b>0.018</b>
Grand Mean	85	118	7.40	3058	15.7

## Discussion

Almost all varieties matured prior to fall frosts in Melita. Some of the later maturing varieties came rather close to the fall frost. Some of the earlier maturing varieties such as Dekalb 23-10RY and SC12-997R2 may not have yielded as well as some of the other later maturing varieties

due to their ability to mature prior to the absolute potential of the full season being utilized. That is, the later the maturity the greater the ability of that variety to fully use the entire crop heat units provided to improve yield over early maturing varieties.

A producer picking varieties for the next growing season should still consider an early variety rather than a later higher yielding variety since the final CHU of the season was 106% (from Seed date to Fall frost) above the normal 2498 CHU.



Photo: Secan variety trial plots taken July 2015.

# Early Season Soybean Response to Wheat Residue Management in Manitoba

## Early season soybean response to wheat residue management in Manitoba

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### Introduction

- Soybeans have been expanding into new, shorter growing regions of Manitoba over the past 5 years.
- Fall tillage is being used to facilitate fast soil warming in the spring in order to plant early and expand the growing season.
- Soil erosion by wind is still a considerable problem in Manitoba due to the heavy tillage that is currently practiced.
- Other soybean growing regions in Ontario and Mid-West United States have had success with no-till soybeans.
- Carrington Research Extension Centre in Carrington, North Dakota have shown no soybean yield response to tillage system (conventional till, no-till, strip-till) over several years.<sup>1</sup>
- Is there a missed opportunity for Manitoba to save the cost and time of tillage when planting soybeans?

### Research Questions

- Can tillage be reduced before planting soybeans in Manitoba?
- What is the impact of wheat residue management on soil temperature in the spring, soybean emergence and yield?

### Methods

- Wheat residue management treatments were established in the fall, and a soybean test crop was planted the following spring at the following locations:
  - Carman, MB (Planted: May 29, 2014, May 22, 2015)
  - Melita, MB (Planted: May 29, 2015)
- Randomized complete block design, 4 replications.
- Plot size: 8m long, 18m wide.
- Soybean variety: Dekalb 24-10RY (relative maturity 00.5).
- Soybeans were planted on 30" row spacing using a disc drill with little residue capability in 2014, and a planter with residue capabilities in 2015.
- Wheat residue ground cover was determined by taking 3 pictures of residue per plot, and analyzing the pictures in Assess 2.0 to determine % residue ground cover.
- Soil temperature at 5 cm was recorded using iButton® data loggers with a sampling period of one hour for the length of the growing season.
- Emergence counts were taken up to 22 days after planting with a sample area of 4 m of row for Carman in 2014, and 6 m of row for Carman and Melita in 2015 per plot.

### Results

#### Soil Temperature

- Strip till had the highest day time soil temperature the day before planting (Figure 1A), followed by disking and tall stubble at Carman in 2015.
- Disking had the coolest night time temperature, while fall rye had the warmest night time temperature at Carman in 2015.
- All residue management treatments were above the average recommended soil temperature of 10 °C at the time of planting for all sites (data not shown).

#### Soybean Emergence

- Early soybean emergence (10 DAP) was lowest in short stubble and highest in strip till relative to all other treatments at Carman in 2015 (Figure 1B). No differences in plant stand were observed for all treatments by 15 DAP.
- Final soybean emergence for disc and short stubble treatments were not statistically different in all 3 site years (Table 1). Fall rye treatment lowered final soybean emergence relative to disking by 4,000 and 10,000 plants/ac at Carman in 2014 and Melita in 2015, respectively.

#### Soybean Yield

- There was no soybean yield response to residue management treatments at Carman in 2015 (Table 1). In 2014, strip till, tall stubble and disking had the highest soybean yields at Carman.

### Summary

- This research suggests that tillage can be reduced before planting soybeans in Manitoba.
- Planter/seeding equipment should match residue ground cover capabilities for planting soybeans.
- More research is needed with an early planting date into colder soils, and at locations in Western Manitoba on long-term no-till production land.

### Reference

- Endres, G., and Hendrickson, P. 2010. Row crop performance with tillage systems and placement of fertilizer. In 2010 Carrington Research Extension Centre Annual Report. Vol. 51.

### Acknowledgments

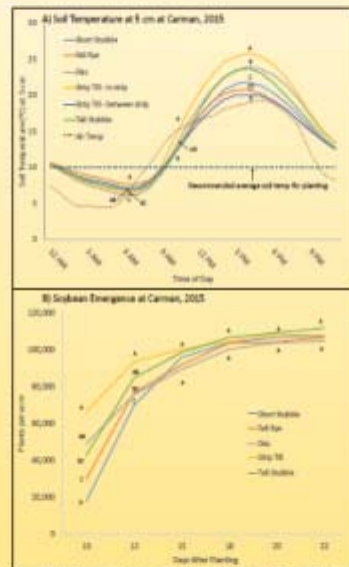


Figure 1. A) Soil temperature at 5 cm the day before planting (May 21, 2015) and B) soybean emergence 10 to 22 days after planting at Carman, 2015 for Strip Till, Disc, Tall Stubble, Short Stubble, and Fall Rye wheat residue management treatments.

Table 1. Soybean final plant stand 22 days after planting at Carman (2014, 2015) and Melita (2015), and soybean yield at Carman (2014, 2015) for Strip Till, Disc, Tall Stubble, Short Stubble, and Fall Rye wheat residue management treatments.

Treatment	Plant Stand (plants/ac)			Soybean Yield (bu/ac)	
	2014	2015	2015	2014	2015
Strip Till	148,000 ±	202,000 ±	185,700 ±	38 ±	58 ±
Disc	111,000 ±	108,000 ±	176,700 ±	35 ±	52 ±
Tall Stubble	115,000 ±	111,000 ±	181,000 ±	38 ±	52 ±
Short Stubble	125,000 ±	107,000 ±	179,000 ±	34 ±	54 ±
Fall Rye	101,000 ±	106,000 ±	171,000 ±	29 ±	58 ±

# Effects of genetic sclerotinia tolerance and foliar fungicide applications on the incidence and severity of sclerotinia stem rot infection in Argentine canola (CARP-SCDC-2013-16)

Final Project Report for the **SASKATCHEWAN CANOLA DEVELOPMENT COMMISSION (SASKCANOLA)**

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## *Abstract / Executive Summary*

A three-year field study was conducted at five locations in Saskatchewan and Manitoba to evaluate the relative effectiveness of genetic tolerance and foliar fungicide applications to reduce sclerotinia stem rot infection in Argentine canola (*Brassica napus*). A secondary objective was to determine if, and under what conditions, foliar fungicide applications might be required when growing a cultivar with genetic tolerance to this disease. All locations were within the Black soil zone and/or irrigated and were selected to have moderate to high levels of disease pressure. While overall environmental conditions, subsequent disease pressure and canola yields varied across location-years, actual disease incidence was generally quite low and treatment effects were fairly subtle. Under the conditions encountered, disease levels were frequently lower for the tolerant hybrid 45S54 relative to 45H29 which is susceptible to sclerotinia. Interactions between hybrid and fungicide treatments for sclerotinia incidence and severity were such that fungicides reduced disease in the susceptible but not the tolerant hybrid where disease levels were low regardless of fungicide treatment. Not necessarily unexpectedly considering that disease incidence was less than 5% on average and only exceeded 10% in 1/14 cases, fungicide effects on seed yield were small and, in most individual cases, not significant. Averaged across locations and hybrids, there was a slight but significant yield increase with fungicide; however, the economic returns associated with the applications would at best be



marginal depending on grain and fungicide costs. While the interaction was not significant, there was limited evidence that the yield response was slightly larger and more consistent with the susceptible versus the tolerant hybrid. There was no benefit to dual applications over single applications, regardless of application timing or location and, under this low disease pressure, were no measurable benefits to applying fungicides with a tolerant hybrid. While our results showed that genetic tolerance was effective for reducing disease and reducing the need for fungicide applications, the susceptible hybrid frequently yielded higher under the low disease pressure that was encountered. The greatest challenge for managing sclerotinia in canola continues to be accurately predicting whether yield responses to costly fungicide applications are likely. Genetic tolerance is an exciting advancement that has potential to reduce dependence on fungicides and provide adequate protection under low to moderate disease pressure. However, to be widely adopted and utilized to its full potential, sclerotinia tolerance should be incorporated into broader range of hybrids and, given the sporadic and unpredictable nature of this disease, yields must remain competitive with susceptible hybrids.

### *Background / Introduction*

Sclerotinia stem rot causes significant yield loss for canola in western Canada each year; however, the degree to which this disease affects individual fields varies dramatically depending on specific environmental and weather conditions. For example, in 2011 a total of 241 canola fields were surveyed (Dokken-Bouchard et al. 2012) and it was found that 81% of the crops surveyed were affected by sclerotinia; however, the actual percent incidence ranged from 0-91% and averaged 9.4%. In 2012, sclerotinia stem rot was observed in 91% of fields surveyed with incidence ranging from 0-95% but a provincial average of 19.0% (Miller et al. 2013). In 2013, sclerotinia pressure was substantially lower with the disease occurring in 60% of fields surveyed, mean incidence ranging from 1-8% among regions and 5% province-wide average (Miller et al. 2014). Moderate pressure was again encountered in 2014 with disease detected in 80% of the fields surveyed and a provincial average of 14% incidence (Dokken-Bouchard et al. 2015). With respect to seed yield, a crude rule of thumb is that approximately 0.5% of yield may be lost for every 1% of infected plants; however, the actual impacts of sclerotinia incidence on yield often vary (Del Rio et al. 2007). At low levels of disease (i.e. 5% or lower), sclerotinia incidence does not generally impact canola yields due to the plant's ability to compensate provided that severity is not too high (Del Rio et al. 2007; Kutcher and Malhi 2010).

Past research aiming to reduce the impacts of sclerotinia on canola in western Canada has looked at many factors with varying levels of success. With the adoption of reduced- and no-tillage systems, many growers have expressed concerns over higher residue levels leading to increased disease and have considered burning and/or tillage as potential solutions. However, Kutcher and Malhi (2010) showed burning could actually increase sclerotinia incidence while tillage had no effect, therefore concluding that neither of these practices were effective or desirable methods for managing sclerotinia. Similar research conducted at Melfort also concluded that tillage did not impact sclerotinia and, furthermore, showed that crop rotation was also ineffective for reducing sclerotinia or response to fungicide applications (Kutcher et al. 2011). With respect to nitrogen fertility and landscape position, it is intuitive that higher N rates would produce a denser canopy and greater chance of sclerotinia infection and that lower slope positions would retain more moisture resulting in a better environment for disease. However, while this can sometimes be the case, actual results vary dramatically with environmental conditions and strong healthy crops are also better able to defend against disease (Kutcher et al.

2005). Under low to moderate disease pressure, Brandt et al. (2007) observed a stronger yield response to fungicide at low seeding rates which, while somewhat counter intuitive, was possibly due to the extended flowering period allowing more time for infection to spread and negatively affect the crop. They (Brandt et al. 2007) also detected slightly higher sclerotinia levels with hybrid versus open-pollinated canola (possibly due to a denser canopy) and, as expected, lower disease levels when foliar fungicide was applied. Difficulties managing this disease using basic agronomic practices may be largely due to the fact that the pathogen is extremely widespread but, for the disease to develop, specific combinations of soil (pathogen), weather and crop conditions must be met.

Foliar fungicides have proven to be the most consistent and effective method of controlling sclerotinia stem rot in canola. While throughout much of the Prairies, annual fungicide applications to canola are unlikely to be economical over the long-term (i.e. Kutcher et al. 2005; Brandt et al. 2007; Kutcher et al. 2011), the benefits can be substantial with proper timing and heavy disease pressure. For example in 2012 at Indian Head, where disease pressure was severe, fungicide applications resulted in average yield increases up to 30% in small plot trials; however, field-scale trials completed at the same location over the past six seasons, have rarely shown economic benefits (Chris Holzapfel, unpublished data). Considerable resources have been directed towards developing practical methods to assess sclerotinia risk in canola in order to help producers determine when and where fungicides applications are likely to be beneficial (McLaren et al. 2004). Petal tests to assess the level of inoculum present in specific fields have shown reasonably strong correlations with sclerotinia infection; however, results are affected by the timing of the petal collection and still largely dependent on weather (Turkington and Morrall 1993; McLaren et al. 2004). While the traditional 3-5 day turnaround for petal test results has been somewhat impractical for producers, recent advancements in DNA testing may dramatically reduce the turnaround time while increasing the reliability of such tests (Ziesman et al. 2013). Another tool that is under development/evaluation and may provide early warnings of sclerotinia development are pre-inoculated sclerotia depots which are placed directly in the field and monitored for the period leading up to flowering (Buchwaldt et al. 2015). Risk assessment tables and weather-based risk models (i.e. Canola Council 2009) can also help producers make better informed decisions as to whether or not to spray but, similar to petal tests, the reliability of such approaches continue to be hampered by our inability to accurately predict upcoming weather patterns on a site-specific basis (McLaren et al. 2004).

While variation in the susceptibility of individual cultivars has been documented (Bradley and Khot 2006), commercial cultivars that are considered tolerant to sclerotinia stem rot have only relatively recently been introduced (Falak et al. 2011). Under severe disease pressure, tolerant cultivars have exhibited at least a 50% reduction in sclerotinia relative to susceptible controls (Falak et al. 2011). It is important to note that sclerotinia tolerant canola hybrids can still be affected by the pathogen responsible for this disease; however, the expectation is that tolerant hybrids will exhibit fewer symptoms and reduced yield loss relative to susceptible hybrids under the same conditions. If reliable, genetic sclerotinia tolerance could provide a first line of defense that might appeal both to growers in regions where high disease pressure has made annual fungicide applications commonplace and those in regions where sclerotinia is more variable and difficult to predict. Because sclerotinia infection is not eliminated in tolerant cultivars, conditions may exist where foliar fungicide applications are still recommended. Furthermore, combining tolerant hybrids with fungicide applications may reduce the potential for the pathogen to overcome individual control measures – experience has shown that relying heavily

on any single technology is often risky and unsustainable. This project was initiated to enhance our current understanding of the benefits and limitations that might be expected with both genetic tolerance and foliar fungicide applications.

### *Objectives*

The specific objectives of this study are:

- 1) To evaluate the relative effectiveness of genetic tolerance and foliar fungicides to reduce sclerotinia stem rot infection in canola under field conditions.
- 2) To determine if, and under what conditions, foliar fungicide applications may still be required when growing a hybrid with genetic tolerance to sclerotinia.

### *Materials & Methods*

Field trials were initiated in 2013 at three locations in Saskatchewan and two in Manitoba. Two of the locations had access to irrigation and all of the locations were considered to at least have a moderate risk for sclerotinia in canola based on their climates. The locations were Indian Head, SK (50°33'N 103°39'W), Melfort, SK (52°50' N 104°35'), Melita MB (49°17' N 101°00'), Outlook, SK (51°28' N 107°03') and Brandon, MB (49°52' N 99°58'). The plots at Outlook and Brandon received frequent, light irrigation through flowering to create conditions more favourable for disease development at these locations. Canola at Indian Head, Melfort and Melita did not receive supplemental irrigation. Plot size ranged from approximately 15-25 m<sup>2</sup> depending on the specific seeding and spraying equipment at each location, and alleyways between the plots were kept mowed over the growing season in the majority of cases.

The treatments were a factorial combination of two canola hybrids and four fungicide treatments for a total eight treatments. The hybrids were: 1) 45H29 RR (susceptible) and 2) 45S54 RR (tolerant) and the foliar fungicide treatments were: 1) untreated check, 2) fungicide applied at 20% bloom, 3) fungicide applied at 50% bloom and 4) fungicide applied at both crop stages. The treatments were arranged in a Randomized Complete Block Design (RCBD) with four replicates.

#### Canola Hybrid

- 1) 45H29 (susceptible)
- 2) 45S53 (tolerant)

#### Foliar Fungicide Treatment

- 1) Check (no fungicide)
- 2) Early (246 g Boscalid ha<sup>-1</sup> at 20% bloom stage)
- 3) Late (246 g Boscalid ha<sup>-1</sup> at 50% bloom stage)
- 4) Dual (full rate of fungicide at both stages)

Both hybrids were glyphosate tolerant (Roundup Ready<sup>®</sup>) and the target seeding rates were 125-150 viable seeds m<sup>-2</sup>. Seed from the same source was used at all locations with a relatively high rate recommended to promote dense crop canopies conducive to disease development. Tillage systems and seeding equipment varied across locations (Tables 1-3). Row spacing ranged from 20-30 cm and nitrogen (N) fertilizer was either side-banded or broadcast and incorporated prior to seeding (Outlook). In 2014, two sites (Brandon and Outlook) had to be reseeded due to poor initial establishment – no fertilizer was applied during the second seeding operation. Fertilizer sources were granular urea, monoammonium phosphate, potassium chloride and ammonium



sulphate and the rates varied with site but were intended to be non-limiting and balanced. Canola was swathed, pushed or straight-combined depending on the specific field equipment available at each location. Weed control was achieved with tillage and/or pre-emergent herbicide applications combined with either one or two in-crop applications of glyphosate. Additional agronomic details along with dates of field operations and data collection activities for each year are provided in Tables 1-3.

The data collected from each plot included spring plant density (to assess overall stand density and variability), mean disease incidence (% MDI), mean disease severity (0-5 MDS), seed yield, seed weight and percent green seed. Mean plant densities were determined by counting two separate 1 meter sections of crop row per plot approximately 4 weeks after planting and converting the mean values to plants  $\text{m}^{-2}$ . At the sites where sclerotinia was observed in 2013 and all sites in 2014-15, a total of 100 plants per plot were rated on a scale of 1-5 (Kutcher and Wolf 2006; Table A-1). The values derived from these ratings were percent incidence of infected plants (MDI) and the overall mean disease severity rating for the entire plot (MDS). Yields were determined from the harvested seed samples and are expressed as  $\text{kg ha}^{-1}$  on a clean seed basis and corrected to a uniform seed moisture content of 10%. Seed weight was determined by weighing and counting 1000-2000 seeds using automated seed counters and calculating  $\text{g 1000 seeds}^{-1}$  for each plot. Percent green seed was determined by crushing 200-500 seeds per plot and counting the number of distinctly green seeds. Seed size and percent clean seed were not measured at Melfort in 2013 or 2015 and plant densities were not measured at Melita in 2014; therefore these location-years were excluded from the analyses of these variables.

Response data were analysed using a combined Mixed model with the effects of location-year (L), hybrid (HYB), fungicide treatment (FUNG) and all potential interactions considered fixed with the effect of replicate considered random. Despite the large number of sites, the rationale for keeping location-year fixed at this stage was to improve our ability to identify and isolate responsive sites, recognizing the variability and importance of environmental conditions for this disease. Least squares means were separated using Fisher's protected least significant difference (LSD) test. Heterogeneous variance estimates were permitted across location-year; however, the more complex analyses were only utilized when it was a significant improvement over the simpler model assuming homogenous variance across all location years. For selected variables, single degree-of-freedom contrasts were used to compare to the control to the combined treated plots both across hybrids and separately for the susceptible and tolerant hybrids. Various transformations were explored for percentage and disease rating data; however, none improved the model fit so no transformations were utilized. All treatment effects and differences between means were considered significant at  $P \leq 0.05$ .

**Table 1. Dates of selected field operations and data collection activities completed in SaskCanola sclerotinia study at various locations in 2013.**

<b>Field Operation / Data Collection</b>	<b>Indian Head</b>	<b>Melfort</b>	<b>Outlook</b>	<b>Brandon</b>	<b>Melita</b>
Previous Crop / Tillage System	Spring Wheat / Zero-Tillage	Spring Wheat / Zero- Tillage	Spring Wheat / Reduced Tillage	Fallow / Conventional Tillage	Oat / Zero-Tillage
Pre-Emergent Herbicide	May 17	May 22	May 13	May 24 (cultivation only)	n/a
Seeding Date	May 16	May 23	May 16	May 24	May 16
Row Spacing	30 cm	20 cm	25 cm	20 cm	24 cm
Fertility (kg N-P <sub>2</sub> O <sub>5</sub> -K <sub>2</sub> O-S ha <sup>-1</sup> )	130-35-18-18	60-20-10-10	82-20-15-0	0-0-0-0 <sup>z</sup>	113-34-0-0
Emergence Counts	June 27	June 28	June 7	June 7	June 10
In-crop Herbicide 1	June 12 (440 g glyphosate ha <sup>-1</sup> )	June 24 (667 g glyphosate ha <sup>-1</sup> )	June 18 (667 g glyphosate ha <sup>-1</sup> )	June 11 (667 g glyphosate ha <sup>-1</sup> )	June 12 (445 g glyphosate ha <sup>-1</sup> )
In-crop Herbicide 2	June 27 (440 g glyphosate ha <sup>-1</sup> )	n/a	n/a	n/a	n/a
Foliar Fungicide 1	July 4	July 9	July 2	July 2	July 2
Foliar Fungicide 2	July 9	July 12	July 4	July 8	July 8
Sclerotinia Ratings	August 21-22	August 27	August 20	August 27	August 14
Swathing	n/a	n/a	August 27	August 26 <sup>y</sup>	August 15
Combining	September 16	September 12	September 6	October 3	September 3

n/a – not applicable / available

<sup>z</sup> Soil test residual nutrients exceeded estimated crop requirements – fertilizer was not applied at this site

<sup>y</sup> Canola was pushed as opposed to swathed

**Table 2. Dates of selected field operations and data collection activities completed in SaskCanola sclerotinia study at various locations in 2014.**

<b>Field Operation / Data Collection</b>	<b>Indian Head</b>	<b>Melfort</b>	<b>Outlook</b>	<b>Brandon</b>	<b>Melita</b>
Previous Crop / Tillage System	Spring Wheat / Zero Tillage	Cereal / Zero Tillage	Spring Wheat / Reduced Tillage	Fallow / Conventional Tillage	Winter Wheat / Zero Tillage
Pre-emergent Herbicide	May 18	n/a	May 12	June 9	May 22
Seeding date	May 14	May 21	June 3 <sup>x</sup>	June 10 <sup>x</sup>	May 22
Row spacing	30 cm	20 cm	25 cm	20 cm	24 cm
Fertility (kg N-P <sub>2</sub> O <sub>5</sub> -K <sub>2</sub> O-S ha <sup>-1</sup> )	130-34-17-17	105-35-0-15	135-40-15-12	55-10-0-24	106-35-30-20
Emergence Counts	June 9	June 11	July 7	June 24	n/a
In-crop herbicide 1	July 5 (667 g glyphosate ha <sup>-1</sup> )	June 17 (667 g glyphosate ha <sup>-1</sup> )	July 8 (440 g glyphosate ha <sup>-1</sup> )	July 3 (667 g glyphosate ha <sup>-1</sup> )	June 16 (440 g glyphosate ha <sup>-1</sup> )
In-crop herbicide 2	n/a	n/a	n/a	n/a	n/a
Foliar fungicide 1	July 9	July 8	July 16	July 26	July 8
Foliar fungicide 2	July 12	July 10	July 20	July 30	July 11
Sclerotinia ratings	August 29 <sup>z</sup>	August 26	September 9	September 17-18	August 18
Swathing	n/a	n/a	September 15	September 26	Aug 29
Combining	October 8 October 19 <sup>y</sup>	September 9	September 24	October 16	September 3-5

n/a – not applicable / available

<sup>z</sup> Ratings only completed on replicate #1 due to delayed maturity and poor establishment in remaining replicates

<sup>y</sup> Replicate #1 combined on October 8 and replicates #3-4 combined on October 19 due to differences in maturity

<sup>x</sup> Reseeded due to poor establishment with initial seeding date

**Table 3. Dates of selected field operations and data collection activities completed in SaskCanola sclerotinia study at various locations in 2015.**

<b>Field Operation / Data Collection</b>	<b>Indian Head</b>	<b>Melfort</b>	<b>Outlook</b>	<b>Brandon</b>	<b>Melita</b>
Previous Crop / Tillage System	Spring Wheat / Zero-Tillage	Oats / Zero-Tillage	Spring Wheat / Reduced Tillage	Fallow / Conventional Tillage	Fallow / Zero-Tillage
Pre-Emergent Herbicide	May 9	n/a	May 4 (cultivation only)	May 12 (cultivation only)	May 4
Seeding Date	May 15	May 20	May 13	May 15	May 5
Row Spacing	30 cm	20 cm	25 cm	20 cm	24 cm
Fertility (kg N-P <sub>2</sub> O <sub>5</sub> -K <sub>2</sub> O-S ha <sup>-1</sup> )	130-35-18-18	62-31-0-31	90-20-0-0	170-10-24	119-35-30-25
Emergence Counts	June 9	n/a	June 4	June 9	June 10
In-crop Herbicide 1	June 15 (667 g glyphosate ha <sup>-1</sup> )	June 18 (667 g glyphosate ha <sup>-1</sup> )	June 18 (667 g glyphosate ha <sup>-1</sup> )	June 8 (667 g glyphosate ha <sup>-1</sup> )	June 15 (445 g glyphosate ha <sup>-1</sup> )
In-crop Herbicide 2	n/a	n/a	n/a	n/a	n/a
Foliar Fungicide 1	July 1	July 10	June 29	June 30	June 29
Foliar Fungicide 2	July 4	July 13	July 3	July 2	July 4
Sclerotinia Ratings	August 19	n/a	August 19	August 14	August 4
Swathing	n/a	n/a	August 20	August 18	August 4
Combining	September 10	September 12	September 11	September 2	August 14
n/a	–	not	applicable	/	available

## Results and Discussion

### Weather conditions

Mean monthly temperatures and precipitation amounts for the 2013-15 growing seasons (May-Aug) for each location are presented relative to the long-term averages (1981-2010) in Tables 4 and 5. Relative to the long-term average, temperatures varied widely across months and site-year. Generally speaking July, when initial infection is likely to occur, had relatively cool to normal temperatures in 2013-14 and above normal temperatures in 2015; however, precipitation levels during this month were extremely variable ranging from 11-268% of the long-term averages. When averaged across the four month growing season, mean temperatures ranged from 95-106% of normal for individual site-years while total precipitation ranged from 78-170%. Again, the sites at Outlook and Brandon received supplemental irrigation to maintain a moist crop canopy through flowering and early pod fill to increase the potential for disease development. Irrigation amounts are included in the precipitation levels reported for Outlook but specific details of the irrigation schedule at Brandon are not available. At Indian Head in 2014, extreme rainfall in June resulted in early flooding damage which was followed by a premature frost when the damaged canola was still quite green. While all measurements were still completed at this location-year, the data was considered unreliable and removed from the final combined analyses.

**Table 4. Mean monthly temperatures relative to the long-term averages (1981-2010) for the 2013 and 2014 growing season at each trial location (Environment Canada 2016).**

Month	Year	Indian Head	Melfort	Outlook	Brandon	Melita
----- Mean Temperature (°C) -----						
May	2013	11.9 (110%)	12.0 (112%)	12.9 (109%)	10.8 (96%)	11.2 (105%)
	2014	10.2 (94%)	10.0 (94%)	10.8 (92%)	10.7 (96%)	11.6 (108%)
	2015	10.3 (95%)	9.9 (93%)	10.4 (88%)	9.0 (80%)	11.2 (105%)
	LT	10.8	10.7	11.8	11.2	10.7
June	2013	15.3 (97%)	15.4 (97%)	15.9 (97%)	16.9 (102%)	17.0 (106%)
	2014	14.4 (91%)	14.0 (88%)	14.7 90%)	15.8 (96%)	16.6 (103%)
	2015	16.2 (103%)	16.4 (103%)	17.3 (105%)	16.6 (101%)	16.9 (105%)
	LT	15.8	15.9	16.4	16.5	16.1
July	2013	16.3 (90%)	16.4 (94%)	17.5 (94%)	17.9 (94%)	18.7 (97%)
	2014	17.3 (95%)	17.5 (99%)	18.4 (99%)	17.9 (94%)	19.4 (101%)
	2015	18.2 (99%)	17.9 (102%)	19.2 (103%)	19.2 (101%)	20.6 (107%)
	LT	18.2	17.5	18.6	19.1	19.3
August	2013	17.1 (98%)	17.7 (105%)	18.8 (105%)	18.2 (100%)	19.0 (103%)
	2014	17.4 (100%)	17.6 (105%)	18.2 (102%)	17.9 (98%)	19.2 (104%)
	2015	17.0 (97.7%)	17.0 (101%)	17.4 (97%)	17.9 (98%)	19.4 (105%)
	LT	17.4	16.8	17.9	18.2	18.4
4-Month Average	2013	15.2 (97%)	15.4 (101%)	16.3 (101%)	16.0 (98%)	16.5 (102%)
	2014	14.8 (95%)	14.8 (97%)	15.5 (96%)	15.6% (96%)	16.7 (104%)
	2015	15.4 (99%)	15.3 (100%)	16.1 (99%)	15.7 (96%)	17.0 (106%)
	LT	15.6	15.2	16.2	16.3	16.1

**Table 5. Mean monthly precipitation amounts relative to the long-term averages (1981-2010<sup>z</sup>) for the 2013 and 2014 growing season at each trial location (Environment Canada 2016).**

Month	Year	Indian Head	Melfort	Outlook <sup>z</sup>	Brandon	Melita
----- Total Precipitation (mm) -----						
May	2013	17.1 (33%)	18.0 (42%)	12.7 (30%)	58.6 (104%)	51.2 (83%)
	2014	36.0 (70%)	24.4 (57%)	81.2 (191%)	114.3 (203%)	104.7 (169%)
	2015	15.6 (30%)	7.1 (16%)	38.3 (90%)	0.7 (1%)	83.4 (135%)
	LT	51.8	42.9	42.6	56.4	61.9
June	2013	103.8 (134%)	96.9 (179%)	81.5 (128%)	122.9 (156%)	78.4 (103%)
	2014	199.2 (257%)	169.8 (313%)	117.2 (183%)	143.5 (182%)	152.6 (200%)
	2015	38.3 (50%)	54.8 (101%)	51.6 (81%)	26.2 (33%)	105.0 (137%)
	LT	77.4	54.3	63.9	78.8	76.4
July	2013	50.4 (79%)	100.0 (130%)	103 (183%)	60.4 (87%)	141.0 (248%)
	2014	7.8 (12%)	94.6 (123%)	66.4 (118%)	29.9 (43%)	40.7 (72%)
	2015	94.6 (148%)	149.8 (195%)	150.4 (268%)	67.6 (11%)	8.6 (15.1%)
	LT	63.8	76.7	56.1	69.1	56.9
August	2013	6.1 (12%)	10.6 (20%)	53.8 (126%)	70.0 (110%)	24.0 (56%)
	2014	142.2 (277%)	60.4 (115%)	51.5 (120%)	69.3 (109%)	102.3 (237%)
	2015	58.8 (115%)	57.4 (110%)	67.5 (158%)	73.4 (116%)	25.6 (59%)
	LT	51.2	52.4	42.8	63.4	43.2
4-Month Total	2013	177.4 (78%)	225.5 (100%)	251 (122%)	311.9 (117%)	294.6 (124%)
	2014	385.2 (170%)	349.2 (154%)	316.3 (154%)	357.0 (133%)	400.3 (168%)
	2015	207.3 (92%)	269.1 (119%)	307.8 (150%)	241.3 (90%)	222.6 (93%)
	LT	226.3	226.3	205.4	267.7	238.4

<sup>z</sup> Precipitation amounts for Outlook include supplemental irrigation

### Overall Analyses of Variance

The overall tests of fixed effects and their interactions are presented for all response variables in Table 6. The effects of location were highly significant ( $P < 0.001$ ) for all variables. The main effects of hybrid were significant for sclerotinia incidence ( $P = 0.005$ ), severity ( $P = 0.007$ ), seed yield ( $P < 0.001$ ) and seed weight ( $P < 0.001$ ) while the main effects of fungicide were significant for sclerotinia incidence ( $P < 0.001$ ), severity ( $P = 0.015$ ) and seed yield ( $P = 0.051$ ). Significant interactions between hybrid and fungicide treatment were detected for sclerotinia incidence and severity ( $P = 0.02-0.03$ ) but no other variables. Interactions between location-year and hybrid were significant for emergence, yield and seed weight ( $P < 0.001$ ) while location interactions with fungicide treatment were only significant for percent green seed ( $P < 0.001$ ). The three-way interaction between location, hybrid and fungicide treatment was not significant for any variables except for plant density ( $P = 0.012$ ).

**Table 6. Analyses of variance for location, hybrid and fungicide treatment effects and their interactions for selected response variables.**

Response Variable	Effect						
	Location (L)	Hybrid (HYB)	Fungicide (FUNG)	HYB × FUNG	L × HYB	L × FUNG	L × HYB × FUNG
	p-value						
Emergence <sup>z</sup> (plants m <sup>-2</sup> )	< 0.001	0.155	0.456	0.717	< 0.001	0.093	0.012
Yield <sup>x</sup> (kg ha <sup>-1</sup> )	< 0.001	< 0.001	0.051	0.248	< 0.001	0.947	0.475
Scl. Incidence <sup>u</sup> (% infected)	< 0.001	0.005	< 0.001	0.017	0.279	0.789	0.309
Scl. Severity <sup>u</sup> (0-5)	< 0.001	0.007	0.015	0.033	0.406	0.948	0.241
Green Seed <sup>u</sup> (%)	< 0.001	0.203	0.988	0.098	0.936	< 0.001	0.571
Seed Weight <sup>u</sup> (g 1000 seeds <sup>-1</sup> )	< 0.001	< 0.001	0.551	0.612	< 0.001	0.880	0.440

<sup>z</sup> 13 sites; <sup>x</sup> 14 sites; <sup>u</sup> 12 sites

### Crop Establishment

Mean plant densities for location-year, hybrid and location-year by hybrid are presented in Table 7 along with p-values indicating whether hybrid effects were significant at individual location-years. Across sites, overall plant densities ranged from 40-159 plants m<sup>-2</sup> so, while variable, canola establishment at all sites was considered sufficient to not be limiting to yield. While there was some variation in establishment between varieties amongst individual sites, the effects were not consistent and there was no difference in average plant populations between the two hybrids when averaged across sites. As expected, fungicide applications (which occurred after the emergence counts) did not affect canola emergence. With a three-way interaction (location-year × hybrid × fungicide) for plant density yield ( $P = 0.051$ ), the results were not presented and were presumably due to chance since, again, no fungicides had been applied at the time these measurements were completed.

**Table 7. Tests of effect slices and treatment means for location ( $P < 0.001$ ), hybrid ( $P = 0.155$ ) and location x hybrid ( $P < 0.001$ ) effects on canola emergence at 13 location-years in Saskatchewan and Manitoba. Standard errors of the treatment means are enclosed in parentheses.**

	----- Effect -----	----- Hybrid -----		
	(HYB×LOC)	Location Avg.	Susceptible	Tolerant
Location-Year	----- p-value -----	plants m <sup>-2</sup> -----		
Brandon-2013	0.006	159 a (4.3)	148 b (5.8)	170 a (5.8)
Brandon-2014	0.014	63 cd (3.5)	71 b (4.5)	56 b (4.6)
Brandon-2015	0.009	40 f (2.6)	45 a (3.2)	35 b (3.2)
Indian Head-2013	0.345	56 d (2.4)	55 a (2.8)	58 a (2.8)
Indian Head-2014	—	—	—	—
Indian Head-2015	0.139	63 c (2.6)	66.0 a (3.2)	61 a (3.2)
Melfort-2013	0.949	49 e (2.3)	49 a (2.7)	49 a (2.7)
Melfort-2014	< 0.001	46 ef (2.1)	39 b (2.4)	53 a (2.4)
Melfort-2015	0.410	83 b (3.0)	85 a (3.8)	81 a (3.8)
Melita-2013	0.121	149 a (5.7)	141 a (7.8)	158 a (7.8)
Melita-2014	—	—	—	—
Melita-2015	< 0.001	58 cd (2.5)	52 b (3.1)	65 a (3.1)
Outlook-2013	0.833	63 cd (3.7)	62 a (4.9)	64 (4.9)
Outlook-2014	0.028	62 cd (3.1)	56 b (4.0)	68 a (4.0)
Outlook-2015	0.973	90 b (5.7)	90 a (7.9)	90 a (7.9)
Average (all sites)	—	—	76.8 a	74.3 a

#### *Sclerotinia Incidence and Severity*

Mean disease incidence (MDI) and severity (MDS) were calculated from ratings (Kutcher and Wolf 2006) completed on 100 plants per plot just prior to physiological maturity. Mean MDI for location-year, hybrid and location-year by hybrid interactions are provided in Table 8. For the sites where all plots were rated, overall average MDI (across hybrids and fungicide treatments) ranged from 0-11% with the highest overall values generally observed at Brandon and the lowest at Indian Head. There was only one case where MDI exceed 10% therefore, at the majority of sites, disease pressure in the plots was too low to be expected to have much impact on yield. Significant differences in MDI were detected between the two hybrids at 17% of the individual sites and, when differences occurred, the values were lower for the tolerant hybrid. Regardless of overall disease levels or whether the differences were significant, the absolute MDI values trended higher for the susceptible variety in 67% of the sites and were slightly but significantly higher when averaged across sites (3.6% susceptible versus 2.7% tolerant).



**Table 8. Tests of effect slices and treatment means for location ( $P < 0.001$ ), hybrid ( $P = 0.006$ ) and location x hybrid ( $P = 0.255$ ) effects on mean sclerotinia incidence (MDI) at 12 location-years in Saskatchewan and Manitoba. Standard errors of the treatment means are enclosed in parentheses.**

	----- Effect -----	----- Hybrid -----		
	(HYB×LOC)	Location Avg.	Susceptible	Tolerant
Location-Year	---- p-value ----	----- % of plants infected -----		
Brandon-2013	0.003	11.4 a (1.55)	13.2 a (1.66)	9.7 b (1.66)
Brandon-2014	0.261	2.6 c (1.55)	3.3 a (1.66)	1.9 a (1.66)
Brandon-2015	0.109	3.6 bc (1.55)	4.6 a (1.66)	2.7 a (1.66)
Indian Head-2013	0.521	1.1 c (1.55)	1.5 a (1.66)	0.8 a (1.66)
Indian Head-2014	—	—	—	—
Indian Head-2015	1.000	0.3 c (1.55)	0.3 a (1.66)	0.3 a (1.66)
Melfort-2013	1.000	0.0 c (1.55)	0.0 a (1.66)	0.0 a (1.66)
Melfort-2014	0.789	2.9 bc (1.55)	3.1 a (1.66)	2.8 a (1.66)
Melfort-2015	0.009	4.2 bc (1.55)	5.8 a (1.66)	2.7 b (1.66)
Melita-2013	—	—	—	—
Melita-2014	0.521	1.4 c (1.55)	1.0 a (1.66)	1.8 a (1.66)
Melita-2015	0.454	7.2 ab (1.55)	7.6 a (1.66)	6.8 a (1.66)
Outlook-2013	—	—	—	—
Outlook-2014	0.592	2.6 bc (1.55)	2.9 a (1.66)	2.3 a (1.66)
Outlook-2015	1.000	0.4 c (1.55)	0.4 a (1.66)	0.4 a (1.66)
All Sites (average)	—	—	3.6 A (0.48)	2.7 B (0.48)

Fungicide treatment and location-year by fungicide treatment means for MDI are provided in Table 9. While the effects of fungicide were not large enough to be considered significant, and varied with location-year, there was enough of a trend that the main effect of fungicide treatment was significant. Averaged across all location-years, MDI of the unsprayed control was 4.3% which was significantly higher than any of the treated plots (2.4-3.1%). In general, location effects on MDI were much stronger than either hybrid or fungicide effects. The most notable reduction in MDI with fungicides occurred at Melita in 2014 where the control averaged 5% (still likely too low to result in a detectable yield reduction) but incidence was less than 1% in the treated plots.

**Table 9. Tests of effect slices and treatment means for fungicide ( $P = 0.003$ ) and location x fungicide ( $P = 0.744$ ) effects on mean sclerotinia incidence (MDI) at 12 location-years in Saskatchewan and Manitoba. Standard errors of the treatment means are enclosed in parentheses.**

	--- Effect ---	----- Fungicide -----			
	FUNG×LOC	Control	1-20% bloom	2-50% bloom	Dual App.
Location-Year	--- p-value ---	----- % of plants infected -----			
Brandon-2013	0.043	13.6 a (1.85)	12.1 a (1.85)	10.9 a (1.85)	9.1 a (1.85)
Brandon-2014	0.655	3.4 a (1.85)	3.1 a (1.85)	2.4 a (1.85)	1.5 a (1.85)
Brandon-2015	0.725	4.9 a (1.85)	3.0 a (1.85)	3.8 a (1.85)	2.9 a (1.85)
Indian Head-2013	0.273	2.8 a (1.85)	1.6 a (1.85)	0.1 a (1.85)	0.0 a (1.85)
Indian Head-2014	—	—	—	—	—
Indian Head-2015	0.988	0.6 a (1.85)	0.1 a (1.85)	0.4 a (1.85)	0.1 a (1.85)
Melfort-2013	1.000	0.0 a (1.85)	0.0 a (1.85)	0.0 a (1.85)	0.0 a (1.85)
Melfort-2014	0.896	3.3 a (1.85)	2.8 a (1.85)	2.3 a (1.85)	3.4 a (1.85)
Melfort-2015	0.138	4.3 a (1.85)	5.3 a (1.85)	5.4 a (1.85)	2.0 a (1.85)
Melita-2013	—	—	—	—	—
Melita-2014	0.005	5.0 a (1.85)	0.0 b (1.85)	0.3 b (1.85)	0.3 b (1.85)
Melita-2015	0.109	9.3 a (1.85)	6.0 a (1.85)	5.8 a (1.85)	7.8 a (1.85)
Outlook-2013	—	—	—	—	—
Outlook-2014	0.204	4.6 a (1.85)	2.4 a (1.85)	2.3 a (1.85)	1.3 a (1.85)
Outlook-2015	0.999	0.4 a (1.85)	0.5 a (1.85)	0.3 a (1.85)	0.4 a (1.85)
All Sites (average)	—	4.3 A (0.53)	3.1 B (0.53)	2.8 B (0.53)	2.4 B (0.53)

Despite the relative low disease pressure, when MDI data from all location-years were combined the interaction between hybrid and fungicide treatment was significant (Table 10). The interaction showed a reduction in sclerotinia incidence with fungicide applications, regardless of timing, for the susceptible hybrid but not the tolerant hybrid. Without fungicide, MDI averaged 5.8% and was approximately reduced by half 2.2-3.2% for all remaining treatments. This interaction was further verified by the contrasts which detected an overall reduction in MDI with fungicides for the susceptible hybrid ( $P < 0.001$ ) but not the tolerant hybrid ( $P = 0.555$ ). It is possible that this interaction may not have occurred under heavy disease pressure as increased symptoms on both hybrids would have been expected. In the current study, even the highest overall incidence level of 5.8% was likely too low to result in significant yield reductions.

**Table 10. Treatment means and contrast results for hybrid x fungicide ( $P = 0.017$ ) effects on mean sclerotinia incidence (MDI) at 12 location-years in Saskatchewan and Manitoba. Standard errors of the treatment means are enclosed in parentheses.**

Fungicide Treatment	----- Hybrid -----	
	Susceptible (45H29)	Tolerant (45S54)
	----- % of plants infected -----	
Control	5.8 a (0.63)	2.9 b (0.63)
1-20% bloom	3.2 b (0.63)	2.9 b (0.63)
2-50% bloom	2.9 b (0.63)	2.7 b (0.63)
Dual App.	2.6 b (0.63)	2.2 b (0.63)
	----- p-value -----	
Check vs Treated (both hybrids)	< 0.001	
Check vs Treated (susceptible)	< 0.001	—
Check vs Treated (tolerant)	—	0.555

While MDI does not take the severity of infection in individual plants, mean disease severity is the average overall severity (on a scale of 0-5) of all of the individual plants rated. Consequently, MDS takes into account both percent incidence and potential yield loss on the basis of where the infection occurs on the plant. For example, while infection that is isolated to a few pods (rating of 1) may affect less than 10% of the seeds on that plant, lower stem infections (rating of 5) have potential to inhibit seed development on the entire plant (5). Overall, the results for MDS mimicked those already discussed for MDI and are reported in Tables 11-13.

Similar to MDI, MDS was affected by location-year and cultivar but the interaction between these two factors was not significant. Disease severity was highest as Brandon in 2013 followed by Melita, Melfort and Brandon in 2015. All remaining sites had MDS values of less than 0.1 which indicated that incidence was  $\leq 2\%$  and considered negligible. While there were relatively few sites where the hybrid effect was significant on its own, when averaged across locations, MDI was higher for the susceptible hybrid (0.117) than for the tolerant hybrid (0.078).

**Table 11. Tests of effect slices and treatment means for location ( $P < 0.001$ ), hybrid ( $P = 0.006$ ) and location x hybrid ( $P = 0.255$ ) effects on mean sclerotinia severity (MDS) at 12 location-years in Saskatchewan and Manitoba. Standard errors of the treatment means are enclosed in parentheses.**

	----- Effect -----	----- Hybrid -----		
	(HYB×LOC)	Location Avg.	Susceptible	Tolerant
Location-Year	----- p-value -----	----- 0-5 -----		
Brandon-2013	0.051	0.383 a (0.05)	0.432 a (0.056)	0.334 a (0.056)
Brandon-2014	0.334	0.079 b-e (0.05)	0.103 a (0.056)	0.055 a (0.056)
Brandon-2015	0.064	0.146 bcd (0.05)	0.192 a (0.056)	0.099 a (0.056)
Indian Head-2013	0.475	0.044 cde (0.05)	0.062 a (0.056)	0.026 a (0.056)
Indian Head-2014	—	—	—	—
Indian Head-2015	0.930	0.013 de (0.05)	0.016 a (0.056)	0.011 a (0.056)
Melfort-2013	1.000	0.000 e (0.05)	0.000 a (0.056)	0.000 a (0.056)
Melfort-2014	0.930	0.031 de (0.05)	0.033 a (0.056)	0.029 a (0.056)
Melfort-2015	0.002	0.175 bc (0.05)	0.253 a (0.056)	0.098 b (0.056)
Melita-2013	—	—	—	—
Melita-2014	0.841	0.015 de (0.05)	0.010 a (0.056)	0.020 a (0.056)
Melita-2015	0.821	0.193 b (0.05)	0.199 a (0.056)	0.188 a (0.056)
Outlook-2013	—	—	—	—
Outlook-2014	0.564	0.078 b-e (0.05)	0.093 a (0.056)	0.064 a (0.056)
Outlook-2015	0.960	0.014 de (0.05)	0.015 a (0.056)	0.013 a (0.056)
All Sites (average)	—	—	0.117 A (0.016)	0.078 B (0.016)

Also consistent with the results for MDI, MDS was affected by fungicide treatment but the interaction between fungicide treatment and location-year was not significant. As expected, MDI was highest in the control and significantly reduced with fungicide applications. Although differences amongst the treatments where fungicides were applied were not significant, the general trend was for the least disease with a dual application followed by single applications at 50% bloom and then 20% bloom (Table 12).

**Table 12. Tests of effect slices and treatment means for fungicide ( $P = 0.003$ ) and location x fungicide ( $P = 0.744$ ) effects on mean sclerotinia severity (MDS) at 12 location-years in Saskatchewan and Manitoba. Standard errors of the treatment means are enclosed in parentheses.**

	--- Effect ---	----- Fungicide -----			
	FUNG×LOC	Control	1-20% bloom	2-50% bloom	Dual App.
Location-Year	p-value	----- 0-5 -----			
Brandon-2013	0.021	0.485 a (0.07)	0.428 ab (0.07)	0.338 bc (0.07)	0.283 c (0.07)
Brandon-2014	0.857	0.103 a (0.066)	0.098 a (0.066)	0.066 a (0.066)	0.050 a (0.066)
Brandon-2015	0.585	0.199 a (0.066)	0.120 a (0.066)	0.154 a (0.066)	0.110 a (0.066)
Indian Head-2013	0.331	0.111 a (0.066)	0.063 a (0.066)	0.003 a (0.066)	0.000 a (0.066)
Indian Head-2014	—	—	—	—	—
Indian Head-2015	0.983	0.028 a (0.066)	0.005 a (0.066)	0.019 a (0.066)	0.003 a (0.066)
Melfort-2013	1.000	0.000 a (0.066)	0.000 a (0.066)	0.000 a (0.066)	0.000 a (0.066)
Melfort-2014	0.998	0.035 a (0.066)	0.028 a (0.066)	0.025 a (0.066)	0.036 a (0.066)
Melfort-2015	0.081	0.178 a (0.066)	0.213 a (0.066)	0.241 a (0.066)	0.070 a (0.066)
Melita-2013	—	—	—	—	—
Melita-2014	0.834	0.055 a (0.066)	0.000 a (0.066)	0.003 a (0.066)	0.003 a (0.066)
Melita-2015	0.277	0.245 a (0.066)	0.158 a (0.066)	0.133 a (0.066)	0.238 a (0.066)
Outlook-2013	—	—	—	—	—
Outlook-2014	0.340	0.155 a	0.064 a	0.059 a	0.035 a
Outlook-2015	1.000	0.015 a	0.016 a	0.011 a	0.013 a
All Sites (average)	—	0.134 A (0.02)	0.099 AB (0.02)	0.088 B (0.02)	0.070 B (0.02)

While the main effects of both hybrid and fungicide were significant on their own, the interaction between these factors was also significant. The interaction for MDS was identical to that observed for MDI whereby disease severity was highest with the untreated, susceptible hybrid while all other treatments were lower and did not significantly differ from each other (Table 13). Similar to MDI, the contrasts for the control versus all treated plots was significant for the susceptible but not the tolerant canola hybrid.

**Table 13. Treatment means and contrast results for hybrid x fungicide ( $P = 0.017$ ) effects on mean sclerotinia severity (MDS) at 12 location-years in Saskatchewan and Manitoba. Standard errors of the treatment means are enclosed in parentheses.**

Fungicide Treatment	Hybrid	
	Susceptible (45H29)	Tolerant (45S54)
	----- 0.5 -----	
Control	0.191 a (0.0239)	0.077 b (0.0239)
1-20% bloom	0.107 b (0.0239)	0.091 b (0.0239)
2-50% bloom	0.094 b (0.0239)	0.081 b (0.0239)
Dual App.	0.077 b (0.0239)	0.063 b (0.0239)
	----- p-value -----	
Check vs Treated (both hybrids)	0.004	
Check vs Treated (susceptible)	< 0.001	—
Check vs Treated (tolerant)	—	0.967

#### Seed Yield

Canola seed yield was affected by both location-year and hybrid with a significant interaction between these two factors (Table 14). Overall mean yields ranged from 1898-4420 kg ha<sup>-1</sup> for individual location-years and, generally speaking, were more variable from year-to-year than from location-to-location. On average, the susceptible hybrid (3105 kg ha<sup>-1</sup>) yielded 8% higher than the tolerant hybrid (2878 kg ha<sup>-1</sup>); however, disease pressure was relatively low in all cases and, with the significant interaction, this yield separation did not occur at all location-years. Yield differences between hybrids were detected at Brandon in all three years, Indian Head in 2015, Melita in 2013 and Outlook in 2015 (6/14 location-years). In all cases where a hybrid effect was detected, yields favoured the susceptible cultivar; however, the effects did not appear to be specifically attributable to low disease pressure or any particular environmental conditions (i.e. drier versus excess moisture). For example, disease pressure at Brandon was generally higher than any other locations yet the susceptible variety appeared to have the greatest yield advantage at this location, despite exhibiting fewer sclerotinia symptoms. At the locations where yield differences between the hybrids were detected, the 45H29 advantage ranged from 9-21%.

**Table 14. Tests of effect slices and treatment means for location ( $P < 0.001$ ), hybrid ( $P < 0.001$ ) and location x hybrid ( $P < 0.001$ ) effects on canola seed yield at 14 location-years in Saskatchewan and Manitoba. Standard errors of the treatment means are enclosed in parentheses.**

	---- Effect ----	----- Hybrid -----		
	HYB×LOC	Location Avg.	Susceptible	Tolerant
Location-Year	--- p-value ---	----- kg ha <sup>-1</sup> -----		
Brandon-2013	< 0.001	2139 fg (121.8)	2346 a (131.6)	1932 b (131.6)
Brandon-2014	< 0.001	4071 ab (141.6)	4429 a (162.4)	3713 b (170.7)
Brandon-2015	0.046	2942 e (140.2)	3113 a (162.3)	2770 b (166.2)
Indian Head-2013	0.987	3596 cd (114.8)	3596 a (118.3)	3596 a (118.3)
Indian Head-2014	—	—	—	—
Indian Head-2015	< 0.001	3079 e (113.7)	3209 a (116.2)	2949 b (116.2)
Melfort-2013	0.305	2171 fg (130.5)	2241 a (147.3)	2101 a (147.3)
Melfort-2014	0.731	2002 g (118.2)	1989 a (124.9)	2016 a (124.9)
Melfort-2015	0.577	2965 e (119.6)	2990 a (127.5)	2941 a (127.5)
Melita-2013	0.033	4420 a (177.4)	4717 a (221.3)	4124 b (228.4)
Melita-2014	0.981	1898 g (122.8)	1899 a (132.4)	1896 a (133.4)
Melita-2015	0.138	2430 f (116.2)	2480 a (121.0)	2379 a (121.0)
Outlook-2013	0.706	3862 bc (128.9)	3886 a (144.2)	3838 a (144.2)
Outlook-2014	0.076	2849 e (115.8)	2907 a (120.3)	2791 a (120.3)
Outlook-2015	0.005	3452 d (134.5)	3665 a (154.3)	3239 b (154.3)
All Sites (average)	—	—	3105 A (38.5)	2878 B (39.0)

The overall effect of fungicide treatment on canola yield was just barely considered significant at  $P = 0.051$  and there was no interaction with location-year ( $P = 0.947$ ). Fungicide treatment effects on yield were never significant for individual location-years; however there was a tendency for slightly lower yields in the control at several locations which, combined, contributed to the significant overall effect (Table 15). While marginally significant, the overall yield response to fungicide was relatively weak with only the only difference between the control and the T2 fungicide application considered significant according to the multiple comparisons test.

**Table 15. Tests of effect slices and treatment means for fungicide ( $P = 0.051$ ) and location x fungicide ( $P = 0.947$ ) effects on canola seed yield at 14 location-years in Saskatchewan and Manitoba. Standard errors of the treatment means are enclosed in parentheses.**

	--- Effect ---	----- Fungicide -----			
	FUNG×LOC	Control	1-20% bloom	2-50% bloom	Dual App.
Location-Year	--- p-value ---	----- kg ha <sup>-1</sup> -----			
Brandon-2013	0.125	2044 a (149.2)	2012 a (149.2)	2311 a (149.2)	2188 a (149.2)
Brandon-2014	0.636	4082 a (200.9)	3972 a (200.9)	4256 a (200.9)	3972 a (200.9)
Brandon-2015	0.168	2649 a (200.8)	3106 a (200.8)	2890 a (200.8)	3122 a (213.1)
Indian Head-2013	0.391	3510 a (125.1)	3619 a (125.1)	3635 a (125.1)	3620 a (125.1)
Indian Head-2014	—	—	—	—	—
Indian Head-2015	0.898	3055 a (121.0)	3071 a (121.0)	3085 a (121.0)	3105 a (121.0)
Melfort-2013	0.581	2245 a (176.2)	2060 a (176.2)	2285 a (176.2)	2094 a (176.2)
Melfort-2014	0.872	1979 a (137.3)	2035 a (137.3)	2036 a (137.3)	1960 a (137.3)
Melfort-2015	0.687	2956 a (142.1)	2894 a (142.1)	3045 a (142.1)	2966 a (142.1)
Melita-2013	0.681	4150 a (292.5)	4465 a (313.7)	4603 a (292.5)	4464 a (292.5)
Melita-2014	0.763	1812 a (150.0)	1888 a (144.4)	1964 a (166.6)	1927 a (144.4)
Melita-2015	0.064	2406 a (130.0)	2428 a (130.0)	2569 a (130.0)	2314 a (130.0)
Outlook-2013	0.862	3838 a (175.2)	3858 a (175.2)	3803 a (166.8)	3949 a (166.8)
Outlook-2014	0.316	2780 a (128.8)	2855 a (128.8)	2944 a (128.8)	2816 a (128.8)
Outlook-2015	0.514	3439 a (187.9)	3615 a (187.9)	3462 a (187.9)	3292 a (187.9)
All Sites (average)	—	2925 b (45.8)	2991 ab (46.4)	3064 a (46.2)	2985 ab (46.1)

With a weak overall response, the interaction between hybrid and cultivar for seed yield was not significant (Table 16) and the control versus treated contrasts were only significant when both hybrids were combined ( $P = 0.029$ ). While not significant at the desired probability level, the contrasts did suggest a somewhat greater response with the susceptible hybrid ( $P = 0.060$ ) relative to the tolerant hybrid ( $P = 0.223$ ). Despite the lack of statistical significance, the average yield gain with fungicide was 107 kg ha<sup>-1</sup> (3.5%) for 45H29 and 71 kg ha<sup>-1</sup> (2.5%) for 45S54.



**Table 16. Treatment means and contrast results for hybrid x fungicide ( $P = 0.248$ ) effects on canola seed yield at 14 location-years in Saskatchewan and Manitoba. Standard errors of the treatment means are enclosed in parentheses.**

Fungicide Treatment	Hybrid	
	Susceptible (45H29)	Tolerant (45S54)
	kg ha <sup>-1</sup>	
Control	3024 abc (57.4)	2825 d (57.6)
1-20% bloom	3081 ab (57.6)	2904 cd (59.4)
2-50% bloom	3153 a (57.4)	2974 cd (58.9)
Dual App.	3160 a (57.1)	2810 e (58.9)
	p-value	
Check vs Treated (both hybrids)	0.029	
Check vs Treated (susceptible)	0.060	—
Check vs Treated (tolerant)	—	0.223

#### Percent Green Seed and Seed Weight

Percent green seed varied with location-year but there were no differences between the two hybrids either combined across sites or at individual sites (Table 17). Percent green averaged from 0.0-1.6% for individual location-years with variation attributable to differences in environmental conditions and timing of operations.

**Table 17. Tests of effect slices and treatment means for location ( $P < 0.001$ ), hybrid ( $P = 0.203$ ) and location x hybrid ( $P = 0.936$ ) effects on percent green seed at 12 location-years in Saskatchewan and Manitoba. Standard errors of the treatment means are enclosed in parentheses.**

	---- Effect ----	----- Hybrid -----		
	HYB×LOC	Location Avg.	Susceptible	Tolerant
Location-Year	---- p-value ----	----- % -----		
Brandon-2013	1.000	0.04 ghi (0.057)	0.04 a (0.080)	0.04 a (0.080)
Brandon-2014	0.659	0.16 fgh (0.057)	0.14 a (0.080)	0.19 a (0.080)
Brandon-2015	0.912	0.01 hi (0.057)	0.01 a (0.080)	0.00 a (0.080)
Indian Head-2013	1.000	0.21 ef (0.057)	0.21 a (0.080)	0.21 a (0.080)
Indian Head-2014	—	—	—	—
Indian Head-2015	0.825	0.39 d (0.057)	0.40 a (0.080)	0.38 a (0.080)
Melfort-2013	—	—	—	—
Melfort-2014	1.000	0.00 i (0.057)	0.00 a (0.080)	0.00 a (0.080)
Melfort-2015	—	—	—	—
Melita-2013	0.048	1.23 b (0.058)	1.34 a (0.083)	1.11 a (0.083)
Melita-2014	0.168	0.33 de (0.057)	0.41 a (0.080)	0.25 a (0.080)
Melita-2015	0.782	0.61 c (0.057)	0.63 a (0.080)	0.59 a (0.080)
Outlook-2013	0.724	0.07 f-i (0.059)	0.09 a (0.083)	0.04 a (0.083)
Outlook-2014	0.825	1.61 a (0.057)	1.63 a (0.080)	1.60 a (0.080)
Outlook-2015	0.782	0.18 efg (0.057)	0.20 a (0.080)	0.17 a (0.080)
All Sites (average)	—	—	0.42 A (0.023)	0.38 A (0.023)

While the overall effect of fungicide was not significant ( $P = 0.989$ ) for percent green seed, there was a location-year by fungicide interaction detected ( $P < 0.001$ ; Table 18). The interaction was due to a significant response at Outlook in 2014; however, this response appeared somewhat random and was not observed in any other instances.

**Table 18. Tests of effect slices and treatment means for fungicide ( $P = 0.989$ ) and location x fungicide ( $P < 0.001$ ) effects on percent green seed at 12 location-years in Saskatchewan and Manitoba. Standard errors of the treatment means are enclosed in parentheses.**

	--- Effect ---	----- Fungicide -----			
	FUNG×LOC	Control	1-20% bloom	2-50% bloom	Dual App.
Location-Year	--- p-value ---	----- % -----			
Brandon-2013	0.842	0.00 a (0.113)	0.03 a (0.113)	0.13 a (0.113)	0.00 a (0.113)
Brandon-2014	0.367	0.20 a (0.113)	0.13 a (0.113)	0.30 a (0.113)	0.03 a (0.113)
Brandon-2015	0.998	0.00 a (0.113)	0.00 a (0.113)	0.00 a (0.113)	0.03 a (0.113)
Indian Head-2013	0.970	0.20 a (0.113)	0.18 a (0.113)	0.23 a (0.113)	0.25 a (0.113)
Indian Head-2014	—	—	—	—	—
Indian Head-2015	0.970	0.38 a (0.113)	0.40 a (0.113)	0.35 a (0.113)	0.43 a (0.113)
Melfort-2013	—	—	—	—	—
Melfort-2014	1.000	0.00 a (0.113)	0.00 a (0.113)	0.00 a (0.113)	0.00 a (0.113)
Melfort-2015	—	—	—	—	—
Melita-2013	0.004	1.31 a (0.113)	0.85 a (0.122)	1.44 a (0.113)	1.31 a (0.113)
Melita-2014	0.446	0.38 a (0.113)	0.31 a (0.113)	0.44 a (0.113)	0.19 a (0.113)
Melita-2015	0.099	0.44 a (0.113)	0.75 a (0.113)	0.75 a (0.113)	0.50 a (0.113)
Outlook-2013	0.982	0.03 a (0.122)	0.08 a (0.122)	0.06 a (0.113)	0.09 a (0.113)
Outlook-2014	< 0.0001	1.85 ab (0.113)	2.08 a (0.113)	0.88 c (0.113)	1.65 b (0.113)
Outlook-2015	0.463	0.15 a (0.113)	0.08 a (0.113)	0.19 a (0.113)	0.33 a (0.113)
All Sites (average)	—	0.134 A (0.02)	0.099 AB (0.02)	0.088 B (0.02)	0.070 B (0.02)

Canola seed weight was affected by location-year and hybrid with a significant interaction between these factors ( $P < 0.001$ ; Table 19). Across location-years, mean seed weights ranged from 2.6-6.4 g 1000 seeds<sup>-1</sup> and this variation was presumably due to differences in environmental conditions and, perhaps to a lesser extent, management. The interaction was presumably due to the variation in the magnitude of the observed differences between hybrids as these results were quite consistent with significant differences at all locations and always in favour the tolerant hybrid 45S54.

**Table 19. Tests of effect slices and treatment means for location ( $P < 0.001$ ), hybrid ( $P < 0.001$ ) and location x hybrid ( $P < 0.001$ ) effects on canola seed weight at 12 location-years in Saskatchewan and Manitoba. Standard errors of the treatment means are enclosed in parentheses.**

	---- Effect ----	----- Hybrid -----		
	HYB×LOC	Location Avg.	Susceptible	Tolerant
Location-Year	---- p-value ----	----- g 1000 seeds <sup>-1</sup> -----		
Brandon-2013	0.001	3.83 b (0.047)	3.72 b (0.056)	3.94 a (0.056)
Brandon-2014	0.001	2.56 f (0.047)	2.46 b (0.056)	2.66 a (0.056)
Brandon-2015	< 0.001	3.03 d (0.047)	2.86 b (0.056)	3.21 a (0.056)
Indian Head-2013	< 0.001	3.53 c (0.047)	3.23 b (0.056)	3.83 a (0.056)
Indian Head-2014	—	—	—	—
Indian Head-2015	< 0.001	3.11 d (0.047)	2.88 b (0.056)	3.35 a (0.056)
Melfort-2013	—	—	—	—
Melfort-2014	< 0.001	2.99 d (0.047)	2.71 b (0.056)	3.28 a (0.056)
Melfort-2015	—	—	—	—
Melita-2013	< 0.001	3.03 d (0.048)	2.91 b (0.056)	3.15 a (0.056)
Melita-2014	< 0.001	2.54 f (0.047)	2.38 b (0.056)	2.70 a (0.056)
Melita-2015	< 0.001	2.64 ef (0.047)	2.43 b (0.056)	2.86 a (0.056)
Outlook-2013	< 0.001	6.36 a (0.048)	6.21 b (0.058)	6.50 a (0.058)
Outlook-2014	< 0.001	2.73 e (0.047)	2.55 b (0.056)	2.91 a (0.056)
Outlook-2015	< 0.001	3.92 b (0.047)	3.68 b (0.056)	4.15 a (0.056)
All Sites (average)	—	—	3.17 A (0.016)	3.54 A (0.016)

Fungicide treatment did not affect seed weight ( $P = 0.989$ ) and there was no interaction between fungicide treatment and location-year ( $P = 0.880$ ; Table 20). When averaged across all location-years, seed weight ranged from 3.34-3.56 g 1000 seeds<sup>-1</sup> amongst the four fungicide treatments.

**Table 20. Tests of effect slices and treatment means for fungicide ( $P = 0.989$ ) and location x fungicide ( $P = 0.880$ ) effects on canola seed weight at 12 location-years in Saskatchewan and Manitoba. Standard errors of the treatment means are enclosed in parentheses.**

	--- Effect ---	----- Fungicide -----			
	FUNG×LOC	Control	1-20% bloom	2-50% bloom	Dual App.
Location-Year	--- p-value ---	----- g 1000 seeds <sup>-1</sup> -----			
Brandon-2013	0.984	3.83 a (0.071)	3.83 a (0.071)	3.82 a (0.071)	3.85 a (0.071)
Brandon-2014	0.623	2.51 a (0.071)	2.59 a (0.071)	2.61 a (0.071)	2.53 a (0.071)
Brandon-2015	0.900	3.05 a (0.071)	3.05 a (0.071)	2.99 a (0.071)	3.05 a (0.071)
Indian Head-2013	0.686	3.50 a (0.071)	3.54 a (0.071)	3.50 a (0.071)	3.59 a (0.071)
Indian Head-2014	—	—	—	—	—
Indian Head-2015	0.890	3.09 a (0.071)	3.09 a (0.071)	3.13 a (0.071)	3.15 a (0.071)
Melfort-2013	—	—	—	—	—
Melfort-2014	0.772	3.03 a (0.071)	3.03 a (0.071)	2.98 a (0.071)	2.95 a (0.071)
Melfort-2015	—	—	—	—	—
Melita-2013	0.007	2.90 b (0.076)	3.18 a (0.071)	2.95 b (0.071)	3.10 ab (0.071)
Melita-2014	0.655	2.50 a (0.071)	2.52 a (0.071)	2.60 a (0.071)	2.53 a (0.071)
Melita-2015	0.887	2.62 a (0.071)	2.68 a (0.071)	2.66 a (0.071)	2.62 a (0.071)
Outlook-2013	0.446	6.40 a (0.076)	6.39 a (0.076)	6.37 a (0.071)	6.27 a (0.071)
Outlook-2014	0.686	2.70 a (0.071)	2.71 a (0.071)	2.72 a (0.071)	2.80 a (0.071)
Outlook-2015	0.815	3.95 a (0.071)	3.92 a (0.071)	3.93 a (0.071)	3.87 a (0.071)
All Sites (average)	—	3.38 A (0.021)	3.34 A (0.021)	3.35 A (0.021)	3.56 A (0.021)

### *Summary and Conclusions*

Overall, this study showed that sclerotinia incidence and severity were reduced by either using tolerant hybrid or fungicide applications; however, overall disease pressure was low and neither technology eliminated the disease when it was present at notable levels. Under the low disease pressure encountered, there was little benefit to applying fungicide for tolerant hybrid as there were no further reductions in disease and effects on yield were generally not significant or likely to be economical. That being said, yields were frequently higher with the susceptible hybrid and, even there, the economic viability of fungicide applications was questionable at best for the vast majority of individual locations-years. In most cases where there was evidence of a yield increase with fungicides, yields tended to be higher at the later of the two fungicide applications; however, these results would not be expected

under all conditions. Furthermore, at 50% bloom, the application window for controlling sclerotinia with fungicide application is rapidly closing. Because early infection generally has the greatest potential to yield loss therefore it is generally advisable to apply fungicide between 20-50% bloom and before a significant number of petals have dropped. Not surprisingly given the low levels of disease, there were no benefits to dual fungicide applications with regard to either visual symptoms or actual seed yields. Overall, these results showed that tolerant hybrids are effective for reducing disease and less likely to benefit from fungicide; however, susceptible hybrids may frequently yield higher, at least under low disease pressure as encountered in these trials.

Concerns are occasionally raised as to whether small plots are appropriate for evaluating diseases such as sclerotinia, primarily due to edge effects and increased air flow through the canopy. In addition, this disease tends to be more severe in low-lying, wet areas of the field while plot trials tend to be situated on well-drained, uniform sites. Nonetheless, all sites strived to make plot sizes as large as possible and, at Indian Head, the current results are consistent with those of field-scale evaluations conducted with susceptible hybrids over the same period. While we know that fungicides can dramatically reduce yield loss under heavy disease pressure, we saw few responses despite repeating the trial 14 times at locations which were specifically selected to have moderate to high disease pressure. Due the relatively small and inconsistent responses, the challenge for managing sclerotinia in canola continues to be accurately predicting whether yield responses to fungicide applications are likely and future research should continue to develop and improve predictive tools. While this can be a challenge for all diseases, it is especially the case for sclerotinia which can only be controlled well before the first symptoms develop. Genetic tolerance is an exciting advancement that has could help to reduce our dependence on fungicides and provide adequate protection under the relatively low disease pressure than is not uncommon in western Canada.

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### *Appendices*

Table A-1. Rating system used to quantify sclerotinia infection levels at each location (Kutcher and Wolf 2006)		
Disease Rating (0-5)	Lesion Location	Canola Symptoms
0	None	No symptoms
1	Pod	Infection of pods only
2	Upper	Lesion situated on main stems or branch(es) with potential to affect up to ¼ of seed formation and filling on plant
3		Lesion situated on main stems or a number of branches with potential to affect up to ½ of seed formation and filling on plant
4		Lesion situated on main stems or a number of branches with potential to affect up to ¾ of seed formation and filling on plant
5	Lower	Main stem lesion with potential effects on seed formation and filling of entire plant



# Performance of *Brassica carinata* Varieties to *Brassica napus* (Argentine Canola)

Cooperators: Agrisoma Biosciences Inc. – Ottawa ON, [www.agrisoma.com](http://www.agrisoma.com)

## Introduction

*Brassica carinata* A. Braun, commonly known as Ethiopian mustard, has an oil profile ideal for use in the biofuel industry, specifically for biojet fuel. This crop is extremely well suited to production in semi-arid areas. It offers good resistance to biotic stressors, such as insects and disease, as well as abiotic stressors, such as heat and drought. *Carinata* is a vigorous crop with a high branching growth pattern and large seed size. It has excellent harvestability, with good lodging and shatter resistance. An elite line (AAC A100 & AAC A110) has been developed by Agrisoma Biosciences Inc., selected for 2012, and has the following production characteristics:

- Oil Content 44%
- Protein 28%
- Maturity Zone is Mid-long season (12-14 days later than oriental mustard)
- Blackleg Resistance Excellent
- Lodging Resistance Very Good to Excellent

*Brassica carinata* will be able to access the full suite of *Brassica* spp. pest control options. Minor use registrations targeting seed treatments, selective broadleaf and grass control herbicides have been initiated. (Source: Agrisoma Biosciences Inc.)

*Brassica carinata* has 34 chromosomes with genome composition BBCC, and is thought to result from an ancestral hybridisation event between *Brassica nigra* L. (genome composition BB) and *Brassica oleracea* L. (genome composition CC). *B. carinata* has high levels of undesirable glucosinolates and erucic acid making it a poor choice for general cultivation as an oilseed crop in comparison to the closely related *Brassica napus* L. (canola). On October 29 of 2012, the first flight of a jet aircraft powered with 100 percent biofuel, made from *Brassica carinata*, was completed by Agrisoma Biosciences Inc. (Source: Wikipedia) Johnson *et al.* (2007) reported that nitrogen requirements for *Brassica carinata* are similar to *Sinapis alba* L. (yellow mustard) and *Brassica napus* (Argentine canola).

In 2012, WADO partnered with Agrisoma Biosciences Inc. to determine the nitrogen-yield response of *B. carinata*, compared to canola and camelina. Results of these studies are found in the 2012 WADO Annual Report. In 2013 and 2014, Agrisoma partnered with WADO to test some new and existing *B. carinata* lines compared to a common *B. napus* (Argentine canola). WADO continues to partner with Agrisoma and have had consistent results with *B. carinata* comparing to *B. napus* over the past few years.

## Methods

A soil test was taken prior to seeding the plots to determine background nutrient profiles (table 1). Trials were planted into a Newstead Loamy Sand south of Melita, MB. Plots were seeded into Summer Fallow.

**Table 1:** Spring soil test values prior to seeding in the 0-24" depth for the *B. carinata* variety trial in Melita, MB in 2015.

Depth	pH	N ppm	P ppm Olsen	K ppm	S lbs/ac	Organic Matter %
0-6"	7.9	16	6	411	72	3.4
6-24"		63			360	

Seven *B. carinata* cultivars and two *B. napus* varieties (L130 LL and 9553 RR) were seeded into plots arranged in a randomized complete block design and replicated four times. Plots were seeded May 28 at a depth of 3/8". Final plot dimension was 1.44 m wide by 9 m long. Fertilizer was sideband with liquid UAN and a granular blend at a rate 111 lbs/ac N, 35 lbs/ac P, 30 lbs/ac K and 20 lbs/ac S. Prior to seeding, the area was burned off with a tank mix of Roundup, Rival, and Aim at a rate of 1 L/ac, 0.5 L/ac, and 10 ml/ac, respectively. On June 18, Assure II at 0.15 l/ac and Muster at 8 g/ac herbicides and adjuvant were sprayed on plots to control broadleaf and grassy weeds. Desiccant was applied to *carinata* plots on August 28<sup>th</sup> (Reglone at 0.9 l/ac plus Roundup). *B. napus* plots were harvested for seed yield on August 25<sup>th</sup> and *B. carinata* was combined on September 3<sup>rd</sup> both with a Classic Wintersteiger plot combine. Data collected included: emergence, stand, days to flower, days to maturity, height, seed yield, seed weight, and seed moisture content. Sub samples were sent to Agrisoma for oil content analysis. Data was analyzed with a two-way analysis of variance (ANOVA) Agrobase Gen II statistical software using the nearest neighbours analysis (NNA).

## Results

There were significant differences among varieties of *B. carinata* and between *B. napus* to *B. carinata* (Table 2). *B. napus* varieties were among the worst yielding varieties compared to most other *B. carinata* types. The top yielding varieties of *B. carinata* differed by as much as 33% compared to the best *B. napus* variety.

There were significant differences in days to flower, days to maturity and crop height. Also significant differences were found in seed weight, where generally *B. carinata* types were heavier than *B. napus* types by about 28% on average. There were no significant differences in lodging.

**Table 2:** Brassica carinata and canola variety performance and yield values in Melita, MB in 2015.

Variety	Days to Flower days	Days to Maturity days	Height cm	Seed Weight g/500	Grain Yield kg/ha
110994EM	46.0	91.0	136	1.81	2134
AAC A110	46.5	90.3	150	1.70	2110
LL napus	34.0	77.3	123	1.29	1667
RR napus	42.0	83.3	125	1.43	1691
5223	46.0	91.0	137	1.97	2230
5228	46.0	91.0	140	1.68	2005
5454	46.0	91.3	141	2.01	1876
5489	46.5	91.5	138	1.77	1755
5499	46.5	90.5	120	2.09	1970
CV%	2	2	6	6	12
LSD (p<0.05)	1.2	2.4	11	0.16	331
P value	<0.0001	<0.0001	<0.0001	<0.0001	0.0127
R-squared	0.97	0.93	0.71	0.89	0.56
Grand Mean	44.4	88.6	134.3	1.7	1938

### Observations

Some of the highest yielding varieties of carinata were also the tallest in crop height. Being carinata and inherently shatter resistant, these varieties would likely be suited for straight cutting as their height (leading to canopy lodging) would likely reduce shatter losses during harvest.

Over the past several years growing carinata, WADO has experienced heavy flea beetle infestations requiring multiple insecticide applications throughout the season over the same trial. Producers should plan to use a registered seed treatment or in crop insecticide spray.

During the time of the trial, the Melita location received 128% of normal rainfall. *B. carinata* is more adapted to drier conditions than canola. *B. carinata* and canola yields may have been suppressed by excessive soil moisture. This was similar to growing conditions in 2013, however the *B. napus* check (Nexera 2012 CL) fared better in 2013 than in 2014.

### Conclusions

Given the extensive ancestry of carinata in the rather large and diverse mustard family, carinata has a promising future. WADO plans to continue its research efforts with *B. carinata* and Agrisoma Biosciences Inc.

In general, most varieties of *B. carinata* statistically held up against the yield potential of the *B. napus* canola variety. This is comparable to results observed in the WADO 2012, 2013, and 2014 trials.

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**Photo:** Argentine canola and *Brassica carinata* July 16, 2015 near Melita, MB.

## Brown and Oriental Mustard (*Brassica juncea*) Coop Test

### Cooperators

- Mustard 21 Canada Inc.
- AAFC Saskatoon

**Research Site:** Melita, MB

**Location:** SW 26-3-27 W1

**Cooperator:** John Snyder

**Previous Crop:** Summer Fallow

**Soil Texture:** Newstead Loamy Fine Sand

**Soil Test:**

Depth	pH	N	P	K	S	Organic Matter
		ppm	ppm Olsen	ppm	lbs/ac	%
0-6"	7.8	13	4	347	104	2.8
6-24"		27			360	

### Background

Mustard seed (*Brassica spp.*) is an annual, cool season crop that can be grown in a short growing season, commonly in rotation with small grains. A relative of canola, mustard seed has the advantage of being more tolerant to drought, heat, and frost. Canada produces three mustard types: yellow (*Sinapis alba*), brown, and oriental (*Brassica juncea*). (AAFC)

Brown and oriental mustard seed are hot and spicy. Brown mustard seed is ground into flour which is used to produce hot mustard used in European products. The oil content of brown mustard seed is about 36%. Oriental mustard seed is often used to produce spicy cooking oils. There are oriental mustard seed varieties grown in Canada that have oil contents of up to 50%, although the average oil content is approximately 39%. (AAFC)

The 2015 Coop Mustard Trial was initiated to compare new lines versus established cultivars to see if the new lines have potential as new varieties. Melita was one of 15 trial sites across Western Canada and Montana grown last year and the only one in Manitoba. The Melita site was successful.

Varieties/lines that were being tested in the 2015 Coop Mustard trials were the following:

Brown mustard (*Brassica juncea*):

1. Centennial Brown (check)
2. AAC Brown 100 (B474DH71)
3. B59DH7
4. B123DH47

Oriental mustard (*B. juncea*):

1. Cutlass (check)
2. AAC Oriental 200 (O60DH17)
3. O123DH16
4. O123DH136
5. O1504DH3

## *Objectives*

The Mustard 21 Coop breeding objectives are the following:

- Developing high yielding and white rust (2a) resistant brown and oriental mustard varieties.
- Establishing the Ogura cms system for hybrid breeding in brown and oriental mustard.
- Improving quality traits: low fixed oil content, high protein content, high mucilage content (yellow mustard), seed size, seed color.

Objectives of this trial in Melita were the following:

- Compare seed yield and quality parameters of new lines of brown and oriental mustard to established varieties of mustard to those across various locations of the Canadian prairie provinces and in Montana USA.

## *Methods*

This trial consisted of 11 varieties in plots that were 1.44 m wide x 9 m long. Varieties were organized in a randomized complete block design and replicated four times. Plots were direct seeded May 28<sup>th</sup> at a depth of  $\frac{1}{2}$ ". Fertilizer was applied at 111 lbs/ac nitrogen, 35 lbs/ac phosphorous, 30 lbs/ac potassium, and 20 lbs/ac sulfur. Plots were maintained weed free with Assure II at 0.15 l/ac and Muster at 8 g/ac tank mixed with adjuvant on June 18<sup>th</sup>. Plots were swathed on August 7<sup>th</sup> and harvested on August 20<sup>th</sup> with a Wintersteiger plot combine.

Data collected included days to flower, days to maturity, height, lodging, seed weight and yield. Data was subject to a two-way analysis of variance (ANOVA) was calculated using Analyze-it version 2.03 statistical software (Microsoft). Coefficient of variation (CV), least significant difference (LSD), grand mean and R-squared were calculated and summarized in the results table.

## *Results*

There were significant differences among entry days to flower, days to maturity, seed weight and yield (Table 1) at the Melita site. A summary of five locations from the 2015 trials is illustrated in Table 2, 3, 4, 5 including yield, disease resistance, quality, and glucosinolate parameters.

Lodging was not an issue for any of the varieties.

**Table 1:** Days to flower, days to maturity, crop height, seed weight, and grain yield of *B. juncea* lines in Melita, 2015.

Entry	Crop Type	Days to Flower days	Days to Maturity days (70%SCC)	Height cm	Seed Weight g/500	Yield kg/ha
O123DH25	Oriental	32.8	70	141.0	1.16	2257
O123DH16	Oriental	30.8	70	126.0	1.13	2228
Cutlass	Oriental	31.0	70	127.5	1.13	2227
B59DH7	Brown	31.0	70	135.5	1.21	2209
O060DH17	Oriental	34.5	70	133.3	1.10	2074
Centennial Brown	Brown	34.5	70	132.8	1.35	2065
B474DH71	Brown	36.5	70	139.0	1.47	2049
O123DH136	Oriental	34.3	70	138.0	1.20	1999
B474DH11	Brown	36.3	70	125.3	1.24	1917
O1504DH3	Oriental	37.3	71	135.5	1.24	1860
B123DH47	Brown	31.5	70	130.3	1.05	1795
CV%		3.0	0	6.5	10.3	6.4
LSD (p<0.05)		1.5	0	NS	0.18	188
P value		<0.0001	<0.0001	0.1840	0.0029	<0.0001
Rsquared		0.88	1.00	0.38	0.55	0.75
Grand Mean		33.7	70	133.1	1.21	2062

**Table 2:** Agronomic Performance of the Brown Mustard Lines from the Co-op Mustard Tests 2015 (all sites.)

Entry	Average Yield kg/ha	Seed Size g/1000 Seeds	Oil %	Protein %	Allyl GSL umol/g Seed	Chloro mg/kg seed	Color (WI)	Maturity (days)	White rust (2a)
Centennial Brown (check)	1825	2.77	34.2	30.5	123	2.95	-4.46	86	S
AAC Brown 100	1944	3.18	35.0	30.4	132	4.47	-3.44	86	R
B59DH7	1861	2.33	34.8	30.7	127	1.58	-6.67	86	R
B123DH47	1828	2.25	35.4	31.3	136	2.74	-7.18	86	S
LSD (5%)	124	0.11	0.62	0.48	4.8	1.18	1.58	2.1	
# Station Years	5	4	4	4	3	4	4	4	

**Table 3:** Agronomic Performance of the Oriental Mustard Lines from the Co-op Mustard Tests 2015 (all sites).

Entries	Average Yield kg/ha	Seed Size g/1000 Seeds	Oil %	Protein %	Allyl GSL umol/g Seed	Chloro mg/kg seed	Color (WI)	Maturity (days)	White rust (2a)
Cutlass (check)	1959	2.46	38.8	29.5	130	1.87	-33.5	86	R
AAC Oriental 200	2053	2.25	37.1	29.2	128	1.22	-26.3	86	R
O123DH16	1847	2.53	38.4	29.7	128	1.86	-31.1	86	R
O123DH25	2081	2.44	38.1	29.4	140	1.95	-34.9	89	R
O123DH136	1974	2.64	36.1	31.0	144	1.25	-33.1	87	R
O1504DH3	1829	2.74	37.5	30.2	133	3.02	-27.6	89	R
LSD (5%)	124	0.11	0.62	0.48	4.8	1.18	1.58	2.14	
# Station Years	6	4	5	5	4	5	5	5	

**Table 4:** Summary of glucosinolate contents of the brown mustard lines from the Co-op Mustard Test 2015 (all sites).

Entry	Allyl	BUT ( $\mu\text{mol/g seed}$ )	IND	Hydroxy IND
Centennial Brown (check)	123	0.68	0.03	2.78
AAC Brown 100	132	5.30	2.46	2.66
B59DH7	127	0.68	0.22	3.32
B123DH47	136	0.52	0.05	4.00
LSD (5%)	4.8	0.26	0.13	0.26
# Station Years	3	3	3	3

**Table 5:** Summary of glucosinolate contents of the oriental mustard lines from the Co-op Mustard Test 2015 (all sites).

Entry	Allyl	BUT ( $\mu\text{mol/g seed}$ )	IND	Hydroxy IND
Cutlass	130	0.59	0.27	3.36
0123DH16	128	0.34	0.25	3.61
0123DH25	140	0.81	0.21	3.04
0123DH136	144	0.65	0.33	3.04
01504DH3	133	0.87	0.08	3.40
LSD (5%)	4.8	0.26	0.13	0.26
# Station Years	4	4.0	4	4

## Discussion

WADO had to reseed this trial (initially seeded May 1<sup>st</sup>) due to extreme flea beetle pressure, despite using two applications of Matador insecticide in an attempt to recover the trial. The reseeding was successful.

In comparison to a trial beside this one, treated nearly the same, *B. juncea* had similar or superior yields compared to *B. carinata* and *B. napus* varieties. It was quite dry during the month of August, when pod development was transpiring, which may have favored yield development of *B. juncea* compared to *B. carinata* and *B. napus* varieties.

*B. juncea* varieties matured about 20 days earlier than *B. carinata* and 10 days earlier than *B. napus* crop types. This may prove to be a more suitable initial crop to grow in rotation with winter wheat or rye than canola or *B. carinata* to allow for compliance with seeding date deadlines for crop insurance in winter cereals.

Crop height was about 10 cm taller for *B. juncea* than *B. napus* types. This could involve a larger more cumbersome swathing operation. But it also provides the opportunity to leave taller stubble with more snow catching ability for better winter cereal survival.



**Photo:** Plots of *Brassica juncea* at Melita in late flower in Melita, MB in 2015. Photo taken July 16.

### *References*

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# Herbicide Screening and the Effects of Betamix $\beta$ Herbicide Rates for Buckwheat Production

**Cooperator:** Manitoba Buckwheat Growers Association – Les McEwan

## Introduction

Currently buckwheat has few herbicides registered for controlling weeds in Manitoba. Only Poast Ultra (450 g/L sethoxydim, BASF Canada) is currently registered for use preseed or in-crop at all stages. Restrictions for its use must be followed to avoid unacceptable residues of sethoxydim in the harvested crop. Sethoxydim is a Group 1 herbicide. Recent herbicide resistance among several weed species including Wild Oats (1990), and Green Foxtail (1991) to Group 1's has become evident in Manitoba fields. Other weed species such as Redroot Pigweed, Wild Buckwheat, Cleavers, and volunteer canola have herbicide tolerances of their own and often populate buckwheat stands. As a result, buckwheat can be a difficult crop to manage.

Betamix- $\beta$  EC (Bayer CropScience Canada) is a selective post emergent herbicide used in sugar beets, spinach, June-bearing strawberries and is registered across Canada. Betamix is comprised of two active ingredients, desmedipham (153 g/L) and phenmedipham (153 g/L) and is a Group 5 herbicide. In June-bearing strawberries and garden beets, Betamix is applied at rates between 1.15-1.75 L/ha (0.47 L/ac - 0.70 L/ac). Referenced from Bayer CropScience Label.

Weeds controlled Include:

Group I: Weeds vulnerable to Betamix if sprayed before reaching the 4 leaf stage.

<u>Common Name</u>	<u>Scientific Name</u>
Lamb's-quarters	<i>Chenopodium album</i>
Wild Buckwheat	<i>Polygonum convolvulus</i>
Green Foxtail (Wild Millet)	<i>Setaria viridis</i>
Yellow Foxtail (Pigeon Grass)	<i>Setaria glauca</i>
Mustard	<i>Brassica spp. Sisymbrium spp.</i>
Pigweed	<i>Amaranthus spp.</i>

Group II: Weeds which may be controlled if sprayed before reaching the 2 leaf stage, when use of Betamix is preceded by a pre-plant or pre-emergence herbicide treatment.

<u>Common</u>	<u>Name Scientific Name</u>
Nightshade	<i>Solanum spp.</i>
Kochia*	<i>Kochia scoparia</i>
Goosefoot	<i>Chenopodium spp.</i>
Ragweed	<i>Ambrosia spp.</i>
Stinkweed	<i>Thlaspi arvense</i>
French weed	Field Pennycress

\*Spray Kochia while in the rosette stage, less than 2.5 cm in diameter.

In the summer of 2012, WADO initiated a small herbicide screening trial on buckwheat to explore the response of buckwheat to several herbicides (non-registered) including post-seeding pre-emergent use of Linuron 400 SC [United Agri-Products] (400 g a.i./L) at a low and high rates. Minimal crop injury (at 0.75 L/ac rate) and to a lesser extent lack of stand reduction indicated that the use of linuron might exhibit promising potential as a weed control option in buckwheat. In 2013, WADO tested several increments of increasing rates of linuron applied pre-emergent to buckwheat. Based on results from this trial, linuron appeared to be a promising herbicide offering plant stand safety, with no apparent effect on grain yield and the potential to be used at low rates. Grain samples were not sent away for residue testing. The results of that trial are summarized in the 2012 & 2013 WADO Annual Reports.

As of September 2012, after a re-evaluation of the herbicide linuron, Health Canada's Pest Management Regulatory Agency (PMRA), under the authority of the Pest Control Products Act, is proposing to phase out the sale and use of all linuron products in Canada. This is because an evaluation of available scientific information found that, under the current conditions of use, the human health and environmental risks estimated for linuron do not meet current standards. To understand more about what the outcome is for linuron in regards to the proposal please visit: <http://www.hc-sc.gc.ca/cps-spc/pest/part/consultations/prvd2012-02/prvd2012-02-eng.php>. Unfortunately, this was not good news in terms of seeking a minor use registration of the product in the future.

WADO tested some additional *post emergent* products which were also being researched by other institutions including desmedipham/phenmedipham and Armezon (topramezone). Wall and Smith in 1999 (AAFC) used desmedipham in buckwheat at rates of 500-700 g a.i./ac with success. WADO was unable to get desmedipham for testing (absent in North American Inventory), however this active was available in a blend from Betamix  $\beta$  (desmedipham + phenmedipham; Bayer Crop Science). WADO hoped that the phenmedipham component of the product would have little effect on buckwheat in addition to the desmedipham component already found to be tolerant by buckwheat by Wall and Smith.

Armezon (BASF Chemical Company, USA) was tested at AAFC (Scott, SK) by Eric Johnson in 2012. Armezon is a group 27 herbicide. Johnson had some success at lower rates without plant injury. Further testing on Armezon was also initiated again in 2013.

In 2014 and 2015 a trial was set up to test the efficiency of Betamix on stands of buckwheat. Objectives of this trial included:

1. To observe the crop injury response of buckwheat to various Betamix rates on plant growth and grain yield.
2. To document weed populations and weed control between rates of Betamix.
3. To determine optimal rate of Betamix for maximum yield potential in buckwheat.

Results presented in this report are related to the 2015 trial.

## *Methods*

Plots were located south of Melita, MB on the legal land location SW 27-3-27 W1 on a Newstead Loamy Fine Sand. Plot treatments were located on Summer Fallow. A pre-emergence application of glyphosate (Roundup Transorb) at a rate of 0.33 L/ was applied on June 1. Buckwheat was seeded on June 1<sup>st</sup> into 6 row plots (9.5" spacing) 1.44 m wide by 9 meters long using SeedHawk dual knife openers. Seeding rate was 183 p/m<sup>2</sup> (63 lbs/ac) using the 'Horizon' variety provided by Nestibo Agra (Deloraine, MB).

Fertilizer was sideband during seeding at a rate of 88 lbs/ac nitrogen using 28-0-0 UAN, and a granular blend of 12-17-15-10 applied at 200 lbs/ac.

Spring Soil Test:

Legal	Depth	pH	N lbs/ac	P ppm Olsen	K ppm	S lbs/ac	Organic Matter %
SW 26-3-27 W1	0-6"	7.5	13	4	347	104	2.8
	6-24"		27			360	

The plot field did not to have any residual pre-emergent herbicide applications in 2014 and 2015. Spray treatments were applied June 23 at approximately 15 cm crop height. A hand held sprayer pressurized by CO<sub>2</sub> was used to spray each herbicide treatment. Four fan nozzles (8002VS) at 50 cm spacing were pressurized to 40 psi during application. Betamix was applied with water at 10 gal/ac and product rates ranged from 0.25 L/ac to 2.00 L/ac. Treatments were arranged in a randomized complete block design and replicated three times. A weedy check and a hand weeded check were included to determine a base line for weed pressure and herbicide injury, respectively.

Plots were sprayed with Assure II to control grassy weeds on June 24 and at a rate of 0.2 L/ac. The hand weeded check was weeded several times throughout the season to minimize the effects of weed flushes after seeding.

Plots were swathed September 28<sup>th</sup>. Plots were harvested October 8 with a Hege 140 plot combine. Samples were collected, cleaned using a table seed cleaner (Eclipse 432, Seedburo) and weighed. Samples were corrected to 16% moisture.

Data collected included percent crop injury at bolting and at flower (of the unsprayed check), photos of each plot at bolting, percent flowers delayed (of the unsprayed check), weed biomass (taken during flower), grain yield, grain test weight, and grain moisture. Weed biomass was taken as a wet weight of fresh weeds hand picked out of plots within an area of 1.44 m<sup>2</sup>. Data was analyzed using Analyze-it 2.03 statistical software (Microsoft Co.) using a two way analysis of variance. Coefficient of variation and least significant difference (Fishers unprotected) was calculated.

Crop injury, flower delay, and weed biomass were used as independent variables and were tested against grain yield (dependent variable) to determine the strength of their relationship to each other using a Pearson correlation analysis to test for their correlation coefficient (r) and the significance of their relationship. If significant, a linear regression analysis was also performed to test for the strength of their association (R-squared) and their equation describing their relationship ( $y = mx + b$ ) also using Microsoft Analyze-it v2.03 statistical software.

**Picture:** 2015 plots of buckwheat showing some signs of stunting at bolting from herbicide injury using Betamix herbicide.



## Results

There were significant differences ( $p < 0.05$ ) in percent crop injury at bolting and flower (Table 1). There were no significant differences in delay of flower, weed biomass, maturity, grain yield, and grain test weight.

**Table 1:** Percent crop injury of check, percent flowers delayed of check, grain yield, test weight and weed biomass in buckwheat plots under rates of Betamix herbicide in Melita, MB in 2015.

Treatment No.	Herbicide Rate	Treatment	Crop Injury @ Bolt % of check	Crop Injury at Flower % of check	Flower Delay % of check	Mature Plant Height cm	Grain Yield kg/ha	Test Weight g/0.5L	Weed Biomass wet kg/m <sup>2</sup>
1	Check, unsprayed, hand weeded		-	-	-	120	1927	256	0.13
2	Check, unsprayed, not hand weeded		-	-	-	120	1848	260	0.29
3	0.25	L/ac Betamix	5.0	5.0	4.0	124	2021	256	0.14
4	0.50	L/ac Betamix	6.7	10.0	6.7	115	1830	263	0.22
5	0.75	L/ac Betamix	11.7	18.3	10.0	114	2056	261	0.16
6	1.00	L/ac Betamix	13.3	15.0	11.7	116	1921	266	0.18
7	1.50	L/ac Betamix	20.0	21.7	18.3	104	2042	259	0.21
8	2.00	L/ac Betamix	26.7	30.0	28.3	108	1979	254	0.14
CV%			39	55	86	9	10	3	74
LSD ( $p < 0.05$ )			7.4	12.5	NS	NS	NS	NS	NS
P value			<b>0.001</b>	<b>0.016</b>	0.053	0.334	0.755	0.454	0.842
Grand Mean			10.4	12.5	9.9	115	1953	260	0.19
R-squared			0.88	0.77	0.64	0.73	0.63	0.34	0.40

There was no significant relationship between crop injury, weed biomass, with grain yield or test weight (Table 2).

**Table 2:** Relationships between crop injury, flower delay and crop yield in buckwheat from applications of Betamix herbicide in Melita, MB in 2015.

Relationship	Correlation r	P value (2-tailed)	Significant?
Crop Injury Bolting X Grain Yield	0.15	0.543	No
Crop Injury Flower X Grain Yield	0.15	0.548	No
Delay of Flower X Grain Yield	0.05	0.845	No
Weed Biomass x Grain Yield	-0.09	0.737	No

Volunteer canola was present in all plots as a weed and there were visual differences in volunteer canola biomass among rates of Betamix. Therefore there was suppression of volunteer canola rather than control in plots sprayed with Betamix. This trial did not divide weed biomass values among individual weed species. Environmental conditions may have influenced weed control from Betamix applications including excessive moisture before or after application (Appendix 1).

## Discussion

In 2014, Betamix appeared to improve weed control in buckwheat production but led to greater crop injury with higher rates. In 2015, Betamix did not improve weed control significantly despite the rate used but still lead to crop injury at bolting and flowering stages. A 0.75 L/ac rate caused an 11.7% crop injury at the bolt stage however this nor higher rates translated into a significant enough crop injury to reduce grain yield.

Betamix herbicide appears to be a promising herbicide for post application control of weeds in buckwheat.

A formal request to Bayer CropSciences Canada may be initiated to ask permission to further pursue a formal minor use registration request with Health Canada's Pest Management Regulatory Agency (PMRA ) for use of Betamix on buckwheat in Manitoba. Contact WADO for future updates.

## References

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**Appendix 1:** Weather Data. Highlighted area was application date of Betamix herbicide. Data derived from the Pierson, MB weather station courtesy of Manitoba Agriculture Food and Rural Development.

Date	Temp Max °C	Temp Min °C	Temp Ave. °C	Precip. (mm)	Accum. GDD	Wind Direction °N	Wind Gust km/hr
01-Jun-15	29.3	9.7	19.5	0	228.8	33	56
02-Jun-15	16.9	10.5	13.7	62.2	237.5	5	52
03-Jun-15	19.6	9.9	14.8	0.2	247.3	5	37
04-Jun-15	22.3	7.5	14.9	0	257.2		<31
05-Jun-15	25.5	11.7	18.6	0	270.8	15	35
06-Jun-15	27	14.5	20.8	31.8	286.6	28	46
07-Jun-15	26.9	13.9	20.4	0	302	33	44
08-Jun-15	32.4	13.3	22.9	0	319.9	33	32
09-Jun-15	25.5	15.8	20.7	0	335.6	33	50
10-Jun-15	25.4	11.7	18.6	0	349.2		<31
11-Jun-15	28	12	20	0	364.2		<31
12-Jun-15	28.7	14	21.4	0	380.6	19	57
13-Jun-15	24.2	13.7	19	0.4	394.6	31	39
14-Jun-15	25.4	11.5	18.5	0	408.1	31	46
15-Jun-15	21.8	9	15.4	0	418.5	35	35
16-Jun-15	24	6.8	15.4	0	428.9	18	35
17-Jun-15	26.8	9.7	18.3	0	442.2	1	46
18-Jun-15	20.7	9.7	15.2	1.4	452.4		<31
19-Jun-15	24.4	12.8	18.6	0.6	466	16	33
20-Jun-15	24.3	12.6	18.5	11.2	479.5		<31
21-Jun-15	25.7	10.6	18.2	3.2	492.7	27	54
22-Jun-15	23.9	13.4	18.7	0	506.4	33	39

23-Jun-15	28.4	11.6	20	0	521.4	25	32
24-Jun-15	30.2	12.8	21.5	0	537.9		<31
25-Jun-15	29.8	13.2	21.5	0	554.4	33	57
26-Jun-15	30.8	12.7	21.8	0	571.2		<31
27-Jun-15	29.8	16.7	23.3	0	589.5	34	41
28-Jun-15	28	14.7	21.4	0	605.9		<31
29-Jun-15	29.9	16.9	23.4	0	624.3		<31
30-Jun-15	23.2	15.9	19.6	0	638.9		<31
01-Jul-15	25	15.3	20.2	0	654.1		<31
02-Jul-15	27.2	14.3	20.8	0	669.9		<31
03-Jul-15	29.3	13.9	21.6	0	686.5		<31
04-Jul-15	31.1	17.9	24.5	2.4	706	29	69
05-Jul-15	24	14.2	19.1	0.4	720.1	34	32
06-Jul-15	20.8	10.9	15.9	0	731		<31
07-Jul-15	24.8	6.5	15.7	0.2	741.7	20	35
08-Jul-15	23	12	17.5	0	754.2		<31
09-Jul-15	30.8	9.7	20.3	0	769.5	25	39
10-Jul-15	30.2	14.3	22.3	0	786.8		<31
11-Jul-15	31.4	20	25.7	0	807.5	16	46
12-Jul-15	33.2	18.1	25.7	0.6	828.2	24	37
13-Jul-15	27.7	17.6	22.7	1.8	845.9		<31
14-Jul-15	30.3	17.4	23.9	0.2	864.8		<31
15-Jul-15	31.6	15.7	23.7	0	883.5		<31
16-Jul-15	28.5	17.9	23.2	5	901.7		<31
17-Jul-15	22	13	17.5	0.2	914.2		<31
18-Jul-15	23.8	12.9	18.4	0.4	927.6	32	57
19-Jul-15	27.8	13.2	20.5	0	943.1	31	48
20-Jul-15	26.2	10.7	18.5	0	956.6	34	32
21-Jul-15	26.3	10.3	18.3	0.4	969.9		<31
22-Jul-15	31.1	16.6	23.9	0	988.8	16	37
23-Jul-15	24.8	17.8	21.3	0.8	1005.1	36	37
24-Jul-15	29.7	14.1	21.9	0	1022	22	37
25-Jul-15	31.5	13.4	22.5	0	1039.5		<31
26-Jul-15	31.4	13.7	22.6	0	1057.1	18	41
27-Jul-15	31.3	15	23.2	0	1075.3	11	67
28-Jul-15	26.1	14.1	20.1	2.4	1090.4	28	67
29-Jul-15	27.1	13.8	20.5	0.2	1105.9	31	72
30-Jul-15	25.8	12.7	19.3	0	1120.2	31	52
31-Jul-15	27.5	12.1	19.8	0	1135		<31
01-Aug-15	32.6	10	21.3	0	1151.3	1	35
02-Aug-15	25.2	13.5	19.4	0	1165.7	35	41
03-Aug-15	27.3	9	18.2	0	1178.9		<31
04-Aug-15	27.6	9	18.3	0	1192.2		<31
05-Aug-15	25	15	20	15.8	1207.2	18	37
06-Aug-15	21.5	14.3	17.9	1.6	1220.1		<31
07-Aug-15	26.1	13.8	20	0.4	1235.1	28	46
08-Aug-15	25.8	11.5	18.7	0	1248.8		<31
09-Aug-15	27.2	10.4	18.8	0	1262.6		<31
10-Aug-15	30	11.2	20.6	0	1278.2		<31
11-Aug-15	33	12.5	22.8	0	1296	18	35

12-Aug-15	36.3	17.8	27.1	0	1318.1	18	35
13-Aug-15	34.3	18.4	26.4	0	1339.5		<31
14-Aug-15	38.3	16	27.2	0	1361.7	20	41
15-Aug-15	34.1	17.2	25.7	1.8	1382.4	29	46
16-Aug-15	22.3	10.8	16.6	0	1394	29	41
17-Aug-15	23.6	9.3	16.5	0	1405.5	33	32
18-Aug-15	24.8	8.5	16.7	0.4	1417.2		<31
19-Aug-15	25.3	9.5	17.4	0	1429.6		<31
20-Aug-15	29.3	8.5	18.9	0.6	1443.5	3	39
21-Aug-15	24.8	11.2	18	0	1456.5	7	39
22-Aug-15	18.4	11.6	15	24.4	1466.5	34	63
23-Aug-15	19.6	7.4	13.5	0	1475	32	59
24-Aug-15	23.4	3.7	13.6	0	1483.6		<31
25-Aug-15	24	6.6	15.3	0	1493.9		<31
26-Aug-15	29	13	21	0	1509.9	18	37
27-Aug-15	30.3	9.2	19.8	0	1524.7		<31
28-Aug-15	29.8	14.7	22.3	0	1542		<31
29-Aug-15	33.8	11.9	22.9	0	1559.9		<31
30-Aug-15	34.2	15.2	24.7	0	1579.6	32	44
31-Aug-15	26.1	11.3	18.7	8.2	1593.3	25	48
01-Sep-15	31.9	7.1	19.5	0	1607.8	16	33
02-Sep-15	33.4	10.7	22.1	0	1624.9	16	41
03-Sep-15	31.9	20.4	26.2	0	1646.1	13	35
04-Sep-15	22.6	14.4	18.5	0	1659.6	7	46
05-Sep-15	16.4	13.8	15.1	21.4	1669.7	6	43
06-Sep-15	20.8	11.1	16	17.4	1680.7	4	44
07-Sep-15	20.3	6.8	13.6	0	1689.3	26	41
08-Sep-15	19.6	6.4	13	0	1697.3	30	41
09-Sep-15	19.3	4.7	12	0	1704.3		<31
10-Sep-15	16.7	2.5	9.6	0	1708.9	1	32
11-Sep-15	23.3	1.2	12.3	0	1716.2		<31
12-Sep-15	28.7	5.2	17	0	1728.2	25	33
13-Sep-15	30.6	9	19.8	0	1743	2	44
14-Sep-15	22.2	5.6	13.9	0	1751.9	11	33
15-Sep-15	18.8	6.7	12.8	0	1759.7	5	41
16-Sep-15	21.1	8.6	14.9	4.2	1769.6	26	35
17-Sep-15	15.9	5.6	10.8	13.4	1775.4	30	41
18-Sep-15	20.7	2.3	11.5	0	1781.9		<31
19-Sep-15	24.3	4.2	14.3	0	1791.2	22	33
20-Sep-15	25.7	3.8	14.8	0	1801	25	35
21-Sep-15	23.9	6	15	0	1811	33	50
22-Sep-15	16.1	3.4	9.8	0	1815.8		<31
23-Sep-15	19.5	3.6	11.6	0.2	1822.4	10	41
24-Sep-15	19.2	10.6	14.9	0.6	1832.3		<31
25-Sep-15	26.1	9	17.6	0.2	1844.9	19	52
26-Sep-15	30.3	15.4	22.9	0	1862.8	19	54
27-Sep-15	21.3	9.6	15.5	2.2	1873.3		<31
28-Sep-15	15.3	1.3	8.3	0	1876.6	33	37
29-Sep-15	20.7	-1.7	9.5	0	1881.1	20	32
30-Sep-15	23.5	7.3	15.4	0	1891.5	15	37



## Sunflower or Corn Intercropped with Hairy Vetch

Westman Agricultural Diversification Organization Inc. (2015)

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Hairy vetch (*Vicia villosa*) is considered a winter annual and is also noted as a biennial or perennial. The plant is a fine stemmed, viney legume that is adapted to most soil types and is very competitive. Vines can grow over 100 cm long when able to trellis. Hairy vetch, when grown as a monocrop, lodges and tangles profusely with a height of 30 cm (similar to a good crop of Laird Lentils) and becomes difficult to swath. It apparently can contribute 60-120 lbs/ac nitrogen back to the soil from nitrogen fixation (source [www.hort.purdue.edu](http://www.hort.purdue.edu)). Hairy vetch has become popular in organic plow downs and the cover crop cultures for this reason. WADO's observations with hairy vetch indicate the plant has good late season frost tolerance, but has highly variable (16-80%) winter survivability depending on environmental conditions and seed source. Root development is rather shallow and similar to field pea, which may make it a good candidate for intercropping with deep rooted crops. Pod maturity is late seasoned (late August) when planted in the spring (May), and prone to shatter. Hairy vetch pasturage and seed can be toxic to livestock and should not be fed as forage in full bloom or containing seed, but is safe as a silage or hay. (Panciera R.J, Ritchey J.W & D.A 1992. Hairy Vetch Poisoning in Cattle: Update and Experimental Induction of Disease. J VET Diagn Invest. Vol. 4: 318-325). Prior to seed production, hairy vetch feed quality is exceptional and is similar to alfalfa (WADO feed analysis, 2008 & 2015). Hairy vetch can be pastured, hayed, or ensiled (Heson P.R., Schotch H.A., 1968 Vetch culture and uses. US Department of Agriculture Farmers' Bulletin 1740. US Government Printing Office, Washington DC.).

Sunflower and corn are two crops that are ideal for intercropping with hairy vetch because they have some compatibility in herbicide use, the timing of physiological development of both crops, potential fall-winter grazing in sunflower fields, and differing root zones. Authority 480 herbicide (sulfentrazone) distributed by NuFarm and FMC was registered for use in sunflower in 2011 in Manitoba. It is also compatible (unregistered) for weed control in hairy vetch according to observations by WADO (2009, 2011 and 2013-2015). By nature sunflower planted in spring develops its growth stages rather quickly in June. Hairy vetch on the other hand, develops rather slow initially, then peaks significant biomass development in August when planted in the spring. By this time, sunflower has finished physiological development, drops its leaves and allows hairy vetch to continue to flourish. The potential of intercropping sunflower and hairy vetch is rather large.



Intercropping corn and hairy vetch has slightly less compatibility as the growth habits are rather similar where the majority of growth for both is experienced in midsummer. Herbicide options are limited and all that are currently registered for use in corn will cause damage to hairy vetch. Corn is also more competitive for resources such as nutrients, light and moisture. However there is a demand to increase fodder feed values after corn grain harvest.



## Objectives

1. Understand the interaction between sunflower or corn yield and hairy vetch.
2. Understand the nitrogen economy and its economic value applied to monocrop and intercrop systems of sunflower or corn and hairy vetch.

WADO conducted an experiment with row cropped sunflowers and intercropped hairy vetch in 2013 and 2014. In 2012, the same trial was conducted but seed yield was lost due to blackbirds. For corn, a couple attempts in previous years have been foiled by deer browsing.

This report will divide the analysis of sunflower with hairy vetch and corn with hairy vetch into two separate sections. Sunflowers are discussed first in the following section.

## Sunflower and Hairy Vetch

### Methods

A soil test was taken prior to seeding the plots to determine background nutrient profiles. Trials were planted into a Newstead Loamy Fine Sand soil type southwest of Melita, MB. Plots were seeded into summer fallow.

Soil Test							
Legal Land Location SW 26-3-27W1							
Depth	pH	N ppm	P ppm Olsen	K ppm	S lbs/ac	CEC meq	Organic Matter
0-6"	7.7	10	8	405	120	22.91	3.2
6-24"		60			360		

Trial area was pre-treated with a tank mix of Roundup, Aim and Authority herbicide at 1 L/ac, 10 ml/ac, and 100 ml/ac, respectively, prior to seeding on May 15. Plot treatments consisted of 30" row confectionary sunflowers (10" spacing variety '6946' from NuSeed America) with and without hairy vetch. Sunflowers were direct seeded at a depth of 3/4" using an air seeding system with Seedhawk dual knife openers by directing three 9.5" rows into one 30" row. Hairy vetch seed was broadcast prior to seeding the sunflowers at a rate of 22 lbs/ac. Incorporation of the seed was possible by soil disturbance of the openers still on 9.5" spacing with approximately 30% soil disturbance. Hairy vetch was inoculated with pea/lentil granular Rhizobia (BeckerUnderwood). Plot treatments were arranged in a Randomized Complete Block Design that were 1.44 m wide by 9 meters long and were replicated 3 times. Fertilizer was sideband at a rate of 65 lbs/ac actual nitrogen and 35 lbs/ac actual phosphorous, 30 lbs/acre K and 20 lbs/ac S, using liquid 28-0-0 UAN and granular 11-52-0 MAP and granular potash (0-0-60) and granular ammonium sulfate (21-0-0-24). Plots were kept weed free with an application of Select (Clethodim) at a rate of 120 ml/ac applied June 15.

A SPAD 502 meter (Spectrum Technologies) was used to measure leaf chlorophyll content in sunflower. Chlorophyll content in leaves can be correlated to potential yield and nitrogen deficiencies. Readings were taken from each plot by sampling 15 random leaves of the second developed leaf under the flower per plot during R5.5 (mid-flower) stage of sunflower development. The 15 samples were calculated as a plot average. SPAD readings were taken August 21.

Soil moisture content was taken as an average of two readings per plot using a HydroSense II (Campbell Scientific). Sensor probes rods (CS658) are 20 cm long and measure soil volumetric water content (percent water) in a sandy soil (soil setting 1). Readings were taken August 21.

One 0.25 m<sup>2</sup> biomass sample of hairy vetch was taken from each hairy vetch treatment plot on September 16. Individual plot samples were sent to Central Testing Laboratories (Winnipeg, MB) for a wet chemistry forage test to determine protein content in order to determine nitrogen fixation accumulation.

Plots were harvested for sunflower grain October 16<sup>th</sup> with a Wintersteiger Classic plot combine. Seed samples were cleaned using a fanning mill with a top screen consisting of ½" expanded metal. Data collected from cleaned samples included: gross weight, percent moisture, seed weight determined for 500 seeds, and test weight.

Individual plot soil tests were taken on October 30 prior to freeze up to assess any noticeable differences in soil nutrient content. Plots were soil sampled with 3 cores per plot at 0-6" and 6-24" depths. Soil samples were sent to Agvise Laboratories (Northwood, ND) for analysis of soil nitrogen parameters to assess any nitrogen mineralization and fixation accumulations.

Nitrogen values and economics was subject to a two-way analysis of variance (ANOVA) using Analyze-it 2.03 statistical software (Microsoft) when more than two treatments were compared. Otherwise all other parameters were analyzed with an independent t-test both treatments. Coefficient of variation, standard error, p-values, least significant difference at the 0.05 level of significance (fishers unprotected LSD) and R-squared were calculated.



## Results

There were significant differences in hairy vetch biomass production and accumulations of nitrogen from biomass residues (Table 1). There were no differences in sunflower grain test weight, seed weight, grain yield, SPAD meter readings on leaf chlorophyll content and crude protein of hairy vetch biomass.

There were no significant differences in soil nitrogen levels at the 0-6" depth, 6-24" and 0-24" depth totals (Table 2). There were highly significant differences in total nitrogen in the system (biomass N + soil N) after harvest. These variations translated into highly significant differences in nitrogen economics but were significant only in monocrop hairy vetch crops. There was significant nitrogen accumulation in the system of sunflower plots with hairy vetch compared to those without hairy vetch. In addition, monocrop hairy vetch plots accumulated more nitrogen than in the intercrop soils. However this gain in nitrogen in the intercrop trial did not translate into a significant economic gross benefit. This is likely due to the economic value of nitrogen being diluted in the cash value of the

sunflowers; whose economics in yield performance outweigh the value of the nitrogen influence during statistical calculations.

There were no significant differences in percent soil organic matter or volumetric water content among treatments with plots cropped with hairy vetch being higher than those without (Table 3). Dry conditions at the time of sampling may have reduced the ability to decipher differences in water use in all three treatments.

**Table 1:** SPAD meter reading of sunflower plants, hairy vetch biomass, nitrogen accumulation in biomass, sunflower crop height, sunflower grain test weight seed weight, and sunflower grain yield in sunflower and hairy vetch intercropping compared to their monocrop derivatives.

Treatment	Mean Sunflower SPAD n=15	Hairy Vetch Biomass kg/ha	Crude Protein %	Nitrogen from Biomass Residues lbs/ac	Grain Yield kg/ha	Seed Weight g/500	Test Weight g/0.5L
Sunflower	28.7	-	-	-	4300	77.2	168.5
Sunflower + H. Vetch	28.9	4104	23.0	61.1	4377	68.6	167.4
H. Vetch	-	6777	22.7	99.5	-	-	-
Grand Mean	29	5441	23	80	4338	73	168
P value	0.894	<b>0.004</b>	0.732	<b>0.007</b>	0.927	0.184	0.758
S.E.	1.4	443.9	0.8	7.4	783.6	5.3	3.2

**Table 2:** Total residual soil nitrogen, biomass nitrogen, total nitrogen values and their economic values (assuming a nitrogen value of \$0.55/lb) of the N itself and the value of that N applied to the grain system value (assuming 32.00 cwt value for sunflower grain) under plots of hairy vetch and sunflower intercropping compared to their monocrop types.

Treatment	Nitrogen (lbs/ac)				\$ per acre	
	0-6"	6-24"	0-24"	Biomass N + Soil N	Total System N Value	Gross Income
Sunflower	6.0	7.0	13.0	13	\$ 7.15	\$ 1,232.73
Sunflower + H. Vetch	5.0	6.0	11.0	72	\$ 39.68	\$ 1,287.10
H. Vetch	8.3	6.0	14.3	114	\$ 62.61	\$ 62.61
CV%	24.3	15.8	13.8	11.7	11.7	25.6
LSD (p<0.05)	NS	NS	NS	18	\$ 9.70	\$ 499.81
P value	0.128	0.444	0.180	<b>0.0002</b>	<b>0.0002</b>	<b>0.004</b>
Grand Mean	6.4	6.3	12.8	66	36	861

**Table 3:** Percent soil organic matter and volumetric water content after crop production and standard error after each cropping treatment.

Treatment	Organic Matter		Vol. Water Content	
	%	St. Error	%	St. Error
Sunflower	3.0	0.2	8.0	0.4
Sunflower + H. Vetch	3.1	0.2	7.2	0.6
H. Vetch	3.2	0.1	9.4	1.5
CV%	3.4		20.2	
LSD (p<0.05)	NS		NS	
P value	0.123		0.352	

## Corn and Hairy Vetch

### Methods

A soil test was taken prior to seeding the plots to determine background nutrient profiles. Trials were planted into a Newstead Loamy Fine Sand soil type southwest of Melita, MB. Plots were seeded into summer fallow.

Soil Test							
Legal Land Location SW 26-3-27W1							
Depth	pH	N ppm	P ppm Olsen	K ppm	S lbs/ac	CEC meq	Organic Matter
0-6"	7.7	10	8	405	120	22.91	3.2
6-24"		60			360		

Trial area was pre-treated with a tank mix of Roundup, Aim herbicide at 1 L/ac and 10 ml/ac, respectively, prior to seeding on May 15. Plot treatments consisted of 30" row corn (8" spacing) using variety DK26-79 RR from Dekalb, Monsanto, with and without hairy vetch. Corn was direct seeded at a depth of 3/4" using an air seeding system with Seedhawk dual knife openers by directing three 9.5" rows into one 30" row. Hairy vetch seed was broadcast prior at a rate of 22 lbs/ac to seeding the sunflowers. Incorporation of the seed was possible by soil disturbance of the openers still on 9.5" spacing with approximately 30% soil disturbance. Hairy vetch was inoculated with pea/lentil granular inoculant (BeckerUnderwood). Plot treatments were arranged in a Randomized Complete Block Design that were 1.44 m wide by 9 meters long and were replicated 3 times. Fertilizer was sideband at a rate of 75 lbs/ac actual nitrogen and 35 lbs/ac actual phosphorous, 30 lbs/acre K and 20 lbs/ac S, using liquid 28-0-0 UAN and granular 11-52-0 MAP and granular potash (0-0-60) and granular ammonium sulfate (21-0-0-24). Plots were kept weed free with an 20 gal/ac water volume tank mix application of Basagran herbicide at a rate of 0.91 L/ac and Accent herbicide (with non-ionic surfactant Agral 90) applied at 13.5 g/ac on June 15. Accent herbicide caused some plant injury to hairy vetch and delayed growth. Biennial wormwood had to be hand weeded from the plots later in July as herbicide was not sufficient for its control.

A SPAD 502 meter (Spectrum Technologies) was used to measure leaf chlorophyll content in corn. Chlorophyll content in leaves can be correlated to potential yield and nitrogen deficiencies. Readings were taken from each plot by sampling 15 random leaves of the second developed leaf under the flower per plot during silk stage of corn development. The 15 samples were calculated as a plot average. SPAD readings were taken August 21.

Soil moisture content was taken as an average of two readings per plot using a HydroSense II (Campbell Scientific). Sensor probes rods (CS658) are 20 cm long and measure soil volumetric water content (percent water) in a sandy soil (soil setting 1). Readings were taken August 21.

One 0.25 m<sup>2</sup> biomass sample of hairy vetch was taken from each hairy vetch treatment plot on September 16. Individual plot samples were sent to Central Testing Laboratories (Winnipeg, MB) for a wet chemistry forage test to determine protein content in order to determine nitrogen fixation accumulation.

Plots were harvested for grain corn October 16<sup>th</sup> with a Wintersteiger Classic plot combine. Seed samples were cleaned using a fanning mill with a top screen consisting of ½" expanded metal. Cleaned samples were recorded for data including gross weight, percent moisture, seed weight determined for 500 seeds, and test weight.

Individual plot soil tests were taken on October 30 prior to freeze up to assess any noticeable differences in soil nutrient content. Plots were soil sampled with 3 cores per plot at 0-6" and 6-24" depths. Soil samples were sent to Agvise Laboratories (Northwood, ND) for analysis of soil nitrogen parameters to assess any nitrogen mineralization and fixation accumulations.

Nitrogen values and economics was subject to a two-way analysis of variance (ANOVA) using Analyze-it 2.03 statistical software (Microsoft) when more than two treatments were compared. Otherwise all other parameters were analyzed with an independent t-test both treatments. Coefficient of variation, standard error, p-values, least significant difference at the 0.05 level of significance (fishers unprotected LSD) and R-squared were calculated.

## Results

There were significant differences in hairy vetch biomass production, and accumulations of nitrogen from biomass residues (Table 1). There were no differences in corn grain test weight, seed weight, and grain yield, SPAD meter readings on leaf chlorophyll content or in crude protein of hairy vetch biomass.

There were no significant differences in soil nitrogen levels at the 0-6" depth, 6-24" and 0-24" depth totals (Table 2). There were highly significant differences in total nitrogen in the system (biomass N + soil N) after harvest. These variations translated into highly significant differences in nitrogen economics but were significant only in monocrop hairy vetch crops. Hairy vetch in corn plots did not provide economic benefit compared to monocrop corn plots. This is likely due to the economic value of nitrogen being diluted in the economic analysis of the corn whose economics in yield performance outweigh the value to the nitrogen influence. There were no significant differences in percent soil organic matter or volumetric water content among treatments with plots cropped with hairy vetch being higher than those without (Table 3). Dry conditions at the time of sampling may have reduced the ability to decipher differences in water use in all three treatments.

**Table 1:** SPAD meter reading of sunflower plants, hairy vetch biomass, nitrogen accumulation in biomass, sunflower crop height, sunflower grain test weight. Seed weight and sunflower grain yield in sunflower and hairy vetch intercrops compared to their monocrop derivatives.

Treatment	Mean Sunflower SPAD n=15	Hairy Vetch Biomass kg/ha	Crude Protein %	Nitrogen from Biomass Residues lbs/ac	Grain Yield kg/ha	Seed Weight g/500	Test Weight g/0.5L
Corn	51.1	-	-	-	5929	126.3	382.9
Corn + H. Vetch	51.3	1871	20.9	25.3	5950	136.7	380.7
H. Vetch	-	6073	20.1	78.4	-	-	-
Grand Mean	51	3972	20	52	5940	131	382
P value	0.952	<b>0.019</b>	0.170	<b>0.015</b>	0.979	0.228	0.759
S.E.	3.1	1098.0	0.5	12.9	736.4	7.3	6.7

**Table 2:** Total residual soil nitrogen, biomass nitrogen, total nitrogen values and their economic values (assuming a nitrogen value of \$0.55/lb) of the N itself and the value of that N applied to the grain system value (assuming 32.00 cwt value for sunflower grain) under plots of hairy vetch and sunflower intercropping compared to their monocrop types.

Treatment	Nitrogen (lbs/ac)				\$ per acre	
	0-6"	6-24"	0-24"	Biomass N + Soil N	Total System N Value	Gross Income
Corn	14.0	14.0	28.0	28	\$ 15.40	\$ 448.46
Corn + H. Vetch	11.0	25.0	36.0	61	\$ 33.73	\$ 468.33
H. Vetch	18.3	19.0	37.3	116	\$ 63.65	\$ 63.65
CV%	30.3	45.1	32.3	23.4	23.4	16.6
LSD (p<0.05)	NS	NS	NS	32	\$ 19.96	\$ 123.06
P value	0.234	0.391	0.572	<b>0.0064</b>	<b>0.0064</b>	<b>0.001</b>
Grand Mean	14.4	19.3	33.8	68	\$ 37.60	\$ 326.81

**Table 3:** Percent soil organic matter and volumetric water content after crop production and standard error after each cropping treatment.

Treatment	Organic Mater		Vol. Water Content	
	%	St. Error	%	St. Error
Corn	2.97	0.12	6.4	0.6
Corn + H. Vetch	3.00	0.12	7.1	1.3
H. Vetch	3.00	0.10	9.0	2.1
CV%	1.8		26.7	
LSD (p<0.05)	NS		NS	
P value	0.694		0.358	

## Discussion

As in 2013 and 2014, the prospect of intercropping hairy vetch with sunflower looks promising according to the 2015 results. It appears that there is no significant reduction in grain yield, test weight, or final economic values once again.

Fixed nitrogen found in both soil test nitrate residues, and hairy vetch biomass may provide additional nitrogen credit during decomposition for the next season's crop rotation such as malt barley. In the corn-hairy vetch system this was about 33 lbs/ac N extra in the 2015 season, while the sunflower-hairy vetch system yielded about 59 lbs/ac N above a monocrop of corn or sunflower, respectively.

Hairy vetch is a possible host for cutworm and earworm development. This may aggravate the already susceptible sunflower or corn plants who are also a favorite for cutworms early in development. Further field examination may be required in future testing to determine the extent of this issue.

Intrinsic benefits that may be realized in future crop rotation are, greater soil N residue credits produced from the hairy vetch, as well as soil and ecosystem health and grazing day potential that could be utilized in real time after harvest. With just over 1.6 ton per acre in sunflower and 0.84 ton per acre in corn of available forage, a significant grazing period could be utilized. There were also no harvest issues with having extra biomass below the sunflower heads and corn cobs. The hairy vetch did not interfere with harvesting of the grain or the knife or pickup of the combine.

The potential for grazing sunflower or corn stubbles intercropped with hairy vetch seems promising but poisoning from hairy vetch in livestock is still a risk. The economic value of the N credit (assuming 55 cents/lbs N) from hairy vetch residues is similar to the value of the forage itself (assuming 2 cents/lbs market value). Based on the economic values it would be a decision in the hands of the producer to choose to graze or leave residues for N credit for the next crop.

Direct seeding into hairy vetch mulches may prove difficult with current seeding equipment commonly used by farmers. A vertical tillage unit or a discer may be required to manage such heavy and tangled residues. The development of seeding openers designed to manage thick thatches of biomass may prove beneficial in this scenario.

Use of applied nitrogen fertilizers in hairy vetch is likely unnecessary. In legumes such as pea, addition of nitrogen fertilizers and or peas grown on nitrogen rich soils may fail to nodulate properly and prefer to uptake nitrogen from soil based nitrogen reserves. It is believed that hairy vetch reacts in a similar way if high levels of nitrogen are present at the time that nodulation should occur. This may create a nutrient deficiency overall for sunflower as hairy vetch would be accumulating free nitrogen. SPAD meter results from the trial in 2014 suggest that sunflowers were struggling to have proper nitrogen nutrition in intercrop plots compared to monocrop plots. High rainfall in 2014 and low nitrate soil tests may have exacerbated this. However, later in the season of 2014, evidence of insignificant grain yield differences in sunflower and insignificant soil test differences would suggest sunflower recovering yield possibly through nitrogen uptake from fixed nitrogen in vetch intercrops (ie. hairy vetch donating extra nitrogen to sunflower) and soil nitrogen mineralization due to an extended late season dry period. N<sup>15</sup> isotope testing would assist in understanding the amount of transfer between crops. In 2013, SPAD meter readings were not significant between intercrops and monocrops. Specific nitrogen placement in sunflower rows or slow release products may assist in proper nodulation in hairy vetch and sunflower nutrition.

Hairy vetch seed was produced in 2015 in sunflower plots but not in corn plots. It is suspected that the Accent herbicide used in corn production and the competitive ability of the corn itself may have caused vetch plant injury and delayed the onset of flower and pod development in the corn and hairy vetch intercrop system. However in the sunflower plots, Authority herbicide did not cause injury in hairy vetch, therefore vetch was able to grow at a normal pace. Hairy vetch seed can lead to volunteer hairy vetch in following crops and may become a weed in following crops or as a contaminant in the current sunflower or corn sample or grain sample of the following crop. There are weed control options to control hairy vetch, but they are less likely to be found if a pulse crop would be in rotation after sunflowers such as peas, lentils, dry beans or faba beans. A cereal crop would likely pose the most options to control volunteer hairy vetch seedlings in the next growing season. If hairy vetch is planted later it reduces the time for the plant to produce seed before fall frosts.



**Photos:**



July 16<sup>th</sup>. All three cropping system treatments, hairy vetch, sunflower and the intercrop. Sunflower with a head start in growth. At this stage hairy vetch development appears slower and is focused on ground coverage with very little upward growth noted.



August 22<sup>nd</sup>. Sunflower has utilized most of its resources required for growth by now and plant growth peaks. Sunflowers start to set seed. Hairy vetch is climbing the sunflower stalks and enters a rapid growth stage.



Sept 8. Hairy vetch continues to grow and fix nitrogen long after the sunflowers have stopped their nutrient demand.

Note the left plot is flat, characteristic of the hairy vetch monocrop, while the right plot has vetch climbing upright on the sunflower stalks.





Moist micro-environment in the canopy of a farmer's field near Deloraine, MB indicates the presence of Sclerotinia and sunflower rust.

Hairy vetch may act as a vector for infection of sunflower foot rot caused by Sclerotinia. Rust may flourish in the humid canopy produced by hairy vetch and sunflower leaves.



Also plots in Melita showed signs of Stemphylium blight in the hairy vetch late in the year.



July 16. Vetch still trying to recover from herbicide injury from Accent herbicide. Corn has become very competitive. According to the biomass data in this report of the hairy vetch, corn was nearly twice as competitive than sunflower over the vetch biomass production.



September 8 Corn and Hairy vetch plots. Note the weed pressure cause by biennial wormwood in the vetch plot on the right.



October 16 – Just before harvest tassels were broken over to facilitate easier harvest with straight cut rigid header on the combine. Hairy vetch had recovered from herbicide damage caused by Accent herbicide.

Hairy vetch did not climb the corn as well as it did in sunflower as well.

## Corn Population, Row Spacing and Nitrogen Rate for Expanding Corn Production in Western Manitoba

### Cooperators

- Prince Farms – Waskada, Manitoba

### *Background*

Corn production is expanding into western Manitoba, offering new revenue streams and increased diversity and profitability for Manitoba farmers.

Nitrogen fertilizer is generally the most physiologically and economically important nutrient in crop production and generally is the most expensive and limiting nutrient available. Most often it has to be supplied to the crop annually; however its availability is rather elusive over the season based on losses from denitrification, volatilization, leaching, soil erosion, and crop removal. Timing and placement of the nitrogen application can reduce these economic losses. Side banding nitrogen is an improvement compared to surface application for these reasons. Moreover prescribed applications during the growing season based on crop demand and/or climatic events can reduce these risks and provide sufficient nutrient levels when the crop needs it. Getting into the field at the ground level to scout the entire field for a nitrogen application can be cumbersome, time consuming and slow. Generally producers determine an estimate of the nitrogen requirements for the season and this is applied at seeding rather than utilizing a second or third application in crop. This practice opens the door to large nitrogen losses and therefore large economic losses given the right conditions.

Corn production has historically been grown on 30" row spacing as that was the width that an oxen could walk down the rows to plow them. These days, oxen have been replaced with tractors, however the tradition of the oxen still survives since tractor and equipment design carried along with it the established agronomy of the past era. These traditions were also based on lower latitudes where seedling populations became standard for this 30" row spacing method. Given the north-bound expansion of corn into the Northern Great Plains, both crop management practices for the different growing conditions and equipment design should be revisited. There is limited information and research

overall regarding these parameters for Manitoba. We also need to keep in mind the intrinsic genetic changes this crop has undergone in the last decade in terms of maturity adaptability and yield potential.

Electronic technology is becoming more accessible to producers and is potentially a powerful tool for farmers in conducting on farm scientific research. Currently the majority of producers make decisions based on generalized agronomy fact sheets and previous field history. This leaves them at the whim of season long weather variations which determines their final grain yields and quality. However, with ever changing and in-expensive technology such as phone apps and drones (UAVs; Unmanned Ariel Vehicles) becoming more accessible, producers now have some new tools to make more timely decisions, reduce costs on the farm, and reduce risk such as fertilizer losses in corn production. These technologies are new and therefore understudied both in the scientific community and at the farm level. This technology, together with existing technology such as local weather stations and proven hand held devices such as the SPAD meter (Spectrum Technologies Inc., Aurora, IL), could improve overall crop production efficiency.

The use of Unmanned Ariel Vehicles (UAVs) such as the AgEagle (<http://ageagle.com/>) and the Ebee (<https://www.sensefly.com>) have become popular in the last five years and have shown potential in agriculture more than any other industry. Digital cameras can be attached to UAVs and are able to capture near infrared images of crops which can be correlated to a NDVI (Normalized Difference Vegetation Index). Simply put, NDVI is a measure of biomass that is strongly correlated to potential yield. Producers using this tool, could do prescribed applications of fertilizer based on crop needs, reducing natural nitrogen losses and risk based on short term climate predictions. NDVI can also be a predictor for crop health in terms of disease, water stress, insect damage or any other crop limiting component. UAVs can save time in crop scouting, reduce labour and help make informed decisions on larger expanses of crop land.

Y-drop is a simple attachment to your existing sprayer which allows you to apply fertilizer on corn with a high clearance boom up to a growth stage near the base of the boom (<http://agalternatives.com/higheryields.html>). Corn is opposite to most other crops where corn requires most of its fertilizer in grain fill. Y drops allow farmers to be able to apply fertilizer all the way up to tassel. The Y drops apply the fertilizer below the canopy reducing leaf burn, and volatilization. It is also applied right beside the stalk to work with the natural ability of the corn plant which collects moisture from dews or light rains and brings it to the base of the stalk which takes it down in to the roots very quickly. With this technology farmers can apply fertilizer at different times throughout the season when the plant needs it. This reduces the front loading of fertilizer and allows for fertilizer to be applied as growing conditions change.

There is limited information that pertains to our geographical area in regards to optimum agronomic practices such as nitrogen fertilizer application, row spacing and plant population in corn production. These issues must be identified and investigated in order to support growers interested in producing corn. There is interest among growers in the region to move towards narrower row spacing and timed fertilizer applications. Agronomic practices need to be economical as well as environmentally responsible. New technologies such as Y drop applicators offer both but must be tested regionally. The use of UAV technology and hand held measuring devices like SPAD meters and phone apps could help assist in on farm data collection that was once neither possible nor practical. Having tools such as these could help improve input efficiency, sustainability, assist in risk management, adaptability, climate change, and ultimately farm gate income. This project tests reliability of a hand held SPAD meter and

UAVs as streamlined technology field tools. These new technologies need be applied to factors such as seeding rates and nitrogen rates.

According to DuPont-Pioneer Canada, narrow row corn has more efficient nutrient and water uptake, decreases time for row closure (thus reducing loss of water) and decreases weed competition and the use of herbicides. There is also added light efficiency compared to plants being spread out more in 30" rows. With these factors there is an increase in yield.

<https://www.pioneer.com/home/site/us/agronomy/library/row-width-corn-grain-production/>

With narrow row spacing, the corn plants are more evenly spaced reducing erosion from both wind and water and improving overall stand ability. This will lead to greater farm incomes overall. <http://www.extension.umn.edu/agriculture/corn/planting/narrow-row-corn-production/>

Y drop technology is currently distributed through 360 Yield Center in Illinois, USA. This new technology has not been tested, adopted or available in Manitoba or Canada. Through local testing and communication, there will be an opportunity for Manitoba businesses to distribute this technology and for producers to purchase it for adoption on their farm. This will result in new revenue streams for the Manitoba economy. These would be sold by cutting edge companies that are involved in crop consulting.

The use of UAVs is a relatively new technology itself and its potential in agriculture is greatest more than any other industry. Looking at the big picture of when, where, and how much fertilizer to apply, using the technology of UAV's to see trends in fields before the human eye can see them to apply fertilizer with the y-drops, finding problems quickly and diagnosing them are all benefits to be realized by farmers.

UAVs may allow farms to have more control over final yield and their final incomes. Having real time information about entire fields rather than time consuming ground field scouting could assist in more accurate and precise decisions during crop growth. These decisions could have great financial impact. Having this tool tested and proved will provide a backdrop to industry that will help further the adoption and acceptance of the technology.

Hand held technologies like SPAD meters and phone apps have many uses in agriculture. One app in particular is able to measure chlorophyll content in plants and could be used to correlate chlorophyll content in plants to final yield. Knowing this information during the growing season could take the guess work out of making the decision to apply fertility and/or fungicide treatments midseason, improving final yield prediction and reducing costs of un-needed or over applied input applications.

Doing a couple of field scale trials with these tools has generated information on the perks, the flaws, and the experience with the technology at both the research community and farm community levels.

## Trial 1: Corn Nitrogen Timing and Rate Trial

### Objectives

1. On-farm test of new technology (UAVs, Y Drops, SPAD meters) to predict and facilitate in crop application of nitrogen fertilizer for corn.
2. To determine the optimum timing of nitrogen fertilizer application in corn.
3. Demonstrate new technology such as UAVs and phone apps for measuring early season growth and identify nitrogen deficiency symptoms to validate nitrogen fertilizer, row spacing and plant population objectives listed above.
4. Demonstrate Y drops as a feasible tool for late tassel nitrogen topdressing applications in corn.

### Methods

Using Y drop technology, liquid nitrogen (UAN) was applied in crop, compared to the typical management practice of applying full fertility at planting. Plot treatments were 1/4 acre in size. Treatments were arranged in a Strip Block Design, replicated 3 times.

#### Treatments:

1. 180 lbs N applied at planting (check)
  2. 60 lbs N at planting, 60 lbs at knee height
  3. 60 lbs N at planting, 120 lbs at knee height
- Plus one check strip with 60 lbs/ac applied N all season beside trial area

#### Plot Data collected:

- Plant stand (20 ft plant count in row by average of 5 counts)
- Chlorophyll content at knee height and tassel (SPAD Meter, WADO) on 50 plants per plot
- NDVI using Ebee UAV technology. Visual average on treatment using PostFlight Terra software.
- Yield/moisture, seed weight, bushel weight, (collected from yield monitor and grain cart weigh wagon on farm)
- Grain protein content (sent to BioVision Laboratories, Winnipeg, MB)

#### Data Analysis:

The Westman Agricultural Diversification Organization used yield and plot data collected for the season and provided in house data analysis for the farm. A two-way Analysis of Variance (ANOVA), Pearson correlation and linear regression analysis will be used to draw conclusions from the field trials.

### Agronomy Information

Seeding Date	May 3, 2015
Seeding Rate (ppa)	38,000
Row Spacing	15 inches
Corn Variety	P7443 (Pioneer)
Seeding Depth	2.25 inches
Anhydrous Application Date	April 25, 2015

Fertilizer Blend	50 lbs/ac P, 40 lb/ac K, 10 lbs/ac S; Applied with April 25 Anhydrous pass.
Y drop Application Date	July 12, 2015
Y Drop Fertilizer Application	UAN at specific rate + 5 lbs/ac Sulfur
Herbicide Products	Roundup and Battalion
Harvest Date	October 28, 2015

## Results

There were significant differences in SPAD meter reading, NDVI readings (Figure 1), and grain moisture among nitrogen treatments in the corn plots (Table 1). The greatest SPAD meter reading was at 180 lbs/ac N applied as anhydrous ammonia at seeding indicating that delaying fertilizer application later in the year with the use of Y drops may have been less efficient. NDVI was also highest for 180 lbs/ac N at seeding and with 60 lbs/ac N at seeding combined with 120 lbs/ac N with Y drops. Grain moisture was significantly higher in low fertility plots where nitrogen was applied at only 60 lbs/ac with Y drops, compared to higher fertility plots. There was a nitrogen response trend although not significant with lower yield and lower test weights with lower fertility application when only 60 lbs/ac N was applied with Y drops compared to higher fertility treatments. Variation in land topography, fertility, salinity, moisture retention, and lack of rain in August (Appendix 1: Waskada weather data) may have caused variation in collecting reliable yield information. Even population indicates that the seeding equipment was accurate and working properly.

**Table 1 :** Effect of nitrogen application on grain corn at seeding and with Y drop topdressing applicators on plant population, SPAD meter reading, NDVI, grain moisture, bushel weight, seed weight, and grain yield near Waskada, MB in 2015

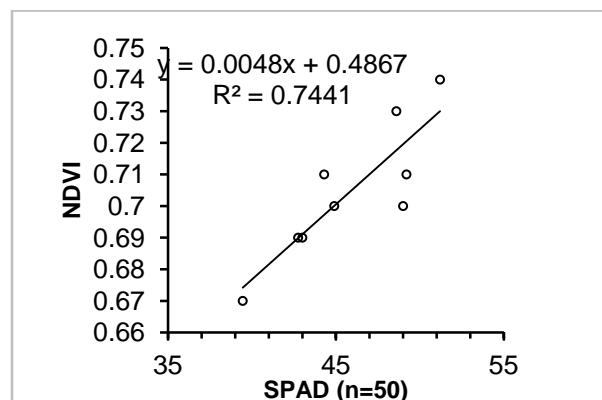
N-Treatment (lbs/ac)	Population ppa	SPAD	NDVI	Moisture %	Bushel Weight g/0.5L	Seed Weight g/500	Yield kg/ha	Protein %
180 Anhyrous @ Seeding	32757	49.6	0.72	17.6	366	122	7719	8.00
60 @ seeding + 60 with Y drops	33512	41.7	0.68	18.9	359	122	7758	8.08
60 @ seeding + 120 with Y drops	34151	46.1	0.71	17.9	369	118	8249	8.32
CV%	2.9	4.2	1.8	2.4	1.0	3.7	7.2	9.4
LSD (p<0.05)	NS	4.3	0.03	1.0	7.86	NS	1292	NS
P value	0.318	<b>0.018</b>	<b>0.044</b>	<b>0.039</b>	<b>0.059</b>	0.204	0.508	0.868
R-squared	0.59	0.88	0.82	0.82	0.85	0.61	0.41	0.26
Grand Mean	33473	45.8	0.70	18.1	364	121	7909	8.13
0 N Check	33454	30.6	0.64	19.7	363	118	7965	8.23

There was no significant relationship between SPAD meter readings or NDVI reading to grain yield (Table 1). However there was a significant positive correlation and regression relationship between NDVI and SPAD meter readings (Figure 1). This was a strong relationship ( $r = 0.86$ ) and explained that there is about a 74% association between them. Despite this, it did not translate into a relationship that determined yield, likely due to the large variation in field topography, salinity, and moisture retention in the field.

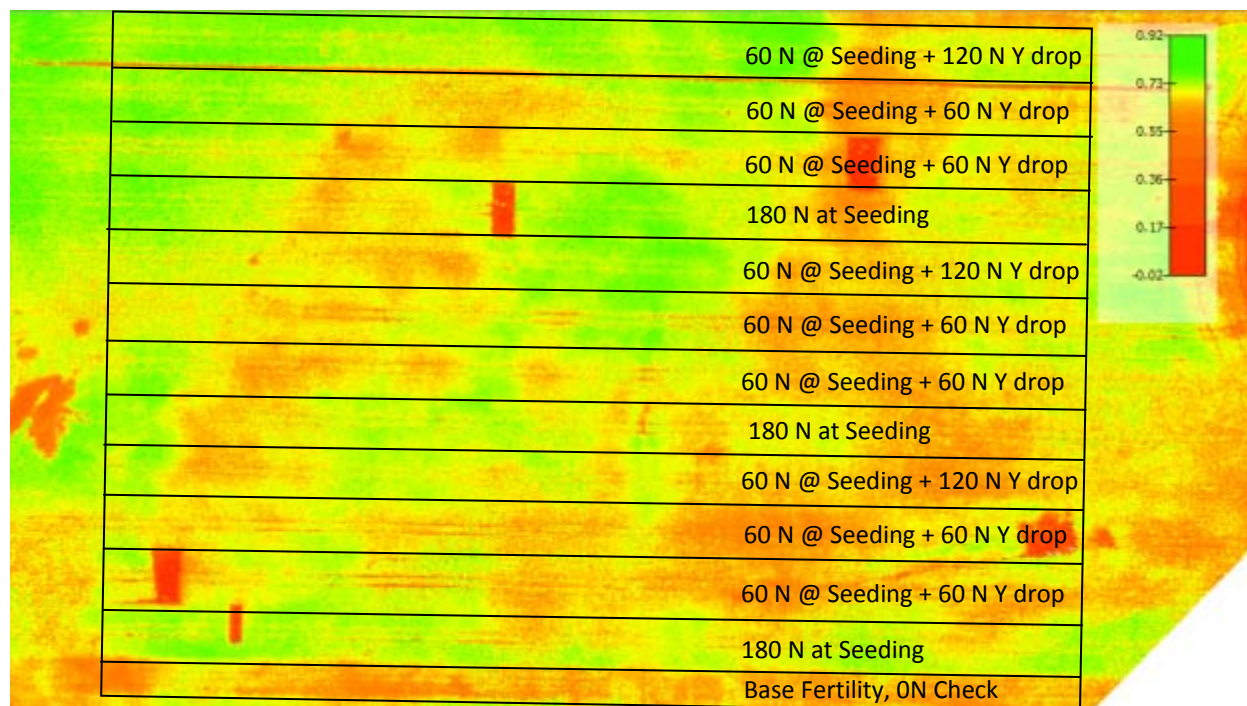


**Table 2:** Pearson Correlation and linear regression of SPAD meter values and grain yield, NDVI and grain yield and NDVI and SPAD meter readings in corn indicating the strength of their relationship and the significance of that relationship.

Relationship	Pearson Correlation r value	P value	Significant?	Linear Regression		Linear Equation of Best Fit
				R <sup>2</sup>	St. Err.	
SPAD x Yield	0.02	0.9656	No	-	-	-
NDVI x Yield	0.15	0.6927	No	-	-	-
NDVI x SPAD	0.86	0.0028	Yes	0.744	0.12	$y = 0.0048x + 0.4867$



**Figure 1:** Correlation of SPAD meter and NDVI reading in the grain corn plots near Waskada, MB in 2015 and the corresponding best fit linear equation and regression value.

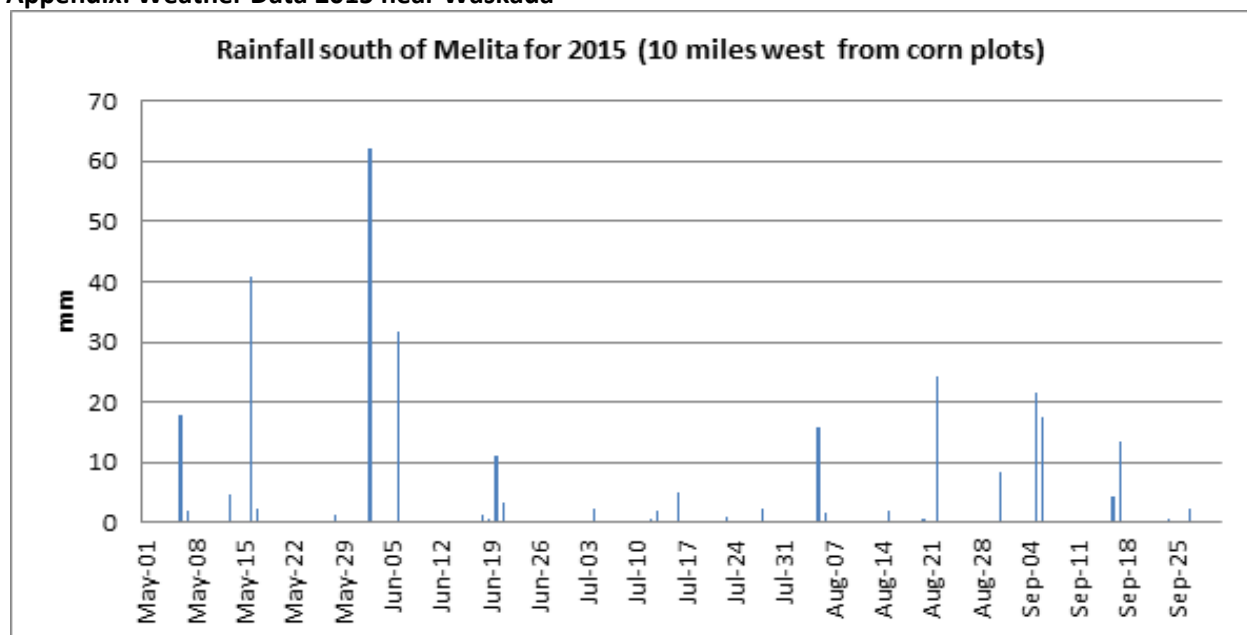


**Figure 2:** NDVI aerial photo of nitrogen corn trial located near Waskada, MB in 2015.

## Discussion

Use of Y drop topdressing applicators certainly gives the option to postpone fertilizer applications. Combined with UAV imagery technology, a producer could prescribe zone based fertilizer application during crop development to improve nitrogen use efficiency and placement in variable field situations. The NDVI image (Figure 2) provided an indication that the field was quite variable. It is fair to assume that there was a nitrogen response in this field (comparing 0 N check and 180 N at seeding). However, due to the large variability within the field, it was difficult to attain consistency as a single plot observation. Large farm research plots such as these may benefit better from yield maps in correlation to UAV NDVI imagery, combined with salinity data or crop moisture stress data (generated from thermal images) in pre-determined random locations as measures of observations. Sample replications throughout the treatment may be more accurate than a single yield data point for an entire area over an acre in size. Having smaller multiple observations within that acre would likely provide more informative accurate results.

## Appendix: Weather Data 2015 near Waskada



## Trial 2: Corn row spacing and plant population

### Objectives

1. To determine the optimum row spacing and plant population for corn and any interaction between these factors.
2. Demonstrate new technology such as UAVs and phone apps for measuring early season growth and identify nitrogen deficiency symptoms to validate nitrogen fertilizer and row spacing and plant population objectives listed above.



## Methods

Two 60' planters will be compared at 3 seeding rates for a total of 6 treatments. Treatments will be arranged in a Randomized Complete Block Design, replicated 4 times. Plot treatments would be 1/4 acre in size. Plot fertility will be fixed at 180 lbs/ac N applied at the time of seeding.

Treatments:

1. 30 " rows at 20,000 seeds/ac
2. 30" rows at 30,000 seeds/ac
3. 30" rows at 40,000 seeds/ac
4. 15" rows at 20,000 seeds/ac
5. 15" rows at 30,000 seeds/ac
6. 15" rows at 40,000 seeds/ac

Plot data that will be collected:

- Plant stand (20 ft plant count in row by average of 5 counts)
- Chlorophyll content at knee height and tassel (SPAD Meter, WADO) on 50 plants per plot
- NDVI using Ebee UAV technology. Visual average on treatment using PostFlight Terra software.
- Yield/moisture, seed weight, bushel weight, (collected from yield monitor and grain cart weigh wagon on farm)
- Grain protein content (sent to BioVision Laboratories, Winnipeg, MB)

## Agronomy Information

Seeding Date	May 11, 2015
Row Spacing	15 inches
Corn Variety	P7443 (Pioneer)
Seeding Depth	2.25 inches
Fertilizer application Date	April 29, 2015
Fertilizer Blend	60 lbs/ac N, 50 lb/ac P, 40 lbs/ac K, 10 lbs/ac S; Applied April 29
Y drop Application (top dressing)	July 12, 2015
Y Drop Fertilizer Rate, Date	110 lbs/ac N from UAN + 5 lbs/ac Sulfur applied July 16
Herbicide Products	Roundup and Battalion
Harvest Date	October 28, 2015

## Results

There were significant differences in row spacing plant count, SPAD meter reading, NDVI, grain moisture, and seed weight. Plant counts were significantly lower due to an error at seeding in which the drive shaft of the planter spun the same speed for both row spacing configurations, as 30" spacing was achieved by turning off ever other 15" planting unit causing an unforeseen error apparent in the data. Plant counts should have been the same if the trial was seeded properly (at approx 34000 ppa) but this was not the case. This is also observed in the probability of interaction between row spacing and seeding rate being significant as well. However, this did not translate into yield or test weight differences among row spacing. SPAD meter readings were higher for 30" than in 15" row spacing indicating that more resources were available for plant growth, likely a combination of light, moisture and nutrients. However NDVI values (Figure 1 and 2) were higher in 15" rows likely accounting for a

denser crop with fewer gaps between rows as would be in present in a 30" row spacing plot which may have reduced NDVI values. Grain samples were significantly drier in 15" row spacing likely due to forced early maturity by lack of moisture and nutrient resources compared to 30" row spacing. Seed weight was larger in 30" row spacing likely due to greater access to resources as well.

There were significant differences among plant population (to be expected when this is the variable being tested), SPAD meter reading, moisture and seed weight (photo). SPAD meter readings, grain moisture and seed weight were greatest for low populations, indicating that there was greater access to resources such as nutrients, moisture and sunlight. There were no significant differences in yield regardless of row spacing or population in this trial.

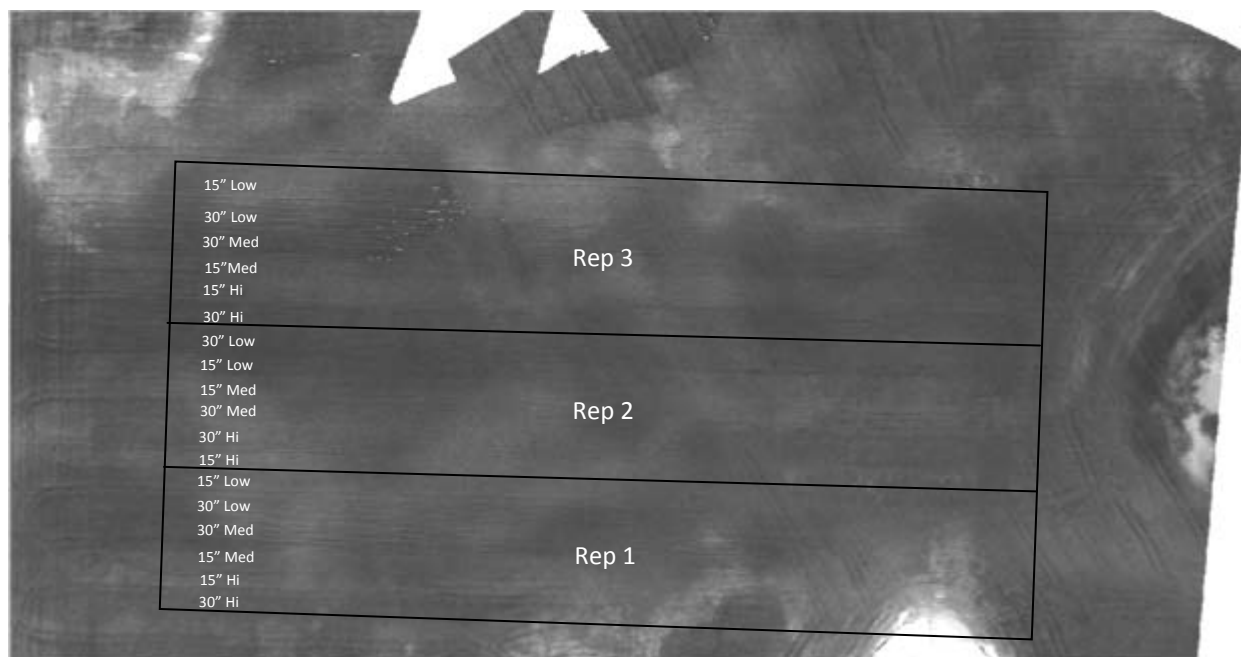
Additional research will have to be performed with a correctly set planting system to observe populations with differing row spacing in order to assess for any interaction. The data produced from this trial was unable to measure this interaction due to the seeding error. Therefore, in this data, there is no definitive conclusion as to which row spacing or combination of population is more superior or inferior for planting corn in the Northern Great Plains located in South Western Manitoba.

**Table 1:** Effects of row spacing and planting population of grain corn on plant count, SPAD meter reading, NDVI, grain yield, grain moisture, seed weight, and test weight in mega plots located near Waskada, MB in 2015.

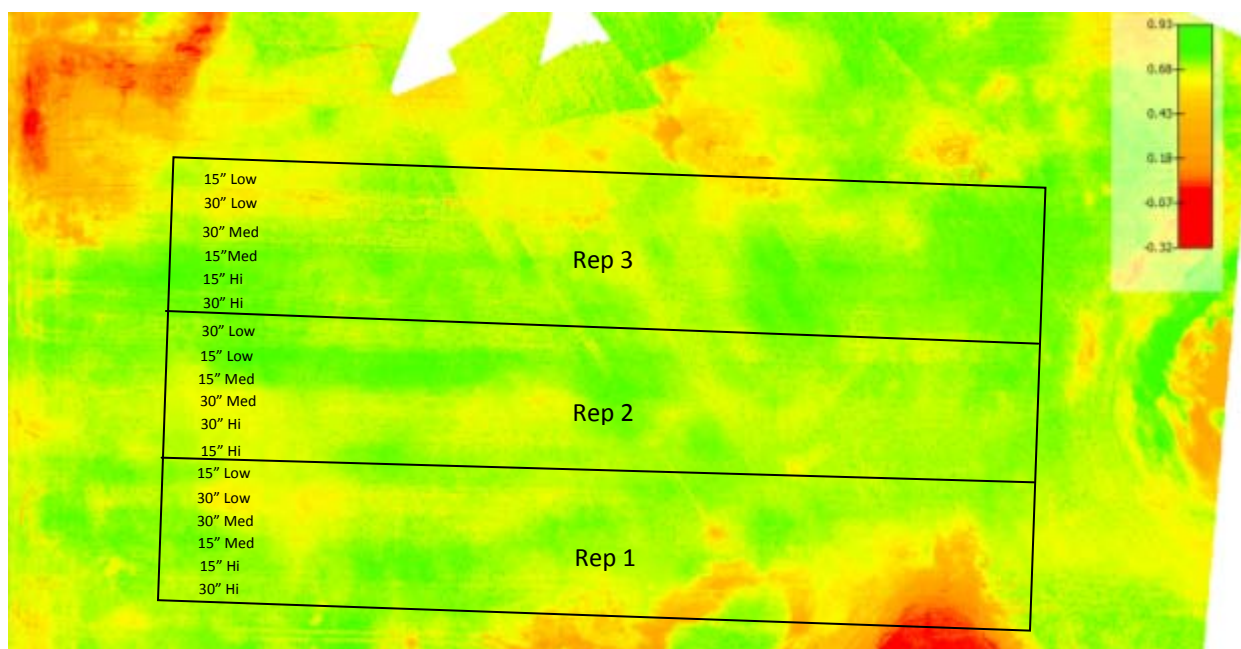
Row Spacing	Population	Plant Count ppa	SPAD	NDVI	Grain Yield kg/ha	Moisture %	Seed Weight g/500	Test Weight g/0.5L	Protein %
30"		17734	50.7	0.70	8244.3	17.8	263.8	375.6	8.3
15"		34422	41.6	0.74	7944.0	16.8	239.1	373.8	8.4
	High	30928	45.3	0.71	8260.4	16.9	243.8	374.3	8.6
	Medium	25846	43.9	0.73	8198.5	17.3	249.2	374.3	8.3
	Low	21461	49.4	0.72	7823.5	17.8	261.3	375.5	8.2
30"	High	20270	50.1	0.70	8725.9	17.6	262.1	375.3	8.8
15"	High	41586	40.4	0.73	7794.9	16.1	225.5	373.2	8.4
30"	Medium	17772	48.2	0.71	8359.9	17.9	265.1	374.3	8.4
15"	Medium	33919	39.6	0.75	8037.2	16.7	233.3	374.2	8.3
30"	Low	15159	53.9	0.70	7647.2	17.8	264.2	377.0	7.9
15"	Low	27762	44.9	0.74	7999.8	17.7	258.4	373.9	8.4
Grand Mean		26078	46.2	0.7	8094.2	17.3	251.4	374.7	8.4
CV%		5.4	5.4	2.2	11.2	2.7	5.0	1.1	3.3
Prob. Row Spacing		<b>&lt;0.0001</b>	<b>0.0002</b>	<b>0.003</b>	0.508	<b>0.004</b>	<b>0.006</b>	0.381	0.828
Prob. Population		<b>0.0004</b>	<b>0.043</b>	0.776	0.111	<b>0.020</b>	<b>0.022</b>	0.463	0.077
Prob. Row Spacing x Population		<b>0.005</b>	0.923	0.853	0.510	0.086	0.156	0.851	0.058
LSD Population (p<0.05)		1865	4.0	0.06	NS	0.5	10.3	2.8	NS
LSD Row Spacing (p<0.05)		1620	2.9	0.02	NS	0.5	14.6	4.6	NS
LSD Pop x Row Spacing (p<0.05)		2806	NS	NS	NS	NS	NS	NS	NS
R-Square		0.99	0.94	0.89	0.39	0.88	0.86	0.78	0.56



**Photo:** Cobs on left are from 15" spacing exhibiting shorter cobs with smaller seeds compared to those on the right from 30 inch rows.



**Figure 1:** Reflectance Map of corn spacing and population trial near Waskada, MB in 2015.



**Figure 2:** NDVI Map of corn spacing and population trial near Waskada, MB in 2015.

### *Discussion*

The seeding error in this trial brought an understanding of the contrast between the use of NDVI compared to the use of the SPAD meter. The NDVI analysis generated from the reflectance map (Figure 1) gave a bird's eye view of the entire crop health and not individual plants as does the SPAD meter. The SPAD meter, in this case, was not able to assess field efficiency or deficiencies like NDVI and NDVI was not able to give individual plant health either. However when used together, both plant health and field

efficiency was able to be compared and contrasted. The SPAD meter was able to determine that increased row spacing and lower populations delivered increased individual plant health (more resources available per plant per acre), whereas NDVI was able to gain insight into resource use over the field, that is, 15" row spacing and high populations were utilizing light efficiently (greater NDVI) per acre than 30" rows at lower populations. Both tools have their own intrinsic value, indicating that despite their similarity in measuring plant and crop health, their interpretations can have different conclusions. Variation in land quality gave rise to variable grain yields likely translating into insignificant outcomes. The NDVI map was able to capture this variation and also captured previous and historical field operations prior to this experiment. The imagery shed light into what appears to be cultivation in the previous year which skewed the variation of the imagery.



Photo: Visual difference between 30" row spacing (left) to 15" row spacing (right) of corn spacing and population trial near Waskada, MB in 2015.

## Industrial Hemp Variety Trials – Trial Descriptor

Susan McEachern and Angel Melnychenko - PCDF  
 Jeff Kostuik – Hemp Production Services

### *Site Information*

#### *Locations:*

Arborg, Manitoba  
 Melita, Manitoba  
 Codette, Saskatchewan  
 QuAppelle, Saskatchewan  
 Lethbridge, Alberta

Carberry, Manitoba  
 Roblin, Manitoba  
 Outlook, Saskatchewan  
 Falher, Alberta  
 Vegreville, Alberta

### *Cooperators:*

Canada-Manitoba Crop Diversification Centre (CMCDC), Carberry, MB  
Parkland Crop Diversification Foundation (PCDF), Roblin, MB  
Prairies East Sustainable Agriculture Initiative (PESAI), Arborg, MB  
Westman Agriculture Diversification Organization (WADO), Melita, MB  
Ag Grow Research, Codette, SK  
Crops and Irrigation Branch, Saskatchewan Ministry of Agriculture, Outlook, SK  
Dale Horn, QuAppelle, SK  
Alberta Innovates, Technology Futures, Vegreville, AB

### *Plant Breeding Programs:*

Alberta Innovates Technology Futures  
Hemp Genetics International (HGI)  
Ontario Hemp Alliance  
Parkland Industrial Hemp Growers Coop (PIHG)  
PhytoGene Resources Inc.  
Terramax Corporation

### *Background*

The Parkland Crop Diversification Foundation has been working on hemp agronomy since 1998, when hemp was legalized for commercial production in Canada. For the past number of years PCDF has coordinated an industrial hemp grain and fibre variety trial that provides the opportunity to showcase and research hemp varieties at different locations across Western Canada. Data is collected at all locations and agronomic and fibre quality data is statistically analyzed and summarized into an informational package for the hemp fibre and grain industries.

This trial was grown at 10 locations in 2015. Some locations participated in both the fibre and grain portions of the trial while others grew the grain portion. The Diversification Centres in Manitoba participated in the trial which included Arborg, Carberry, Melita and Roblin. In partnership with other cooperators and researchers, the trial was grown in Codette, Outlook and QuAppelle, Saskatchewan, as well as Falher, Lethbridge and Vegreville, Alberta.

The yield % CV for some of the locations was greater than the industry accepted level of 15%. As such, the data from these locations will not be discussed in the report. This trial is a great tool for producers and industry to make informed decisions in regards to hemp production.

### *Objective*

To evaluate industrial hemp varieties for fibre and grain yield and their agronomic adaptation to various locations in Western Canada.

### *Procedure and Project Activities*

Sixteen hemp varieties were submitted by various organizations to be included in the test (Table 1). The number of varieties tested at each location varied depending on the terms of the agreement with each organization. Seeding rates were calculated based on TKW and % germination to target a seeding rate of 250 plants per meter squared. Seed was packaged at PCDF in Roblin and sent to each of the



cooperators. The experimental design was small plot, randomized complete block design over 4 replicates.

**Table 2:** 2015 Industrial Hemp Variety Trial Varieties Grown at Participating Locations

Canda	Grandi
CanMa	GranMa
CFX-1	Joey
CFX-2	Judy
CRS-1	Katani
Debbie	Piccolo
Delores	Silesia
Finola	X-59

**Table 2:** 2015 Industrial Hemp Variety Trial Inputs at Cooperating Locations

Location	Seeding Date	Plot Size Seeded	Fibre Harvest Date	Plot Size Harvested (Fibre, Grain)	Grain Harvest Date	Grain Days from Seeding to Combining
Arborg	May 22	8.22 m <sup>2</sup>	August 18	Fibre:1.0m <sup>2</sup> Grain:N/A	N/A	N/A
Carberry	May 12	8.4m <sup>2</sup>	August 19	Fibre:0.6m <sup>2</sup> Grain: 6.0m <sup>2</sup>	September 3	114
Melita	May 11	16.47m <sup>2</sup>	August 6	Fibre:0.97m <sup>2</sup> Grain:12.0m <sup>2</sup>	August 25	106
Roblin	May 21	8.4 m <sup>2</sup>	August 17	Fibre:1.8m <sup>2</sup> Grain:5.4m <sup>2</sup>	September 14	117
Codette	May 30	6.86m <sup>2</sup>	N/A	6.86m <sup>2</sup>	October 9 & 10	133 & 134
Outlook	May 22	12.0m <sup>2</sup>	N/A	12.0m <sup>2</sup>	October 28	140
QuAppelle	June 8	15.0 m <sup>2</sup>	N/A	15.0m <sup>2</sup>	October 19	133

**Table 3:** Soil Nutrient Analysis Estimated Available Nutrients from 0-24" Depth at Locations (actual amounts)

Location	*N	*P	*K	*S
Arborg	204 lbs/acre	28 ppm	390 ppm	54 lbs/acre
Carberry	12 lbs/acre	19 ppm	191 ppm	38 lbs/acre
Melita	51 lbs/acre	6 ppm	320 ppm	432 lbs/acre
Roblin	30 lbs/acre	9 ppm	151 ppm	50 lbs/acre
Codette	8 lbs/acre	8 ppm	139 ppm	166 lbs/acre
Outlook	210 lbs/acre	31 ppm	480 ppm	640 lbs/acre
QuAppelle	N/A	N/A	N/A	N/A

\*N = Nitrate

\*P = Phosphate (Olsen)

\*K = Potassium

\*S = Sulphate

**Table 4:** 2015 Spring Nutrient Applications (actual lbs/acre) at Cooperating Locations

Location	*N	*P <sub>2</sub> O <sub>5</sub>	*K <sub>2</sub> O	*S <sub>2</sub> O <sub>4</sub>
Arborg	90	27	0	15
Carberry	138	27	0	0
Melita	102	35	30	15
Roblin	113	35	15	10
Codette	153	30	30	7
Outlook	120	25	0	0
QuAppelle	100	18.3	0	0

\*N = Nitrogen

\*P<sub>2</sub>O<sub>5</sub> = Phosphorus

\*K<sub>2</sub>O = Potash

\*S<sub>2</sub>O<sub>4</sub> = Sulphur

## Industrial Hemp Fibre Variety Trial

### Background

Fibre was the main production focus for industrial hemp when the federal government legalized production in 1998. Fledgling companies, such as Consolidated Growers and Processors, were formed in the late 1990's to process hemp fibre. Unfortunately the industry had a slow start and companies like Consolidated folded (Arnason 2015). Plains Industrial Hemp Processing Ltd. is located at Gilbert Plains, MB with limited processing conducted to date.

Jan Slaski, Alberta Innovates and Technology Futures, feels that even though there have been false starts in the industry, Canada will gain traction in fibre processing and utilization. Hempcrete, automobile parts and new types of textiles are a few examples. Slaski feels we are on the verge of seeing hempcrete buildings across Alberta and beyond. (Bickis 2015)

One of the limitations to starting a fibre processing plant is the investment, \$30 million to say the least (Bickis 2015). Cylab International has built a decortication plant in southern Alberta. The natural fibre

raw materials will be grown in Alberta, Saskatchewan and Manitoba. Initial processing will occur at the Albertan plant, close to the source of the fibres. Intermediate manufacturing will occur in Canada as well with the intent to use processes developed in part with Canadian universities. The intermediate parts will be shipped to a final manufacturing facility in southern California, close proximity to customers. The intermediate parts will be rolled, pressed, extruded, protruded, etc. into finished products and shipped to customers. (cylabgroup (Admin) 2014)

In Manitoba, FibreCITY in Winnipeg continues to develop the necessary test capabilities, material databases and standards for processing hemp. The work that FibreCITY conducts will aid companies with processing industrial hemp fibre. Locally in the Parkland region, a hemp processor received federal and provincial funding of \$125,000 for new equipment to transform hemp fibre into absorbent pellets for kitty litter (Government of Canada 2016). Hemp Sense Inc. will manufacture a natural, dust-free, environmentally friendly kitty litter. Their goal is to tap into a North American market worth \$2.6 billion. Hemp straw can absorb up to five times its weight in water. Another possible application for the litter would be oil and chemical spill cleanup.

In the U.S., industrial hemp and products made from its fibres are making headlines. An American flag made from Kentucky grown industrial hemp was flown over the U.S. Capitol on Veteran's Day – November 11, 2015. States like Kentucky are leading the race to commercialize industrial hemp. North Carolina is making gains now that Senate Bill 313, the Industrial Hemp Research Act, is law. ((NAIHC) 2015)

PCDF continues to play an important role in researching varieties that are well adapted to Western Canadian growing conditions and providing FibreCITY with feed stock to test.

### *Objective*

To evaluate various industrial hemp varieties for fibre yield and quality.

### *Procedure and Project Activities*

Please refer to the Industrial Hemp Variety Trials – Trial Descriptor for information on trial treatments, locations, inputs, nutrient analysis and spring nutrient applications at each trial location.

### *Results and Discussion*

Table 1 summarizes the plant counts for Melita and Roblin locations. Since this trial is used for grain and fibre the target plant stand was 250 plants/m<sup>2</sup>. Plant stands for fibre production is normally 250 to 350 plants/m<sup>2</sup>, whereas grain is 100 to 150 plants/m<sup>2</sup>. Traditionally, Roblin has excellent growing conditions and this is reflected in the plant counts recorded. The plant counts at the Melita site are significantly less than at Roblin and more in line with grain production. One reason for the reduced plant stands could be excess moisture and cool conditions after seeding. Melita received above normal temperatures and no moisture in early May which created ideal seeding conditions. But temperatures dropped and three inches of rain fell on May 16 creating cool and wet conditions, which hemp does not like.



**Table 1:** 2015 Industrial Hemp Fibre Variety Trial Plant Population (pl/m<sup>2</sup>) at Melita and Roblin, MB

Variety	Melita	Roblin
CRS-1	75	204
Finola	102	252
X59	138	258
Delores	--	277
Canda	138	258
Joey	129	269
Silesia	141	231
CFX-1	119	275
CFX-2	135	240
Debbie	--	225
Judy	--	292
Piccolo	143	275
Grandi	103	277
Katani	126	267
GranMa	137	319
CanMa	154	--
<b>Grand Mean</b>	126	261
<b>% CV</b>	18.7	22.5
<b>LSD 5%</b>	33.7	83.8
<b>Significant Difference</b>	Yes	Yes

**Table 2:** 2015 Industrial Hemp Fibre Variety Trial Heights (cm) from Cooperating Locations

Variety	Lethbridge	Melita	Roblin	Vegreville
CRS-1	178	169	120	162
Finola	109	125	71	122
X59	139	172	101	143
Delores	191	--	133	167
Canda	190	178	125	184
Joey	181	173	123	179
Silesia	229	205	146	215
CFX-1	138	156	100	151
CFX-2	143	152	100	142
Debbie	--	--	120	--
Judy	--	--	130	--
Piccolo	135	158	83	133
Grandi	121	120	87	141
Katani	119	141	86	139
GranMa	146	180	115	178
CanMa	155	172	--	160
<b>Grand Mean</b>	155	162	109	158
<b>% CV</b>	10.9	13.7	9.5	10.3
<b>LSD 5%</b>	24.1	31.8	14.8	23.3
<b>Significant Dif.</b>	Yes	Yes	Yes	Yes

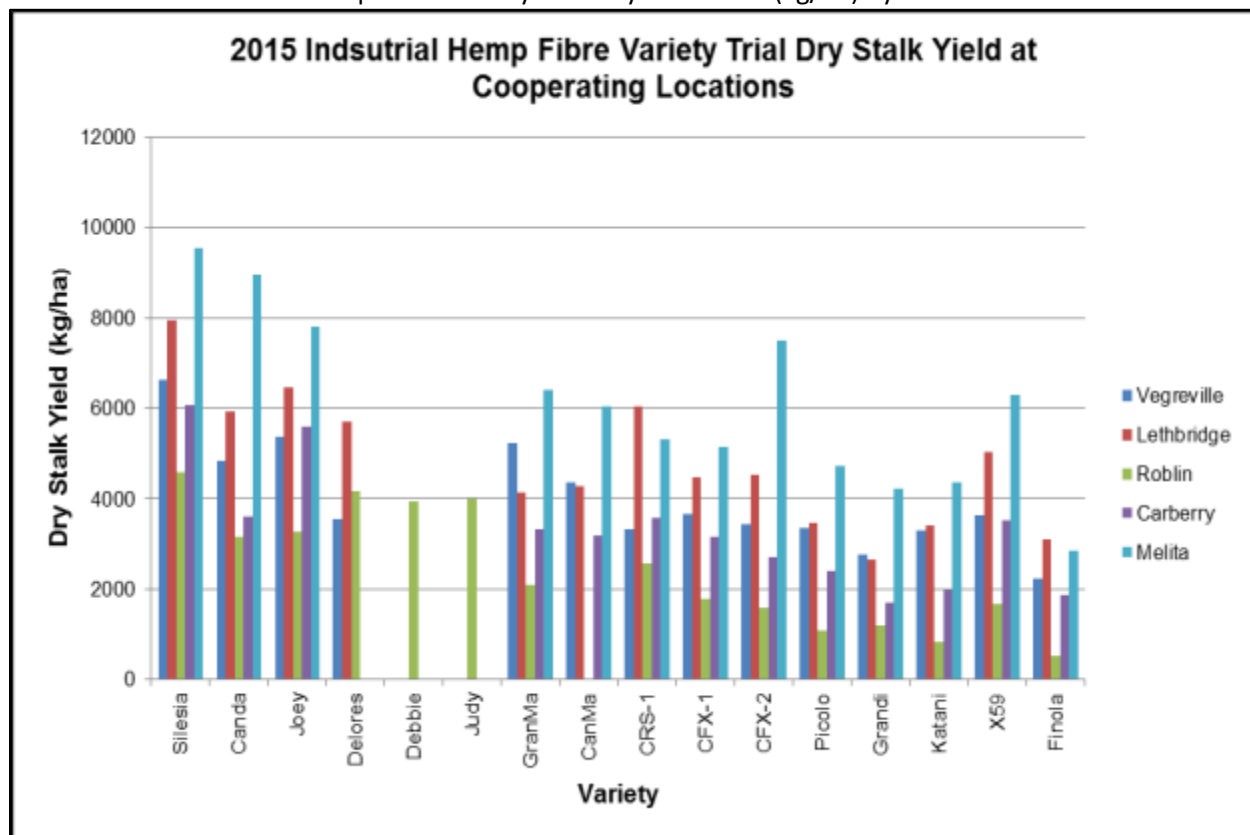
Table 2 summarizes the height data for a number of locations across Western Canada. Silesia (dual purpose variety) was consistently the tallest variety at all locations and Finola (grain variety) was the shortest. The heights at Roblin were shorter than other years, likely due to the early season drought. Overall, the ranking amongst the varieties was relatively consistent across the sites.

Table 3 and Chart 1 illustrate the dry stalk yield of all the varieties that were grown at each location. Silesia was consistently the highest yielding for dry stalk amounts and it was significantly higher yielding at all locations. Silesia is tailored more for fibre applications so the results are consistent with previous years, as expected. Finola is a shorter variety and bred for grain production. Finola has the least amount of dry stalk yield and it is significant when compared to the other varieties except for Picolo, Grandi and Katani (also grain production varieties). Roblin had the lowest dry stalk yield for 2015 and this can be correlated to the shorter heights caused from an early season drought.

**Table 3:** 2015 Industrial Hemp Fibre Variety Trial Dry Stalk Yield (kg/ha) at Cooperating Locations

Variety	Carberry	Lethbridge	Melita	Roblin	Vegreville
CRS-1	3584 b	6053 b	5313 efg	2568 d	3315 def
Finola	1884 d	3116 fg	2865 h	520 j	2233 f
X59	3534 b	5025 bcde	6302 de	1689 efg	3645 cde
Delores	--	5702 bcd	--	4159 ab	3540 de
Canda	3602 b	5927 bc	8958 ab	3166 c	4852 bc
Joey	5582 a	6463 b	7813 bc	3264 c	5268 b
Silesia	6081 a	7951 a	9531 a	4575 a	6633 a
CFX-1	3168 bc	4468 cdef	5156 efg	1786 ef	3661 cde
CFX-2	2700 bcd	4529 cdef	7500 cd	1581 fgh	3442 def
Debbie	--	--	--	3947 b	--
Judy	--	--	--	4004 b	--
Picolo	2415 cd	3467 fg	4740 fg	1088 hi	3344 def
Grandi	1710 d	2655 g	4219 gh	1194 ghi	2771 ef
Katani	1983 d	3424 fg	4375 g	834 ij	3292 def
GranMa	3329 bc	4149 ef	6406 de	2109 de	5235 b
CanMa	3180 bc	4268 def	6042 ef	--	4373 bcd
<b>Grand Mean</b>	3289	4800	6094	2432	3979
<b>% CV</b>	21.8	21.5	15.8	15.0	21.7
<b>LSD 5%</b>	1031	1477	1383	522	1237
<b>Significant Difference</b>	Yes	Yes	Yes	Yes	Yes

**Chart 1: 2015 Industrial Hemp Fibre Variety Trial Dry Stalk Yield (kg/ha) by Location**



## Conclusions

Fibre production and processing continues to develop in Canada. Various companies have built processing plants in Alberta and Manitoba. FibreCITY is working with the industry and PCDF to develop necessary test capabilities, material data-bases and standards for processing hemp. Locally in the Parkland region, Hemp Sense Inc. has received funding from federal and provincial governments for processing equipment to produce a highly absorbent kitty litter that will be used in a multi-billion pet industry and may have applications for oil and chemical spill cleanup.

## Acknowledgments

PCDF would like to acknowledge the following individuals and organizations:

- Growing Forward 2 funding contribution to make this research project possible.
- The organizations that provided varieties for this trial.
- CMCDC, PESAI, WADO, AITF, Ag Grow Research, Terramax, Dale Horn and the Saskatchewan Ministry of Agriculture for growing the trial.
- Garth Livingston for providing the land for the trial.
- FibreCITY for analyzing the quality data.
- Craig Linde, MAFRD for conducting the statistical analysis.

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## Schedule

PCDF has played an important role in the development and launching of the industrial hemp industry in Manitoba and the Parkland region. PCDF will continue to organize and support industrial hemp variety trial testing for cooperators across Western Canada.

## Industrial Hemp Grain Variety Trial

Susan McEachern, Angel Melnychenko and Jeff Kostuik

### Background

Canadian industrial hemp acreage reached a high of 105,000 acres in 2014. The expansion of acreage coupled with a rise in yields resulted in higher production than expected. Traditionally production contracts project yields at 500 lbs/acre. In recent years, growers have been successful at producing yields of 750 to 1,200 lbs/acre. 2015 saw a decline in acreage to 85,000. One reason for this decline may have been the slowdown in grain movement from farm to processor of previous year's production. This may have signaled growers that a glut in production has occurred and managing the stocks would be important to ensure seed quality for processing.

Industrial hemp acreage for 2016 is projected to decline. Manitoba Harvest, the largest hemp seed processor, is not offering production contracts for conventional production. They anticipate current contracted seed stocks will fill their demand into 2017. Organic production contracts with Manitoba Harvest are still available for 2016. Compass Diversified Holdings, an American firm, acquired Manitoba Harvest earlier this year and Hemp Oil Canada in December. Hemp Oil may not have production contracts for 2016 as well (Arnason and Glen 2015). Since two large hemp processors are owned by the same company, this could have an impact on future contract pricing since competition has been reduced.

Parkland Industrial Hemp Growers (Dauphin, MB), Hempco (McGregor, MB) and Hemp Production Services (Western Canada) will have conventional and organic production contracts available for 2016, but acreage may be conservative.

The decline in acreage could also have an impact on the projected industry growth. Canadian Hemp Trade Alliance was forecasting hemp acreage to hit 250,000 by 2018. This could be difficult to achieve if production contracts stay static beyond 2016 and producers find other cropping options. The shining light for the hemp industry is demand for products remains strong and there are more processing plants coming on stream. Hemp Genetics International/Hemp Production Services is expanding their presence in Canada. Hemp Production Services has a de-hulling, oil and protein processing plant in Arborg, MB. Their team has grown with the addition of Jeff Kostuik, Director of Operations for the Central Region and Anndrea Hermann, Sales and Business Director (Hemp Production Services 2015). The federal and Manitoba provincial governments have invested in new equipment to support the growth in the hemp processing industry. Hemp Oil Canada Inc. at St. Agathe, MB was provided with \$390,000 to purchase and install a new optical sorter and packaging system for their new facility. The new equipment will modernize their operations and facilitate their competitiveness in the international hemp seed market (Germination September 2015 pg. 38).

The industrial hemp industry is working hard with Health Canada to reduce restrictions with marketing certain parts of the hemp plant. Currently producers can only market the stock and seeds. Harvesting, processing and marketing of industrial hemp bracts and leaves is forbidden because leaves and bracts are associated with marijuana use. Cannabinoids found in hemp, such as Cannabidiol (CBD), effective in treating schizophrenia, anxiety and post-traumatic stress disorder, is found in the bracts and leaves of industrial hemp. CBD has the potential to expand markets, profitability and total utilization of hemp production. (Commodity News Service Canada 2015)

Canadian industrial hemp growers want Health Canada to recognize hemp as a beneficial natural health product. Seeking approval for health claims is a lengthy process, but once received will give hemp additional recognition and merit in the consumer marketplace. The claim will focus on oil and byproducts and should translate into increased profitability. (Duckworth 2015)

Variety development continues to be strong for industrial hemp growers. The 2015 industrial hemp variety trial grew to sixteen varieties with five new varieties included in the group. Six breeding programs participated in the evaluation program and are listed above. Growers will have many options for selecting a variety best suited to their region and farming operation.

### *Objective*

To evaluate industrial hemp varieties for grain yield, agronomic adaptation and fibre quality attributes in Western Canada.

### *Procedure and Project Activities*

Please refer to the Industrial Hemp Variety Trials – Trial Descriptor for information on trial treatments, locations, inputs, nutrient analysis and spring nutrient applications at each trial location.

**Table 1:** 2015 Industrial Hemp Grain Variety Trial Average Plant Population (plants/m<sup>2</sup>) by Location

<b>Variety</b>	<b>Melita</b>	<b>Roblin</b>
CRS-1	75	204
Finola	102	252
X59	138	258
Delores	--	277
Canda	138	258
Joey	129	269
Silesia	141	231
CFX-1	119	275
CFX-2	135	240
Debbie	--	225
Judy	--	292
Piccolo	143	275
Grandi	103	277
Katani	126	267
GranMa	137	319
CanMa	154	--
<b>Grand Mean</b>	126	261
<b>% CV</b>	18.7	22.5
<b>LSD 5%</b>	33.7	83.8
<b>Significant Difference</b>	Yes	Yes

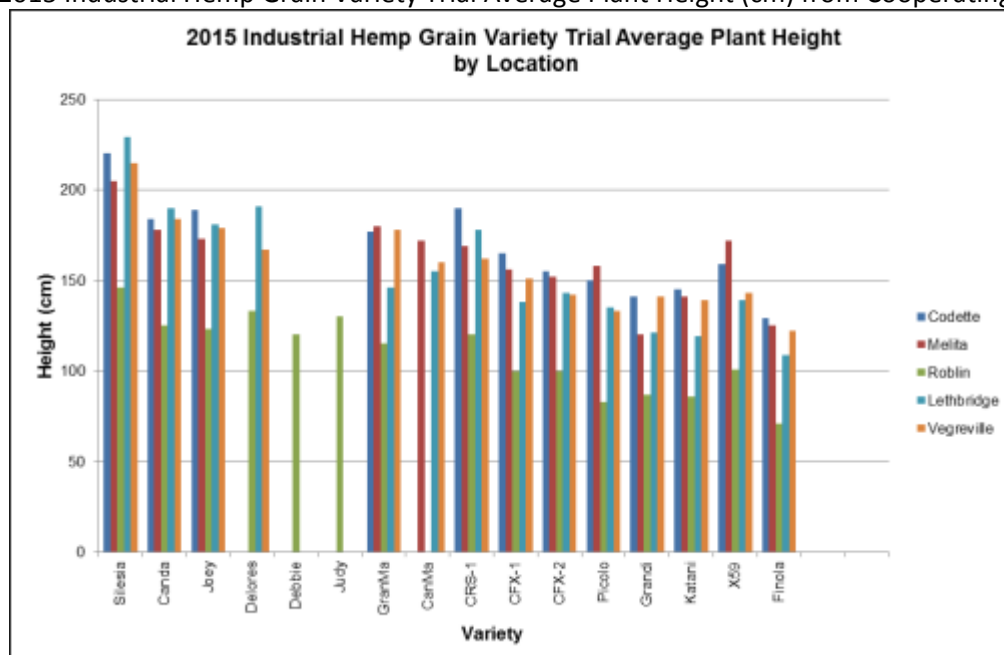
Table 1 summarizes the plant counts for Melita and Roblin locations. Since this trial is used for grain and fibre the target plant stand was 250 plants/m<sup>2</sup>. Traditionally, Roblin had excellent growing conditions for germination and this is reflected in the plant counts recorded. Plant counts at the Melita site are significantly less than at Roblin. One reason for the reduced plant stands could be excess moisture and cool conditions after seeding. Melita received above normal temperatures and no moisture in early May which created ideal seeding conditions. But temperatures dropped and three inches of rain fell on May 16 creating cool and wet conditions, which hemp does not like.

At Roblin, plant counts were similar for all the varieties except for GranMa having significantly higher plant counts than Debbie, Silesia and CRS-1. At Melita, plants counts were also very similar for all the varieties. The exception was CanMa having significantly higher stands than Grandi, CFX-1, Finola and CRS-1.

**Table 2:** 2015 Industrial Hemp Grain Variety Trial Average Plant Height (cm) from Cooperating Locations

Variety	Codette	Lethbridge	Melita	Roblin	Vegreville
CRS-1	190	178	169	120	162
Finola	129	109	125	71	122
X59	159	139	172	101	143
Delores	--	191	--	133	167
Canda	184	190	178	125	184
Joey	189	181	173	123	179
Silesia	220	229	205	146	215
CFX-1	165	138	156	100	151
CFX-2	155	143	152	100	142
Debbie	--	--	--	120	--
Judy	--	--	--	130	--
Piccolo	150	135	158	83	133
Grandi	141	121	120	87	141
Katani	145	119	141	86	139
GranMa	177	146	180	115	178
CanMa	--	155	172	--	160
<b>Grand Mean</b>	146	155	162	109	158.2
<b>% CV</b>	9.4	10.9	13.7	9.5	10.3
<b>LSD 5%</b>	19.7	24.1	31.8	14.8	23.3
<b>Sign Diff</b>	Yes	Yes	Yes	Yes	Yes

Table 1 and Chart 2 summarize the height data for a number of locations across Western Canada. Silesia was consistently the tallest variety at all locations and Finola was the shortest. The heights at Roblin were shorter than other years due to an early season drought. Overall, the ranking amongst the varieties was relatively consistent across the sites.

**Chart 1:** 2015 Industrial Hemp Grain Variety Trial Average Plant Height (cm) from Cooperating Locations

**Table 3:** 2015 Industrial Hemp Grain Variety Trial Average Thousand Kernel Weight (g) by location

Variety	Codette	Melita	Roblin
CRS-1	18.9	12.8	19.0
Finola	13.6	11.6	14.3
X59	18.6	14.9	18.0
Delores	--	--	18.8
Canda	20.4	14.3	19.2
Joey	19.3	12.8	17.4
Silesia	17.9	11.8	16.1
CFX-1	17.5	14.7	17.8
CFX-2	16.7	13.3	16.5
Debbie	--	--	18.4
Judy	--	--	18.4
Piccolo	15.2	13.3	15.8
Grandi	16.6	12.9	16.0
Katani	16.6	13.8	15.2
GranMa	17.6	12.6	16.9
CanMa	--	13.0	--

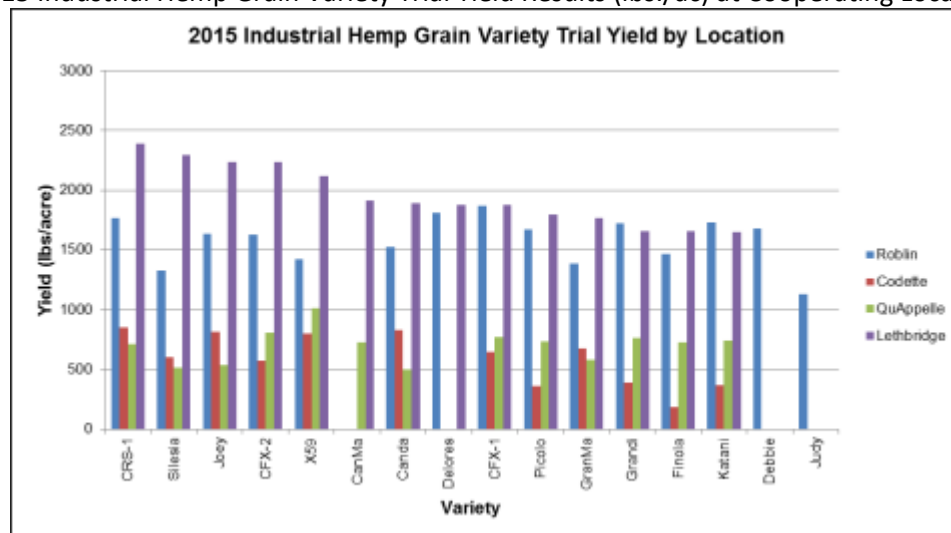
Thousand kernel weight is summarized in Table 3. Data was collected on composite samples from all reps for each site. No statistical analysis was conducted. Growing conditions can impact thousand kernel weight. This would explain why there are some varietal inconsistencies between the sites. Overall Canda, X59 and CRS-1 are larger seeded and Finola and Piccolo are smaller seeded.

**Table 4:** 2015 Industrial Hemp Grain Variety Trial Yield (kg/ha) Results for Check CRS-1

Variety	Roblin	Codette	QuAppelle	Lethbridge
CRS-1	1980 ab	1866 ab	798 c	2677 a
Finola	1646 def	1706 b	814 bc	1854 e
X59	1597 ef	1904 ab	1132 a	2376 abcd
Delores	2030 ab	--	--	2105 bcde
Canda	1711 cdef	1580 b	562 d	2116 bcde
Joey	1828 bcde	1719 ab	602 d	2506 abc
Silesia	1489 fg	1664 b	580 d	2566 ab
CFX-1	2093 a	1816 ab	866 bc	2098 bcde
CFX-2	1819 bcde	2054 a	905 b	2501 abc
Debbie	1881 abc	--	--	--
Judy	1262 g	--	--	--
Piccolo	1871 abcd	1611 b	826 bc	2010 cde
Grandi	1926 abc	1789 ab	858 bc	1855 e
Katani	1938 abc	1885 ab	831 bc	1851 e
GranMa	1553 f	1799 ab	652 d	1975 de
CanMa	--	--	814 bc	2146 bcde
<b>Grand Mean</b>	1775	1783	788	2188
<b>% CV</b>	9.2	13.4	10.3	16.1
<b>LSD 5%</b>	232	346	116	505
<b>Sign. Difference</b>	Yes	Yes	Yes	Yes



**Chart 2: 2015 Industrial Hemp Grain Variety Trial Yield Results (lbs./ac) at Cooperating Locations**



**Table 5: 2015 Industrial Hemp Grain Variety Trial Yield Results (% of check) at Roblin, MB\***

Variety	Yield % of Check	Site Years Tested		2015 Yield % of CRS-1
Alyssa	82	13		-
Anka	81	10		-
Canda	110	18		86
CanMa	88	3		-
CFX-1	93	18		106
CFX-2	94	17		92
CRS-1	100	21		100
Delores	98	19		103
Finola	60	16		83
Grandi	97	1		97
GranMa	78	1		78
Joey	117	13		92
Jutta	94	8		-
Katani	98	1		98
Picolo	95	1		95
Silesia	75	11		75
X59	101	12		81
Varieties that are being evaluated for approval				
Debbie	94	11		95
Judy	64	1		64
CHECK CHARACTERISTICS			CRS-1 (lb/acre)	1763
CRS-1	1548 lb/acre	21 site years	CV%	9.2
			LSD%	12
			Sign Diff	Yes
			Seeding Date	21-May
			Harvest Date	14-Sep

\* This table is taken from Seed Manitoba 2016. (Manitoba Seed Growers Association 2015)

Table 4 and Chart 2 summarize the yield data for Roblin, Codette, QuAppelle and Lethbridge. Even though there were ten locations for the project, only three achieved the industry standard of acceptable %CV of less than 15%. Lethbridge, Alberta's main hemp production area was included for interest reasons but further testing will be required to confirm trends in variety performance.

Variety yield rankings varied between the sites. At Roblin, CFX-1 was significantly higher yielding than all the other varieties except for CRS-1, Delores, Picolo, Grandi and Katani. Judy was grown at Roblin only and it was significantly lower yielding than all the other varieties except for Silesia. At Codette, CFX-2 was significantly higher yielding than all the other varieties except for CRS-1, X-59, Joey, CFX-1, Grandi, Katani and GranMa. X-59 was the highest yielding variety at QuAppelle and it was significant in comparison to the other varieties. The yield trend at Lethbridge saw CRS-1 as the highest yielding variety and Finola, Grandi and Katani as the lowest yielding varieties.

Table 5 summarizes the long term yield results for all industrial hemp varieties that have been tested over the years at Roblin. Please note the number of location years. The more years of testing gives better representation of how a variety will perform over a varying amount of environmental conditions. Joey is the highest yielding variety in comparison to the check CRS-1. Katani, Grandi and Picolo are new varieties in 2015 and they performed in the top eight of the variety list, but only one station year.

## *Conclusions*

Canadian industrial hemp acreage declined in 2015. Production contracts for 2016 are projected to decline because there is a surplus of seed stock. For conventional production, Manitoba Harvest and Hemp Oil Canada have adequate production to supply their needs into 2017. There may be some production contracts with companies like PIHG, Hempco, and Hemp Production Services. Production contracts for organic are still available for all processors. A number of changes have occurred in the hemp industry, from company mergers and consolidation to expansions in staffing and processing for other companies. CHTA and the hemp industry are working with Health Canada to expand production options to legally include bracts and leaves for cannabidiol (CBD) extract and to recognize hemp as a beneficial natural health product. Variety development continues to grow with 6 new varieties included in the 2015 industrial hemp variety trial. Canadian industrial hemp industry is positioning itself for growth and prosperity.

## *Acknowledgments*

PCDF would like to acknowledge the following individuals and organizations:

- Growing Forward 2 funding contribution to make this research project possible.
- The organizations that provided varieties for this trial.
- CMCDC, PESAI, WADO, AITF, Ag Grow Research, Dale Horn and the Saskatchewan Ministry of Agriculture for growing the trial.
- Garth Livingston for providing the land for the trial.
- Craig Linde, MAFRD for conducting the statistical analysis.

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## Schedule

PCDF will continue to manage and conduct the industrial hemp variety trial.

# WADO Flax Fibre Project 2015

## Cooperators

- European Flax Fibre Company
- Eric Liu – MAFRD – Fibre and Composites Specialist (Winnipeg)
- Manitoba Diversification Centres (Portage, Arborg, Melita)
- Prairie Agricultural Machinery Institute (Portage la Prairie)

## Location and Soil Characteristics

**Research Site:** Elva, MB

**Location:** SW 26-3-27 W1

**MCIC Soil Zone:** F

**Soil Texture:** Newstead Loamy Fine Sand

**Soil Test:**

Legal	Depth	pH	N lbs/ac	P ppm Olsen	K ppm	S lbs/ac	Organic Matter %
SW 26-3-27 W1	0-6"	7.5	12	7	301	94	2.9
	6-24"		30			360	

## Crop Rotation

In 2014 the area was summer fallow.

**Pre-seed Herbicide application (burnoff):** Authority (sulfentrazone) @ 100 mL/ac + Credit (glyphosate) @ 1 L/ac + Aim (carfentrazone) @ 10 mL/ac ---all tank mixed applied at 10 gal/ac applied May 6, 2015 just after seeding. It rained next day.

Weeds burned off included:

Green Foxtail [*Setaria viridis* (L.) P.Beauv]  
Yellow Foxtail [*Setaria pumila* (Poir.) Roem. & Schult.]  
Wild Oats [*Avena sativa* L.]  
Wild Mustard [*Sinapis arvensis* L., Brassica kaber (DC.) L.C. Wheeler var. pinnatifida (Stokes) L.C. Wheeler]  
Red Root pigweed [*Amaranthus retroflexus* L.]  
Volunteer canola [Brassica napus L.]  
Canada Thistle [Cirsium arvense (L.) Scop.]

## Objective

1. To grow two fibre flax varieties across several regions in Manitoba and assess for flax fibre yield and quality (in a small field scale of 2 acres).
2. Pull the large plots of each variety and leave to ret over the fall of 2015.
3. Bale and ship back to Europe for quality and fibre yield assessment.

## Methods

**Harrowed:** May 8 to condition soil lumps and make a level seed bed.

**Seed Date:** May 12, 2015 Rolled rocks after seeding with land roller.

**Seed Rate:** 75 lbs/ac

**Seed Depth:** 3/8"

### Varieties, Layout, Size:

Two flax fibre varieties named Alize and Arethra were seeded in blocks about 1 acre in size per variety side by side. The block was 115 meters long. Approximately 24 strips (1.44 meter wide) of Alize and Arethra were seeded. Long strips aided in fiber harvest in terms of the number of turns required at the headlands of each variety.

### Fertilizer Applied:

Sideband 55 lbs/ac N from 28-0-0 UAN, 135 lbs/ac of a granular blend of 12-17-15-10.

**Seeder:** Seedhawk dual knife system with 6 rows with 9.5" spacing.

**Soil Seeding Conditions:** Perfect with excellent soil moisture. Tractor traveling about 3.5 mph.

### Herbicide Application in Crop:

Application 1:

Products:	Select (Clethodim, surfactant) + Mextrol 450 (tankmixed)
Rates:	100 mL/ac and 0.5 L/ac
Date:	June 16, 2015

**Fall Weather Conditions during Retting (after pulling and prior to baling) – see Appendix A**

## Results

**Table:** Results of yield after baling of fibre flax in Melita, MB in 2015.

Variety	Alize	Arethra
Area (ha)	0.57	0.75
Total Field Weight (kg)	2616	4045
Yield (kg/ha)	4590	5394
Est. Fibre* Yield kg/ha	1377	1618
Number Usable	8	13
Bales per Hectare	14	17
Bale Properties		Value
Bale width	1.19	meters
Bale Volume	1.35	m3
Bale Weight	260	kg
Bale Density	193	kg/m3

## Comments

Seeding was successful and plots were visually impressive. Seeding was accomplished using GPS guidance which kept rows straight and easy to pull at fibre harvest.

Application of in crop herbicides was a week too late. The MCPA component cause some stunting and twisting injury of both varieties. This is due to the late development of the crop during application followed by warm humid weather. Ideally the application of Mextrol 450 should have been 1 week earlier and at a reduced rate of 0.4 L/ac rather than 0.5 L/ac. Weed control was effective and the crop was able to recover after about 1 week.

There was no lodging this year regardless of variety tested.

The puller unit worked fantastic in general, pulling 5 rows at a time. Soil conditions were dry that day and with a sandy soil texture, plants pulled with ease. There were very little issues with weeds, likely due to the use of Authority herbicide in the spring.

When pulling occurred, plants were at physiological maturity where 95% of the bolls were brown, stems were generally green and leaves were only on the upper third of the plant whereas all other leaves had dropped naturally. The unit travelled about 4-5 mph and it took about 3 hours to pull 2 acres.

### Order of Fibre Harvest Operations:



Pulling Date – Aug 12, 2015

Cam from PAMI operated the unit.

Turning Date: Sept 2, 2015

Cam from PAMI operated the unit.

Baling Date – Oct 15, 2015

Used a Verhaeghe 504 VE baler. Baling took about 2 days and was done by Cam Kliever of PAMI.

Bale Picking Date – Oct 19, 2015

Bales had to be baled in such a way that the stems were aligned in the same direction so that the bale was formed with roots on one side and seed bolls on the other. Sisal twine was used during baling and had to be strung between the layers of straw during the bale making process so that it will unwind in the factory as a single continuous later as it was in the field. Bales were wrapped with sisal during the final wrapping stage of the bale before being ejected from the baler.

Baling was cumbersome due to the complicated pickup system involved with this baler model. Steel fingers on the baler pickup would scratch the ground, sometimes hitting rocks. Sometimes flax straw would bunch and plug the pickup. This happened over a dozen times. Another problem was that the ejection lever in the tractor was hit by mistake without the driver knowing, causing the back door of the baler to open. The baling team caught this twice and the bale had to be ejected prematurely creating a smaller than desired bale. However on one occasion, the door had been opened and we continued to bale causing a back pressure on the hydraulics and eventually burst a hose that had to be fixed.

Rocks often got caught between the intake belt and the belt drive wheels stopping operations until the rock was physically removed. Wind also caused issues during pickup where wind would toss the straw off centre causing a plug in the intake.

In total there were about 22 plugs or issues during the baling process that had to be resolved. However, with great determination the field eventually baled. Future modifications to the pickup design on the baler should be considered.

It took about two hours to pick all the bales and transport them to the shop at Melita with WADO's gooseneck trailer. Bales were stored on pallets and covered with a tarp with wood pallets on top for fall storage. Bales were wrapped with sisal.





**Photo (left):** Illustration of the intake system of the baler. A conveyer of steel and rubber fingers feeds the flax into the baler with stems aligned the same direction for the entire makeup of the bale making process. The driver must be careful to keep the direction of the flax correct after every turn.

**Photo (right):** Bunches of straw in the baler intake were problematic during high winds. Bunches had to be untangled by hand dozens of times in the field.



**Photo (left):** Quality of fibre after retting and baling.

**Photo (right):** A bale was placed in a pickup truck, weighed and measured to determine bale density so that that density could be applied to all other bales for shipping purposes. WADO used a local producer owned elevator and measured to the nearest kilogram.



## What's Next?

The plan is to ship the bales to Europe for analysis. Logistics need to be sorted out such as phytosanitary certificates prior to shipping the bales.

**Appendix A – Weather Variable Data during the growing season at Melita site in 2015.**

Date	Temp Max °C	Temp Min °C	Temp Ave. °C	Precip. (mm)	Accum. GDD	Wind Direction °N	Wind Gust km/hr
01-May-15	24.5	2.3	13.4	0	8.4	25	44
02-May-15	25.6	6.9	16.3	0	19.7	34	41
03-May-15	17.6	4.4	11	0	25.7	31	48
04-May-15	23	0.8	11.9	0	32.6		<31
05-May-15	25.7	7.1	16.4	0	44	17	50
06-May-15	19.1	12.2	15.7	17.8	54.7	18	41
07-May-15	13.3	5.6	9.5	1.8	59.2	34	65
08-May-15	6.9	0.7	3.8	0	59.2	35	37
09-May-15	11.3	-0.9	5.2	0	59.4	9	35
10-May-15	12.2	-1.2	5.5	0	59.9	6	39
11-May-15	14.2	2.5	8.4	0	63.3	2	43
12-May-15	15.2	0.1	7.7	0	66	9	35
13-May-15	8.9	5.2	7.1	4.6	68.1	9	37
14-May-15	11.8	3.7	7.8	0	70.9	3	32
15-May-15	21.1	0.1	10.6	0	76.5		<31
16-May-15	13.3	4.5	8.9	40.8	80.4	5	65
17-May-15	9.7	-0.5	4.6	2.4	80.4	1	80
18-May-15	11.8	-0.7	5.6	0	81	36	48
19-May-15	17.9	-0.6	8.7	0	84.7		<31
20-May-15	24.4	3.5	14	0	93.7	34	32
21-May-15	23.7	6.4	15.1	0	103.8		<31
22-May-15	26.4	7	16.7	0	115.5	16	35
23-May-15	28.7	9.5	19.1	0	129.6		<31
24-May-15	27.2	9.4	18.3	0	142.9	10	32
25-May-15	29.7	11.6	20.7	0	158.6		<31
26-May-15	29.5	13.2	21.4	0	175	36	41
27-May-15	23.5	10.1	16.8	0.4	186.8	6	41
28-May-15	23.3	10	16.7	1.2	198.5	34	59
29-May-15	14.2	5.2	9.7	0	203.2	3	48
30-May-15	15.3	-0.1	7.6	0	205.8		<31
31-May-15	20.4	6.5	13.5	0	214.3	21	39
01-Jun-15	29.3	9.7	19.5	0	228.8	33	56
02-Jun-15	16.9	10.5	13.7	62.2	237.5	5	52
03-Jun-15	19.6	9.9	14.8	0.2	247.3	5	37
04-Jun-15	22.3	7.5	14.9	0	257.2		<31
05-Jun-15	25.5	11.7	18.6	0	270.8	15	35
06-Jun-15	27	14.5	20.8	31.8	286.6	28	46
07-Jun-15	26.9	13.9	20.4	0	302	33	44
08-Jun-15	32.4	13.3	22.9	0	319.9	33	32
09-Jun-15	25.5	15.8	20.7	0	335.6	33	50



10-Jun-15	25.4	11.7	18.6	0	349.2		<31
11-Jun-15	28	12	20	0	364.2		<31
12-Jun-15	28.7	14	21.4	0	380.6	19	57
13-Jun-15	24.2	13.7	19	0.4	394.6	31	39
14-Jun-15	25.4	11.5	18.5	0	408.1	31	46
15-Jun-15	21.8	9	15.4	0	418.5	35	35
16-Jun-15	24	6.8	15.4	0	428.9	18	35
17-Jun-15	26.8	9.7	18.3	0	442.2	1	46
18-Jun-15	20.7	9.7	15.2	1.4	452.4		<31
19-Jun-15	24.4	12.8	18.6	0.6	466	16	33
20-Jun-15	24.3	12.6	18.5	11.2	479.5		<31
21-Jun-15	25.7	10.6	18.2	3.2	492.7	27	54
22-Jun-15	23.9	13.4	18.7	0	506.4	33	39
23-Jun-15	28.4	11.6	20	0	521.4	25	32
24-Jun-15	30.2	12.8	21.5	0	537.9		<31
25-Jun-15	29.8	13.2	21.5	0	554.4	33	57
26-Jun-15	30.8	12.7	21.8	0	571.2		<31
27-Jun-15	29.8	16.7	23.3	0	589.5	34	41
28-Jun-15	28	14.7	21.4	0	605.9		<31
29-Jun-15	29.9	16.9	23.4	0	624.3		<31
30-Jun-15	23.2	15.9	19.6	0	638.9		<31
01-Jul-15	25	15.3	20.2	0	654.1		<31
02-Jul-15	27.2	14.3	20.8	0	669.9		<31
03-Jul-15	29.3	13.9	21.6	0	686.5		<31
04-Jul-15	31.1	17.9	24.5	2.4	706	29	69
05-Jul-15	24	14.2	19.1	0.4	720.1	34	32
06-Jul-15	20.8	10.9	15.9	0	731		<31
07-Jul-15	24.8	6.5	15.7	0.2	741.7	20	35
08-Jul-15	23	12	17.5	0	754.2		<31
09-Jul-15	30.8	9.7	20.3	0	769.5	25	39
10-Jul-15	30.2	14.3	22.3	0	786.8		<31
11-Jul-15	31.4	20	25.7	0	807.5	16	46
12-Jul-15	33.2	18.1	25.7	0.6	828.2	24	37
13-Jul-15	27.7	17.6	22.7	1.8	845.9		<31
14-Jul-15	30.3	17.4	23.9	0.2	864.8		<31
15-Jul-15	31.6	15.7	23.7	0	883.5		<31
16-Jul-15	28.5	17.9	23.2	5	901.7		<31
17-Jul-15	22	13	17.5	0.2	914.2		<31
18-Jul-15	23.8	12.9	18.4	0.4	927.6	32	57
19-Jul-15	27.8	13.2	20.5	0	943.1	31	48
20-Jul-15	26.2	10.7	18.5	0	956.6	34	32
21-Jul-15	26.3	10.3	18.3	0.4	969.9		<31
22-Jul-15	31.1	16.6	23.9	0	988.8	16	37
23-Jul-15	24.8	17.8	21.3	0.8	1005.1	36	37
24-Jul-15	29.7	14.1	21.9	0	1022	22	37
25-Jul-15	31.5	13.4	22.5	0	1039.5		<31
26-Jul-15	31.4	13.7	22.6	0	1057.1	18	41
27-Jul-15	31.3	15	23.2	0	1075.3	11	67
28-Jul-15	26.1	14.1	20.1	2.4	1090.4	28	67
29-Jul-15	27.1	13.8	20.5	0.2	1105.9	31	72

30-Jul-15	25.8	12.7	19.3	0	1120.2	31	52
31-Jul-15	27.5	12.1	19.8	0	1135		<31
01-Aug-15	32.6	10	21.3	0	1151.3	1	35
02-Aug-15	25.2	13.5	19.4	0	1165.7	35	41
03-Aug-15	27.3	9	18.2	0	1178.9		<31
04-Aug-15	27.6	9	18.3	0	1192.2		<31
05-Aug-15	25	15	20	15.8	1207.2	18	37
06-Aug-15	21.5	14.3	17.9	1.6	1220.1		<31
07-Aug-15	26.1	13.8	20	0.4	1235.1	28	46
08-Aug-15	25.8	11.5	18.7	0	1248.8		<31
09-Aug-15	27.2	10.4	18.8	0	1262.6		<31
10-Aug-15	30	11.2	20.6	0	1278.2		<31
11-Aug-15	33	12.5	22.8	0	1296	18	35
12-Aug-15	36.3	17.8	27.1	0	1318.1	18	35
13-Aug-15	34.3	18.4	26.4	0	1339.5		<31
14-Aug-15	38.3	16	27.2	0	1361.7	20	41
15-Aug-15	34.1	17.2	25.7	1.8	1382.4	29	46
16-Aug-15	22.3	10.8	16.6	0	1394	29	41
17-Aug-15	23.6	9.3	16.5	0	1405.5	33	32
18-Aug-15	24.8	8.5	16.7	0.4	1417.2		<31
19-Aug-15	25.3	9.5	17.4	0	1429.6		<31
20-Aug-15	29.3	8.5	18.9	0.6	1443.5	3	39
21-Aug-15	24.8	11.2	18	0	1456.5	7	39
22-Aug-15	18.4	11.6	15	24.4	1466.5	34	63
23-Aug-15	19.6	7.4	13.5	0	1475	32	59
24-Aug-15	23.4	3.7	13.6	0	1483.6		<31
25-Aug-15	24	6.6	15.3	0	1493.9		<31
26-Aug-15	29	13	21	0	1509.9	18	37
27-Aug-15	30.3	9.2	19.8	0	1524.7		<31
28-Aug-15	29.8	14.7	22.3	0	1542		<31
29-Aug-15	33.8	11.9	22.9	0	1559.9		<31
30-Aug-15	34.2	15.2	24.7	0	1579.6	32	44
31-Aug-15	26.1	11.3	18.7	8.2	1593.3	25	48
01-Sep-15	31.9	7.1	19.5	0	1607.8	16	33
02-Sep-15	33.4	10.7	22.1	0	1624.9	16	41
03-Sep-15	31.9	20.4	26.2	0	1646.1	13	35
04-Sep-15	22.6	14.4	18.5	0	1659.6	7	46
05-Sep-15	16.4	13.8	15.1	21.4	1669.7	6	43
06-Sep-15	20.8	11.1	16	17.4	1680.7	4	44
07-Sep-15	20.3	6.8	13.6	0	1689.3	26	41
08-Sep-15	19.6	6.4	13	0	1697.3	30	41
09-Sep-15	19.3	4.7	12	0	1704.3		<31
10-Sep-15	16.7	2.5	9.6	0	1708.9	1	32
11-Sep-15	23.3	1.2	12.3	0	1716.2		<31
12-Sep-15	28.7	5.2	17	0	1728.2	25	33
13-Sep-15	30.6	9	19.8	0	1743	2	44
14-Sep-15	22.2	5.6	13.9	0	1751.9	11	33
15-Sep-15	18.8	6.7	12.8	0	1759.7	5	41
16-Sep-15	21.1	8.6	14.9	4.2	1769.6	26	35
17-Sep-15	15.9	5.6	10.8	13.4	1775.4	30	41

18-Sep-15	20.7	2.3	11.5	0	1781.9		<31
19-Sep-15	24.3	4.2	14.3	0	1791.2	22	33
20-Sep-15	25.7	3.8	14.8	0	1801	25	35
21-Sep-15	23.9	6	15	0	1811	33	50
22-Sep-15	16.1	3.4	9.8	0	1815.8		<31
23-Sep-15	19.5	3.6	11.6	0.2	1822.4	10	41
24-Sep-15	19.2	10.6	14.9	0.6	1832.3		<31
25-Sep-15	26.1	9	17.6	0.2	1844.9	19	52
26-Sep-15	30.3	15.4	22.9	0	1862.8	19	54
27-Sep-15	21.3	9.6	15.5	2.2	1873.3		<31
28-Sep-15	15.3	1.3	8.3	0	1876.6	33	37
29-Sep-15	20.7	-1.7	9.5	0	1881.1	20	32
30-Sep-15	23.5	7.3	15.4	0	1891.5	15	37
01-Oct-15	20.1	9.9	15	0	1901.5	16	48
02-Oct-15	16.6	8.6	12.6	0.4	1909.1	16	52
03-Oct-15	13	6.5	9.8	1.6	1913.9	16	46
04-Oct-15	10.7	7.6	9.2	3.2	1918.1	17	33
05-Oct-15	11	6.6	8.8	0	1921.9	27	33
06-Oct-15	15.5	1.1	8.3	0	1925.2		<31
07-Oct-15	15.1	0.5	7.8	0	1928	15	46
08-Oct-15	17.6	1.9	9.8	0	1932.8	34	33
09-Oct-15	21.2	-1.5	9.9	0	1937.7	18	43
10-Oct-15	27.1	8.1	17.6	0	1950.3	26	37
11-Oct-15	21.2	7.7	14.5	0	1959.8	27	63
12-Oct-15	12.8	2.4	7.6	1.4	1962.4	31	85
13-Oct-15	18.1	-0.9	8.6	0	1966	27	46
14-Oct-15	18	1.8	9.9	0	1970.9	31	63
15-Oct-15	11.1	-1.5	4.8	0	1970.9	32	48
16-Oct-15	13.3	-3.4	5	0	1970.9		<31
17-Oct-15	14.4	-5.6	4.4	0	1970.9	18	35
18-Oct-15	20.5	1.7	11.1	0	1977	19	39
19-Oct-15	19	3.1	11.1	0	1983.1		<31
20-Oct-15	15.2	6.6	10.9	1.6	1989	9	33
21-Oct-15	14.4	1.5	8	0	1992	30	35
22-Oct-15	18.7	-2.1	8.3	0	1995.3	16	43
23-Oct-15	13.1	1.1	7.1	8.2	1997.4	36	43
24-Oct-15	13.4	-1.3	6.1	1.6	1998.5	27	32
25-Oct-15	7.1	-4.2	1.5	0.2	1998.5		<31
26-Oct-15	9.7	-2.2	3.8	0.2	1998.5		<31
27-Oct-15	7.5	0.8	4.2	4.8	1998.5	30	56
28-Oct-15	2	-0.5	0.8	0	1998.5	34	56
TOTAL				331	1998.5		
Average				275	1700		



**WADO**

Westman Agricultural  
Diversification Organization Inc.

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