




WADO

Westman Agricultural Diversification Organization

2013 Annual Report

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2013 Industry Partners

(Alphabetical Order)

Agriculture and Agri-Food Canada
Agrisoma
ARDI – Agri-Food Research Development Initiative
Arye Seeds – Minto, MB
Barker's Agri-Centre - Melita
BASF
Boissevain Select Seeds
Canada Manitoba Crop Diversification Centre- Carberry
Canadian Hemp Trade Alliance
Canadian International Grains Institute
Ducks Unlimited Canada
Fisher Farms - Wawanesa
FMC Agricultural Solutions
Gowan Agro Canada
Ellis Seeds – Wawanesa
Indian Head Agricultural Research Foundation
Manitoba Agriculture Food and Rural Initiatives – Crops Branch and GO Teams
Manitoba Beef Producers
Manitoba Buckwheat Growers Association
Manitoba Corn Growers Association
Manitoba Crop Variety Evaluation Team
Manitoba Food Development Centre
Manitoba Pulse Growers Association
Melita Rink Committee
National Sunflower Association of Canada
Nestibo Agra
Northstar Seeds
Parkland Crop Diversification Foundation - Roblin
Parkland Industrial Hemp Growers
Paterson Grain
Pepsico Foods
Plains Industrial Hemp Processing
Prairie Agricultural Machinery Institute - Portage
Prairies East Sustainable Agriculture Initiative – Arborg
Renwick Farm - Elva
RM of Arthur
RM of Pipestone
Rural Municipality of Arthur
Secan Seeds
Seed Manitoba
Soya UK Ltd. – Southhampton, UK
Tilbury Farms – Melita
Town of Melita
University of Manitoba
University of Manitoba
University of Saskatchewan (CDC)
Western Feed Grains Development Cooperative – Minto, MB
Winter Cereals Canada

Farmer Co-operators – 2012-2013 Trial Locations

Elliott Bros. - Reston
Darren Peters - Boissevain
Wayne White – Melita
Greig Farms – Melita, Elva
Kendall Heise – Isabella
Mike Fisher – Wawanesa
Ellis Seeds – Wawanesa
Boissevain Select Seeds - Boissevain

Introduction

Westman Agricultural Diversification Organization Inc. (WADO) manages a wide range of value-added diversification, Ag 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 Manitoba. These include Roblin (PCDF), Arborg (PESAI) and the Fed/Prov Canada/Manitoba Diversification Centre's (CMCDC) based in Carberry, Portage and Winkler. 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 excel.

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. (Photo: left) is the Diversification Technician/Specialist-term 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 had excellent Summer Staff for 2013, they were an important reason we were able to successfully handle more than 2300 plots throughout the SW region. A full salute goes out to the three main summer staff; Aly Turnbull (lower right) from Pipestone, Liam Bambridge (top middle and lower left) from Melita, and Chantal Elliott (top right) of Pipestone.

WADO also had the privilege of employing two fall and winter employees; Jessica Mayes (right) of Pierson who was an asset to the team during the fall harvest and Jennifer Lockert (left) of Sedley Saskatchewan who worked for WADO during the later fall to help finish harvest and process hundreds of samples. Thanks to all for their hard work!

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)

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All WADO annual reports are posted at the provincial website:
http://dev4.manweb.internal/agriculture/diversification/wado/reports.html

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 2013.

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. Members include; Elmer Kaskiw of Shoal Lake, Lionel Kaskiw of Souris, Murray Frank of Brandon, Amir Farooq of Hamiota, and Scott Chalmers of Melita.

2013 Weather Report and Data – Melita Area

It was a late spring for Melita this year with the last of the spring melts occurring into the first week of May. Despite the late spring, the frost date occurred prematurely on May 13th at -3.5°C. Seeding conditions were poor due to excess moisture and frequent rains with tight opportunity breaks. Most crops were seeded late (May) in record timing & speed. This was to assure the seed was planted prior to crop insurance deadlines in June. To make this deadline, night time seeding was utilized when possible. Due to ample rain fall throughout the growing season, crop maturity was pushed well into September this year. With above normal temperatures and below normal rain fall in August, crops were able to speed up maturity in time to produce high yields prior to the first fall frost. First fall frost occurred on October 10th at -0.6°C.

Season Summary May 1 - September 1			
	Actual	Normal[1]	% of Normal
Number of Days	124		
Growing Degree Days	1510	1436	105.2
Corn Heat Units	2410	2338	103.1
Total Precipitation (mm)	390	303	128.7

Figure 1: Growing season summary

Melita - WADO 2013 Season Report by Month								
Month	April	May	June	July	August	September	October	Total
Precip (mm)	6	70	119	162	39	86	48	530
Norm Precip.[1]	34	55	77	68	52	47	32	365
Temp Ave°C	-5	12	18	20	20	16	5	
Norm. Temp[1]	5	12	17	19	19	13	5	
CHU	0	395	631	732	689	547	130	2994
GDD	0	222	389	459	463	341	54	1874

1. Normals based on 30-yr averages, Environment Canada

Figure 2: 2013 Melita Seasonal Growing Report

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. This is because warm-season crops do not develop at all when daytime temperatures fall below 10°C. They do however 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. This is 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. Using the CHU 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, Wawanesa, and Reston. Continuous real time data is recorded every 15 minutes which can be viewed publicly at the following locations:

http://tgs.gov.mb.ca/climate/DisplayImage.aspx?StationID=melitaWADO
http://tgs.gov.mb.ca/climate/DisplayImage.aspx?StationID=hamiotaWADO
http://tgs.gov.mb.ca/climate/DisplayImage.aspx?StationID=reston245
http://tgs.gov.mb.ca/climate/DisplayImage.aspx?StationID=wawane240

2013 Precipitation & Corn Heat Unit (CHU) Maps

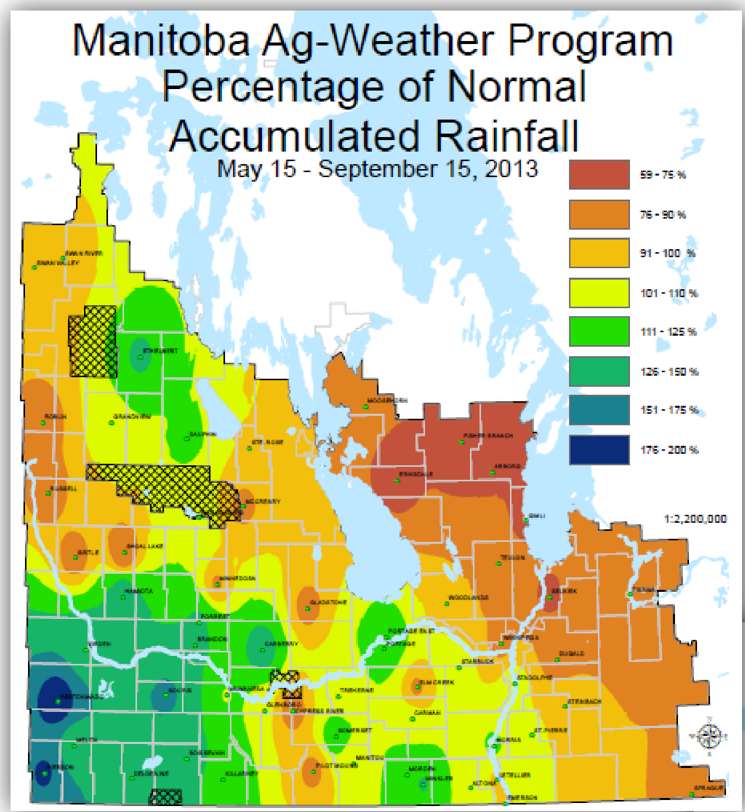
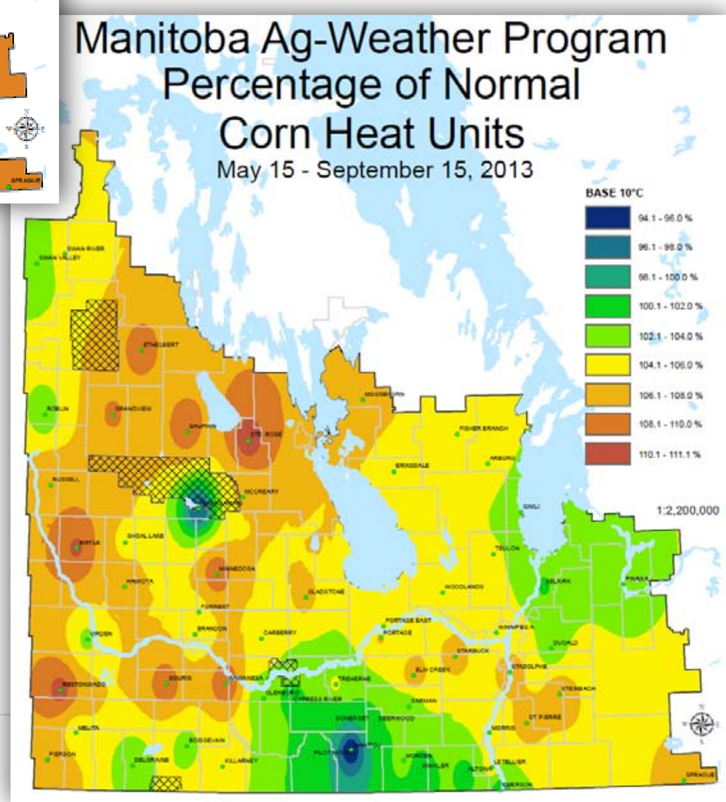


Figure 4: (Above) Manitoba Ag-Weather Program Percentage of Normal Accumulated Rainfall in Southern Manitoba

Figure 3: (Below) Manitoba Ag-Weather Program Percentage of Normal CHU in Southern Manitoba



WADO Tours and Special Events

Ag Days (picture left), held January 15-17 in Brandon, was the largest event WADO was involved in during the 2013 year. WADO, in attendance with the other diversification centres featured a booth that showcased new farming opportunities and possibilities. Over 60,000 people were in attendance during the event.

WADO also spoke at the Special Crops Symposium in Winnipeg held February 7th at the Victoria Inn. Approximately 400 attended the tradeshow. Scott Chalmers was a guest speaker. He discussed the merits of intercropping sunflower and hairy vetch, which relates to a trial that WADO has been undertaking the past few years.

On February 14, Scott also presented at the Paterson Special Crops Day in Melita which was held at the Old Age Centre. He conversed about sunflowers, corn and soybean updates from the trials that were held in the previous years. Approximately 60 people were in attendance. This included local producers, and industry partners who have special interest in the crops that were being discussed.

On February 28, WADO gave a tour to a visitor from Dalbag, Queensland Australia. Bryan Granshaw (pictured second from right) was awarded a Nuffield scholarship. This allowed him to travel across the world to better understand the concepts and principles of intercropping. Bryan owns and operates a sugar cane farm in Australia where he has started intercropping soybeans among his sugar cane rows. He also no-tills his cane and uses GPS guidance systems to improve his operation. He claims to use significantly less fertilizer and water based on these innovative techniques. The University of Queensland is now collaborating with him on his farm to conduct tests on his system. WADO spend most of the day with Bryan, his wife, and board member Al McKenzie. They were also fortunate enough to have toured a local bison farm owned by WADO board member Brooks White. Mr. White's far is located near Pierson Manitoba. He actively intercrops and performs cover cropping practices on his farm alongside raising the heard of bison. To learn more about Bryans scholarship you can follow his blog online available at: www.bryan-granshaw.blogspot.com

On April 30, WADO was invited to speak to students from Melita, Waskada and Pierson at the Pierson School. This was for their Pierson Petroleum Project Day. Students who attended were able to learn about aspects of the local oil industry from transportation and service rigs to environmental services. WADO offered a demonstration on the environmental topic dealing with a real-time soil probing, testing soil pH, demonstrating different soil components, nutrients, and textures, and why our soil is important. Approximately 70 high school students attended during the day.

WADO's main summer tour in Melita (picture right) on July 30 saw over 100 people attended. Many people from fellow research institutions, producers and industry were in attendance. This year WADO hosted the tour with the help of a rain fast tent just in case. Producers were able to visit and have lunch under the tent beside the plots. All plots at each site were showcased with a wide range of content including; Brassica carinata, soybeans, sunflowers, hemp, canola, and intercropping concepts.

Another WADO sponsored event included a field tour of the Hamiota plots on August 15th. WADO hosted 50 plus people who were in attendance that day. Plots including the MCVET variety trials, and the Western Feed Grain Cooperative trial were showcased.

WADO also attended and spoke at the winter wheat clinics that were held Hamiota and Souris. An average of 60 people attended the day to learn about the agronomy of winter wheat. This day was sponsored by MAFRID.

Crop Days sponsored by Manitoba Agriculture, Food and Rural Development (MAFRD) and WADO were held at Souris and Hamiota on December 16th and 17th, respectively. Averages of 50 people were in attendance at each event. WADO presented some results on the latest data from the plots in 2013 including intercropping, flax fibre production, and how weather is affecting the dynamics of weeds in the area.

The RM of Pipestone and the Manitoba Weeds Supervisors Association hosted an Annual Weeds Day in Cromer MB on November 13. There was an in depth discussion on the impact of invasive weeds and Clubroot disease in farm and oilfield areas. WADO spoke at the event on several problematic weeds of concern in the southwest including; kochia, biennial wormwood, northern willowherb, volunteer canola and giant ragweed. Approximately 40 people were in attendance.

Understanding Plot Statistics

There are two types of plots at WADO. The first type is demonstration plots. Demonstration plots are not used to determine statistical differences between data; they are typically used only for examples, showcasing and observation. The second type of plots WADO has is Replicated plots. These 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 these calculations, we can determine several important numbers such as coefficient of variation (CV), least significant difference (LSD) and R-squared. CV indicates how well the trial was carried out 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 2013' 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 and www.seedmb.ca — provides valuable variety performance information for Manitoba farmers. Look for Seed Manitoba 2014 this December.

Winter Wheat Variety Trails

Cooperators

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

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 be suitable for the planned end-use.

CDC Falcon transition delayed

The Canadian Grain Commission plans to move CDC Falcon, Manitoba's most popular variety, from the Canada Western Red Winter (CWRW) class to the Canada Western General Purpose (CWGP) class as of August 1, 2014. This one-year delay will allow farmers more time to evaluate possible replacement varieties if their planned end-use markets need "milling type" wheat.

Please note that CDC Kestrel, CDC Clair, CDC Harrier and CDC Raptor (varieties not commonly grown in Manitoba) will be moved from the CWRW class to the CWGP class as of August 1, 2013, a year earlier than CDC Falcon.

Updated Long-Term Data

To assist with variety decisions, MCVET publishes variety data in Seed Manitoba's 2014 Variety Selection & Growers Source Guide available at 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 a few years. Long-term data can be found in the 2013 Winter Wheat Variety Descriptions Table. The "Yield % Check" column provides an indication of how the listed varieties performed compared to the check CDC Falcon. Remember that only direct comparisons can be made between CDC Falcon and the variety chosen to compare it to. The more site-years, the more dependable the data. If farmers want to choose their own check, the website www.seedinteractive.ca gives them that ability.

Flourish and Moats, possible CWRW replacements for CDC Falcon, have now been tested for a third year so additional data is available. New CWGP entries in 2013 are 1603-137-1 and DH01-25-135*R, and 1303-132-1. More caution must be exercised when evaluating the performance of these three varieties as the data only represents one or two years of data.

Multi-site Data for 2013

Multi-site data can be found in the Yield Comparisons Table. Although yields are expressed as per cent of CDC Falcon, comparisons are not restricted to only CDC Falcon. Comparisons can be made between other varieties.

For example, you may want to compare the performance of CDC Buteo and Sunrise at Carman.

> The first step will be to look at the "Sign Diff" value — a "yes" or "no" will indicate if a real difference exists between varieties. At Carman, there is a significant difference between the varieties tested.
>
> You then need to look at the "LSD %" value. LSD stands for Least Significant Difference and it shows the percentage that individual varieties must differ by to be considered significantly different. At the Carman location, varieties must differ by nine per cent to be significant. Since yields of CDC Buteo and Sunrise differs by 17 per cent, statistically Sunrise yielded more than CDC Buteo at Carman.
>
> The next step would be to determine if that yield potential is consistent across all sites. Out of the 5 locations, Sunrise yielded significantly more than Buteo at 3 locations, but at the remaining locations the performance of CDC Buteo and Sunrise is similar at 2 sites while CDC Buteo yielded significantly more than Sunrise at one location (Winnipeg). Therefore by looking only at the 2013 data, farmers can see that yield potential of Flourish and Moats is fairly similar.

Keep in mind that data accumulated over several sites in a single year must always be viewed with caution. Varieties that excel under one set of environmental conditions may not perform as well under the next year's conditions.

Farmers can also go to www.seedinteractive.ca where they can select multiple varieties, locations and years that best compare with their farm, while still offering the ability to choose their own check variety.

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. Combined with previous testing, also done by Dr. Anita Brulé-Babel at the University of Manitoba, enough data exists to assign and in one case change, ratings to some of the varieties.

The rating for CDC Buteo has been changed to moderately resistant or MR from the previous intermediate (I) rating. Data for CDC Ptarmigan and Peregrine shows both at an intermediate (I) rating. All other varieties are either susceptible (S) or moderately susceptible (MS), or not enough data exists yet to give a rating.

It is important to note with future testing, more changes to the ratings may occur in order to provide the most accurate information to farmers. But it is a great first step and subsequently great news for farmers as FHB can be an issue in winter wheat production. In 2013, MCVET is evaluating the variety W454 which has improved resistance to FHB.

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 climate and soil type differences among variety yields.

Methods

This trial consisted of 11 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). Plots were established at various locations in southwest Manitoba by WADO with accordance to their agronomic specifications (Table 2). However, due to extreme winter kill issues experienced in the fall of 2012 and spring of 2013, only the Melita location was kept, but was not immune from winter kill in general. Locations including Boissevain, Reston, and Isabella were terminated due to winter kill losses. A plot air seeder equipped with SeedHawk dual knife openers was used to seed plots. Herbicides were applied at 10 gal/ac water volume at recommended application rates. Melita was not sprayed with an in-crop fungicide application. Plots were combined (photo on page 15) with a Hege 140 plot combine. Samples were measured for moisture and test weight.

Table 1: Site locations and the previous crop type and soil tests.

Site	Legal Land Location	Previous Crop	Depth	N	P	K	S	pH
				lbs/ac	ppm Olsen	ppm	lbs/ac	
Melita	NE 36-3-27W	Canola	0-6"	14	11	130	14	7.8
			6-24"	18			36	
Boissevain	NE 19-4-19W1	Canola	trial terminated					
Reston	NW 7-7-27 W1	Canola	trial terminated					
Isabella	NE 10-15-25 W1	Canola	trial terminated					

Table 2: Specific site location information

Site	Seed Date	Seeding Fertilizer App. (lbs/ac)	Top Dressing 50 lbs/ac N	Herbicides	App. Date	Harvest
Melita	15-Sep	63-30-0-0	14-May	Achieve + Mextrol	28-May	30-Aug

Results

There were significant differences among varieties (Table 3). The variety Emerson, the Fusarium resistant variety, was the top yielding and highest protein variety for the trial. Emerson yielded similar to several other varieties at the Melita location including Swainson, Moats, 1303-132-2, and AAC Gateway.

Table 3: Varieties of winter wheat and their corresponding yield and protein content in Melita in 2013.

		Yield		Protein*
Variety	Identity	kg/ha	% Check	%
Emerson	W454	5146	132	12.6
Swainson	DH01-25-135R	5069	130	10.9
Moats	S01-285-7*R	4612	119	11.6
1303-132-2	1303-132-2	4274	110	10.8
AAC Gateway	W478	4081	105	11.9
CDC Falcon	S94-4	3891	100	11.3
Flourish	W434	3736	96	11.5
1603-137-1	1603-137-1	3609	93	11.2
Sunrise	DH99-55-2	3589	92	10.4
CDC Buteo	S96-33	3589	92	11.3
Broadview	W425	3260	84	11
	CV%	14.9		
*Taken from Manitoba Seed Guide 2014 Variety Descriptions	LSD (p<0.05)	1041	27	
	P value	0.0469		
	Grand Mean	4078	105	
	Significant?	Yes		
	R-Square	0.58		


Winter Wheat Harvest

Spring Wheat

Cooperators

- MCVET
- Seed Manitoba

Research Site: Melita, MB

Location: NE 36-3-27 W1

Land Cooperator: Wayne White

Previous Crop: Canola

Soil Texture: Liege Sandy Loam

Soil Test:

Site	Depth	pH	N lbs/ac	P ppm Olsen	K ppm	S lbs/ac
Melita	0-6"	8.1	15	9	174	116
	6-24"		60			198
	0-24"		75			314

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 to support the high quality food demand, feed wheat, ethanol and other industries for yield potential and protein content. This variety data is used to support the province wide data set published in Manitoba's Seed Guide for 2014.

Methods

The evaluation consisted of two trials, one with 17 Canada Western Red Spring (CWRS) varieties and the other with 7 varieties of Canada Western General Purpose (CWGP) and Canada Prairie Spring Red (CPSR). Each trial had a CWRS check (Glenn) and were in plots that were 1.44 m wide x 8.5 m long. Varieties were organized in a randomized complete block design. All varieties were replicated three times. Plots were direct seeded May 27th at a depth of 5/8" using a dual knife SeedHawk air seeder. Fertilizer was sideband at 85 lbs/ac nitrogen and 30 lbs/ac phosphorous in using liquid 28-0-0 UAN and granular 11-52-0 MAP. Plots were maintained weed free using Tundra Herbicide at a rate of 0.8 L/a. Plots were desiccated with Maverick glyphosate 1 L/ac on September 4. Plots were harvested at full maturity on September 9th. Data collected included yield and test weight. Yield and protein data are summarized. The CWRS class trial experienced flooding in July and replication 3 was lost and not included in the analysis. This was not the case in the General Purpose class trial.

Results

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

Table 1: Varieties of spring wheat, wheat classes and their corresponding grain yield and protein content in Melita.

Variety	Identity	Class	Yield kg/ha	Percent Check	Protein* %
Vesper VB	BW415	CW Red Spring	4445	106	14.4
Glenn (check)	BW406	CW Red Spring	4185	100	14.5
AAC Brandon	BW932	CWRS	4058	97	14.3
Kane	BW342	CW Red Spring	4040	97	14.4
AAC Elie	BW931	CWRS	3992	95	14.3
CDC Stanley	BW880	CW Red Spring	3868	92	14.5
CDC Kernen	BW881	CW Red Spring	3846	92	14.7
CDC Utmost VB	BW883	CW Red Spring	3804	91	14.5
CDC Thrive	PT575	CW Red Spring	3726	89	14.6
Whitehawk	HW024	CW Hard White Spring	3702	88	13.7
Cardale	BW429	CWRS	3572	85	14.6
CDC VR Morris	BW423	CWRS	3534	84	14.5
CDC Plentiful	PT580	CWRS	3458	83	14.4
SY433	BW433	CW Red Spring	3358	80	14.6
AAC Redwater	PT457	CWRS	3331	80	14.3
AAC Bailey	BW901	CWRS	3001	72	14.9
AAC Iceberg	HW021	CWHWS	2885	69	13.5
*Taken from Manitoba Seed Guide 2014 Variety Descriptions		CV%	6.8		
		LSD (p<0.05)	531	13	
		P value	0.0038		
		Grand Mean	3694	88	
		No. of Reps	2		
		R-Square	0.91		

Table 2: Varieties of spring wheat, wheat classes and their corresponding grain yield and protein content in Melita.

Variety	Identity	Class	Yield kg/ha	Percent Check	Protein* %
Pasteur	GP032	CW General Purpose	4864	109	12.9
AAC Proclain	GP080; SWS416	CWGP	4643	104	12.6
Enchant VB	HY694	CPSR	4505	101	13.2
Glenn (check)	BW406	CW Red Spring	4444	100	14.5
SY985	HY985	CPS Red	4266	96	13.5
CDC NRG003	GP003	CW General Purpose	4215	95	12.9
HY1312	HY1312	CPSR	3951	89	13.9
*Taken from Manitoba Seed Guide 2014 Variety Descriptions		CV%	5.6		
		LSD (p<0.05)	448	10	
		Grand Mean	4412	99	
		P value	0.01		
		R-squared	0.78		

Oats

Cooperators

- MCVET
- Seed Manitoba

Research Site: Melita, MB
Location: NE 36-3-27 W1
Cooperator: Wayne White
Previous Crop: Canola
Soil Texture: Liege Sandy Loamy
Soil Test:

Site	Depth	pH	N lbs/ac	P ppm Olsen	K ppm	S lbs/ac
Melita	0-6"	8	12	11	344	96
	6-24"		9			156
	0-24"		21			252

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 9 varieties of hulled oats in plots that were 1.44 m wide by 8.5 m long. Varieties were organized in a randomized complete block design and replicated three times. Plots were direct seeded May 29th at a depth of 5/8". Fertilizer was sideband at 85 lbs/ac nitrogen and 30 lbs/ac phosphorous using liquid 28-0-0 UAN and granular 11-52-0 MAP. Plots were maintained weed free using Stampede herbicide and MCPA ester 500 herbicides at rates of 1.25 lbs/ac and 0.5 L/ac, respectively, applied with a 20 gal/ac water volume on June 13th. Plots were desiccated with an application of glyphosate (Credit) on August 30 at a rate of 1 L/ac. Plots were harvested at full maturity September 12th. Protein samples were analyzed from composite samples of each variety. Data collected included, maturity, yield and test weight. Agronomic characteristic data can be made available upon request. Yield and protein will be summarized. Composite samples were not provided by the Melita site in time for protein testing.

Table 1: Protein Comparisons

Protein Comparisons

Variety	2013 Protein (%)										
	Arborg	Beausejour	Boissevain	Dauphin	Hamiota	Melita	Neepawa	Rosebank	St. Adolphe	Stonewall	Thornhill
AAC Justice	12.0	11.8	12.1	10.7	12.0	—	12.5	13.2	12.6	11.8	11.7
CDC Big Brown	13.1	12.7	13.4	11.9	13.3	—	13.5	13.1	13.3	13.1	13.0
CDC Haymaker	13.9	13.1	13.3	12.2	13.3	—	13.5	13.6	13.6	13.3	12.5
CDC Ruffian	12.3	12.5	12.5	11.3	11.9	—	12.0	13.0	13.0	11.9	12.1
CDC Seabiscuit	12.6	12.5	13.2	11.5	12.1	—	13.6	13.2	15.7	12.5	12.6
Leggett	13.6	13.4	13.6	11.9	13.4	—	14.4	14.1	14.6	12.4	13.6
Souris	12.8	13.0	12.8	12.1	12.9	—	14.4	13.4	13.6	12.1	12.1
Stride	14.0	13.3	13.4	12.1	13.8	—	13.1	14.4	15.2	14.0	12.8
Varieties that have been supported for registration											
OT3061	12.6	12.2	11.9	11.1	12.2	—	12.9	13.0	13.2	13.0	12.0
SITE GRAND MEAN (%)	13.0	12.7	12.9	11.6	12.8	—	13.3	13.4	13.9	12.7	12.5

Table 2: Variety Description

Variety[1]	Site Years Tested	Yield bu/acre	Protein %	Maturity +/- 96 days	Height +/- 33 inches	Test Wt +/- 39.3 lb/bu	Hull %	Hull Colour	Resistance Level: Lodging	Smut	Crown Rust	Stem[2] Rust	BYD[3]
AAC Justice⊛	12	143	11.8	0	2	0.5	22.8	White	G	R	R	I	I
AC Morgan	36	133	11.8	-1	6	-1.0	25.2	White	G	I	S	S	MS
Bradley⊛	29	131	12.6	2	3	—	—	White	G	R	MS	MS	MS
CDC Big Brown⊛	39	134	12.5	-1	1	0	20.4	Tan	G	R	R	MS	MS
CDC Dancer⊛	59	127	12.6	-3	5	0.5	19.6	White	G	R	I	I	MS
CDC Haymaker (F)⊛	12	119	12.8	2	10	-1.0	22.0	White	G	MR	S	S	—
CDC Minstrel⊛	40	136	11.1	0	3	-0.2	22.3	White	VG	R	MS	I	MS
CDC ProFi	39	121	13.0	-3	1	-1.0	20.0	White	G	MS	S	I	MS
CDC Ruffian⊛	22	145	12.0	0	0	-0.8	20.5	White	G	R	I	S	S
CDC Seabiscuit⊛	34	134	12.4	0	6	-0.5	20.1	White	G	MR	S	I	S
CDC Weaver⊛	36	127	12.5	-1	5	-1.0	19.0	White	F	R	S	I	MS
Furlong⊛	93	125	12.4	-1	8	0.5	20.3	Tan	G	R	S	I	MR
HiFi⊛	63	136	12.9	-3	6	0	24.7	White	G	MS	R	I	MR
Jordan⊛	51	136	11.3	2	3	-2.0	23.6	White	VG	R	I	I	MR
Leggett⊛	108	135	13.3	0	0	0	23.0	White	G	R	R	I	MS
Pinnacle⊛	68	144	11.7	3	4	-1.2	23.7	White	G	R	S	I	MS
Ronald⊛	84	125	12.3	0	1	0	22.1	White	VG	R	S	I	MR
Souris⊛	51	133	12.5	-4	0	0.5	20.9	White	G	R	R	MR	MS
Stainless	25	128	12.7	-3	5	-0.5	22.4	Light Grey	G	R	R	MR	MR
Stride⊛	34	133	13.5	-2	5	0.6	23.7	White	VG	R	R	I	I
Summit⊛	40	139	12.4	0	-1	0.5	20.8	White	G	R	R	I	I
Triactor⊛	42	152	12.1	-1	3	-1.5	22.1	White	VG	I	MR	S	MS
Varieties that have been supported for registration													
OT3061	12	124	11.9	0	4	-0.8	23.0	White	VG	R	R	I	I
GRAND MEAN		135	12.4										
LSD (0.05)		7	0.3										

1 The letter 'F' indicates a forage type.
2 All varieties are susceptible to new races NA67 and NA76 and these races caused moderate damage to crops in the Red River Valley in 2001 and 2002. Early seeding will generally reduce the likelihood of severe infection.
3 BYD = Barley Yellow Dwarf - a viral disease carried and spread by aphids - early seeding will generally reduce the likelihood of severe infection.

Table 3: Yield Comparisons

Variety	2013 Yield (bu/acre): Arborg	Beausejour	Boissevain	Dauphin	Hamiota	Melita	Neepawa	Rosebank	St. Adolphe	Stonewall	Thornhill
AAC Justice⊛	178	169	187	204	204	201	316	112	191	157	176
CDC Big Brown⊛	177	171	192	168	209	184	310	77	208	130	173
CDC Haymaker⊛	171	174	160	148	210	158	268	88	172	121	164
CDC Ruffian⊛	183	184	198	191	236	199	273	75	200	159	173
CDC Seabiscuit⊛	172	180	205	187	217	170	278	81	203	159	172
Leggett⊛	178	173	201	163	211	171	279	91	204	98	151
Souris⊛	168	180	211	174	200	172	284	90	168	133	186
Stride⊛	181	187	204	159	189	183	321	89	200	124	163
Varieties that have been supported for registration											
OT3061	164	179	183	157	153	155	283	84	205	149	163
SITE GRAND MEAN (bu/acre)	175	178	193	172	203	177	290	87	195	142	169
CV %	5.3	5.4	4.0	7.3	6.7	6.5	9.1	8.8	6.0	6.0	9.0
LSD (bu/acre)	—	—	14	22	23	20	—	13	20	15	—
Sign Diff	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No
Seeding Date	22-May	15-May	16-May	20-May	23-May	27-May	16-May	13-May	09-May	13-May	06-Jun
Harvest Date	06-Sep	03-Sep	22-Sep	25-Sep	30-Sep	12-Sep	09-Sep	28-Aug	22-Aug	02-Sep	03-Oct

Buckwheat

Cooperators

- MCVET
- Nestibo Agra
- Seed Manitoba
- Manitoba Buckwheat Growers Association

Research Site: Elva, MB
Location: SE 36-3-28W1
Cooperator: Grieg Farms
Previous Crop: Oats
Soil Texture: Stanton Sandy Loam
Soil Test:

Site	Depth	pH	N lbs/ac	P ppm Olsen	K ppm	S lbs/ac
Elva	0-6"	8.1	7	2	208	24
	6-24"		12			294
	0-24"		19			318

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 fee 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 in Manitoba.

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 was applied June 6 with glyphosate herbicide at a rate of 1 L/ac. Plots were direct seeded June 6st at a depth of 5/8". Fertilizer applied was 53 lbs N, and 30 lbs P in the form of granular 11-52-0 MAP and 28-0-0 UAN. No in-crop herbicides were applied. Plots were swathed at physiological maturity September 11th. Plots were harvested October 2nd.

Results

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

Table 1: Variety and site comparison chart for Buckwheat

Variety	Yield % Check	Site Years Tested	Days to 50% Bloom +/- Check	Height +/- Check	2013 Average Yield	2013 Yield: % of Koma Arborg	Beausejour	Carberry	Melita
AC Manisoba	113	18	-3	-2	134	131	147	136	111
AC Springfield	115	18	-1	-5	146	131	143	134	113
Horizon	127	9	—	—	132	124	124	119	105
Koma	100	18	0	0	100	100	100	100	100
Koto	121	18	-2	-3	159	138	182	136	133
Mancan	106	18	-2	-6	124	130	127	120	110
Manor	111	4	—	—	—	—	—	—	—
CHECK CHARACTERISTICS						1046	998	910	3282
Koma	1387	18	47	45	CV%	5.1	13.6	10.3	7.0
	lb/acre	site years	days	inches	LSD%	9	25	16	11
					Sign Diff	Yes	Yes	Yes	Yes
					Seeding Date	30-May	15-May	06-Jun	06-Jun
					Harvest Date	07-Oct	11-Oct	18-Oct	02-Oct

Dry Beans

Cooperators

- MCVET
- Manitoba Pulse Growers Association
- Seed Manitoba

Research Site: Elva, MB
Cooperator: Grieg Farms
Soil Texture: Stanton Sandy Loam
Location: SE 36-3-28W1
Previous Crop: Oats
Soil Test:

Site	Depth	pH	N lbs/ac	P ppm Olsen	K ppm	S lbs/ac
Elva	0-6"	7.9	8	2	155	12
	6-24"		12			120
	0-24"		20			132

Background

Dry bean production in Southwest Manitoba is limited to the amount of frost free days, moisture, and accumulated heat unites 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 2013 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.

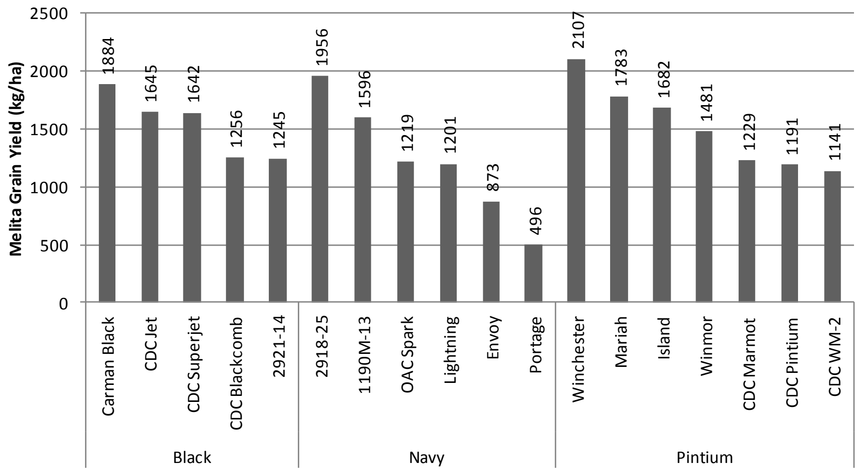
Methods

Trials consisted of 16 varieties of narrow row dry beans in plots that were 1.44 m wide by 5 m long. Varieties were organized in a randomized complete block design and replicated three times. Plots were direct seeded May 16th at a depth of 3/4". No nodulator was used in this trial. Fertilizer was sideband at 66 lbs N/ac, and 30 lbs P/ac using liquid 28-0-0 UAN and granular 11-52-0. Plots were maintained for weeds with Basagran Forte herbicide sprayed at a rate of 0.91 L/ac, applied June 13th with 20 gal/ac water volume. Arrow herbicide was applied June 12th at a rate of 120 mL/ac to control grassy weeds. Plots were harvested (photo below showing mature beans) September 24th with the Hege 140 plot combine.

Results

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

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



Statistic (Melita)	Value
CV%	20.6
LSD (p<0.05)	487 kg/ha
Grand Mean	1424 kg/ha
P value	<0.0001
Significant?	Yes
R-Square	0.8

Table 1: Dry Bean Statistics of Black, Navy and Pintium Beans

Dry Beans

Western Manitoba Soybean Adaptation Trial

Cooperators

- Manitoba Pulse Growers Association
- MCVET
- Seed Manitoba

Research Site: Elva, MB
Location: SE 36-3-28W1
Cooperator: Grieg Farms
Previous Crop: Oats
Soil Texture: Stanton Sandy Loam
Soil Test:

Site	Depth	pH	N lbs/ac	P ppm Olsen	K ppm	S lbs/ac
Elva	0-6"	8.2	9	4	116	10
	6-24"		27			108
	0-24"		36			118

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 2013 in Manitoba. Yield also increased, from 36.3 bushels per acre in 2012 to 38.3 in 2013 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

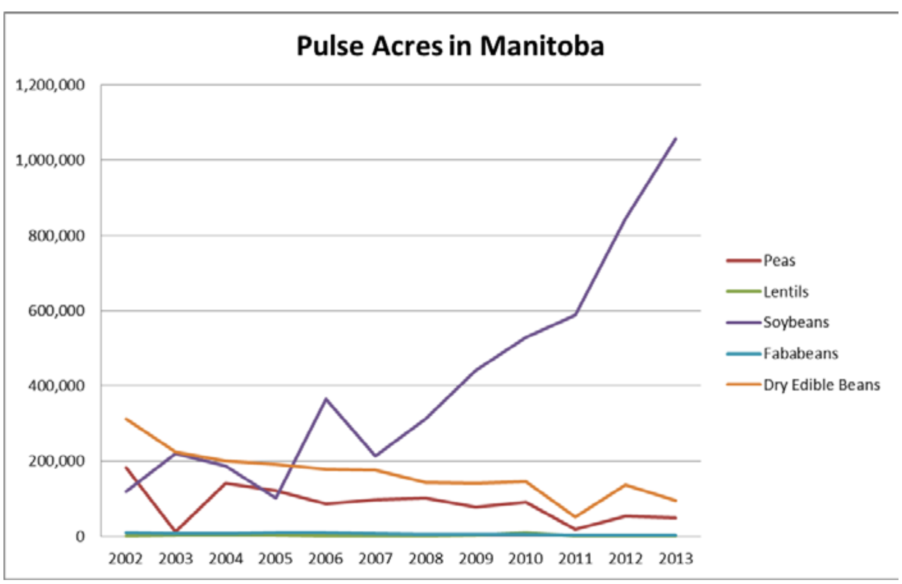


Chart Source: Manitoba Pulse Growers Association, 2013.

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 18 varieties of glyphosate tolerant varieties arranged in a 5x5 completely balanced lattice design and replicated three times. Seed was inoculated with granular Rhizobia (Becker Underwood) just prior to planting. Plots were solid seeded with a SeedHawk dual knife opener air drill and phosphate was sideband. 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: Statistics on planting soybeans

Preseed Burnoff	Seed Date	Seed Depth	Fertilizer Applied	Herbicides	App. Date	Dessication	Harvest
None	16-May	3/4"	58 lbs/ac 11-52-0 MAP	Maverick III Glyphosate applied @ 0.76 L/ac	17-Jun	Reglone 0.9 L/ac applied Oct 3	10-Sep

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

Table 2: Data collected on soybean trial

		Yield (kg/ha)		Site	Mean Yield Percent	Days to Maturity
Variety	Identity	Hamiota	Melita	Mean	Check	Melita - Days
PRO 2525R2	PRO 2525R2	4011	2886	3449	122	133
TH 32004R2Y	32004	3555	3024	3290	117	133
TH 33005R2Y	TH 33005R2Y	3944	2536	3240	115	129
NSC Libau RR2Y	NSMR2-EXP140	3099	3338	3219	114	136
900Y71	PH09005	2802	3579	3191	113	135
LS002R24N	LS002R24N	3853	2522	3187	113	129
900Y61	PH10001	3055	3190	3123	111	132
NSC GLADSTONE RR2Y	NSC GLADSTONE RR2Y	3228	2994	3111	110	130
NSC RESTON RR2Y	NSM EXP 1225 R2	3310	2896	3103	110	123
23-60RY	FLZ612A4	3093	3029	3061	109	135
NSC TILSTON RR2Y	G10 R2; NSMR2-EXP G10	3312	2691	3002	107	130
MCLEOD R2	SC2375R2	3428	2564	2996	106	130
LS 002R23	LS002R23	3384	2414	2899	103	130
NSC Anola RR2Y	NSMR2-EXP 190	3356	2354	2855	101	130
EXP00313R2	EXP00313R2	3202	2460	2831	101	133
23-10RY	23-10RY	3124	2507	2816	100	132
TH 33003R2Y	QG 2475R2Y	2908	2712	2810	100	128
Pekko R2	CFS11.1.01R2	3098	2500	2799	99	129
Bishop R2	SC-1001RR	2574	2797	2685	95	130
Sampsa R2	CFS11.3.01R2	2468	2787	2628	93	136
Vito R2	PR1182713R2	2588	2589	2588	92	134
NSC MOOSOMIN RR2Y	NSC MOOSOMIN RR2Y	2446	2277	2362	84	127
P001T34R	P001T34R	2018	2399	2209	78	127
29002RR	29002RR	2397	1355	1876	67	127
CV%		9.3	14.2			2.5
LSD (p<0.05)		469	625			5
Grand Mean		3079	2666			130.72
P value		<0.0001	0.0001			0.00085
Significant		Yes	Yes			Yes
R-Square		0.83	0.66			0.63

Durum

Cooperators

- WADO
- Seed Manitoba

Research Site: Melita, MB
Location: NE 36-3-27 W1
Cooperator: Wayne White
Previous Crop: Canola
Soil Texture: Liege Sandy Loamy
Soil Test:

Soil Test			N	P	K	S	Organic Matter
Legal Land Location	Depth	pH	lbs/ac	Olsen ppm	ppm	lbs/ac	%
NE 36-3-27 W1	0-6"	8	12	11	344	96	4.3
	6-24"		9			156	
	0-24"		21			252	

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 12 varieties (photo right shows one variety) in plots that were 1.44 m wide x 8.5 m long. Varieties were organized in a randomized complete block design. Variety plots were replicated three times. Plots were direct seeded May 29 at a depth of 5/8". Fertilizer was applied at 85 lbs/ac nitrogen and 30 lbs/ac phosphorous in the form of liquid 28-0-0 UAN and granular 11-52-0 MAP. Plots were maintained weed free using Tundra herbicide at 0.8 L/ac, applied June 13th. Plots were harvested at full maturity on September 12th. A composite sample of each variety was analyzed for protein content.

Results

There were significant differences among variety yields in Melita (Table 1).

Table 1: Statistics on the Durum trial

Variety	Identity	Yield (kg/ha) Melita	Percent Check	Protein* %
AAC Marchwell VB	DT833	4625	106	14.3
Eurostar	DT776	4463	102	13.9
CDC Verona	DT540	4427	101	14.1
Brigade	DT773	4412	101	13.3
Strongfield (check)	DT712	4374	100	14.4
DT832	DT832	4308	98	14.4
Transcend	DT801	4094	94	14.1
CDC Vivid	DT562	3664	84	14.8
AAC Raymore	DT818	3632	83	14.1
DT570	DT570	3412	78	14.2
CDC Desire	DT561	3188	73	14.2
AAC Current	DT816	2794	64	14.3
	CV%	7.1		
	LSD (p<0.05)	479	*Taken from Manitoba Seed Guide 2014 Variety Descriptions	
	P value	<0.0001		
	Significant?	Yes		
	Grand Mean	3949		
	R-Square	0.87		

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 variety AAC Marchwell VB is the first midge tolerant durum variety registered for production in Canada. It will be grown as a varietal blend to protect the Sm1 gene. AAC Raymore is the first solid stemmed variety for production in Canada.

Please Note: CDC Desire will be commercially available for seeding in the Spring of 2014.

Lentils

Cooperators

- WADO
- Manitoba Pulse Growers Association

Seed Manitoba

Research Site: Elva (Melita location), MB
Location: SE 36-3-28W1
Cooperator: Grieg Farms
Previous Crop: Oats
Soil Texture: Stanton Sandy Loam
Soil Test:

Soil Test			N	P	K	S	Organic Matter
Legal Land Location	Depth	pH	lbs/ac	Olsen ppm	ppm	lbs/ac	%
SE 36-3-28W1	0-6"	8.2	9	4	116	10	1.9
	6-24"		27			108	
	0-24"		36			118	

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 more suited for 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 8.5 m long. Varieties were organized in a 3 x 4 rectangular lattice design and replicated three times. A pre-seed application of a tank mix of rival, Cleanstart was applied May 17th at a rate of 0.65 L/ac (trifluralin), 1 L/ac (glyphosate) and 35 ml/ac (carfentrazone), respectively. Plots were direct seeded at a depth of 1.25" on May 13th. Seed was inoculated with pea/lentil Rhizobia (BeckerUnderwood) and phosphate was sideband at 30 lbs/ac from 11-52-0 MAP. Plots were maintained weed-free with Arrow applied at a rate of 120 mL/ac applied June 12th. A separate application of Sencor was applied in-crop at a rate of 111 g/ac. Plots were desiccated August 29th with Reglone at a rate of 0.9 L/ac and were harvested September 3rd.

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

Results

There were significant differences in yield in both Hamiota and Melita (Table 1). Hamiota site is included for regional mean purposes.

Table 1: Statistics 2013 Lentals

		Yield (kg/ha)		Year	Percent
Variety	Identity	Hamiota	Melita	Mean	Check
CDC marble	3494-6	2957	2677	2817	108
CDC Scarlet	3160-21	3196	2409	2802	107
CDC Maxim (Check)	3114	2924	2311	2617	100
CDC Asterix	2861-15a	2868	2212	2540	97
CDC Rosie	3155-18	2855	2142	2499	95
CDC Dazil	IBC 289	2508	2484	2496	95
CDC Imvincible	IBC 112	2513	2428	2470	94
Ruby	1897T-1	3009	1804	2406	92
Rosebud	1788S-4	2881	1863	2372	91
CDC Imax	IBC 187	2374	2352	2363	90
CDC Peridot	IBC 188	2312	2309	2310	88
CDC Imigreen	IBC 145	2136	1608	1872	72
CV%		13.1	10.9		
LSD (p<0.05)		602	410		
Grand Mean		2711	2217		
P value		0.029	0.0012		
Significant?		Yes	Yes		

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 infests lentils where rain is abundant. Stereotypically lentils are grown in regions such as the Brown and Dark Brown soil zones of Saskatchewan. The 2013 growing season would not have been optimal for lentil production in Melita as precipitation and temperatures were above normal favoring disease development.

Sunflower Variety Trials

Cooperators

- WADO
- National Sunflower Association of Canada
- Seed Manitoba

Research Site: Elva, MB
Location: SE 36-3-28W1
Cooperator: Grieg Farms
Previous Crop: Oats
Soil Texture: Stanton Sandy Loam
Soil Test:

Soil Test			N	P	K	S	Organic Matter
Legal Land Location	Depth	pH	lbs/ac	Olsen ppm	ppm	lbs/ac	%
SE 36-3-28 W1	0-6"	8.2	7	2	100	14	1.9
	6-24"		18			54	
	0-24"		25			68	

Background

As part of WADO's support for special crops, WADO partnered with the National Sunflower Association to test Sunflower varieties in Western Manitoba. A site was established two miles north of Elva 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. For 2013, WADO grew confectionary and oil type sunflowers. The confectionary trial failed due to an extreme weather event causing flooding and lodging after the flowering stage.

Methods

Test design:	Randomized complete block design for each type
Treatments:	8 oil types
Replications:	Four
Plot size:	1.524 m x 9 m
Row Spacing:	29.5" x 4 rows/plot
Plant Spacing:	Seeded heavy rate with air seeder then thinned out stand at 8" (oilseed) between plants in row
Seeding date:	May 22, 2013
Fertilizer applied:	Sideband: 96 lbs/ac N. from 28-0-0 and 30 lbs/ac P. from 11-52-0.
Herbicide applied:	Authority at 100 mL/ac, Rival at 0.65L/ac and Glyphosate (Credit) at 1 L/ac May 17 as a pre-seed burnoff. Arrow applied June 27 at 120 mL/ac
Insecticide:	Not Applied
Harvest date:	October 23, 2013
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

Oilseed

Table 1: Variety Description

Variety Descriptions													
					Provincial						Resistance to:		
		Herb		Oil	Yield	Harvest	Days to	Days to	Height			Verticillium	Downy
Company	Variety	Type	DMR	Type	(lbs/acre)	Moisture (%	Bloom	Maturity2	(inches)2	% Oil	Rust3	Wilt	Mildew4
Syngenta	3495 NS/CL/DM	CL	Y	NS	3337	11.2	76	118	70	41.0	HS	MR	MR
Seeds 2000	Cobalt II	CL	Y	HO	2994	17.6	74	119	66	41.1	-	-	-
Seeds 2000	Falcon EX	ExSun	N	NS	3212	16.7	75	120	66	43.4	HS	MR	S
Pioneer Hi-Bred	P63ME70	ExSun	Y	NS	3417	10.8	73	116	73	43.5	HS	MR	R
Pioneer Hi-Bred	P63ME80	ExSun	Y	NS	3501	12.8	74	119	74	44.2	HS	MR	R
Experimental lines are being tested/proposed for registration in Canada													
Syngenta	7111 HO/CL/DM	CL	Y	HO	3093	11.4	70	115	64	38.3	MR	MR	R
NuSeed Global	NLK12S069	ExSun	N	NS	3313	17.6	75	116	73	37.2	-	-	-
NuSeed Global	NLK12S070	ExSun	N	NS	3250	15.6	72	115	68	40.2	-	-	-
Overall Average (lbs/ac)					3265	14.2	73	117	69				
Site Years					4	1	4	4	4				

There were significant differences among varieties in regards to yield performance in the Melita (Elva) location (Table 2).

Table 2: Statistics on 2013 Oilseed Sunflower Trial

MELITA - Oilseed Sunflower Trial 2013						
Entry	**Yield (lbs/acre)**	**Harvest Moisture (%)**	**Days to Bloom**	**Days to Maturity**	**Height (inches)**	**Oil Content**
3495 NS/CL/DM	2635	11.2	65	116	65	41.7
Cobalt II	2425	17.6	67	115	67	41.2
Falcon EX	2575	16.7	63	117	63	45.4
P63ME70	2627	10.8	65	116	65	44.6
P63ME80	2698	12.8	69	116	69	45.0
Experimental lines are being tested/proposed for registration in Canada						
7111 HO/CL/DM	2218	11.4	62	116	62	38.7
NLK12S069	2398	17.6	72	116	72	38.5
NLK12S070	2822	15.6	65	116	65	42.5
GRAND MEAN	**2544**	**14.2**	**66**	**116**	**66**	
CV%	**7.7**					
LSD (lbs/acre)	**289**					
Sign Diff	**Yes**					

Industrial Hemp

National Hemp Coop Variety Trials- Trial Descriptor

Jeff Kostuik[1], Susan M^{c}Eachern[1], Angel Melnychenko[1] and Amy Stewart[1]

Site Information

Locations: Arborg, Manitoba
Carberry, Manitoba
Melita, Manitoba
Roblin, Manitoba
Kemptville, Ontario
Melfort, Saskatchewan
QuAppelle, Saskatchewan
Vegreville, Alberta

Cooperators: Prairies East Sustainable Agriculture Initiative (PESAI), Arborg, MB
Canada-Manitoba Crop Diversification Centre (CMCDC), Carberry, MB
Westman Agriculture Diversification Organization (WADO), Melita, MB
Parkland Crop Diversification Foundation (PCDF), Roblin, MB
Wendy Asbil, University of Guelph, Kemptville, ON
Cecil Vera, Agriculture and Agri-Food Canada, Melfort, SK
Hugh Campbell, Terramax, QuAppelle, SK
Jan Slaski, 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

These variety trials will be a tool to evaluate and demonstrate hemp and hemp varieties in a number of regions in Canada. The grain and fibre yields will give producers and industry the tools and varieties they need to produce hemp in a sustainable and economic way. In addition, these trials will give plant breeders an evaluation of their varieties or lines in a range of climates and growing conditions.

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[1] PCDF, Roblin

Quality analysis of grain yield, oil quality and % oil content will give the industry the highest quality crop that produces a good balance of essential fatty acids. Fibre yield and % bast fibre analysis will be a huge boost to the emerging fibre decortication and processing industry to meet the potential markets of textiles, building products and biocomposites.

Quality analysis will also give the industry a competitive advantage by knowing areas of top quality production. For example, is there a northern vigor for hemp that will give superior and enhanced quality and quantity of % oil or superior amounts or improved values of omega 3 and omega 6 fatty acids? These traits can be incorporated into plant breeding programs.

In 2012 the Canadian Hemp Trade Alliance (CHTA) secured funding for these National trials through the Adaptation Innovation Program. In 2013, the CHTA once again applied for funding under the AIP program, this time looking long term at a 5 year plan to evaluate hemp grain and fibre across Canada. To date the CHTA has not heard whether the funding request was successful or not; therefore, for 2013 yield data for both fibre and grain will be reported and quality analysis is on hold until funds become available for testing. Financial support has been received thus far for these trials from Canadian Hemp Partners, Cooperators and Plant Breeding programs and through the Manitoba Crop Diversification Centres (MAFRD).

Objective

To evaluate industrial hemp varieties for fibre and grain yield, as well as other characteristics.

Methods

There were 11 site locations selected or the trials:
Lethbridge, Alberta
Vegreville, Alberta
Arborg, Manitoba
Carberry, Manitoba
Melita, Manitoba
Roblin, Manitoba
Kemptville, Ontario
Laird, Saskatchewan
Melfort, Saskatchewan
QuAppelle, Saskatchewan
Swift Current, Saskatchewan

The Laird and Swift Current trials were lost due to excess moisture. The Lethbridge location did not participate in this year’s trial.

Experimental design was small plot, random complete block design utilizing small plots with 4 replicates.

Table 1: 2013 National Hemp Coop Variety Trial Locations and Varieties Grown

Arborg	Carberry	Kemptville	Melfort	Melita	Roblin	Vegreville
Canda	Canda	Canda	CFX-2	Canda	Canda	Canda
CFX-2	Silesia	Delores	CRS-1	CFX-2	CFX-2	CFX-2
CRS-1	X59	Joey	Finola	CRS-1	CRS-1	CRS-1
Finola		Silesia	Silesia	Debbie	Debbie	Delores
Silesia		X59	X59	Delores	Delores	Finola
X59				Joey	Finola	Silesia
				X59	Joey	X59
					Silesia	
					X59	

Table 2: 2013 National Hemp Coop Variety Trial Inputs at Cooperating Locations

Location:	Arborg	Carberry	Kemptville	Melfort	Melita	Roblin	Vegreville
Treatments	6	3	5	5	7	9	7
Replication	4	4	4	4	4	4	4
Plot Size Seeded	11.0m²	8.4m²	12.0m²	7.5m²	16.5m²	7.0m²	12.0m²
Plot Size Harvested	8.22m²	6.0m²	N/A	4.85m²	12.96m²	5.0m²	12.0m²
Seeding Date	May 23	May 13	N/A	May 24	May 13	May 22	May 23
Seeding Rate	250 pl/m²	250 pl/m²	250 pl/m²	250 pl/m²	250 pl/m²	250 pl/m²	250 pl/m²
Fibre Harvest Date	Aug. 30	Aug. 15	N/A	Aug. 31 to Sep. 27	Aug. 9	Aug. 13	Sep. 19 & Sep. 20
Grain Harvest Date	Sep. 25	Sep. 13	N/A	Aug. 31 to Sep. 27	Aug. 28	Sep. 10	Sep. 19 & Sep. 20
Grain Days from Seeding to Combining	126	123	N/A	99 to 126 from seeding to maturity	107	112	120

* Note: At the Vegreville location, grain was collected from the 1m² plots that were harvested for fibre due to problems with the combine that is used to harvest hemp.

Table 3: 2013 Estimated Spring Soil Nutrient Analysis from 0-24" Depth at Cooperating Locations

Location	Arborg	Carberry	Kemptville	Melfort	Melita	Roblin	Vegreville
N*	N/A	35 lbs/ac	N/A	151kg/ha	21 lbs/ac	52 lbs/ac	160 lbs/ac
P*	N/A	32 lbs/ac	N/A	>54 kg/ha	2 ppm	12 ppm	21 lbs/ac
K*	N/A	306 ppm	N/A	>540 kg/ha	170 ppm	198 ppm	405 lbs/ac
S*	N/A	52 lbs/ac	N/A	60 kg/ha	68 lbs/ac	102 lbs/ac	47 lbs/ac
pH	N/A	5.8	N/A	7.7	8.3	6.7	6.3

* N = Nitrate
* P = Phosphate (Olsen)
* K = Potassium
* S = Sulphate

Table 4: 2013 Spring Fertilizer Applications at Cooperating Locations

	Arborg	Carberry	Kemptville	Melfort	Melita	Roblin	Vegreville
N*	90 lbs/ac	115 lbs/ac	N/A	Ammonium phosphate 45 kg/ha	90 lbs/ac	100 lbs/ac	40 lbs/ac
P_2O_5*	27 lbs/ac	25 lbs/ac	N/A		30 lbs/ac	55 lbs/ac	52 lbs/ac
K_2O*	15 lbs/ac	0	N/A		0	10 lbs/ac	0
S*	20 lbs/ac	0	N/A		0	10 lbs/ac	0

* N = Nitrogen
* P = Phosphorus
* K = Potash
* S = Sulphur

National Hemp Coop Grain Variety Trial

Jeff Kostuik[2], Susan McEachern[1], Angel Melnychenko[1] and Amy Stewart[1]

Locations: Arborg, Manitoba
Carberry, Manitoba
Melita, Manitoba
Roblin, Manitoba
Kemptville, Ontario

[1] PCDF, Roblin

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
Wendy Asbil, University of Guelph, Kemptville, ON

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 Canadian hemp Industry continues to grow primarily due to grain processing. Increased market demand for hemp seed and its derivatives catalyzed two of Canada's major hemp grain processors to undergo major infrastructure expansions to accommodate the rise in product demand. Both Manitoba Harvest and Hemp Oil Canada are Manitoba based companies.

To keep pace with the increase in demand, more hemp acres are required to supply processors with consistent high quality grain. New growers are needed and established growers must remain vigilant to grow high quality grain for human consumption.

The production of high quality hemp products starts at the farm level (see pictures on pages 37 and 41). Processors require high quality seed to conduct their processing operations and meet the standards set by end users and consumers. An example is Manitoba Harvest's contract terms. They require 99.9% purity and less than 2% heated seeds to meet their Grade A standard and 99.5% purity and less than 4% heated seeds for Grade B. A systematic approach is required to maximize hemp quality. Successfully obtaining that quality is dependent on proper planning, agronomics, harvest and storage practices. Also proper field and variety selection are necessary for growing hemp in the target production area and consistently produce a high quality food grade product that consumers are demanding.

Methods

Please refer to the National Hemp Coop Variety Trials Trial Descriptor for information on trial treatments and locations, inputs, nutrient analysis and spring nutrient applications at each trial location.

Results

Table 1: 2013 National Hemp Coop Grain Variety Trial Plant Population (plants/m^2) by Location

Variety	Arborg	Carberry	Kemptville	Melfort	Melita	Roblin	Vegreville
Canda	52	72	65	--	209	360	130
CFX-2	46	--	--	86	203	323	110
CRS-1	59	--	--	107	245	318	143
Debbie	--	--	--	--	174	358	--
Delores	--	--	59	--	209	310	90
Finola	53	--	--	51	--	365	115
Joey	--	--	71	--	217	378	--
Silesia	63	83	98	109	--	393	129
X59	69	99	91	101	280	440	209
Grand Mean	57	85	77	91	220	360	132
CV %	16.8	14.0	22.3	15.5	14.4	14.0	13.6
LSD	14.4	20.5	26.3	21.7	47	73.7	26.6
Sign Diff	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 2: 2013 National Hemp Coop Grain Variety Trial Plant Height (cm) from Cooperating Locations

Variety	Arborg	Carberry	Kemptville	Melfort	Melita	Roblin	Vegreville
Canda	240	190	195	--	158	177	194
CFX-2	183	--	--	194	115	173	158
CRS-1	218	--	--	226	133	173	177
Debbie	--	--	--	--	154	186	--
Delores	--	--	195	--	172	180	197
Finola	165	--	--	174	--	161	127
Joey	--	--	185	--	145	181	--
Silesia	238	211	224	255	--	183	209
X59	198	152	157	197	103	166	165
Grand Mean	207	184	191	209	140	175	175
CV %	8.6	6.1	8.9	3.6	9	16.6	5.9
LSD	26.9	19.3	32.1	11.7	18.7	42.4	15.5
Sign Diff	Yes	Yes	Yes	Yes	Yes	No	Yes

Table 3: 2013 National Hemp Coop Grain Variety Trial 1000 Kernel Weight (g) from Cooperating Locations

Variety	Arborg	Carberry	Kemptville	Melfort	Melita	Roblin	Vegreville
Canda	18.3	21.4	20.6	--	--	19.3	18.4
CFX-2	16.5	--	--	13.8	--	17.0	14.2
CRS-1	17.5	--	--	14.3	--	17.6	16.5
Debbie	--	--	--	--	--	18.1	--
Delores	--	--	18.5	--	--	18.2	17.0
Finola	13.0	--	--	10.1	--	12.0	10.9
Joey	--	--	18.7	--	--	18.3	--
Silesia	14.3	17.8	15.1	12.2	--	16.2	13.5
X59	17.3	18.6	17.3	13.1	--	17.6	15.7
Grand Mean	16.1	19.3	18.0	12.7	--	17.1	15.2
CV %	3.5	7.3	4.9	6.4	--	3.8	5.3
LSD	0.9	2.4	1.4	1.2	--	1.0	1.2
Sign Diff	Yes	Yes	Yes	Yes	--	Yes	Yes

Table 4: 2013 National Hemp Coop Grain Variety Trial Yield (kg/ha) Results from Cooperating Locations

Variety	Total (kg/ha)	N	% Check (CRS-1)	Arborg	Carberry	Kemptville*	Melfort	Melita	Roblin	Vegreville*
Canda	1642	4	106	687	2192	1701	--	1401	2289	1725
CFX-2	1612	4	106	601	--	--	2205	1305	2340	1798
CRS-1	1516	4	100	669	--	--	1924	1358	2114	1827
Debbie	1870	2	108	--	--	--	--	1404	2337	--
Delores	1857	2	107	--	--	1416	--	1391	2323	1846
Finola	1362	3	87	424	--	--	1671	--	1991	1254
Joey	2142	2	123	--	--	1541	--	1569	2715	--
Silesia	1165	4	68	472	1466	1597	1376	--	1347	1624
X59	1803	5	98	918	3093	2098	1743	1218	2043	1696
Grand Total				427	1190	1155	1158	978	1646	1260
CV%				6.6	9.8	27.2	12.0	6.5	7.7	19.6
LSD				63	380	N/A	334	N/A	244	N/A
Significant Difference				Yes	Yes	N/A	Yes	N/A	Yes	N/A

* Vegreville and Kemptville locations were excluded from initial summary due to high CV.

Chart 1: 2013 National Hemp Coop Grain Variety Trial Yield (kg/ha) at Roblin, MB

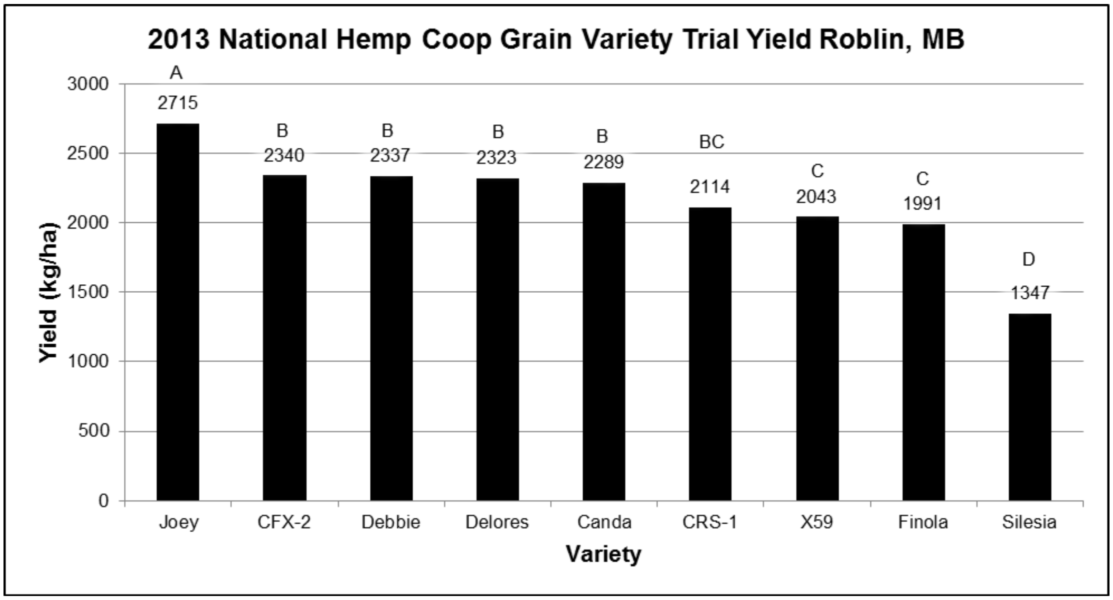

Table 5: 2012 and 2013 National Hemp Coop Grain Variety Trial Yield (kg/ha) Comparison at Cooperating Locations

Variety	12-13 % CRS-1	Arborg		Carberry		Gilbert Plains/ Roblin		Melfort		Melita		Vegreville	
		'12	'13	'12	'13	'12	'13	'12	'13	'12	'13	'12	'13
Alyssa	--	989	--	973	--	820	--	--	--	808	--	912	--
Anka	--	--	--	--	--	1092	--	--	--	1146	--	--	--
Canda	110	1230	687	1505	2192	1455	2289	2466	--	1703	1401	1324	1725
CanMa	--	--	--	994	--	1134	--	2051	--	1320	--	--	--
CFX-1	--	1462	--	1294	--	988	--	1927	--	1324	--	1023	--
CFX-2	100	1152	601	1134	--	1178	2340	2104	2205	1356	1305	1104	1798
CRS-1	100	1456	669	1098	--	1342	2114	2088	1924	1473	1358	972	1827
Debbie	93	982	--	1206	--	1121	2337	--	--	1181	1404	--	--
Delores	99	1110	--	1156	--	1275	2323	--	--	--	1391	--	1846
Finola	74	1072	424	764	--	740	1991	1661	1671	900	--	637	1254
Joey	112	1452	--	--	--	1344	2715	--	--	1372	1569	1331	--
Jutta	--	--	--	--	--	1112	--	--	--	761	--	--	--
Silesia	72	870	472	783	1466	924	1347	1821	1376	852	--	774	1624
X59	102	1689	918	1200	3093	1416	2043	2187	1743	1226	1218	1327	1696

* Note: Kemptville was excluded from table 5 because the yield CV% was greater than 15%

The four main end use streams for hemp grain production is the extraction of oil for industrial, cosmetic and functional foods; hemp meal (byproduct from the oil extraction process) for protein drinks, cooking powder, flour or animal feed; whole seed for bird seed and some human food products; and the hemp hearts for the human food market. Plant stands play an important role for both grain and fibre production. For grain production, plant density will impact seed size which can have a role in the processing of the hemp seeds and the size of the hemp hearts. The lower the plant density the larger the seed size potential is. Growers must determine what their end use market will be before they seed their crop. Seeding rates and plant densities are different for the various end uses. If grain production is the sole purpose of the production then the recommended target plant density is 100 plants/m^2. For fibre or dual purpose production the target plant density is 250-300 plants/m^2. All the entries except Finola have a larger seed size and Canda is the largest of them all. Joey and Canda have consistently been the highest yielding varieties from 2010 to 2013 (see previous Annual Reports for PCDF at http://www.gov.mb.ca/agriculture/diversification/pcdf/index.html. Other noteworthy hemp genotypes that show promise for production and processing are Delores and Debbie. Joey, Canda, Delores and Debbie were bred and developed in the Parkland region.

2012 Hemp Oil Analysis

Keith Watson[1], Jeff Kostuik[3], Susan McEachern[2], Angel Melnychenko[2] and Craig Linde[3]

Objective

Grain samples from the various cooperating sites were sent to CMH Biotechnologies Inc. laboratory at Steinbach, MB for Oil Quality analysis. Oil profiles determine the marketability of the oil and seed into various end use markets.

Background

The hemp seed varieties used in this analysis were provided by Manitoba Diversification Centers' hemp variety trial research work. Locations were in Gilbert Plains, Melita and Arborg. Additional data is included from variety trials carried out by Hemp Genetics International at Laird, Saskatchewan and Alberta Innovates - Technology Futures in Vegreville, Alberta.

Oil extraction of each milled seed sample was performed using a platform shaker and two 60 minute hexane extractions, each using a 50 mL aliquot. The data is for hexane-extractable oil and is presented as oil content per gram of seed and as % oil content by weight.

Fatty acid composition was determined by extraction and methyl esterification of the fatty acids in the oil followed by analysis by GC-MS using a validated method. Results for each methylated fatty acid are expressed as an area %. Samples were done randomly. For the fatty acid profile, each sample was done in duplicate, and each duplicate was injected twice for a total of 4 determinations per sample. The samples were done as a Set, i.e., all the A samples were analyzed first, then the B samples were analyzed next.

Samples were analyzed for Palmitic acid (PA) C16:0, Stearic Acid (SA) C18:0, Oleic acid (OA) – Omega 9 C18:1, Linoleic acid (LA) – Omega 6 C18:2, Gamma-linolenic acid (GLA) – Omega 6 C18:3, Alpha linolenic acid (ALA) - Omega 3 C18:3 (isomer of GLA), Stearidonic acid (SDA) - Omega 3 C18:4. Percent seed oil was also evaluated.

[1] MAFRI, Dauphin
[2] PCDF, Roblin
[3] CMCDC, Carberry

Saturated Fatty Acids (Palmitic & Stearic) – The oil composition of the seed is made up of various fatty acids. A portion of the fatty acid profile consists of saturated fatty acids. The primary saturated fatty acids for hemp are palmitic and stearic acids. The lower the portion of saturated fatty acids the healthier the oil is considered. Examples of saturated fatty acid presence in other crop types are 7% for canola, 9% for safflower, 10% for sunflower and 13% for olive oil. The level of saturated fatty acids in hemp is about 7% and it is comparable to canola which is considered healthy oil. (NutriStrategy 2013)

Monounsaturated fatty acids (MUFA) - Monounsaturated fats, are simply fats that have one double-bonded (unsaturated) carbon in the molecule. MUFAs are typically liquid at room temperature but start to turn solid when chilled. Olive oil is an example of oil that contains a significant portion of monounsaturated fats and it is the main oil consumed in the healthy Mediterranean diet. Monounsaturated fats can help reduce bad cholesterol levels in your blood and lower your risk of heart disease and stroke. They are also typically high in vitamin E, an antioxidant vitamin that most individuals need more of. Oleic fatty acid is the main MUFA of interest. (American Heart Association 2010)

Polyunsaturated fatty acids (PUFA) are fatty acids that contain more than one double bond chain of carbon atoms. This would include C18:1 to C18:4 in the tables below. This class includes many important compounds, such as essential fatty acids (e.g. Omega 3 and 6). Fatty acids supply energy for the muscles, heart and other organs. They also aid in the formation of cell membranes and supply energy for the storage of fat. Polyunsaturated fatty acids are "good" fatty acids that have many health benefits when used to replace saturated fatty acids.

Polyunsaturated fatty acids are better for you than saturated fatty acids. They have been shown to reduce LDL or bad cholesterol while increasing HDL or good cholesterol. Polyunsaturated fatty acids contain essential fatty acids (EFAs) like omega-3 and omega-6 acids. These are fatty acids that the body needs but cannot produce and must be acquired through dietary sources. Essential fatty acids are critical components of cell membrane production. Polyunsaturated fatty acids also help regulate the production of prostaglandin, a substance that helps the body's inflammatory functions. An added benefit of polyunsaturated fats is that they release a hormone which sends a signal to the brain when you are full.

Gamma linolenic acid (GLA) - There are several different types of omega-6 fatty acids. Most omega-6 fatty acids in the diet come from vegetable oils in the form of linoleic acid (LA). The body converts linoleic acid (LA) to GLA and then to arachidonic acid (AA). GLA is thought to have anti-inflammatory properties. Hemp varieties from 2012 data exhibit a 3 to 4% level of GLA.

Stearidonic acid (SDA) is an omega 3 fatty acid sometimes called moroctic acid. It is biosynthesized from alpha-linolenic acid. Natural sources of this fatty acid are the seed oils of hemp, blackcurrant, corn gromwell, echium and cyanobachterium spirulina (blue-green algae). Monsanto is currently developing a SDA Omega-3 soybean so that consumers can consume more SDA in their diet. SDA enriched soy-oil will replace standard soy-oil as an ingredient in many of the food products found in the grocery stores.

Hemp contains a more balanced Omega 6 (LA+GLA) to Omega 3 (ALA) ratio of 3:1 compared to the current Western diet of 10:1 to 20:1. Studies have shown that a lower Omega 6 to Omega 3 ratio would enable the body to prevent the pathogenesis of many diseases such as cardiovascular disease, cancer and inflammatory and autoimmune diseases. (Simopoulos 2010)

Results

Fatty Acid Profile

Table 6: Oil Quality Summary by Location - Gilbert Plains, 2012

Cultivar	% Oil Content	% Palmitic acid (PA)	% Stearic Acid (SA)	% Oleic acid (OA) – Omega 9	% Linoleic acid (LA) – Omega 6	% Gamma-linolenic acid (GLA) – Omega 6	% Alpha linolenic acid (ALA) - Omega 3	% Stearidonic acid (SDA) - Omega 3
		(C16:0)	(C18:0)	(C18:1)	(C18:2)	(C18:3)	(C18:3)	(C18:4)
Alyssa	28.29	4.96	1.97	13.04	57.47	2.90	18.78	0.88
Anka	27.72	4.92	1.91	12.98	57.18	2.77	19.38	0.86
Canda	27.69	4.74	1.91	12.40	57.37	3.51	19.03	1.03
Canma	29.22	5.12	1.96	11.72	56.95	3.42	19.76	1.07
CFX-1	30.42	4.82	1.97	11.74	57.59	3.60	19.22	1.06
CFX-2	32.15	4.70	1.89	11.79	57.91	3.57	19.09	1.05
CRS-1	30.31	4.83	1.87	12.26	57.57	2.73	19.84	0.89
Debbie	29.51	5.01	1.90	12.26	57.57	3.23	19.06	0.97
Delores	29.76	4.88	2.02	13.23	57.73	2.81	18.50	0.82
Delores	29.24	4.84	1.95	12.99	57.54	3.35	18.36	0.96
Finola	29.53	4.73	1.73	10.28	57.40	4.44	20.06	1.36
Joey	29.27	4.77	2.02	12.56	57.09	3.64	18.82	1.09
Jutta	28.74	4.86	1.88	13.13	57.19	2.94	19.11	0.89
Silesia	28.57	5.27	2.01	12.47	56.64	3.42	19.11	1.08
X-59	27.29	5.08	1.61	12.04	55.69	4.91	19.19	1.48

Table 7: Oil Quality Summary by Location - Melita, 2012

Cultivar	% Oil Content	% Palmitic acid (PA)	% Stearic Acid (SA)	% Oleic acid (OA) – Omega 9	% Linoleic acid (LA) – Omega 6	% Gamma-linolenic acid (GLA) – Omega 6	% Alpha linolenic acid (ALA) - Omega 3	% Stearidonic acid (SDA) - Omega 3
		(C16:0)	(C18:0)	(C18:1)	(C18:2)	(C18:3)	(C18:3)	(C18:4)
Alyssa	29.72	5.01	2.25	14.53	57.29	2.87	17.28	0.76
Anka	28.03	5.13	2.24	14.68	57.12	2.81	17.25	0.76
Canda	27.46	5.05	2.10	13.26	57.08	3.82	17.68	1.00
Canma	30.57	5.20	2.20	12.05	58.23	3.33	18.06	0.92
CFX-1	33.35	5.14	1.94	11.75	58.00	3.70	18.48	1.00
CFX-2	33.35	5.14	1.94	11.75	58.00	3.70	18.48	1.00
CRS-1	30.46	5.14	2.14	12.82	57.34	3.25	18.48	0.82
Debbie	29.47	5.08	2.17	13.04	58.15	3.27	17.39	0.89
Finola	30.42	5.10	1.60	9.66	57.79	4.55	20.00	1.30
Joey	28.57	4.98	2.29	13.98	56.20	3.56	18.04	0.95
Jutta	30.15	5.10	2.30	14.78	57.31	2.71	17.01	0.79
Silesia	28.48	4.91	2.19	13.20	56.45	3.58	18.58	1.09
X-59	28.19	5.24	1.64	12.64	55.40	4.94	18.72	1.42

Table 8: Oil Quality Summary by Location - Arborg, 2012

Cultivar	% Oil Content	% Palmitic acid (PA)	% Stearic Acid (SA)	% Oleic acid (OA) – Omega 9	% Linoleic acid (LA) – Omega 6	% Gamma-linolenic acid (GLA) – Omega 6	% Alpha linolenic acid (ALA) - Omega 3	% Stearidonic acid (SDA) - Omega 3
		(C16:0)	(C18:0)	(C18:1)	(C18:2)	(C18:3)	(C18:3)	(C18:4)
Alyssa	28.16	4.82	2.06	12.62	57.10	2.84	19.63	0.92
Canda	27.44	4.66	1.95	12.44	57.43	3.65	18.82	1.06
CFX-1	29.42	4.82	1.85	11.68	58.39	3.67	18.59	1.00
CFX-2	29.08	4.80	1.85	11.27	58.39	3.75	18.89	1.04
CRS-1	28.05	4.72	1.87	12.09	57.85	2.88	19.70	0.90
Debbie	27.26	4.97	2.16	11.75	58.03	3.13	18.97	1.00
Delores	28.00	4.78	2.08	12.76	57.27	3.03	19.19	0.90
Finola	28.85	4.74	1.69	9.69	57.84	4.48	20.22	1.35
Joey	26.75	4.62	1.99	12.50	56.44	4.03	19.20	1.22
Silesia	28.28	4.72	1.75	11.67	57.73	2.80	20.43	0.89
X-59	25.43	4.90	1.80	12.50	55.37	4.87	19.08	1.48

Table 9: Oil Quality Summary by Location - Laird, 2012

Cultivar	% Oil Content	% Palmitic acid (PA)	% Stearic Acid (SA)	% Oleic acid (OA) – Omega 9	% Linoleic acid (LA) – Omega 6	% Gamma-linolenic acid (GLA) – Omega 6	% Alpha linolenic acid (ALA) - Omega 3	% Stearidonic acid (SDA) - Omega 3
		(C16:0)	(C18:0)	(C18:1)	(C18:2)	(C18:3)	(C18:3)	(C18:4)
Alyssa	25.70	4.93	2.25	11.09	56.99	2.58	21.15	1.01
Canda	25.60	4.74	2.15	9.79	57.36	3.29	21.37	1.29
CFX-1	31.72	4.60	1.80	10.81	58.38	3.47	19.80	1.13
CFX-2	31.49	4.39	1.68	10.29	59.47	3.14	19.97	1.06
CRS-1	28.60	4.67	1.96	10.23	58.50	2.73	20.85	1.05
Delores	25.55	4.69	2.27	11.15	58.08	2.78	20.05	0.99
Finola	29.69	4.49	1.62	9.59	57.76	4.17	20.97	1.41
Joey	27.10	4.56	2.12	10.54	57.02	3.76	20.63	1.36
Silesia	25.16	5.01	2.40	10.22	57.31	2.74	21.23	1.09
X-95	25.66	4.75	1.58	10.72	55.89	4.74	20.61	1.70

Table 10: Oil Quality Summary by Location - Vegreville, 2012

Cultivar	% Oil Content	% Palmitic acid (PA)	% Stearic Acid (SA)	% Oleic acid (OA) – Omega 9	% Linoleic acid (LA) – Omega 6	% Gamma-linolenic acid (GLA) – Omega 6	% Alpha linolenic acid (ALA) - Omega 3	% Stearidonic acid (SDA) - Omega 3
		(C16:0)	(C18:0)	(C18:1)	(C18:2)	(C18:3)	(C18:3)	(C18:4)
Alyssa	30.71	4.49	2.21	13.61	57.64	2.33	18.92	0.80
Canda	28.89	4.41	1.94	11.97	57.69	3.48	19.41	1.10
CFX-1	32.02	4.56	1.96	12.27	57.67	3.32	19.19	1.02
CFX-2	32.42	4.51	1.85	11.48	58.21	3.27	19.62	1.05
CRS-1	32.68	4.51	2.03	12.11	58.27	2.33	19.94	0.82
Finola	32.09	4.69	1.76	11.03	57.10	4.38	19.71	1.33
Joey	31.43	4.42	2.27	12.87	56.13	3.65	19.42	1.23
Silesia	29.24	4.51	2.42	12.65	56.51	2.91	19.95	1.06
X-59	30.20	4.55	1.81	12.18	55.90	4.34	19.76	1.47

Table 11: Average Hemp Oil Quality all Locations, 2012

	Cultivar	% Oil Content	% Palmitic acid (PA)	% Stearic Acid (SA)	% Oleic acid (OA) – Omega 9	% Linoleic acid (LA) – Omega 6	% Gamma-linolenic acid (GLA) – Omega 6	% Alpha linolenic acid (ALA) - Omega 3	% Stearidonic acid (SDA) - Omega 3
Site Years			(C16:0)	(C18:0)	(C18:1)	(C18:2)	(C18:3)	(C18:3)	(C18:4)
5	Alyssa	28.52	4.84	2.15	12.98	57.30	2.70	19.15	0.87
2	Anka	27.88	5.03	2.08	13.83	57.15	2.79	18.32	0.81
5	Canda	27.42	4.72	2.01	11.97	57.39	3.55	19.26	1.10
2	Canma	29.90	5.16	2.08	11.88	57.59	3.38	18.91	0.99
5	CFX-1	31.38	4.79	1.91	11.65	58.00	3.55	19.06	1.04
5	CFX-2	31.70	4.71	1.84	11.32	58.40	3.48	19.21	1.04
5	CRS-1	30.02	4.77	1.97	11.90	57.90	2.78	19.76	0.90
3	Debbie	28.75	5.02	2.07	12.35	57.92	3.21	18.48	0.95
4	Delores	28.14	4.80	2.08	12.53	57.65	2.99	19.03	0.92
5	Finola	30.12	4.75	1.68	10.05	57.58	4.40	20.19	1.35
5	Joey	28.62	4.67	2.14	12.49	56.58	3.73	19.22	1.17
2	Jutta	29.44	4.98	2.09	13.96	57.25	2.82	18.06	0.84
5	Silesia	27.94	4.88	2.15	12.04	56.93	3.09	19.86	1.04
5	X-95	27.35	4.90	1.69	12.01	55.65	4.76	19.47	1.51

Geographic location and weather has an impact on fatty acid levels in the seed oil. Some fatty acids are more sensitive to environmental conditions than others. The general thought is that the northern latitudes with cooler growing conditions will elevate the PUFAs and lower the saturated fats in the oil. The oil quality tables above support this thought. The saturated fatty acids and oleic fatty acid levels are slightly higher at Melita, MB compared to the other more northern sites. The PUFAs, ALA and SDA are higher at the northern locations versus the southern location, Melita. Linoleic and GLA seem to remain reasonably constant regardless of location.

Important Considerations and Recommendations

Canadian Hemp varieties are performing well under a wide range of growing conditions. The variety trials this year did show variation amongst varieties and between the regional climatic conditions of the trial locations in the province. More research is required to help determine which varieties are best suited for the various production areas and for different end uses.

The data presented represents a comparison of the yield and fatty acid profiles of the hemp varieties that are currently being grown. Differences in varietal fatty acid profiles are a future consideration for producers and contracting companies when they are selecting a variety to grow and process. Weather and location will affect the fatty acid composition of the oil and there will be some variation from year to year. More years of testing are required to confirm the level of variability so that processors can establish guidelines or tolerances for their processing operations.

Variety selection should be done using multi-year and multi-site data as a criterion to select the best yielding and adapted varieties for a specific location. The confidence level of the data is much higher when there are more sites and years of data.

Industrial hemp is a crop that requires a license for possession and production from Health Canada. All varieties must have every field tested for THC each year by the grower unless the variety is specifically exempt by Health Canada. Growers need to check the exemption list yearly. Early and late varieties will give farmers an opportunity to grow acres and spread out their harvesting due to different harvest maturities.

Ideally hemp should be grown under contract and for the following reasons. For producers it is an assurance of price for their product as long as they meet the purity and % of heated seed requirements of the contract. Most processors offer agronomic services with their contracts to aid producers in selecting the right variety for their production and meeting the quality requirements. Delivery dates are more predictable and reliable for scheduling income sources. For the processor, it is an indicator of the potential volume of seed they will be processing and ensuring they meet end user market demand for the year.

Conclusions

Newly adapted varieties from the Canadian plant breeding programs are now available and show promise of improved long term grain yields. It is important to continue variety testing throughout the various geographic regions of Canada. Continued testing will generate more site years of data, develop a better understanding of variety performance agronomically and oil quality wise in the different production zones and potentially expand the production of hemp so that processors have a consistent high quality source of seed to meet their rising demand for processed products. Data parameters of interest on the grain side of hemp production are seed mortality, 1000 kernel weight, plant height and seed oil quality. Hemp seed mortality is a significant concern and the factors that contribute to poor germination need to be further explored.

The data generated from this report is of key importance to hemp producers and the industry as it plays a major role in crop planning, contracting decisions and economic feasibility. Hemp seed is gaining awareness in the health industry due to its desirable oil profile.

Continued research is required to determine how climate, location and varietal differences affect oil content and quality. Overall, data is limited and more research is required to develop hemp as a popular cropping option in Canada.

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National Hemp Coop Fibre Variety Trial

Jeff Kostuik[4], Susan M[c]Eachern[1], Angel Melnychenko[1] and Amy Stewart[1]

Locations: Arborg, Manitoba
Carberry, Manitoba
Melita, Manitoba
Roblin, Manitoba
Kemptville, Ontario

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
Wendy Asbil, University of Guelph, Kemptville, ON

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

[1] PCDF, Roblin

Background

Stem yield, stem length, stem diameter, bast fibre content in stem, bast fibre yield, percentage of primary fibre in the bast fibre and overall primary fibre yield are all factors in determining the market potential of the hemp fibre industry. There is a genotype by environment (GxE) interaction that affects the fibre content and quality. Proper varietal selection and location of production are important considerations when conducting hemp fibre production.

Currently in Canada there are no set quality requirements for the marketing of hemp fibre. To support an economically viable hemp fibre processing industry in Canada, end-use markets and fibre quality requirements need to be identified. This will ensure producers are growing the appropriate varieties for the target markets and fibre processing plants are established in strategic locations for logistical access to production and end-use markets.

The fibre of interest is referred to as the % and quality of bast fibre vs. hurd and stem. The information presented in this report will be outlined in a format that describes the fibre yield potential of the various varieties and at multiple locations to illustrate the GxE interaction.

Methods

Please refer to the National Hemp Coop Variety Trial's- Trial Descriptor for information on trial treatments and locations, inputs, nutrient analysis and spring nutrient applications at each trial location.

Results

Table 1: 2013 National Hemp Coop Fibre Variety Trial Height (cm) Summary at Cooperating Locations

Variety	Arborg	Carberry	Kemptville	Melfort	Melita	Roblin	Vegreville
Canda	240	190	195	--	158	177	194
CFX-2	183	--	--	194	115	173	158
CRS-1	218	--	--	226	133	173	177
Debbie	--	--	--	--	154	186	--
Delores	--	--	195	--	172	180	197
Finola	165	--	--	174	--	161	127
Joey	--	--	185	--	145	181	--
Silesia	238	211	224	255	--	183	209
X59	198	152	157	197	103	166	165
Grand Mean	207	184	191	209	140	175	175
CV %	8.6	6.1	8.9	3.6	9	16.6	5.9
LSD	26.9	19.3	32.1	11.7	18.7	42.4	15.5
Sign Diff	Yes	Yes	Yes	Yes	Yes	No	Yes

In 2013 the growing conditions were reasonable and the hemp grew to an average height for all the locations except for Melita (Table 1). The Melita site grew a shorter crop than normal. This could be due to the above average precipitation early in the growing season and then the drought conditions in late summer. The range of height recorded was from just over 1 meter tall (X59) to over 2.5 meters (Silesia). Plant height has a direct relationship to the amount of biomass produced for fibre production.

Table 2: 2013 National Hemp Coop Fibre Variety Trial Plant Population (plants/m^2) by Location

Variety	Arborg	Carberry	Kemptville	Melfort	Melita	Roblin	Vegreville
Canda	52	72	65	--	209	360	130
CFX-2	46	--	--	86	203	323	110
CRS-1	59	--	--	107	245	318	143
Debbie	--	--	--	--	174	358	--
Delores	--	--	59	--	209	310	90
Finola	53	--	--	51	--	365	115
Joey	--	--	71	--	217	378	--
Silesia	63	83	98	109	--	393	129
X59	69	99	91	101	280	440	209
Grand Mean	57	85	77	91	220	360	132
CV %	16.8	14.0	22.3	15.5	14.4	14.0	13.6
LSD	14.4	20.5	26.3	21.7	47	73.7	26.6
Sign Diff	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Seeding rate plays a significant role in hemp fibre quality. Stem diameter is the most important factor in achieving consistently high quality fibre. Optimum seeding rates of 250-300 plant/m^2 have been shown to produce hemp stalk diameters (pencil size) that are most sought after for high quality fibre.

Issues in seed mortality for hemp fields have been noted for some time and this impacts a grower's ability to achieve target plant stands. More research is required to identify the cause or causes of excess seed mortality. With that being said, the 2013 Roblin site experienced optimal seed germination and above average plant stands. The seeding rate formula for all the locations used a 40% mortality rate. Seeding and germination conditions at Roblin were ideal this year and this may have reduced the mortality rate of the hemp seeds.

Table 3: 2013 National Hemp Coop Fibre Variety Trial Yield (kg/ha) at Cooperating Locations

Variety	Total (kg/ha)	N	%Check (Canda)	Arborg	Carberry	Kemptville	Melfort	Melita	Roblin	Vegreville
Canda	8433	6	100	12525	5620	3988	--	4120	16975	7369
CFX-2	7223	4	58	7216	--	--	14848	1750	--	5078
CRS-1	8779	4	82	10617	--	--	15379	1572	--	7547
Debbie	10686	2	101	--	--	--	--	3321	18050	--
Delores	8145	4	100	--	--	4335	--	3799	17525	6921
Finola	6510	3	46	4645	--	--	10430	--	--	4455
Joey	8315	3	99	--	--	3172	--	3749	18025	--
Silesia	12638	6	127	15594	7736	8033	16665	--	19575	8223
X59	6701	7	66	8461	4353	2729	13289	1126	11825	5122
Grand Total				6849	3176	3034	8970	2053	11631	4541
CV%				17.3	13.1	23.2	5.2	25.7	10.5	7.2
LSD				2563	1333	1990	1143	1066	2693	687
Significant Difference				Yes	Yes	Yes	Yes	Yes	Yes	Yes

Chart 1: 2013 National Hemp Coop Fibre Variety Trial Yield (kg/ha) at Roblin, MB

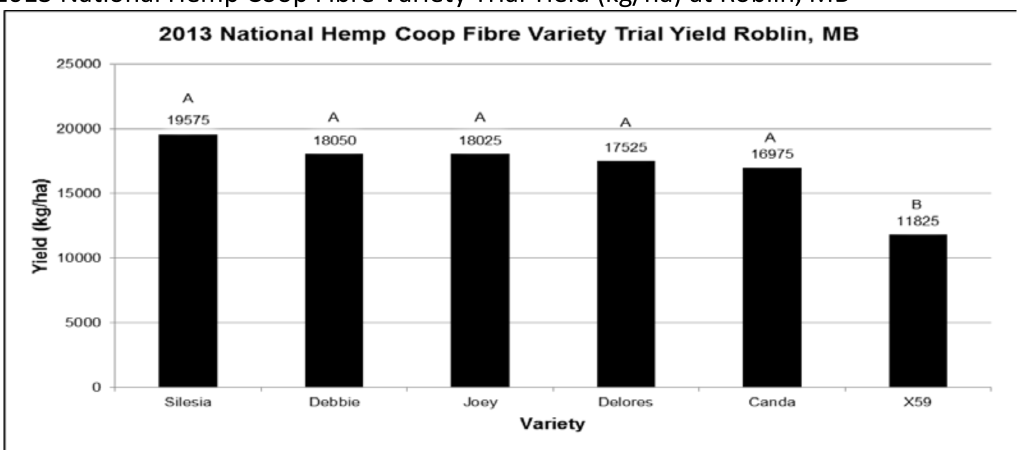

Table 4: 2012 and 2013 National Hemp Coop Fibre Variety Trial Yield (kg/ha) Comparison at Cooperating Locations

Variety	12-13 % Canda	Arborg		Carberry		Gilbert Plains/ Roblin		Kemptville		Melfort		Melita		Vegreville	
		'12	'13	'12	'13	'12	'13	'12	'13	'12	'13	'12	'13	'12	'13
Alyssa	--	8295	--	--	--	2957	--	--	--	--	--	6285	--	4688	--
Anka	--	--	--	--	--	3994	--	--	--	--	--	6907	--	--	--
Canda	100	11613	12525	--	5620	2683	16975	--	3988	14401	--	6285	4120	4008	7369
CanMa	--	--	--	--	--	1372	--	--	--	10683	--	4213	--	--	--
CFX-1	--	--	--	--	--	1751	--	--	--	9550	--	4110	--	3248	--
CFX-2	62	--	7216	--	--	1434	--	--	--	9471	14848	3385	1750	3329	5078
CRS-1	76	9124	10617	--	--	1496	--	--	--	9542	15379	4559	1572	3254	7547
Debbie	103	11613	--	--	--	2299	18050	--	--	--	--	7529	3321	--	--
Delores	102	12442	--	--	--	2656	17525	--	4335	--	--	--	3799	--	6921
Finola	44	--	4645	--	--	648	--	--	--	6531	10430	2279	--	2217	4455
Joey	105	13271	--	--	--	2717	18025	--	3172	--	--	6078	3749	5220	--
Jutta	--	--	--	--	--	2968	--	--	--	--	--	7045	--	--	--
Silesia	120	10783	15594	--	7736	3125	19575	--	8033	17010	16665	6424	--	5984	8223
X59	66	5806	8461	--	4353	1707	11825	--	2729	10516	13289	4490	1126	3253	5122

2012 Variety Fibre Quality Trial Results

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Plant Height

Plant height is one major characteristic that can influence the decision of which variety a grower wishes to plant. Shorter varieties are more applicable for grain production. Mid-height varieties may be dual purpose for both grain and fibre production, while the tallest varieties are tailored more for fibre-only production.

Plant height measurements are taken close to harvest when the plants have reached their maximum height potential, and the crop could be harvested as a fibre-only crop. The height is measured as the average height of the canopy.

Table 5 summarizes the height data recorded from variety trials since 1999 to 2012. The variation in height data is illustrated in the table by the inclusion of minimum and maximum values. More site years of data are desirable to give a representative average under a variety of environmental conditions. Year to year growing conditions have a significant effect on the height of hemp plants.

In 2012, plant height did vary from site to site (Table 5). The 2012 plant heights were generally taller when compared to the average height from 1999 to 2012. The tallest recordings were at the Melita and Melfort sites.

[1] MAFRI, Dauphin
[2] PCDF, Roblin
[3] CMCDC, Carberry

Table 5: Hemp Plant Height (cm) from Variety Trials 1999-2012

Plant Height at Harvest Time (cm) 1999-2012					2012	2012	2012	2012	2012	2012	2012
Variety	Average Height (cm)	Site Years	Min Height (cm)	Max Height (cm)	Arborg	Gilbert Plains	Carberry	Melita	Vegreville	Kemptville	Melfort
Alyssa	183	25	84	240	190	162	194	239	179		
Anka	180	15	85	243		185		243		85	
Canda	163	12	100	233	190	161	182	233	163	106	224
CanMa	178	4	141	210		141	159	203			210
CFX-1	131	12	86	181	142	130	150	148	135	86	181
CFX-2	131	12	78	187	145	130	145	148	135	78	187
CRS-1	155	12	106	226	168	137	164	225	144	106	226
Debbie	197	4	165	239	194	165	188	239			
Delores	164	12	91	215	196	163	191				
Finola	107	14	73	150	123	103	119	125	103	100	150
Joey	163	7	131	189	183	151		189	166		
Jutta	175	5	106	234		179		234		106	
Silesia	204	7	111	259	216	183	212	258	190	111	259
X59	143	7	80	193	150	137	143	164	133	80	193

Table 6: 2012 Industrial Hemp Fibre Variety Trial Yield - Manitoba Locations

				2012 Yield: % of Alyssa		
Variety	Yield % Check	Site Years Tested	2012 Average Yield	Arborg	Gilbert Plains	Melita
Alyssa	100	20	100	100	100	100
Anka	110	10	118		135	110
Canda	107	6	117	140	91	100
CanMa	61	2	60		46	67
CFX-1	55	5	63		59	65
CFX-2	50	5	52		48	54
CRS-1	81	6	87	110	51	73
Debbie	122	3	122	140	78	120
Delores	106	9	134	150	90	
Finola	28	4	32		22	36
Joey	105	5	126	160	92	97
Jutta	108	3	108		100	112
Silesia	107	1	116	130	106	102
X59	68	3	68	70	58	71
Check Characteristics			Alyssa (tonnes/acre)	3.4	1.2	2.5
Alyssa	3.8 tonnes/acre	20 site years	CV	19.8	21.2	12.0
			LSD%	36	23	17
			Sign Diff	yes	yes	yes

Note: Leaves and small branches are removed to give stalk yield only. No allowance is made for field, equipment, or handling loses.

% Fibre Content Analysis

Hemp plants were harvested at physiological maturity. After drying and processing, a 9 inch sample was taken at the midpoint of the plant. The stalk samples were sent to Biolin Research Inc. located in Saskatoon, SK. Biolin conducts a water rett to the stalk samples and determines the fibre/bast content. It is calculated by retting, extracting and cleaning the dry bast fibre. The weight of this fibre is then divided by the original dry weight of the unretted stalk and expressed as a percentage. This process will determine how much clean fibre would theoretically come out of a decorticating system if the stalks are retted and the fiber and shives are cleanly separated.

This is the first year for this type of analysis. The data is limited and should be viewed with this in mind.

Table 7: % Fibre at All Locations in 2012

Variety	Number of Samples	% Fibre Mean	Minimum %	Maximum %
Alyssa	9	21.1	17.2	27.2
Anka	5	19.2	18.0	21.7
Canda	13	19.4	16.8	23.1
CanMa	4	12.7	11.7	14.2
CRS-1	12	17.7	15.4	20.8
Debbie	5	17.5	14.6	19.7
Delores	4	22.9	20.6	27.2
Joey	9	19.7	15.6	22.5
Jutta	6	21.8	20.5	23.7
Silesia	14	21.6	16.6	27.9

Chart 2: % Fibre at All Locations in 2012

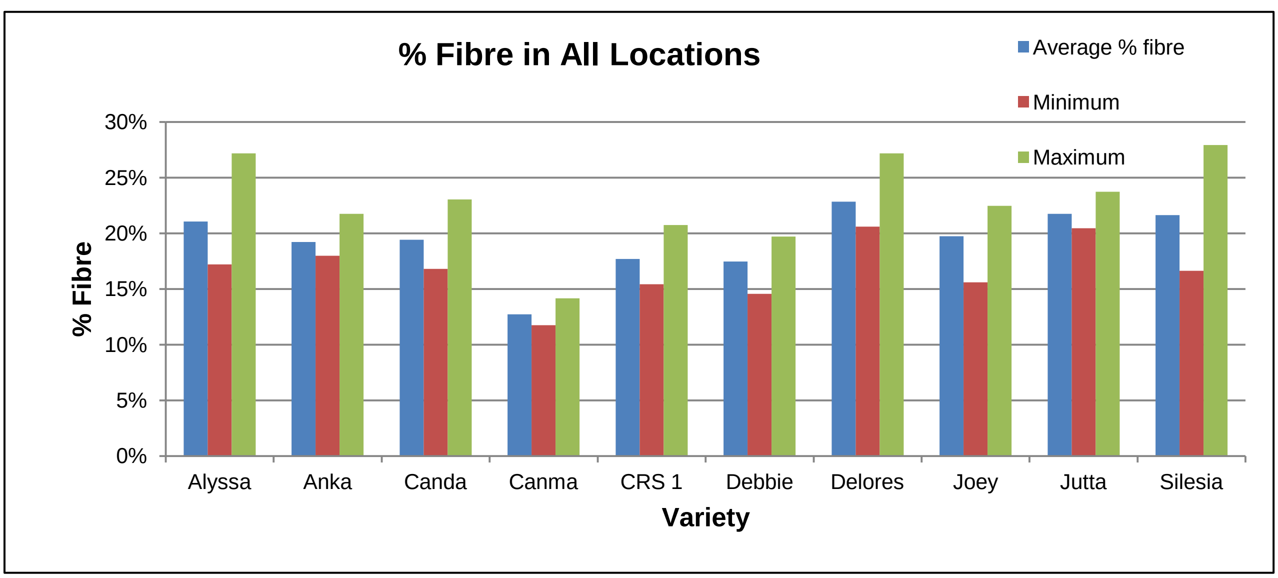

Table 7 and Chart 2 (previous page) illustrate the mean % fibre that was extracted from the various varieties. This is limited data. All the varieties have a range of % fibre that indicates there are various factors influencing plant growth. Factors include climate, location, fertility, plant population etc. The mean % fibre will be more representative and predictable for the different varieties as more data is collected and analyzed. Additional variance is expected between locations as multiple site year data are added. This demonstrates the need for continued testing so that more reliable data is available to determine variety adaptation to the various production zones.

Chart 3: % Fibre by Variety and Location - 2012

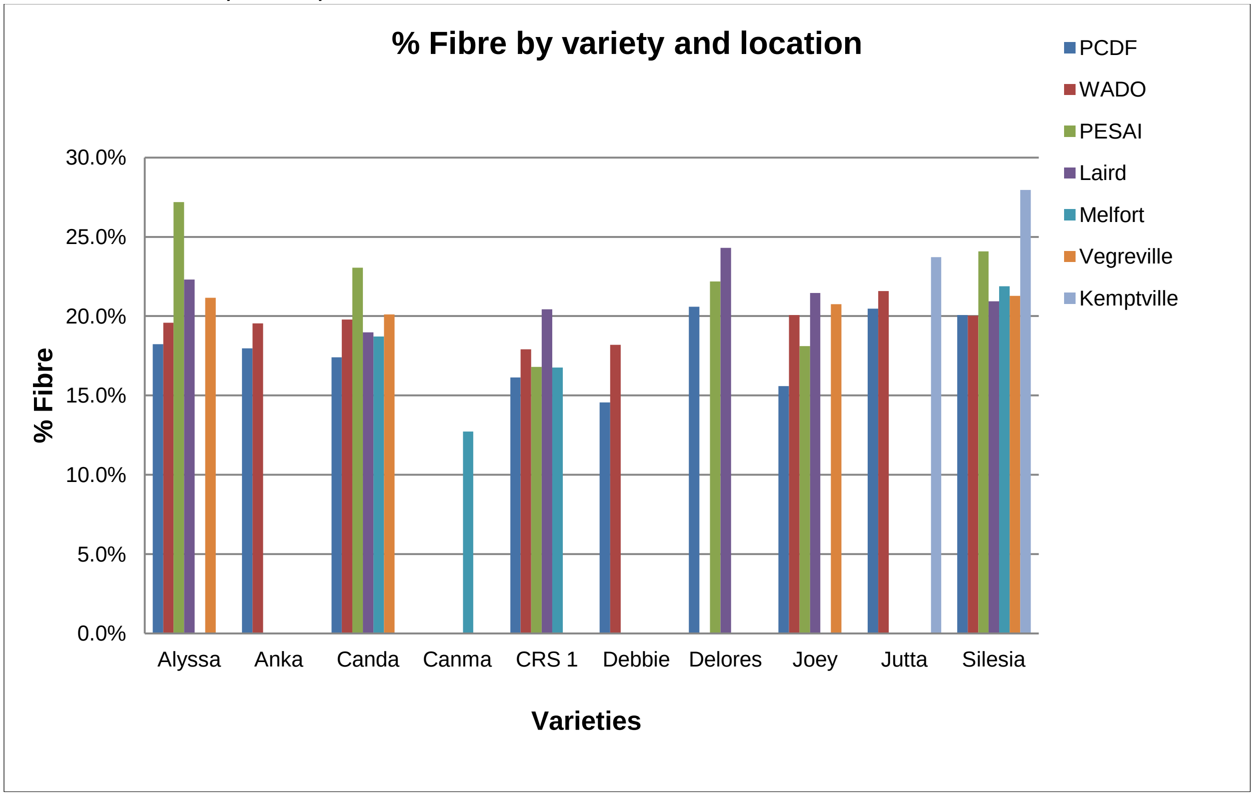

Chart 3 reports the % fibre from each variety at each location. The data is from one year of analysis and should be viewed with discretion. The data illustrates the variability amongst the varieties and between locations. Location and variety recommendations for defined end use fibre production will be achievable in the future once more data is generated and compiled. More research is required to augment the data base.

The fibre content of male plants versus female plants was not analyzed in this trial. The assumption is male plants have a higher percent fibre content but production volume is less due to the lower amount of overall fibre mass. Because of this the overall impact to fibre production is minimal. The possible reason for the higher percent fibre in male plants is that the bast fibre is found only in the inner bark of the stem and is therefore in a higher portion in the small diameter male stems. This hypothesis needs to be evaluated with further research.

Plant Population Effect on Fibre Content

Table 8: % Fibre at Increasing Plant Population at Arborg, MB - 2012

Treatment	Plants Emerged (pl/m²)	Fibre Content of Unretted Straw (%)
25 pl/m²	14	20.1
50 pl/m²	25	21.6
100 pl/m²	56	21.3
150 pl/m²	72	20.8
200 pl/m²	116	21.2
250 pl/m²	104	20.6
300 pl/m²	214	22.5
250 pl/m²	180	21.4

The Arborg location evaluated % fibre in the variety Alyssa from a plant population trial. The target seed population ranged from 25 to 350 seeds per square meter.

The % fibre content did not change significantly from the increased plant population even though there would have been an increase in stalk size from high to low plant populations.

This is one trial and one location. Continued research is required to substantiate these findings.

Diameter Analysis by "Shape System"

The fibre samples from the Gilbert Plains location were analyzed by the Shape System as a way to evaluate the system and introduce it to a method of evaluating hemp fibre.

The Shape System is a research tool available at Biolin Research Inc. in Saskatoon. The samples are mounted on a slide, scanned and then an optical recognition system plus software make a graph of the percentage of fibres that fall between different micron ranges (e.g., 5-9.9, 10.0-14.9, 15.0-19.9….). It also calculates the median, the mean and various percentile cut-offs.

C.V. = St Dev/mean (for fibres, hemp has a relatively big mean and an even bigger St Dev). The lower the CV, the less variation and the more desirable the fibre is for end users where consistency and evenness is valued (e.g., textiles for garments). Hemp generally has a higher CV than flax; flax has a higher CV than cotton and cotton has a higher CV than synthetic fibres.

The most sheer, finest yarn and hence fabrics are made from synthetic fibres and the most coarse are made from hemp. However, there are certain end uses where a large CV would be a positive trait. An example is batt insulation. You need coarse fibres to give stiffness and friction so the insulation stays adhered between the studs. Additionally you need finer fibres to trap and/or stop air flow - hence a high CV would be a positive trait. Similarly, some types of coarse filters and geotextile mats may be best made with high CV fibres. Fine textiles would pose a challenge because most chemical and mechanical treatments would have trouble with varied diameter fibres.

“Ideal numbers” will depend on the end use. Generally, but not always, you will get higher prices for fibre lots that have a relatively low CV because it will be easier to make a consistent product. Fibres with a smaller mean value are generally more valuable.

If the samples are too small and/or not truly representative, the bias can be both ways. You might have the misconception that the fibres are more consistent than they really are or you might be lead to believe your fibres are much less consistent than they really are. If one has the time and money, trials can be conducted with different size and different numbers of sub-samples to develop confidence limits around how likely the sample results really reflect the total lot of fibre or a field of hemp.

Ultimately the number of samples and the size of the samples will depend on the natural variation that occurs for the property in question in that lot or field and on the confidence level you need to have for a given application. The smaller the natural variation and the lower the confidence level required the fewer and/or smaller the samples need to be.

The 10 percentile number represents the diameter of fibre that is just bigger than 10% of the fibres in the sample that was scanned. The 50 percentile represents the diameter of the fibre that is just bigger than 50% of the fibres that were scanned. And the 90 percentile represents the diameter of the fibre that is just bigger than 90% of the fibres that were scanned. The 50 percentile is considered the “median” fibre since 50% are smaller than this number and 50% are bigger. Again the ideal and most useful fibre depends on the end use.

The average diameter ranges from 29 to 39 µm in size. Is this significant? The answer is yes. This means there are mostly small bundles of fibre. An estimate for ultimate fibres might be 5 to 20 microns. In general, the more mature the plant, the larger the fibre bundles due to the ultimate fibres being filled with cellulose and hence are being stretched outward (as a balloon does when you fill it with air) and/or because the pectin between the ultimate bundles is drying up and gluing the ultimate fibres more firmly together. Genetically some varieties may have less pectin and/or finer ultimate fibres. Some varieties may also be more mature at time of harvest and hence have bigger average bundle diameters.

Measuring different varieties at different locations over a number of years is necessary to understand the natural variation that can exist and why it exists and how it could possibly be altered. If you want a real industry with industrial buyers and users, then you have to really know your product and the natural variations you can expect in it; how to test for these variations and how to compensate (e.g., blending and/or other treatments) to make these variations less noticeable or less of a problem for commercial scale end users.

Table 9: Fibre Diameter Analysis by "Fibre Shape" Analysis on Samples from Gilbert Plains, MB- 2012

	CFM Lab Decorticator- "Fibre Shape"					Fibre Diameter Distribution Percentile			
	Fibre Diameters								
Variety	Maximum (µm)	Minimum (µm)	Arith Avg. (µm)	St Dev	C.V. (%)	Percentile 5%	Percentile10%	Percentile 50%	Percentile 90 %
Alyssa	143.3	5.0	29.2	18.3	62.5	12.08	15.85	36.48	70.12
Anka	160.5	5.1	38.9	25.4	65.4	15.12	21.23	52.57	92.27
Canda	153.3	5.1	33.3	21.1	63.4	13.65	18.53	42.83	79.56
CRS-1	158.9	5.4	35.5	22.5	63.2	14.92	19.09	45.41	86.98
Debbie	159.2	5.1	30.5	18.6	61.1	12.87	16.92	38.00	72.74
Delores	157.6	5.3	39.1	25.6	65.5	15.38	21.35	53.39	91.16
Joey	161.9	5.1	37.7	27.7	73.6	12.83	17.74	60.01	92.51
Jutta	159.0	5.1	39.5	27.1	68.5	14.79	21.39	54.54	95.65
Silesia	150.5	5.1	34.1	34.1	64.4	13.71	18.36	44.34	81.98

Alyssa and Debbie have shown that they have the finest fibre in terms of the smallest average diameters, the lowest 50% percentile cut-off and lowest C.V. Their fibre width distributions also look the best with a tight range of fibres at the lowest diameters. The fibre content of Debbie was only 14%. Perhaps it is later maturing and hence both the fibre content and the average diameter were still low. Or genetically it has really finer fibre or maybe it rets faster? On the other hand, Joey shows to have a very wide range of fibre diameters and even a secondary peak between 68 and 80 microns. Is it the most mature one? Is it because of genetics or because it doesn't ret as fast? It will take more samples from different sites and years to determine the real cause of those differences.

Important Considerations and Recommendations

This is the first Bast Fibre yield analysis that has been done on Canadian hemp varieties, so it is only a snapshot of the varieties fibre quality.

Farmers and industry are encouraged to use long-term, multi-site data as a management tool to select varieties. The more years of data from multi-locations will generate a more representative database.

Hemp fibre has a multitude of uses. The hemp fibre industry is in its early infancy in North America. There still remain challenges ahead to successfully grow and market this versatile commodity, while ensuring that both the producer and processor realize a positive economic return.

Canada is taking a lead role in developing new technologies that incorporate hemp and other agriculture crop fiber as a component of manufactured products. The Canadian and provincial governments are investing dollars into manufacturing that will use agriculture composites in their production systems. The Manitoba government plans to spend $20 million over the next 10 years to help fuel the development of more "green" products made from things like hemp and wheat or flax straw. (McNeill 2011) The federal government invested $1.9 million through the Western Diversification Program to the Composites Innovation Centre (CIC) to establish a centre for the innovative use of agricultural products. Prairie Agriculture Fibre Characterization Industrial Technology Capability Centre, better known as FibreCITY, is located in Manitoba. The intent of FibreCITY is to develop the necessary test capabilities, material data bases and standards that will result in a very simple and easily applied test method to ensure that natural fibres selected for specific end uses will be consistent with their requirements thus securing widespread adoption by industry. (Government of Canada 2013)

Some sectors of interest for the composite materials are automotive, construction and aerospace. It is expected that the biocomposites will replace 25 to 30% of a $500 billion global market. The goal of FibreCITY is to enhance a vertically integrated bio-fibre enterprise starting with the breeding of crop varieties that are tailored for the fibre content and quality. The crops will be grown under contract at a premium price and supplied to a regional processing pipeline for the emerging value added biomaterials sector. Some local manufacturers that are incorporating biocomposites into their production lines are Boeing, Standard Aero, New Flyer and Motor Coach Industries. (FibreCITY n.d.)

Manitoba is at the heart of a region that is uniquely positioned to lead the advanced biomaterials industry. Four critical factors are needed to realize this level of success. They are: 1) a sustainable and reliable supply of suitable bio-mass commodity, 2) a strong research and development infrastructure, 3) a dynamic manufacturing sector to add value to the bio-mass and 4) most importantly, the capability to integrate the value chain from end to end. FibreCITY will provide the fourth critical success factor to link the other three that already exist or are in development in the province. (FibreCITY n.d.)

Plains Industrial Hemp Processing (PIHP) at Gilbert Plains, MB has completed its construction and it is currently testing its processing equipment. They will be ready to process hemp fibre in 2014. PIHP is an example of critical factor number three.

Schweitzer Mauduit (SWM) has a long history of processing flax fibre for utilization into specialty paper. Their Permanent Decorticating Facility is located at Carman, MB. They have also been very successful at finding end-use markets for the residual biomass such as flax shives. The local greenhouse operation, Vanderveens, uses the flax shives as a heat source for the greenhouses. SWM is interested in expanding its horizons and incorporating hemp fibre into their processing operations and end-use applications. They have done some research and developmental work at the Alberta Biomaterials Development Centre in Vegreville, AB. (Farm Management Canada 2012) (Love n.d.)

Emerson Hemp Distributors is located at Emerson, MB and they process hemp fibre to be used in the Canadian and US animal bedding and the green building materials markets. (Farm Management Canada 2012)

The federal government has also invested $385,000 to Prairie Pulp & Paper Inc. to conduct further research and development for its chlorine-free and sulphur-free paper made entirely from Manitoba wheat and flax straw. Prairie Pulp and Paper is based in Manitoba and is founded by Jeff Golfman and Woody Harrelson. Other partners include former Manitoba finance minister Clayton Manness. Currently the Step Forward Paper™ is being manufactured in India but the goal is to build a new state-of-the-art facility in Manitoba. Office supply company, Staples, offers the paper at 335 stores across Canada, on their Canadian website Staples.ca and they recently launched the paper into the U.S. market. Unisource offers businesses in Canada direct purchase of the Step Forward Paper. Prairie Improvement Network is conducting a feasibility study for the new non-wood pulp and/or paper mill in Manitoba. Hemp can also be considered as a source of straw for producing non-wood paper. (Cash 2013) (PrairieNetwork 2012) (White 2013)

Alberta also has a strong commitment to the agriculture biocomposite industry and a number of processing plants have been established or are in the developmental stage. A cross-ministry partnership of Agriculture and Rural Development (ARD), Environmental and Sustainable Resource Development (ESRD) and Alberta Innovates and Technology Futures (AITF) have established an Alberta BioMaterials Centre (ABDC) at Vegreville, AB. ABDC is involved in the research and development of hemp and hemp processing systems. TTS Inc. from Edmonton has a joint venture with the Town of Drayton Valley and Weyerhauser to establish a non-woven matting line. Stemia Group is founded by Mike Duckett from the United Kingdom. Stemia Group is currently building a fully integrated bio-refinery that will utilize flax and hemp fibre for pre-fabricated panels to be used in the construction industry. It is a $31 million project and the goal is to have it operational by 2015. The bio-refinery is located in southern Alberta between Lethbridge and Taber. (Farm Management Canada 2012)

The government of Alberta has committed resources in the area of nanotechnology as well. Part of their commitment is the construction of a one-of-a-kind Cellulose Nanocrystals (CNC) pilot plant at AITF's Millwoods location in Edmonton. The plant is a collaboration of governments from Canada and Alberta. The plant will use wood and straw pulp from flax and hemp to create CNC for testing in commercial applications that will lead to production. CNC has many useful properties such as great strength, optical characteristics and very large surface area for the nano scale. Some applications will be drilling fluids, paints and industrial coatings, automotive components, building materials, plastics and packaging, optical devices, inks, pharmaceutical, viscosity control and templates. (Alberta Innovates Technology Futures 2013)

The University of Alberta is researching hemp and its application in interconnected carbon nanosheets for ultrafast supercapacitors with high energy. A hydrothermal process is used to extract the microfibrils from the hemp bast fibre. Subsequent activation and carbonization processes are used to develop carbon nanosheets (CNS) that have a graphene-like structure and they are developed at a much lower cost of production. Because of the unique layer structure of hemp fiber, which is preserved by the processes, the CNS material can work at a much higher power density. The maximum power density of CNS based supercapacitors is more than three times higher than the current commercial supercapacitors. (Nanowerk 2013)

Another new area of interest is cellulose nanofibres. Cellulose nanofibres are derived from plant biomass and this is the most desirable group of nano-products. Firstly, the supply of raw materials is unlimited and renewable. Secondly, it is biodegradable and biocompatible with the animated world. Some expected areas of use for the nanofibres are medicine (drug carriers, surgical materials, prostheses and dressings), cosmetics (creams and nutritional ingredients, feminine protection products and masks), the environment (sensors, filters, nanofilters and absorbers), energy (electric cells and hydrogen storage), chemistry (catalysts with high efficiency and ultra-light materials and composites), electronics (computers, shields for electromagnetic radiation and electronic equipment), textiles (clothing and functional products) and defense (special-purpose clothing and face masks). (Harfield 2013)

Conclusions

Continued research is needed to evaluate varieties so recommendations can be made to select varieties that are most suited to target production areas and provide the high fibre yield and quality processors are looking for. This will assist hemp plant breeders to refine or develop lines/varieties to assist the industry in growth and develop. It is also important that the various segments of the hemp industry continue to work together and take a lead role incorporating hemp into all the possible end-use opportunities that are developing.

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Canadian International Grains Institute Canada Western Red Spring Wheat Trial

Cooperators

- Canadian International Grains Institute – Winnipeg, MB
- Dale Alderson- Independent Seed Consultant

Research Site: Melita, MB
Location: NE 36-3-27
Cooperator: Wayne White
Previous Crop: Canola
Soil Texture: Liege Sandy Loamy

Background

The Canadian International Grains Institute (CIGI) is an independent market development institute established in 1972, based out of Winnipeg, Manitoba. They provide technical expertise, support, applied research and customized agricultural training to the field crop industry including farmers, researchers, marketers, processors and end-product manufacturers. Throughout the past 40 years, CIGI has delivered 1,430 programs and has continued to expand its expertise in processing and testing capabilities for wheat, durum, pulses, barley, oilseeds and special crops.

CIGI's work in specific markets has given them an in-depth understanding of customer and consumer preferences with respect to specific end-product applications. For example, the different textural and color requirements for Asian noodles in Japan, China, Indonesia, Thailand and Taiwan; how pasta processing requirements and products differ in markets like Italy and Venezuela and the significant range of processing conditions and formulations that exist in bakeries producing bread and other products in the United Kingdom, Peru and Colombia. (Canadian International Grains Institute 2013)

China's state-owned company, COFCO has raised concerns about the poor baking quality of Canadian wheat. COFCO is concerned about weak gluten strength in some of the Canadian wheat. Gluten protein is important for keeping the shape of baking goods through the baking process. Part of the issue could be related to the many different varieties of wheat grown by Canadian farmers. CIGI is conducting field research in hopes to address the issue and produce wheat with proper gluten levels for the Asian markets. (Nickel 2013)

This year at WADO, CIGI conducted a trial to study the impact of fungicide and variety on gluten strength for the Asian market for producing pasta, noodles and other baking products.

Objective

To study the impact of fungicide application and wheat variety on gluten strength.

Methods

Treatments:	18: 6 varieties, 3 fungicide treatments (Table 1)
Replication:	2
Plot size:	5.76m x 9m
Test design:	Split Plot Design: Main Plot- Fungicide, Split Plot- Variety
Seeding date:	May 29
Seed Rate:	100 lbs/ac
Seed Varieties:	Sourced from Dale Alderson
Fertilizer applied:	97 lbs/ac N, 30 lbs/ac P using sideband 28-0-0 UAN and 11-52-0 MAP
Pesticide applied:	June 13- Tundra @ 0.8 L/ac
	Group 3 Fungicide: Stratego 250EC @ 202 ml/ac applied July 9
	Group 11 Fungicide: Folicur 432F @ 118 mL/ac applied July 15
Desiccation:	Maverick III and Heat tank mixed at 1 L/ac and 10 g/ac applied Sept. 4
Harvest date:	September 16
Product handling:	Each individual plot harvested with weight and moisture recorded

Plots were direct seeded into canola stubble using a Seedhawk dual knife opener. Fertilizer was sideband. Fungicide applications were applied accordingly; a no fungicide application (control), a group 3 fungicide at flowering and a group 3 and 11 combination where a group 11 fungicide was applied at flag leaf and group 3 fungicide at flowering.

All plots were harvested with a small plot combine. Each treatment was individually bagged and weight and moisture were recorded. A 25 kilogram sample from each plot was then sent to CIGI in Winnipeg for further quality analysis.

Table 3: 2013 CIGI Canada Western Red Spring Wheat Trial Treatments at Melita, MB

Fungicide Treatment	Seed Variety	Fungicide Treatment	Seed Variety	Fungicide Treatment	Seed Variety
None	AC Barrie	Group 3 @ Flower	AC Barrie	Group 11 @ Flag, Group 3 @ Flower	AC Barrie
	Carberry		Carberry		Carberry
	Harvest		Harvest		Harvest
	Kane		Kane		Kane
	Lillian		Lillian		Lillian
	Unity VB		Unity VB		Unity VB

Table 4: 2013 Spring Soil Nutrient Analysis from 0-24" Depth at the Melita, MB Site **

Nutrient	Estimated Available Nutrients	Fertilizer Applied (actual lbs)
N*	21 lbs/acre (low)	96
P*	19 ppm (med)	30
K*	315 ppm (high)	0
S*	168 lbs/acre (high)	0

* N- Nitrate * P- Phosphorus (Olsen) * K- Potassium *S- Sulphate

** Analysis by Agvise Laboratories

Results

There was no formal yield data collection taken in the trial. CIGI is performing gluten quality tests. For more information the results of the research, please contact CIGI (Winnpeg, MB).

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Korean Rye Variety Trial

Cooperator

- Boissevain Select Seeds - Wes Froese, Boissevain, MB

Research Site: Melita, MB
Location: NE 36-3-27
Cooperator: Wayne White
Previous Crop: Canola
Soil Texture: Liege Sandy Loamy

Introduction

Rye is used all over the world not only as a grain crop but as a cover crop. In Korea, rye is subsidized by the Korean government for farmers to use in their fields as a cover crop. Seed is limited in the country so they are seeking additional sources of rye around the world. Apparently the variety 'Goku' is of particular interest there and is used as a cover crop during the winter months as a cover crop. 'Goku' seed was acquired from Boissevain Select Seeds to tests its performance in southwest Manitoba. Rye is one of the most winter hardy crops in Manitoba, however given this variety is from Korea, WADO was unsure of its true winter hardiness and growth characteristics.

Objective

To grow and compare `Goku` Korean rye to Canadian rye in terms of adaptability, overwinter capability and the potential as a export market back to Korean fields.

Methods

Replicated small plots were gorwn in Melita, MB including the three varieties Hazlet, Danko and the Korean variety 'Goku'. In Melita, plots were seeded into canola stubble on September 21, 2012 on the legal land location of NE 36-3-27W1, a Liege sandy loam. Varieties were seeded in a randomized complete block design and replicated three times. Seeding depth was 0.5" deep. Target seeding rate was 250 plants/m^2 however a flat rate of 100 lbs/ac was used in the essence of time. Since Goku has a much smaller seed, it is likely this variety was planted at a heavy rate compared to Danko and Hazlet. Thousand kernel weight (TKWT) are as follows for the varieties:
Hazlet 35.3 g/1000 seeds
Danko 35.6 g/1000 seeds
Goku 26.1 g/1000 seeds
Fertilizer was side band during seeding at a rate of 63 lbs/ac N (28-0-0 UAN) and 30 lbs/ac P from 11-52-0 MAP. Plots were topdressed later in April 4th of 2013 with 40 lbs/ac N from 46-0-0. Plots were 1.44 m wide by 9 m long. Plots were sprayed with Achieve and Mextrol 450 herbicides on May 28 at recommended rates. Plots were monitored during the seasons for emergence in the fall and spring, crop height, lodging, bushel weight, seed yield, seed moisture, flower and maturity dates. Plots were harvested August 21. Variety data was subject to a two-way analysis of variance (ANOVA) using Agrobase Gen II statistical software.

A soil temperature probe was place near the plots in January to assess ground temperatures during the spring freeze-thaw season (Graph 1).

Table 1: Fall Soil Test Prior to Seeding

Soil Test			N	P	K	S	Organic Matter
Legal Land Location	Depth	pH	lbs/ac	Olsen ppm	ppm	lbs/ac	%
NE 36-3-27 W1	0-6"	8.1	15	9	174	116	2.9
	6-24"		60			198	
	0-24"		75			314	

Results

There were no significant differences among varieties except in vigor. Goku exhibited the greatest vigor. This trait could be important in the cover crop industry when competing agains weeds.

Table 2: Rye Trial Results

Variety	Emergence	Vigor	Height	Lodging	Grain Yield	Test Wt*	Spouting*	Ergot*
	p/m^2 (spring)	1-5 (5 most)	cm	%	kg/ha	kg/hL	%	%
Goku	101	4	120	85	3334.1	72	0.13	0.91
Hazlet	120	3	110	83	2637.2	72	0.17	0.57
Danko	88	2	114	83	3896.1	73	0.16	0.47
CV%	12	12	6	6	34	1.1	37	59
Grand Mean	103	3	115	84	3289.1	72.3	0.15	0.65
LSD (p<0.05)	NS	0.8	NS	NS	NS	NS	NS	NS
P value	0.078	***0.004***	0.382	0.907	0.458	0.854	0.626	0.431
R-Square	0.84	0.94	0.64	0.92	0.52	0.93	0.66	0.61

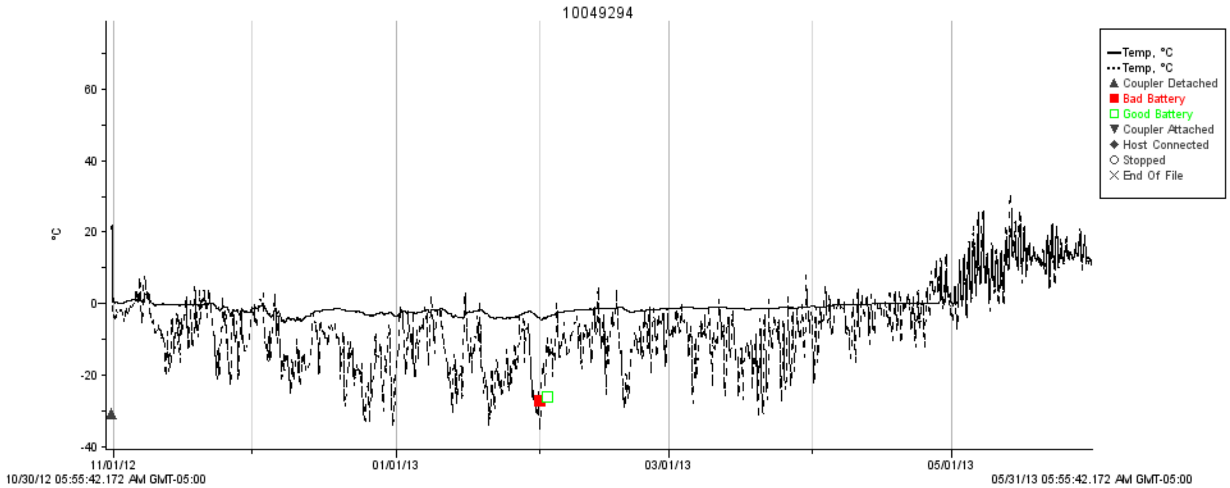
NS- Not Signficant

*Intertek Laboratories (Winnipeg, MB)

Table 3: Composite samples were sent to a laboratory (Intertek, Winnipeg MB) for quality testing and grading.

Plot	Trt	Rep	Grade	Reason For Grade	DKG %	MST%	TWT (kg/hl)	TFM%	Sprouted	Ergot %
101	Goku	1	Rye Sample CW Account Ergot	1.6% Ergot	2.5	12.8	72.5	-	0.18	1.60
102	Hazlet	1	Rye Sample CW Account Ergot	0.45% Ergot	0.5	12.8	74.4	-	0.30	0.45
103	Danko	1	Rye Sample CW Account Ergot	0.55% Ergot	0.6	12.8	74.2	-	0.17	0.55
201	Danko	2	Rye Sample CW Account Ergot	0.57%Ergot	0.5	12.8	73.8	-	0.20	0.57
202	Goku	2	Rye Sample CW Account Ergot	0.87% Ergot	0.7	12.7	74.0	-	0.10	0.87
203	Hazlet	2	Rye Sample CW Account Ergot	0.97% Ergot	0.9	13.0	73.2	-	0.12	0.97
301	Hazlet	3	Rye, No.3 CW	0.3% Ergot	0.9	12.9	69.1	-	0.10	0.30
302	Goku	3	Rye, No.3 CW	0.25% Ergot	0.4	13.1	69.9	-	0.10	0.25
303	Danko	3	Rye, No.3 CW	0.32% Ergot	0.8	13.2	69.5	-	0.10	0.30

Graph 1: Soil Temperature of rye plots during the winter and spring months in Melita from November 2012 to June 2013. Air Temperatures (variable dashed line) reaching -35°C a few times in January 21 and February 1, however, large snow pack held soil temperatures (solid line on top) at bay between -1°C and -5°C.



Conclusions

Goku exhibited the most vigor significantly more than Hazlet and Danko. This trait could be important in the cover crop industry when competing against weeds.

There was significant winter kill among the rye varieties despite the lack of a fall germination count. Counts were not taken since the crop had not emerged but germinated in the fall prior. It was too dry for the crop to germinate which eventually did in the first week of October. Most winter cereal fields were terminated next spring due to winter kill caused by drought and seed born disease, not cold soils. Ergot test results indicated that Goku was highly infested by Ergot disease compared to Hazlet and Danko, however this was not significant. In addition, Goku proved to yield as much the Canadian varieties. However, given its small seed weight compared to Danko and Hazlet, less freight would be needed to transport seed to the end user in order to establish populations in the field thus reducing production costs.

Western Feed Grains Development Cooperative Variety Trial

Cooperators

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

Introduction

(Partially taken from the WFGDC website: http://www.wfgd.ca)

The formation of this cooperative was initiated as an alternative approach to filling a void that existed in feed wheat varieties. For over forty years there have been attempts by both public and private groups to develop and license a feed wheat variety which, until recently, were unsuccessful. These failed attempts were largely due to the traditional approach taken by breeders that has stringent KVD requirements for variety licensing. Some of the cultivars developed by the cooperative will be exempt from licensing and KVD requirements, as seed will be supplied to members only. Grain will be sold only to members and will be used exclusively for livestock feed or ethanol production within a closed loop. Other cultivars developed by the Cooperative have been submitted for registration under the new Canada Western General Purpose wheat class.

Wheat as a feed grain has historically been supplied by default. Poor weather conditions and disease determine the availability of supply. By developing feed wheat cultivars, livestock producers will have a continuous, predictable supply of grain without compromising high value grain for feed. New high yielding cultivars with low FHB and low protein will increase feed value and farm gate revenues, lower feed costs, and reduce the reliance on imported feed grains, both provincially and internationally.

Development of these new cultivars will also create a better feedstock for the production of ethanol. This value-added opportunity will help satisfy the Provincial and Federal Government's objectives to increase the supply of ethanol-blended gasoline in Canada.

This WFGD Cooperative is currently offering memberships (through their website) to both grain producers and end users of the grain. Membership fees collected will finance the research necessary for such development. Feed wheat cultivar releases are anticipated in approximately five to seven years from the time the first crosses are made, and some varieties developed by the Co-op are very close to public release at this time.

Since some of the feed wheat varieties will not be registered, it is imperative that all members enter contracts which state clearly that any grain produced will not enter the export market, they will only sell to recognized members of the Co-op, and the grain will only be used for livestock feed and ethanol production.

Feed grain development is not limited only to feed wheat, as many feed grain varieties could be developed in the future through this cooperative.

The Co-op has selected WFT 603 as a superior line from the co-op's 600 series. WFT 603 has a good disease package and preliminary trials have shown that it is 98% of the yield of check AC Andrew. This line was eligible for "Request for Support for Registration" at the PGDC Meetings in February 2013. The Co-op is now pleased to announce that WFT 603 was approved for registration in 2014. It's is the WFGD Co-op Board's objective to distribute the seed from the nine breeders plots growing in Arizona to at least 9 growers in Western Canada. The Co-op is looking forward to working with WFGD members to multiply the seed to ensure wide distribution of seed in the spring of 2015.

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

Methods

A variety trial was located at four sites in Manitoba: Melita, Roblin, Hamiota, and Arborg. Plots were arranged in a randomized complete block design replicated three times. The Melita site was lost in July due to flooding. This report is concerned with the Hamiota site specifically. The Hamiota site was planted on a Newdale clay loam. The Seeding dates, seeding fertility, weed control, and harvest dates for Hamiota are listed in Table 1.

Table 1: Seeding date, fertility regime, herbicide use and harvest dates for Hamiota.

Location	Seed Date	Fertilizer Applied	Herbicides	Harvest Date
Hamiota	05-Jun	101 lbs/ac from 28-0-0, 11-52-0 30 lbs/ac from 11-52-0	Glyphosate & Heat, preseed Tundra, incrop	08-Oct

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

Data collected included, plant stand, heading dates, lodging, plant height, leaf disease, shatter loss, 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. Site precipitation is summarized in the next table according to each site collected from May 1 to August 31. Data taken from Manitoba Ag-Weather Program.

Site	Actual Precip. (mm)	Normal Precip. (mm)	% of Normal
Hamiota	336	259	130

Table 2: Soil fertility levels and rotation prior to seeding of the trial at each location.

Parameter	pH	N	P	K	S	Organic Matter	ppm
Depth		lbs/ac	PPM Olsen	ppm	lbs/ac	%	Zinc
0-6"	6.0	55	7	373	26	6.8	3.29
6-24"		105			150		
0-24"		160			176		

Results

There were significant yield differences among all sites (Table 3).

Table 3: Mean days to heading, days to maturity, height (HT), test weight, and yield (in kg/ha and bushels per acre) of each variety in Hamiota. Varieties are listed from greatest to least yield.

Treatment No.	Variety/Line	Days to Heading days	Crop Height cm	Days to Maturity days	Test Weight kg/hL	Yield kg_ha
35	20SAWYT-365	50	102	101	70	6479
5	WFT 409	49	120	100	67	6199
15	29SAWSN-3058	51	132	103	73	6115
24	Y08-04-L3 (10.1) H13	50	117	100	71	6096
30	Y07-11 (22SH)(29.4)H8	50	115	97	72	5998
25	Y08-04-L3 (10.1) H14	50	116	99	69	5990
28	Y08-01 L16-S1 (37.2) H4	51	121	100	71	5900
14	WFT 839	51	115	104	71	5863
19	Y09-04 (6SH)(29.4) H9	51	128	99	70	5745
9	WFT 736	51	133	102	70	5711
32	Y07-11 (22SH)(29.4)H14	50	123	99	71	5655
12	WFT 721	51	129	98	68	5539
36	20SAWYT-388	49	92	96	69	5528
20	Y09-04 (6SH)(29.4) H32	49	109	96	66	5467
16	44IBWSN-1136	50	106	98	70	5466
7	WFT 603	49	123	100	71	5455
1	AC Andrew	50	110	98	68	5384
26	Y09-06-Macyk	46	120	96	70	5342
21	Y08-04-L3 (10.1) H11	49	113	97	68	5250
3	Pasteur	52	109	102	66	5246
33	20SAWYT-342	51	108	96	71	5222
17	KAZCIM11-26	50	117	99	70	5218
23	Y08-05-L6 (32.4) H5	49	114	96	69	5193
13	WFT 824	51	127	99	65	5150
29	Y07-11 (22SH)(29.4)H7	51	125	99	71	5139
10	WFT 805	50	130	101	76	5075
18	Y07-11 (22SH)(29.4) H5	52	116	103	67	4966
34	20SAWYT-345	47	124	97	70	4847
27	Y08-04-L3 (10.1) H15	52	125	103	68	4823
22	Y07-11 (22SH)(29.4)H24	48	115	94	73	4751
11	WFT 813	50	115	97	71	4714
31	Y07-11 (22SH)(29.4)H11	51	139	102	71	4649
2	5702 PR	51	131	97	72	4637
4	Sadash	48	105	96	66	4491
8	WFT 717	51	107	98	67	4254
6	WFT 411	51	130	103	71	3972
	CV %	3	11	3	4	12
	Grand Mean	50	118	99	70	5320
	LSD (p<0.05)	2	22	5	5	1003
	P value	***0.0001***	***0.0207***	***0.0008***	***0.0084***	***0.0009***
	R-Square	0.59	0.47	0.55	0.54	0.56

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
Website: http://www.wfgd.ca

Participatory Wheat Breeding Project

Cooperators

- University of Manitoba
  - Iris Vaisman – Technician, Department of Plant Science
  - Gary Martens – Professor, Department of Plant Science
  - Anne Kirk
- Agriculture and Agri-Food Canada
  - Stephen Fox

Research Site: Melita, MB
Cooperator: Wayne White
Soil Texture: Liege Sandy Loam
Location: NE 36-3-27 W1
Previous Crop: Summer Fallow

Background

The participatory wheat breeding program began in 2010 with the goal to involve farmers in the breeding process and to develop varieties specifically suited to farmers with specific needs. Participatory plant breeding (PPB) can involve scientists, farmers, extension agents, consumers and processors. There are 26 farmers in the participatory wheat breeding program for 2013. Populations of wheat are planted at 2 farms in British Columbia and Alberta, 8 in Saskatchewan, 12 in Manitoba and 1 in Ontario and Quebec. While this is the first year of selection for many of the participating farmers, there are seven farmers that are on their third year of selection with the same populations. A portion of the wheat from each of these populations will be returned to the University of Manitoba for further agronomic and quality testing in 2014.

PPB programs have been successful in developing countries where farmers may not have access to improved varieties or inputs. PPB is also thought to be beneficial to organic producers since there is currently no wheat cultivars specifically tailored to this specific environment.

Some of the goals of the participatory breeding program include:

- Selecting wheat varieties for high stress, heterogeneous (differing) environments
- Developing varieties that are specifically suited to a particular farmer's preferences – farmers and participants set the breeding goals
- Increase genetic diversity

A PPB also fights the loss of agricultural diversity or agrobiodiversity. The loss of agrobiodiversity in turn leads to a reduction in the capacity of agricultural ecosystems to continue producing renewable resources (http://www.idrc.ca). It also limits the ecosystem's ability to deal with change. The PPB program is a way to recognize the key roles of farmers and their knowledge and social organization in the management and maintenance of agrobiodiversity.

Developing close farmer-researcher collaboration and a clear vision together with the stakeholders in the breeding process is important.

2013 Summary at WADO

In 2013, WADO grew three lines of wheat including BJ25A-N, BJ10A-N and BJ11A-N of which were the F4 seed based selections from 2012's F4 generation.

During the season, plants were removed (negative selection) that were inferior in each plot. Characteristics such as leaf disease, *Fusarium* infected heads, smut and bunt, weak, short plants, small heads were often pulled. Well after maturity on September 12th, 300 of the most desirable heads were picked (positive selection) to be sent back to the University of Manitoba for threshing. These seeds are to be used again in the 2014 season for another selection. Heads were chosen by and in preference of large size, shatter tolerance, taller heights, even head height development, and *Fusarium* tolerance. WADO students often found that the closer to 300 heads was reached the harder the selections were to make.

The F5 generation will be grown at WADO again in 2014, of which selection will be made again, and used as lines in Stephen Fox's breeding trials.

Photos: (Left) Bucket full of 300 desirable wheat heads of the BJICA-N line. (Right)Three plots of wheat lines compared to the industry standards on deep right side.

For more information regarding the participatory wheat breeding program, please contact the University of Manitoba:

Gary Martens Ph: 204-474-6236 email: gary_martens@umanitoba.ca
Marten Entz Ph: 204-474-6077 email: m_entz@umanitoba.ca

WADO Flax Fibre Project 2013

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)

Research Site: Elva, MB
Location: SE 36-3-28 W1
Cooperator: Greig Farms
Previous Crop: Oats
Soil Type: Stanton Sandy Loam
Soi Test :

Soil Test			N	P	K	S	Organic Matter
Legal Land Location	Depth	pH	lbs/ac	Olsen ppm	ppm	lbs/ac	%
SE 36-3-28 W1	0-6"	8.2	6	2	136	12	1.9
	6-24"		6			24	
	0-24"		12			36	

Objectives

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 2013
3. Bale and ship back to Europe for quality and fibre yield assessment

Crop Rotation and Local Characteristics

In 2012 the area was oats. Prior to this hay for several years. Weeds were burned off prior to seeding including:

Green Foxtail [*Setaria viridis* (L.) P.Beauv]
Yellow Foxtail [*Setaria pumila* (Poir.) Roem. & Schult.]
Tame Oats [*Avena sativa* L.]
Wild Mustard [*Sinapis arvensis* L., Brassica kaber (DC.) L.C. Wheeler var. pinnatifida (Stokes) L.C. Wheeler]

Soil Characteristics

MCIC Soil Zone: G Stanton Loamy Sand

Methods

Pre-seed Herbicide application (burnoff):
Authority (sulfentrazone) @ 100 mL/ac + Credit (glyphosate) @ 1 L/ac + Aim (carfentrazone) @ 35 mL/ac + Rival (trifluralin) @ 0.65 L/ac ---all tank mixed applied at 10 gal/ac applied May 17 just after seeding

Seed Date: May 17, 2013
Seed Rate: 75 lbs/ac
Seed Depth: 3/4"

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 155 meters long. Approximately 17 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.

Above: Seeding the Flax fibre trial
Right: First emergence of trial

Fertilizer Applied:
Sideband 67 lbs/ac N from 28-0-0 UAN, 30 lbs/ac P applied by 11-52-0 MAP

Seeder: SeedHawk dual knife system with 6 rows with 9.5" spacing.
Soil Seeding Conditions: Perfect with fair soil moisture.
Tractor traveling about 3.5 mph.

Herbicide Application in Crop:
Products : Arrow (Clethodim, surfactant) + Mextrol 450 (Bromoxinyl + MCPA; tankmixed)

Rate	120 mL/ac and 0.4 L/ac
Date	June 12, 2013

Fall Weather Conditions during Retting (after pulling and prior to baling) – see Appendix A

Measurements

Just prior to pulling plants, 6 random field samples from each variety were taken to determine plant density, stem density , grain yield, stem weight yield and plant height (Table).

Table 1: Results of height, plant density, and stem density of fibre flax varieties including Arethra and Alize, taken same day as pulling harvest.

	Mean		St. Deviation	
Mean	Alize	Arethra	Alize	Arethra
plants/m	225	265	55	37
pl/m^2	932	1096	226	153
Height cm	71	70	10	7
total plant wt g/m^2	628	731	154	158
total plant biomass kg/ha (non retted)	6285	7314	625	640
total fibre yield less seed yield kg/ha (non	5928	6800	563	535
seed yield kg/ha	356	514	62	105
Total Harvest Area m^2	4018	3794		
Bales collected (retted)	10	8		
Bales/ha (retted)	25	21		
Total Bales Wt kg	280	280		
kg/ha (retted) - approximately	2820	2389		

Comments

Seeding was successful and plots were visually impressive. All operations including seeding and herbicide applications were successful. Seeding was accomplished using GPS guidance which kept rows in a straight and easy to pull at fibre harvest.

Minor lodging was noted in both varieties but where lodging was most prevalent was in areas infected with stem disease (Pasmo) likely due to excess moisture.

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. Little issues with weeds present likely due to the use of Authority herbicide.

Plant stage was at physiological maturity where 95% of the bolls were brown, stems were generally green and leafs were only on the upper third of the plant whereas all other leaves had dropped naturally. Unit would travel about 4-5 mph. To pull the 2 acres it took about 1 ¼ hours.

Order of Fibre Harvest Operations

Pulling Date – Sept 3, 2013
Cam from PAMI operated the unit.

Raking Date – Oct 16, 2013
Used a two tine wheel rake on a three point hitch. Took about 1 hour to rake. A V-rake would work well as a single pass implement and reduce field compaction and would have likely taken 15 minutes.

Baling Date – Oct 23, 2013
Used a Case 8460 baler. Baling took about 40 minutes and was done by a local farmer. Bales were 1.2 meters tall and 1.75 meters wide.

Bale Picking Date – Oct 31, 2013
Took about 1 ½ hour to pick all the bales and transport them to the shop at Melita with WADO's gooseneck trailer.

Bales were stored on mowed grass and covered with a tarp with wood pallets on top for winter storage. Bales were wrapped with twine.

Picture Left: 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.

2012 Wawanesa Site Update

WADO left pulled flax straw to ret over the winter. The field owner noted that some flax rows blew in a spring wind storm. In the spring the area was raked (June 10, 2013) and baled (June 14, 2013). Raking was relatively easy however it seemed that the flax retted too much as the fibres were short and easily separated from the chive. It appeared like less biomass was achieved in 2012 at the Wawanesa site compared to the Elva 2013 site. At Wawanesa a much finer fibre quality was achieved likely due to the extended retting exposure under the snow during the winter and spring months. It will be interesting to see what the fibre quality differences are of the two sites.

In Wawanesa 4 bales of 'Alize' and 2 bales of 'Melina' were harvested over two acres of each variety. For Bethune, only a third sized bale was harvested.

What's Next?

Bales plan to be shipped back 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 flax fibre retting at Elva site.

Date	Ave. Air Temp °C	Max Air Temp°C	Min Air Temp°C	AvgRH%	Rain mm	Ave Soil Temp°C
3-Sep-13	17.6	27.4	8.6	72	0	19
4-Sep-13	20.2	29.2	12.3	73	0	21
5-Sep-13	16.0	22.8	10.2	68	0	19
6-Sep-13	21.1	30.9	11.9	67	0	20
7-Sep-13	23.7	32.6	17.0	75	0	22
8-Sep-13	19.1	24.6	14.5	68	0.2	21
9-Sep-13	16.6	19.1	13.3	89	7.6	19
10-Sep-13	16.6	18.5	14.6	97	35.6	19
11-Sep-13	17.9	26.4	11.7	80	0.2	19
12-Sep-13	16.6	24.4	10.1	63	0	17
13-Sep-13	15.2	25.6	6.3	69	0	17
14-Sep-13	18.1	29.6	7.8	67	0	17
15-Sep-13	16.0	22.8	8.5	70	0	17
16-Sep-13	10.7	19.5	3.4	72	0	15
17-Sep-13	13.6	22.3	4.4	73	0	15
18-Sep-13	18.4	27.7	11.7	74	0	17
19-Sep-13	16.8	22.9	14.1	92	6.6	17
20-Sep-13	12.3	14.4	9.2	91	5.6	15
21-Sep-13	9.8	17.0	4.4	75	0	14
22-Sep-13	10.7	19.2	2.2	76	0	13
23-Sep-13	14.6	22.7	9.1	74	0	14
24-Sep-13	14.6	18.1	11.5	95	21.4	15
25-Sep-13	13.5	22.5	6.3	69	0.2	13
26-Sep-13	17.4	25.2	10.1	65	0	14
27-Sep-13	14.3	19.1	8.8	81	4.6	15
28-Sep-13	10.6	13.9	8.4	83	1	13
29-Sep-13	11.1	18.4	6.5	74	0	13
30-Sep-13	12.9	23.2	3.2	69	0	12
1-Oct-13	14.1	22.6	5.7	58	1	13
2-Oct-13	13.5	18.4	0.0	47	0	12
3-Oct-13	8.9	17.9	2.6	64	0	11
4-Oct-13	6.9	12.3	1.9	76	0	10
5-Oct-13	3.6	5.8	-0.6	77	0	9
6-Oct-13	2.4	10.0	-2.3	79	0	7
7-Oct-13	8.3	21.1	-2.1	65	0	8
8-Oct-13	11.6	20.7	2.1	65	0	10
9-Oct-13	10.4	19.5	2.8	67	0	10
10-Oct-13	9.6	18.8	0.9	69	0	10
11-Oct-13	10.2	20.0	2.1	74	0	10
12-Oct-13	9.7	11.1	6.9	97	44.2	11
13-Oct-13	6.5	11.8	0.4	73	3	8
14-Oct-13	4.3	14.6	-3.1	72	0	7
15-Oct-13	3.8	6.0	0.8	88	0.4	6
16-Oct-13	4.4	12.3	-1.8	76	0	7
17-Oct-13	5.9	14.4	0.1	74	0	7
18-Oct-13	3.9	10.0	-1.7	73	0	7
19-Oct-13	2.4	8.0	-3.3	84	0	5
20-Oct-13	1.4	6.3	-4.4	82	2.8	5
21-Oct-13	0.3	2.0	-2.3	83	0.6	5
22-Oct-13	-1.7	1.2	-4.9	77	0	4
23-Oct-13	-0.7	3.2	-5.6	83	0	3

Performance of Brassica carinata varieties to Brassica napus

Cooperators

- Agrisoma Biosciences Inc. – Ottawa ON, www.agrisoma.com

Introduction

Brassica carinata A. Braun, commonly known as Ethiopian mustard, has an oil profile optimized 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 highly 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)

In 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, Agrisoma partnered with WADO again to test some new and existing *B. carinata* lines compared to a common *B. napus* (Argentine canola).

Methods

A soil test was taken prior to seeding the plots to determine background nutrient profiles. Trials were planted into a Stanton Loamy Sand north of Elva, MB. Plots were seeded into oat stubble from the 2012.

Soil Test			N	P	K	S	Organic Matter
Legal Land Location	Depth	pH	lbs/ac	Olsen ppm	ppm	lbs/ac	%
SE 36-3-28 W1	0-6"	7.9	8	2	155	12	1.9
	6-24"		12			120	
	0-24"		20			132	

Fourteen B. carinata cultivars and 1 B. napus variety (Nexera 2012 CL) were seeded into plots arranged in a randomized complete block design and replicated three times. Plots were seeded May 15, 2013 at a depth of 1/2". Final plot dimension was 1.44 m wide by 9 m long. Fertilizer was side band at a rate of 100 lbs/ac nitrogen and 30 lbs/ac phosphorous using liquid 28-0-0 UAN and granular 11-52-0 MAP. After seeding the area was burned off with a tank mix of glyphosate, Rival, and Aim at a rate of 1 L/ac, 0.5 L/ac, and 35 ml/ac, respectively on May 17. Matador insecticide was applied June 11th to control flee beetle infestations at a rate of 51 mL/ac. On June 12, Muster and Assure II herbicide was sprayed at a rate of 12 g/ac (plus adjuvant Agral 90) and 0.2 L/ac, respectively to control broadleaf and grassy weeds. Plots were desiccated August 29 with a tank mix of Reglone, and glyphosate both applied at rates of 1 L/ac. Plots were harvested for seed yield on September 5th with a Hege 140 plot combine. Data collected included emergence, stand, days to flower, days to maturity, height, seed yield, 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 neighbors analysis (NNA).

Results

There were significant difference among variety days to flower, and height but not among stand, maturity and yield. AAC A100 and the napus check flowered somewhat earlier than all others. In terms of height AAC A110 was significantly different than the napus variety. Having a height advantage during harvest would aid in straight cutting systems where stands tend to lodge and prevent shattering losses compared to shorter types.

Variety	Stand	Start Flower	Height	Maturity	Yield	
	%	Days	cm	Days	kg/ha	%Check
AAC A100	85	49	110	97	2860	104
111011EM	82	53	97	99	2759	100
B. napus (check)	62	48	98	91	2751	100
111010EM	78	52	94	99	2665	97
110996EM	89	52	100	98	2665	97
111000EM	88	50	97	90	2615	95
110998EM	90	52	117	100	2568	93
AAC A110	80	51	106	99	2555	93
110994EM	75	51	93	98	2543	92
5228	85	50	113	98	2507	91
110910EM	85	51	113	98	2442	89
3118	82	50	105	100	2419	88
5231	83	52	98	97	2335	85
5259	86	52	83	99	2138	78
110999EM	77	51	105	97	2010	73
Grand Mean	82	51	102	97	2522	
CV%	18.2	2.6	10.4	5.4	11.1	
LSD (p<0.05)	N/S	2.2	17.9	N/S	N/S	N/S
P value	0.76	***0.02***	***0.04***	0.54	0.13	
R-Square	0.39	0.61	0.58	0.37	0.54	

Table 1: Statistics 2013 Brassica carinata

Observations

One single Brassica carinata variety '5259' appeared to have a very high green seed content compared to all others. It is speculated that this variety was possibly not fully mature upon desiccation locking the chlorophyll content in time. In general all varieties were very competitive and appeared to be a heavy crop. No shatter issues were observed in both B. *napus* and B. *carinata* species.

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 in 2012 in the WADO trials.

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Pepsico (Quaker) Oats Variety Trial

Cooperators

- PepsiC-Fritolay-Quaker-Gadorade 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 were grown in Melita by WADO. This was year two of this partnership.

Methods

Twenty-one varieties were arranged in a randomized complete block design and replicated three times. Trial area was burned off with glyphosate, Heat, and Mextrol 450 herbicides tank mixed at a rate of 1 L/ac, 15 g/ac, and 0.3 L/ac, respectively tank-mixed. Plots were direct seeded into canola stubble at a depth of 5/8” using a SeedHawk dual knife opener. Fertilizer was sideband at a rate of 100 lbs/ac actual nitrogen and 30 lbs/ac actual phosphorous using 28-0-0 UAN and 11-52-0 MAP. 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 13th with a water volume of 20 gal/ac at the five leaf stage. Plots were sprayed with Tilt fungicide at a rate of 120 mL/ac on July 3rd when the crop was extending the penultimate leaf.

Plots were desiccated with glyphosate a full maturity at a rate of 1.5 L/ac on August 30th. Plots were harvested September 16th and 24th with a Hege 140 plot combine. Data collected throughout the season included percent stand, days to maturity, crop height, lodging, leaf disease rating on *Septoria* and Barley Yellow Dwarf Virus (BYDV), test weight, sample moisture, and 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 except Height, Septoria, and BYDV (Table). There were visual quality differences among some plot samples as half the trial was combined on a separate later date. Between harvest dates plots experienced some cool wet weather.

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. 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.

Table 1: Variety, test weight, maturity, heading, lodging, height, and disease rating of various oat varieties grown in Melita in 2013.

Variety	Yield		Test Wt.	DTM	DTH	Lodging	Height	Septoria Leaf Spot	BYDV
	lbs/ac	bu/ac	lbs/ac	days	days	1-5 (5=flat)	cm	1-11 (11 covered)	1-5 (5 flat)
Souris	9379	250	37.5	92	46	4	112	2	2
OT3066	8730	246	35.5	91	47	4	128	2	2
OT3071	8339	243	34.3	93	53	3	132	3	3
OA1331-5	9017	242	37.3	92	54	2	122	3	2
CDC Seabiscuit	8705	238	36.5	92	51	4	123	2	2
OT3067	8937	237	37.7	92	46	2	117	2	2
AC Morgan	8808	237	37.2	92	50	2	121	2	2
CDC Orrin	8509	228	37.3	92	49	3	122	3	1
OT3072	8727	228	38.3	92	52	1	125	2	3
OA1225-2	8781	226	38.8	93	46	5	123	2	3
Bradley	8036	216	37.2	93	46	2	120	2	2
Stride	8741	213	41.1	92	54	3	128	3	2
BetaGene	7742	212	36.5	91	44	1	115	2	3
OT3068	7975	211	37.8	92	52	3	125	2	2
OT3076	7839	207	37.8	91	44	4	127	3	2
HY174-OA	6972	201	34.7	92	44	2	132	2	2
CDC Dancer	7981	200	40.0	92	48	2	125	3	3
Dieter	7278	197	37.0	91	53	2	138	3	3
OA1306-1	7516	195	38.5	92	54	3	135	3	2
Leggett	7633	192	39.7	93	48	4	122	3	3
CDC Morrison	7270	190	38.3	91	45	1	90	2	2
CV%	6.7		4.5	0.7	2.2	34.7	11.5	32.5	37.3
Grand Mean	8234.1		37.6	92.0	48.8	2.7	122.9	2.3	2.3
LSD (p<0.05)	917.1		2.8	1.1	1.8	1.5	23.3	NS	NS
P value	**<0.001**		**0.003**	**0.048**	**<0.001**	**<0.001**	**0.151**	0.903	0.326
R-Square	0.69		0.60	0.49	0.95	0.70	0.43	0.36	0.40

DTH – days to heading
DTM – days to maturity (rachis turns brown above seed)
BYDV – Barley Yellow Dwarf Virus

Agronomic Management of Soybeans in Manitoba

Effects of row spacing and seeding rate on soybean

Final Report for Experiment 1:

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Objective

Evaluate the effects of seeding rate and row spacing on soybean growth, yield and quality in Manitoba's soybean-producing regions

Background

Manitoba's soybean industry has grown rapidly over the past decade. With the development of short-season cultivars adapted to Manitoba conditions, soybean production has expanded from traditional areas in the Red River Valley to other regions of Manitoba, contributing to a record soybean acreage of an estimated 344,000 ha in 2012 (Statistics Canada 2012).

With the growing importance of the soybean industry in Manitoba, and expansion into non-traditional areas, agronomic information appropriate for Manitoba's climatic and soil conditions is required in order to identify those management practices that will optimize crop yield and quality.

Row spacing With expansion of soybeans into non-traditional areas, soybeans have often been grown in narrow rows using conventional seeding equipment because row cropping equipment was uncommon. As soybean has become more established in Manitoba, however, questions have arisen regarding the relative benefits and disadvantages of narrow versus wide row spacing.

Based on studies conducted in North Dakota, reported benefits of narrow row spacing of soybean include increased yield, increased weed competition due to earlier canopy closure, and capacity to use existing seeding and harvest equipment (Berglund and Helm 2003; Endres 2005; Endres and Kandel 2011). Conversely, wider rows may increase air movement among plants reducing disease potential and allow the use of row-crop cultivation for weed control. It has also been suggested that wider rows may be beneficial under drier conditions to reduce moisture losses via transpiration (Berglund and Helm 2003). In Manitoba, where soybean has been recognized as a crop tolerant of wet conditions, row planting equipment may also allow earlier access to the field than an air seeder thereby reducing the risk of delayed seeding in wet years.

Seeding rate Current Manitoba recommendations are to establish between 180,000 to 210,00 plants/acre or 4 plants ft^2 (40 plants m^{-2}) (Manitoba Agriculture, Food and Rural Initiatives, 2012). In studies in North Dakota comparing various seeding rates, higher plant density was shown to increase yield in some cases, although it was found that a lower planting rate might still be more economical when all costs and benefits are considered (Endres 2005; Endres and Kandel 2011).

Interactions between row spacing and seeding rate may also occur. Maintaining the same seeding rate when changing from narrow to wide row spacing increases the number of plants per row. This may cause the plant to produce its lowest pods higher off the ground, potentially reducing the need to roll the field and allowing the lowest pods to be harvested more easily.

Methodology

Field experiments were conducted at various locations across Manitoba from 2011 through 2013 inclusive, for a total of 20 site-years (Table 1). Studies were conducted at Carberry, Melita, Morden and Portage from 2011 through 2013, inclusive; and at Arborg, Beausejour, Brandon and Roblin from 2012 through 2013, inclusive.

At all sites, a randomized complete block design consisting of three replicates of a factorial combination of four seeding rates (20, 30, 40 and 50 pure live seeds m^{-2}) and two row spacings (narrow and wide) was established. Exact row spacing varied among sites as a function of the seeding equipment available, with "narrow" row spacing typically ranging from 8" to 12" and "wide" row spacing ranging from 16" to 30" (Table 1). Plot size was determined by the equipment available at each site, and ranged in area from 5 to 29 m^2.

Standard management practices appropriate for each region were employed. The same soybean cultivar (2475 heat units; RR1) from the same seed source was grown at each site. Soybean was typically seeded between mid-May and mid-June, and harvested in September or October, depending upon location. Detailed information regarding agronomic management is provided in Table 1.

In-season measurements included: plant density, lodging score, days to maturity, height at maturity, yield, and crop development periodically throughout vegetative and reproductive stages. Yield and seed quality (test weight, seed weight, oil and protein concentration) were determined at harvest. At those sites where seed moisture at harvest was measured, reported yields were adjusted to 14% moisture. At the remainder of sites, yields are reported on an air-dry basis. Oil and protein concentration were determined on an Infratec™ Grain Analyzer (Foss North America, Eden Prairie, MN).

For the purpose of this report, data were analyzed by site-year using Proc Mixed in SAS, with row spacing and plant density considered fixed effects and replicate considered a random effect. Contrast analysis was employed to identify linear and quadratic responses to seeding rate. Regression analysis was used to assess the relationship between plant stand and relative seed yield.

Results and Discussion

Plant density Plant stand increased linearly with increasing seeding rate at all experimental sites except Portage in 2013 where a similar numeric trend was observed (Figure 1; Figure 2a). The actual plant stand achieved in the field often ranged between 60 and 100% of the target seeding rate (Figure 2b). Since the same seed source was used at all experimental sites, conditions at seeding and crop emergence were likely important factors influencing plant stand at individual sites. These results suggest that verification of actual plant stands in the field is important to ensure that the plant populations achieved in the field are as expected based on the seeding rates used.

Wide row spacing reduced plant stand in 9 of 20 site-years: at Carberry and Melita in 2011; Arborg, Brandon and Morden in 2012; and at Beausejour, Carberry, Melita, and Portage in 2013 (Figure 1). A higher concentration of plants within the row of the wide-row configuration may have led to reduced emergence and/or attrition of some plants due to increased between-plant competition.

Interactions between seeding rate and row spacing rarely occurred (Morden 2012; Beausejour 2013).

Lodging score Lodging scores were recorded in 9 site-years, with a score of 1 indicating no lodging and 9 indicating complete lodging of the crop. Narrow row spacing resulting in a small increase in lodging score at Melita in 2012, but had no effect in the other site-years assessed. Increasing seeding rate resulted in a linear decline in lodging score at Beausejour in 2012, and at Roblin in 2012 and 2013. Although lodging rating is somewhat subjective, the lodging scores suggest that lodging may have been a greater issue at Roblin than at most other sites. It is unclear to what extent, if any, these observed declines in lodging score affected final seed yield since increasing seeding rate increased yield, or resulted in a similar numeric trend, in all site-years.

Plant height Plant height was determined at crop maturity in 13 site-years. Row spacing and seeding rate had limited effects on plant height (Table 3). In one site-year only (Melita in 2011), plant height was lower for narrow than wide row spacing when averaged across seeding rates, with an average difference of 5 cm. Effects of seeding rate were more frequent, with increasing seeding rate increasing plant height at Melita in 2011, Morden in 2011 and 2012, and Beausejour in 2013. A significant seeding rate x row spacing interaction was evident both at Melita in 2011 and Morden in 2012, but the general response pattern in both site-years, although somewhat variable, was toward higher plant stands with higher seeding rates regardless of row spacing.

Maturity Days to full maturity (stage R8) was recorded in 8 site-years. At Melita in 2012 and Brandon in 2013, wide row spacing resulted in fewer days to maturity than narrow row spacing, with a difference of 3 days at these sites. Increasing seeding rate reduced the days to reach full maturity in half of the 8 site-years assessed. At Brandon in 2012 and at Beausejour and Morden in 2013, the difference between the lowest and highest seeding rate ranged from 1-2 days while, at Melita in 2012, a difference of 4 days was observed. No interactions between row spacing and seeding rate were observed.

Yield Yield varied considerably among site-years, and was influenced both by row spacing and seeding rate (Figure 3). Interactions between row spacing and seeding rate were seldom observed (Morden and Portage in 2011; Arborg in 2012) and inconsistent, suggesting that row spacing and seeding rate may be considered independently of each other.

In all site-years, narrow row spacing produced yields that were equal to or greater than wide row spacing. In 8 of 20 site-years, narrow row spacing increased yield compared to wide row spacing (Arborg, Beausejour, Melita in 2012 and 2013; Carberry in 2012; Roblin in 2013). Yield increases at these sites ranged from approximately 100 to 780 kg ha^{-1}, but were <550 kg ha^{-1} in most site-years. In 6 of the 8 cases where narrow row spacing increased yield, the "wide" row spacing treatments were ≥27" (Arborg - 27"; Beausejour – 27"; Melita – 30"). In the other two cases where row spacing affected yield, the wide row spacing treatments were 16" (Roblin 2013) and 24" (Carberry 2012), respectively, and the yield differences observed were comparatively smaller.

Increasing seeding rate increased seed yield in 17 of 20 site-years (Figure 3). Similar numeric trends were evident in the remaining site-years, but effects were not statistically significant. At Roblin in 2012, variability at the site and a reduced number of replicates may have contributed to the lack of a significant effect while, at Portage in 2013, increasing seeding rate had not increased plant stand which may have limited effects on yield.

Linear increases in yield with increasing seeding rate were observed in most site-years, indicating that there were incremental increases in yield across the range of seeding rates used. In a few site-years (Carberry, Morden in 2011; Beausejour in 2012; Roblin 2013), quadratic responses suggested that yields increased with increasing seeding rate then levelled off as seeding rate was further increased. With the exception of the Morden site, the 40 seed m^{-2} seeding rate often yielded about 95 to 100% of the 50 seed m^{-2} rate. Other exceptions were Arborg, Carberry and Roblin in 2013, where the 40 seed m^{-2} seeding rate yielded approximately 90% of the 50 seed m^{-2} rate. Other exceptions were Carberry in 2011 and Portage in 2013 where the 40 seed m^{-2} seeding rate yielded approximately 114% and 108% of the 50 seed m^{-2} rate, respectively.

Preliminary analysis suggested that differences in actual plant stand measured in the field accounted for approximately 69% of the variability in yield (Figure 4). This analysis was based on 13 site-years of data across Manitoba. Initial analysis to assess the effect of actual plant stand on relative seed yield (i.e. yield as percentage of the highest-yielding seeding rate treatment in each site-year) showed a quadratic relationship, with yield increasing with increasing plant stand then levelling off. Based on the quadratic equation that was fit to the data, plant stands of 20, 30, 35, 40 and 45 plants m^{-2} produced an estimated 84%, 95%, 98%, 100% and 100% of optimum yield, respectively. As evident in Figure 4, variability exists around these estimated values. Current Manitoba recommendations indicate a plant population of 40 plants m^{-2}.

Economic analysis of data from the current study has not been conducted. In studies in North Dakota comparing various seeding rates, higher plant density was shown to increase yield in some cases, although the researchers noted that a lower planting rate might still be more economical when all costs and benefits are considered (Endres 2005; Endres and Kandel 2011).

Seed quality Seed weight, test weight, percent oil and percent protein were determined on harvested seed in all site-years, except Carberry in 2011 due to significant frost damage at that site, for a total of 19 site-years of data. Often, effects of row spacing and seeding rate were relatively small when compared to variability among site-years. A lack of interactions between row spacing and seeding rate suggest that these factors acted independently of one another.

Oil concentration Row spacing and seeding rate had limited and inconsistent effects on percent oil in harvested seed. Row spacing affected percent oil in 3 of 19 site-years but effects were inconsistent, with narrow row spacing increasing percent oil at Melita in 2012 and Arborg in 2013, and decreasing percent oil at Arborg in 2012. Contrast analysis showed that increasing seeding rate decreased percent oil at Arborg, Carberry, Melita and Roblin in 2012, and increased percent oil at Portage in 2011 and Arborg and Carberry in 2013. A quadratic response was measured at Portage in 2013, with percent oil decreasing with increasing seeding rate then increasing slightly. While these effects were statistically significant, the differences in percent oil within a given site-year were generally small compared to the variability among site-years.

Protein concentration Row spacing had a more frequent and consistent effect on percent protein than on percent oil, with wide row spacing resulting in a higher percent protein in 7 of 19 site-years. Differences between narrow and wide row spacing typically ranged from 0.2 to 1.2% protein, with the exception of Arborg 2013 where the difference averaged 3.1%. In part, markedly lower yields in the wide row spacing treatment at Arborg in 2013 may have contributed to a higher percent protein at that site. Contrast analysis indicated that percent protein increased with increasing seeding rate in 7 of 19 site-years (Melita, Morden in 2011; Arborg, Brandon, Roblin in 2012; Beausejour, Portage in 2013) and decreased with increasing seeding rate at Arborg in 2013. As noted for percent oil, while statistically significant, the differences observed were generally small compared to the variability among site-years.

Seed weight Seed weight was higher for wide than narrow row spacing in 9 of 19 site-years, although this did not translate into increased seed yield in any case. Seeding rate influenced seed weight in 7 of 19 site-years, but effects were inconsistent among site-years. Increasing seeding rate increased seed weight in 3 site-years (Arborg, Portage in 2012; Beausejour in 2013), but decreased seed weight in the remaining 4 site-years (Roblin in 2012; Arborg, Carberry, Melita in 2013).

Test weight Test weight was higher for narrow than wide row spacing at Carberry and Roblin in 2012 and Arborg in 2013 , and lower for narrow than wide row spacing at Brandon in 2013. Contrast analysis showed small increases in test weight with increasing seeding rate in 6 of 19 site-years, and small decreases in two site-years.

Summary

Narrow rows produced yields that were equivalent to or greater than wide rows in all site-years. Narrow rows had a yield advantage in almost all cases (6 of 7 site-years) where narrow rows of 9-10" were compared against wide rows ranging from 27-30". In those site-years where wide rows ranged from 16-24", yield differences between narrow and wide rows were less frequent (2 of 13 site-years).

Increasing seeding rate consistently increased plant stand, but the actual plant stand established frequently ranged from 60 to 100% of the target seeding rate, demonstrating the influence of conditions at seeding and crop emergence on final crop establishment. These findings suggest that verification of actual plant stands achieved in the field is important to ensure that plant populations are as expected.

Preliminary analysis of a sub-set of 13 site-years of data indicated that relative yield generally increased with increasing plant stand, then levelled off with further increases in plant stand. Based on this sub-set of data, plant stand accounted for approximately 69% of the variability observed in relative yield. Fitting of a quadratic relationship to these data indicated that actual plant stands of 30, 35 and 40 plants m^{-2} in the field produced an estimated 95, 98% and 100% of optimum relative yield under the conditions of this study. Current Manitoba recommendations indicate a plant population of 40 plants m^{-2}. The relative economic cost versus benefit of increasing seeding rate is an important factor in the selection of seeding rates. While economic analysis of data from the current study has not been conducted, in studies in North Dakota comparing various seeding rates, higher plant density was shown to increase yield in some cases, although the researchers noted that a lower planting rate might still be more economical when all costs and benefits are considered (Endres 2005; Endres and Kandel 2011).

Information regarding lodging score, plant height and days to maturity was collected in select site-years; however, no strong and consistent effects of row spacing and seeding rate were observed. Row spacing had little effect on lodging score and plant height, but wide row spacing resulted in an average of 3 days fewer to full maturity than narrow row spacing in 2 of 8 site-years. Seeding rate sometimes influenced lodging score and plant height, with increasing seeding rate reducing lodging score in 3 of 9 site-years and increasing plant height in 4 of 13 site-years. Increasing seeding rate reduced days to maturity in 4 of 8 site-years but, in most cases (3 of 4 site-years) differences between the lowest and highest seeding rate averaged 1-2 days.

Both row spacing and seeding rate influenced seed quality in some site-years. However, observed effects were generally not consistent among all site-years, and differences among treatments were often comparatively smaller than the differences observed among site-years.

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Table 1. Site and management information for field experiments conducted at eight locations in Manitoba (2011-2013).

	Morden (2011-13)	Brandon (2012-13)	Portage (2011-13)	Melita (2011-13)	Roblin (2012-13)	Arborg (2012-13)	Carberry (2011-13)	Beausejour (2012-13)
Site information								
Legal location	SW 4-3-5W	SW 21-12-18W1	Lot 1 Plan 2049 PL 109	SE 36-3-28W1	NE 20-25-28	NW16-22-2E	South 1/2 8-11-14W	NE 12-13-7E
Soil texture	Fine Loam-Clay	Clay Loam	Clay Loam	Loamy Sand	Clay Loam	Clay	Clay Loam	Clay loam
pH	7.5	7.9	7.9	8.1	6.7	8.0	5.8	7.9
EC	0.4	na	na	8.7	na	na	na	4.7
Soil organic matter (%)	5.1	5.5	5.4	1.9	na	na	6.0	na
Experimental information								
Plot size	5 m^2	2012 - 22.8 m^2 2013 - 12.5 m^2	14.4 m^2	27 - 29 m^2	20 m^2	8.2 m^2	14 m^2	8.2 m^2
Seeding equipment	Zero Till plot seeder	ERDA plot cone seeder	Fabro plot seeder	Seedhawk cone seeder	Fabro plot seeder	Plot cone seeder	Custom plot seeder	Plot cone seeder
Openers	Disc opener	Disc openers	Disc opener	Dual knife opener	Hoe opener	Pillar Laser disc/hoe opener	Narrow hoe opener	Pillar Laser disc/hoe opener
Row spacing (narrow/wide)	25cm/50cm	25cm/50cm	30cm/60cm	25cm/75cm	20cm/40cm	23cm/69cm	30cm/60cm	23cm/69cm
Preceeding Management								
2011	spring/fall cultivation	---	deep tillage, cultivation	fallow	---	---	fall cultivation, harrow	---
2012	spring/fall cultivation	zero-till, barley silage	deep tillage, cultivation	oat stubble	conventional tillage	fall with spring harrow	fall cultivation, harrow	oat stubble, harrowed and rolled
2013	spring/fall cultivation (wheat stubble)	zero-till, barley silage	deep tillage, cultivation	oat stubble	conventional tillage (corn stubble)	fall cultivation, spring harrow	fall cultivation, harrow	oat stubble, harrowed and rolled
Seeding depth	4 cm	2-2.5 cm	na	1.9cm-2.5 cm	2.5 cm	1.5 cm	na	1.25 cm
Harvest Equipment	Wintersteiger	Wintersteiger Delta	Wintersteiger	Hege 140	Wintersteiger	Wintersteiger	Wintersteiger	Wintersteiger
Dates of field operations								
Seeding Date								
2011	May 26, 2011	---	June 13, 2011	June 6, 2011	---	---		---
2012	May 18, 2012	June 1, 2012	na	May 16, 2012	May 30, 2012	May 25, 2012	June 13, 2012	May 16, 2012
2013	May 15, 2013	May 22, 2013	June 5, 2013	May 15, 2013	May 30, 2013	May 23, 2013	May 22, 2013	May 24, 2013
Harvest date								
2011	September 28, 2011	---	na	October 7, 2011	---	---	September 27, 2011	---
2012	na	September 24, 2012	na	September 24, 2012	September 25, 2012	September 26, 2012	October 1, 2012	September 27, 2012
2013	October 3, 2013	October 9, 2013	October 25, 2013	October 15, 2013	October 17, 2013	October 8, 2012	October 18, 2013	October 3, 2013

na - not available

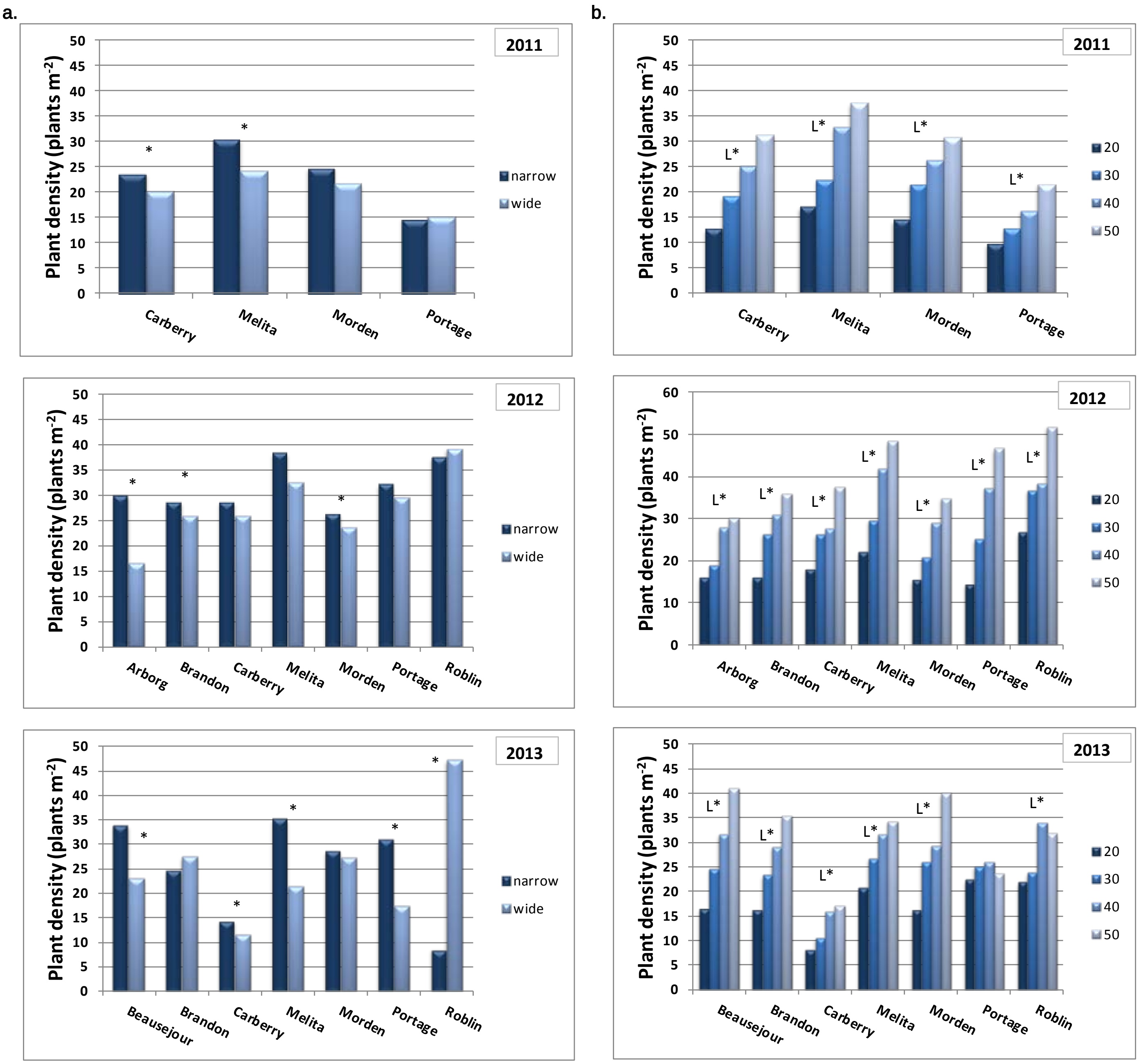
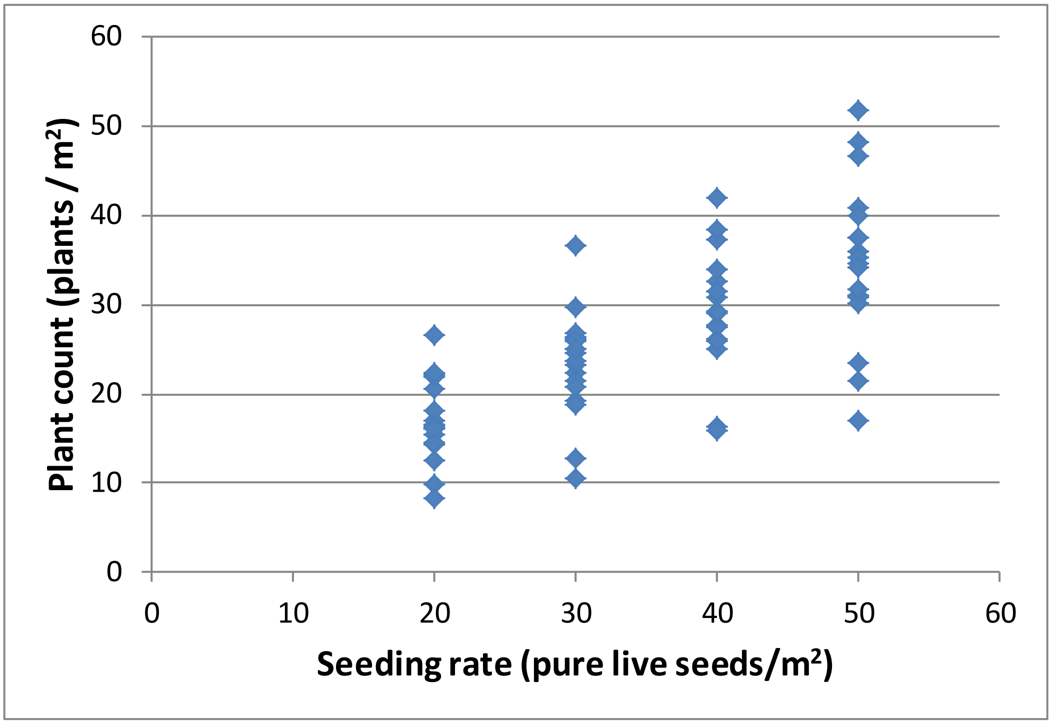


Figure 1: Effect of row spacing (a) and seeding rate as pure live seeds per m^2 (b) on plant density of soybean at various locations across Manitoba (2011-2013). Data were not collected at Beausejour in 2012 and Arborg in 2013. (*indicates a significant effect of treatment based on analysis of variance; L indicates a linear response based on contrast analysis.)

a.



b.

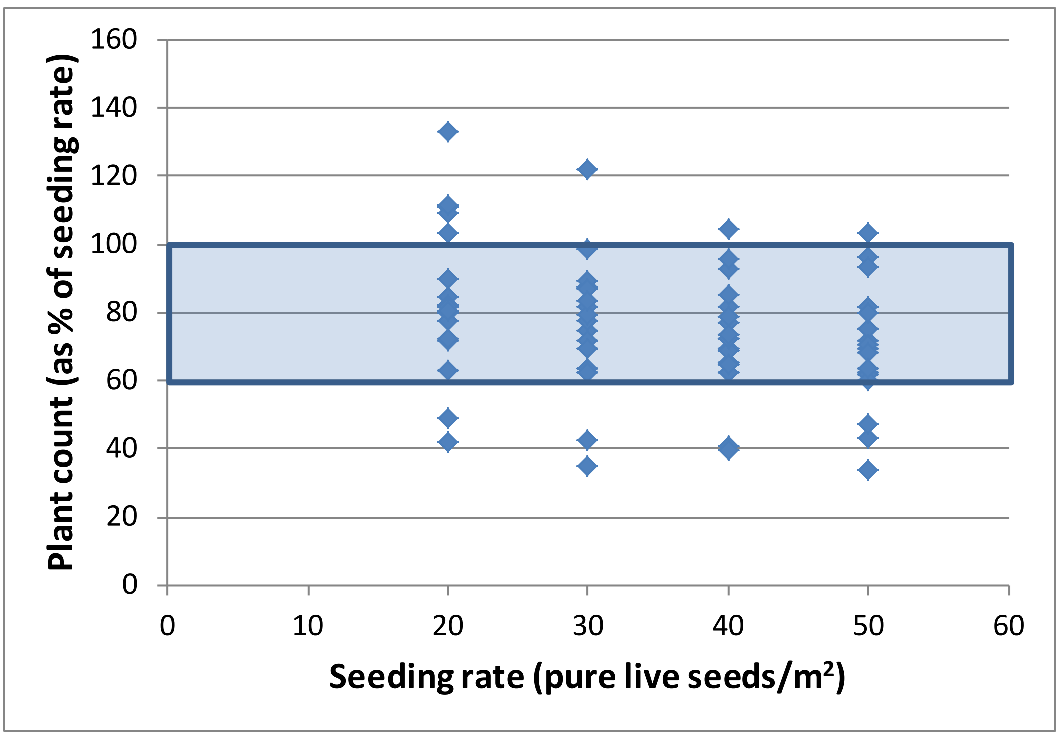


Figure 2: Effect of seeding rate on actual plant counts (a) and plant counts as a percent of the seeding rate (b) for soybean for 18 site-years in Manitoba (2011-2013).

Table 2. Lodging score for soybean as affected by row spacing and seeding rate for 9 site-years in Manitoba

Row spacing	Seeding rate (pure live seeds/m^2)	2011 Portage	2012 Beausejour	2012 Brandon	2012 Melita	2012 Roblin	2013 Beausejour	2013 Brandon	2013 Morden	2013 Roblin
		Lodging score (1-9)*								
narrow		1.1	1.3	1.0	3.3	4.5	4.8	2.8	3.0	4.1
wide		1.0	1.7	1.2	2.4	3.6	4.2	2.6	2.9	4.8
	20	1.2	2.7	1.3	3.5	6.5	4.2	2.7	3.0	7.2
	30	1.0	1.3	1.0	2.7	4.5	4.5	2.7	3.0	4.3
	40	1.0	1.0	1.0	2.5	3.0	4.5	2.7	2.8	3.3
	50	1.0	1.0	1.0	2.8	2.3	4.8	2.8	3.0	3.0
ANOVA		Pr > F								
Seeding rate (SR)		0.42	**0.01**	0.67	0.41	**0.01**	0.89	0.99	0.45	**<0.001**
Row spacing (RS)		0.33	0.33	0.51	**0.05**	0.24	0.28	0.56	0.35	0.19
SR x RS		0.42	0.80	0.67	0.13	0.14	0.27	0.53	0.45	0.54
Contrasts										
Seeding rate - linear		0.20	**0.003**	0.40	0.28	**0.002**	0.46	0.79	0.67	**<0.001**
Seeding rate - quadratic		0.33	0.07	0.51	0.20	0.39	1.00	0.85	0.35	**0.04**

*The lodging score ranged from 1-9, with 1=no lodging and 9=complete lodging, crop flat.

Table 3. Height of mature soybean plants as affected by row spacing and seeding rate for 13 site-years in Manitoba

Row spacing	Seeding rate (pure live seeds/m^2)	2011 Melita	2011 Morden	2011 Portage	2012 Brandon	2012 Melita	2012 Morden	2012 Roblin	2013 Arborg	2013 Beausejour	2013 Brandon	2013 Melita	2013 Morden	2013 Roblin
		cm												
narrow		69.4	70.1	84.6	86.4	95.0	79.7	91.6	43.3	78.3	87.2	53.1	83.9	81.6
wide		73.9	69.9	85.9	90.4	91.3	83.8	90.9	42.4	79.2	89.4	57.8	81.1	84.8
	20	67.8	65.5	85.2	93.0	92.5	77.7	91.3	41.0	74.5	84.8	52.1	83.3	82.2
	30	70.2	70.5	84.8	83.2	93.3	75.7	89.5	41.5	78.3	89.0	54.8	82.8	82.3
	40	72.2	71.2	86.0	88.8	93.3	81.7	93.0	44.8	81.7	89.6	56.8	84.0	86.0
	50	76.5	72.8	85.0	88.5	93.3	92.2	91.3	44.2	80.4	89.7	58.3	80.0	82.3
ANOVA		Pr > F												
Seeding rate (SR)		**0.03**	**0.05**	0.89	0.08	0.99	**0.001**	0.65	0.30	0.07	0.27	0.35	0.69	0.29
Row spacing (RS)		**0.02**	0.92	0.26	0.12	0.10	0.11	0.70	0.59	0.65	0.26	0.08	0.30	0.06
SR x RS		**0.03**	0.07	0.47	0.50	0.60	**0.02**	0.13	0.34	0.21	0.20	0.47	0.36	0.54
Contrasts														
Seeding rate - linear		**0.004**	**0.01**	0.90	0.52	0.80	**<0.001**	0.69	0.10	**0.02**	0.10	0.08	0.46	0.57
Seeding rate - quadratic		0.59	0.35	0.77	0.08	0.85	**0.02**	1.00	0.73	0.19	0.32	0.83	0.50	0.25

Table 4. Days to full maturity (R8) of soybean as affected by row spacing and seeding rate for 8 site-years in Manitoba

Row spacing	Seeding rate (pure live seeds/m^2)	2011 Melita	2011 Morden	2012 Brandon	2012 Melita	2013 Beausejour	2013 Brandon	2013 Melita	2013 Morden
		days after planting							
narrow		125	121	109	114	125	128	134	129
wide		125	121	109	111	125	125	133	129
	20	125	122	110	114	126	126	133	129
	30	126	121	108	113	126	127	133	129
	40	125	121	108	112	124	127	133	128
	50	125	121	109	110	124	128	134	128
ANOVA		Pr > F							
Seeding rate (SR)		0.09	0.38	**0.04**	**0.01**	**0.01**	0.72	0.90	0.11
Row spacing (RS)		0.53	1.00	0.28	**<0.001**	0.59	**0.03**	0.11	0.71
SR x RS		0.75	0.55	0.12	0.24	0.17	0.99	0.95	0.67
Contrasts									
Seeding rate - linear		0.27	0.30	0.31	**0.001**	**0.002**	0.31	0.57	**0.02**
Seeding rate - quadratic		0.22	0.25	**0.01**	0.33	0.59	0.84	0.92	0.71

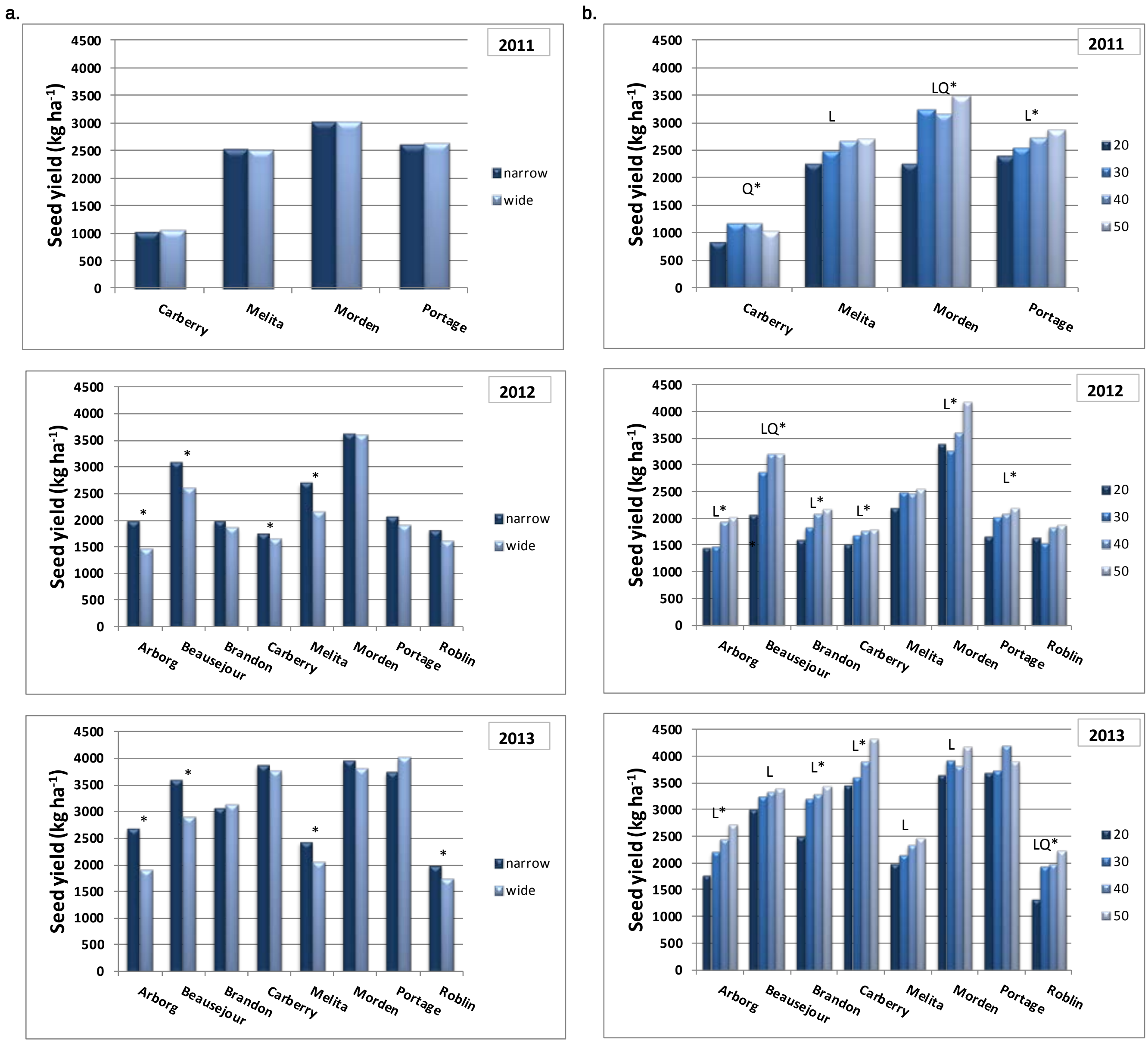


Figure 3: Effect of row spacing (a) and seeding rate as pure live seeds per m^2 (b) on yield of soybean at various locations across Manitoba (2011-2013). (*indicates a significant effect of treatment based on analysis of variance; L indicates a linear response, and Q indicates a quadratic response, based on contrast analysis.)

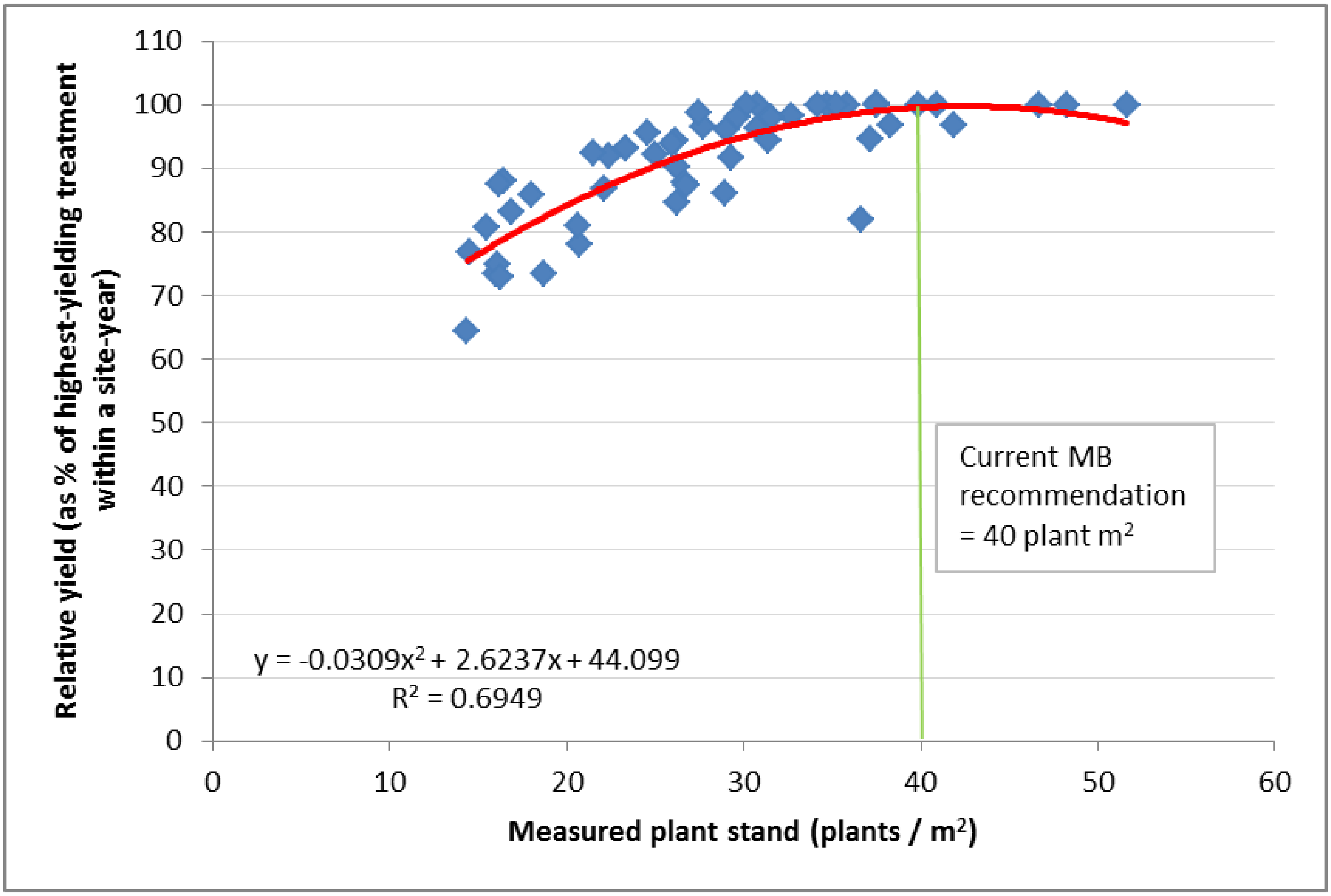


Figure 4: Relationship between actual plant stand and relative yield of soybean (yield as percent of the highest-yielding treatment within each site-year) based on 13 site-years of data from various sites in Manitoba (2011-13). The values presented are the mean of data from narrow and wide row spacing treatments. For this analysis, the following site-years were not included: Beausejour 2012 and Arborg 2013 (plant count data not available), Carberry 2011 (frost damage), Portage 2013 (seeding rate did not have a significant effect on plant stand), and Portage 2011, Carberry 2013 and Roblin 2013 (actual plant stand was ≤50% of goal stand in some or all treatments).

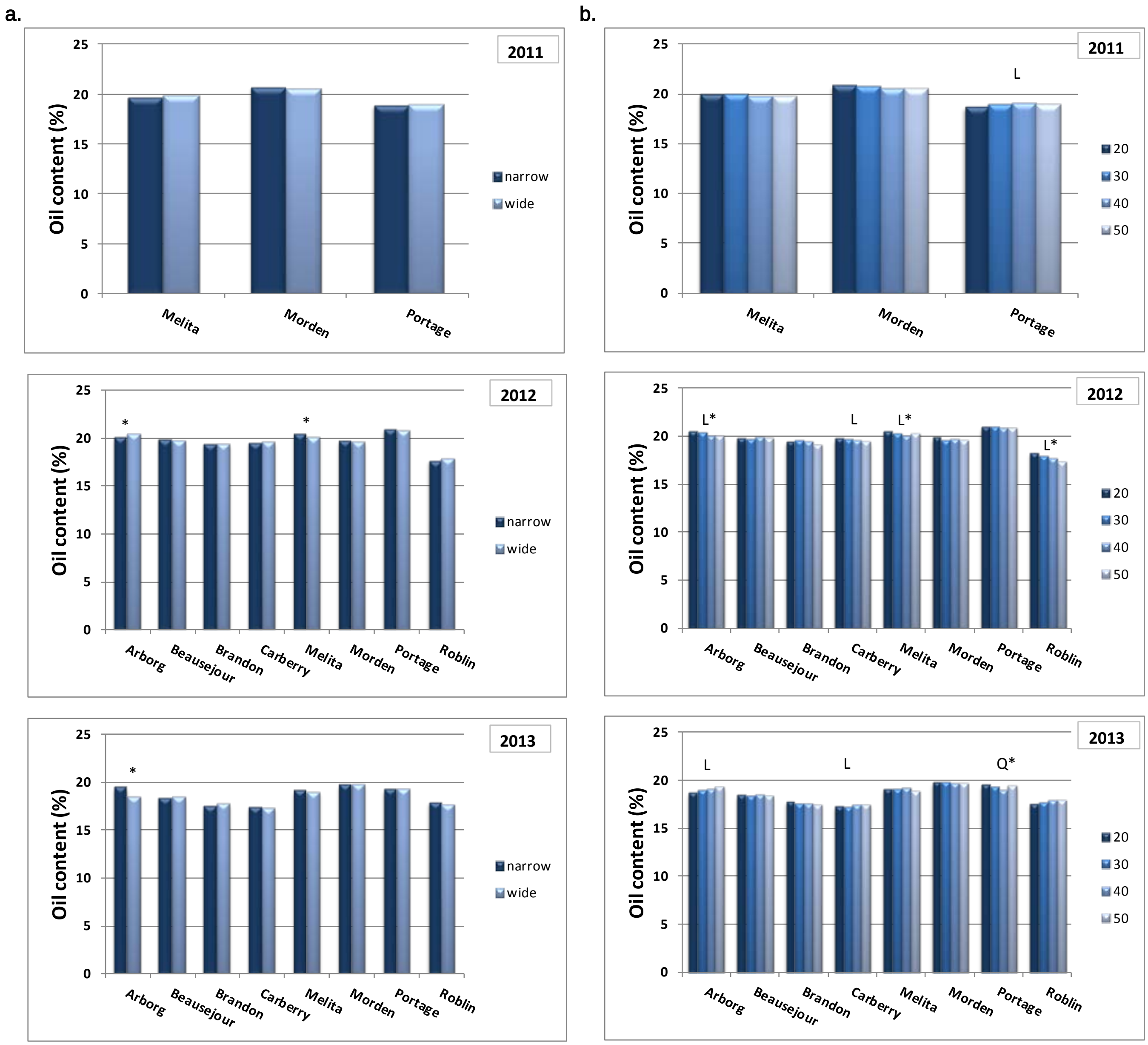


Figure 5: Effect of row spacing (a) and seeding rate as pure live seeds per m^2 (b) on percent oil in harvested seed of soybean at various locations across Manitoba (2011-2013). (*indicates a significant effect of treatment based on analysis of variance; L indicates a linear response, and Q indicates a quadratic response, based on contrast analysis.)

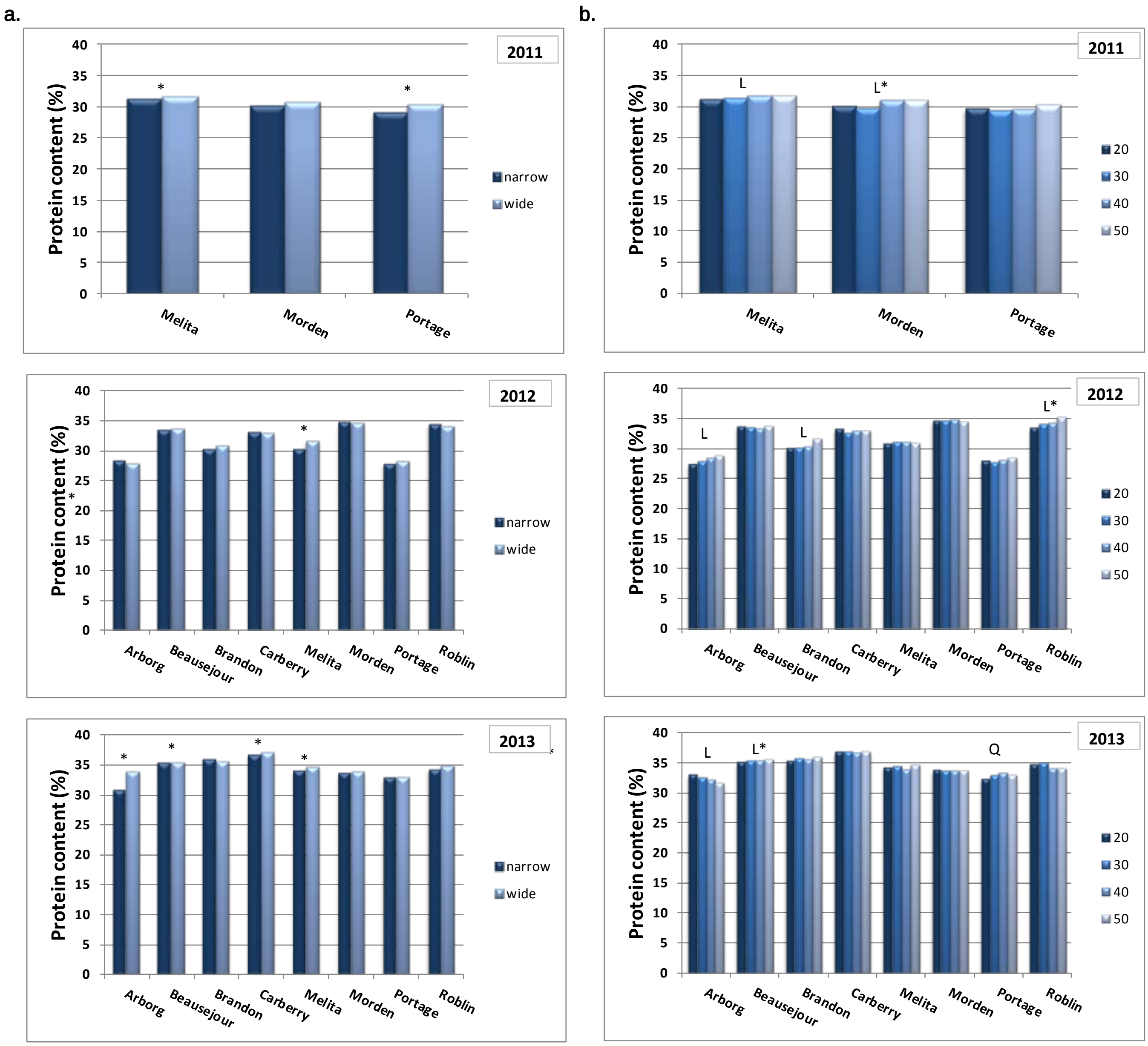


Figure 6: Effect of row spacing (a) and seeding rate as pure live seeds per m^2 (b) on percent protein in harvested seed of soybean at various locations across Manitoba (2011-2013). (*indicates a significant effect of treatment based on analysis of variance; L indicates a linear response, and Q indicates a quadratic response, based on contrast analysis.)

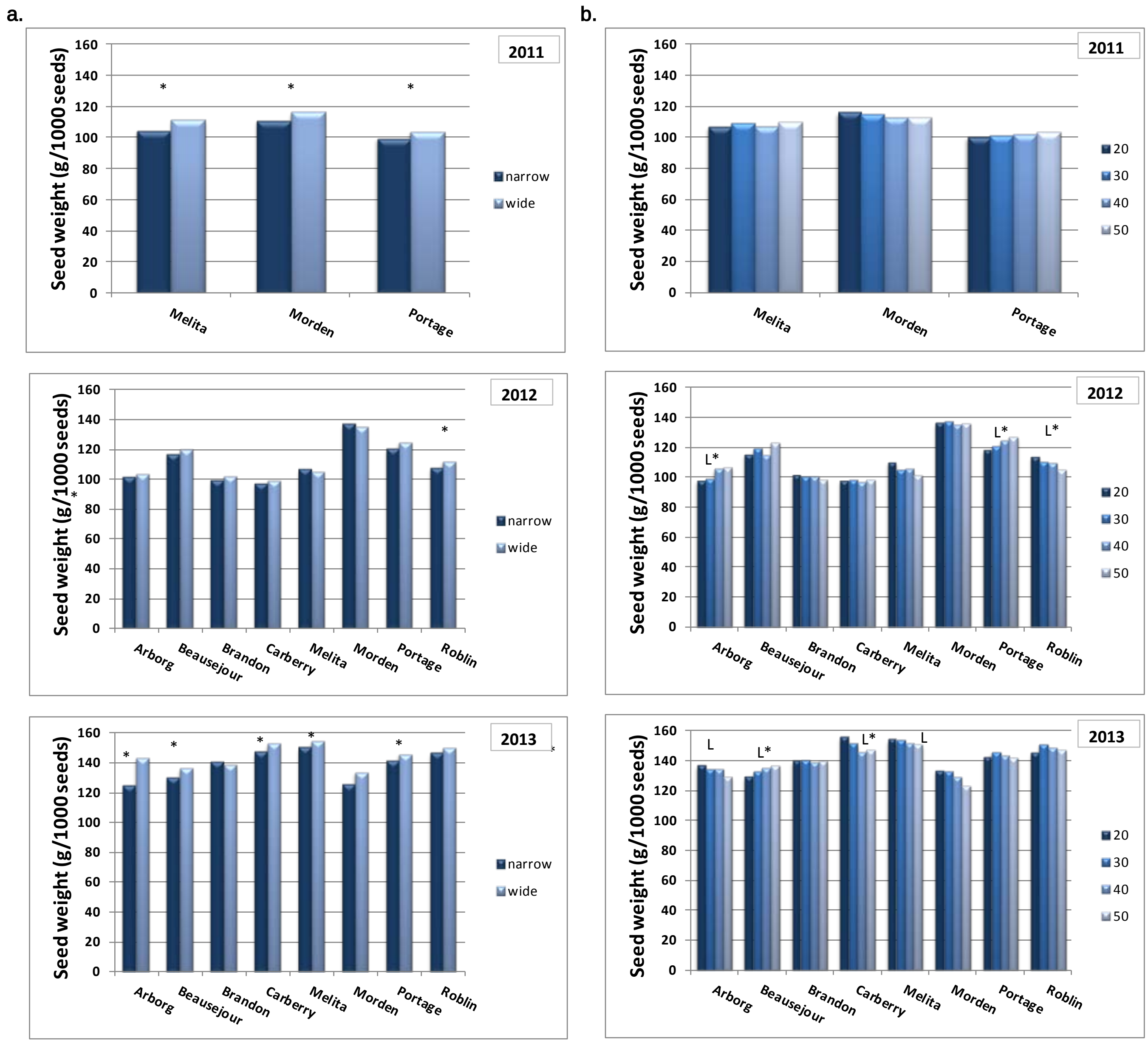


Figure 7: Effect of row spacing (a) and seeding rate as pure live seeds per m^2 (b) on seed weight of harvested seed of soybean at various locations across Manitoba (2011-2013). (*indicates a significant effect of treatment based on analysis of variance; L indicates a linear response based on contrast analysis.)

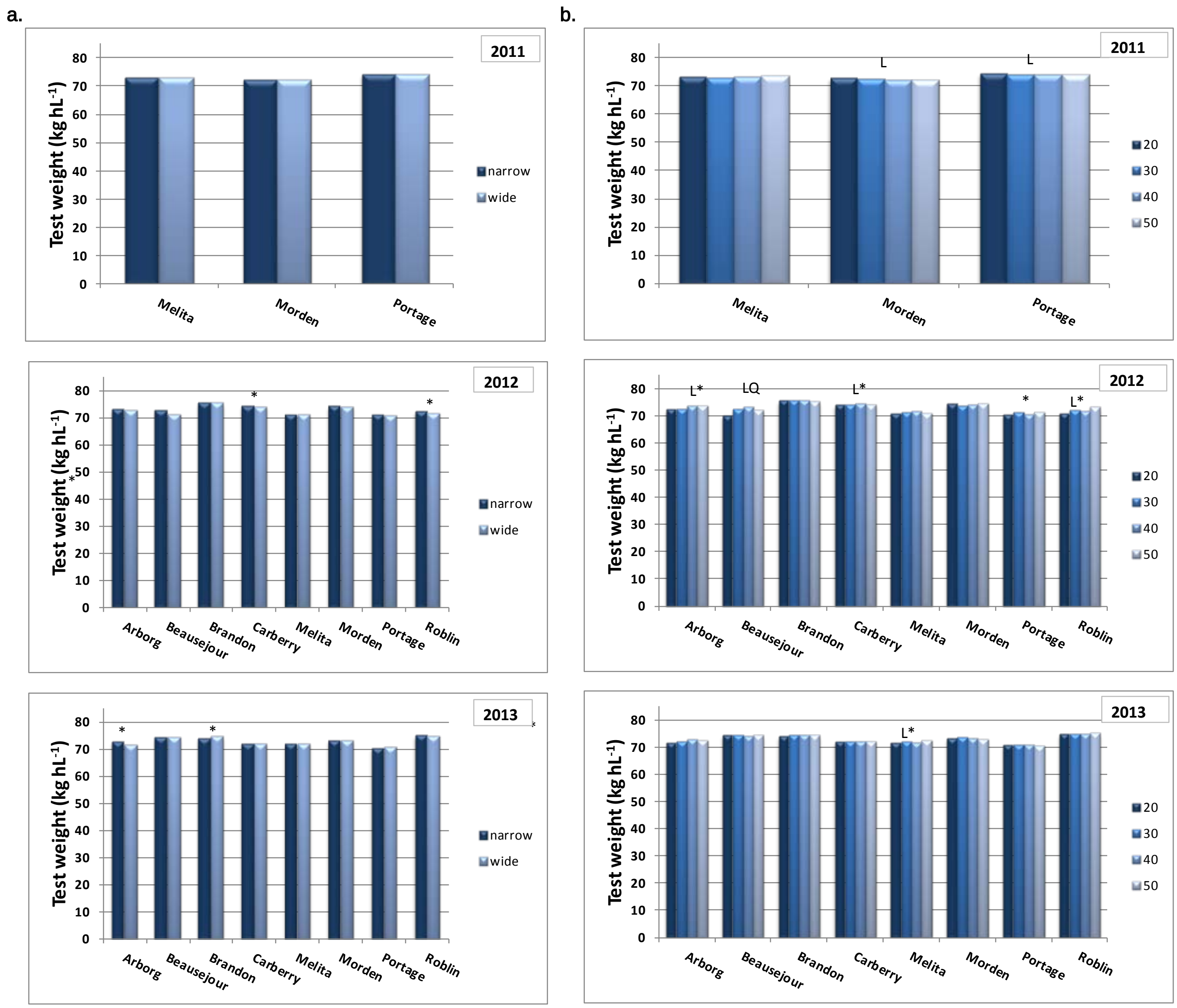


Figure 8: Effect of row spacing (a) and seeding rate as pure live seeds per m^2 (b) on test weight of harvested seed of soybean at various locations across Manitoba (2011-2013). (*indicates a significant effect of treatment based on analysis of variance; L indicates a linear response, and Q indicates a quadratic response, based on contrast analysis.)

Ukrainian Apical Dominate or Terminal Florescent Soybeans 2013

Cooperators

- Manitoba Diversification Centres – Melita, Roblin, Carberry, Arborg
- Soya UK Ltd. – Southhampton, United Kingdom
  http://www.soya-uk.com/SoyaUKseeds/soya.php

Background

Soybeans are a relatively new crop to Manitoba. Recent developments in plant breeding and genetics have introduced soybean into more northern latitudes increasing acres grown in Manitoba dramatically in the last five years. In addition, farm gate values for soybeans have also increased dramatically making them a very profitable and attractive crop for producers. Crop production limitations are complicated in Manitoba since many producers lack proper seeding and harvest equipment. Soybeans are generally seeded with a row crop planter and are harvested with a flex header. Seeding in Manitoba for most crops is done with a narrow row air seeder, and harvest done usually with a ridged header. Ridged headers increase losses in soybean harvest dramatically since soybeans characteristically grow some of their pods very close to ground level. This can vary based on field topography, field stoniness, and variety height. Short varieties are generally prone to greater harvest losses when using a ridged header since their internodes are closer together, making the chances of this loss more frequent.

WADO's former Scott Day, attended a conference in the UK in 2010. Here he met David McNaughton of South Hampton, UK, who was presenting a few new promising varieties of soybean that expressed an unusual growth habit of soybeans producing pods at the apex of the plant termed terminal florescent. These varieties including 'Elena' and 'Vilshanka' originated in the Ukraine (Kiev Oblast), and 'Pripyat' originating in Belarus (Minsk Oblast). These varieties were imported from Soya UK Ltd from Hampshire in the United Kingdom, to Manitoba, Canada, care of WADO. Phytosanitary certificates had to be applied for to clear the varieties in terms of foreign matter such as weed seeds, dirt, and most importantly cyst nematode from the Ukraine. The Canadian Food Inspection Agency accepted the conditions of the seed analyzed by the UK's Department for Environment, Food & Rural Affairs so importation into Canada was granted. 'Elena' and 'Vilshanka' were the two varieties that were successfully imported into Manitoba. They were grown around the province at each of the Manitoba Diversification Centres at Melita and Hamiota, Roblin, Carberry, and Arborg. Plant and yield characteristics were collected. These varieties were compared to a roundup ready variety commonly grown in Manitoba called 23-10 RY from Dekalb.

Variety Descriptions

Elena - Єлена

Elena was bred by Slava Mikhaylov: http://uaan.gov.ua/content/mihaylov-vyacheslav-grigorovich

Bred from multiple individual selection of hybrid populations (Kherson longifolia's Spark) x Kiev 27. Plant height is 85-90 cm. Beans are attached 12-13 cm from lower stalk. Inflorescence - multiflorous tassel on peduncle of 10-15 purple flowers. Beans with 2-3 seeds. Belongs to the Manchurian subspecies adapted to Ukraine. Leaves ternate, with a pointed tip. Seeds are oval, yellow, light brown scar, medium, and oval with white hilum. Thousand seed weight is 160-175 g. Maturity in Kiev region is in 102-105 days. Resistant to damage the most common diseases, low temperature during flowering and fruit formation. The seeds contain 41-42% protein and 20-21% fat. Plants are resistant to lodging and pod shelling. In the comparative variety testing at "Shepherds" experimental farm (1999-2002 years) it yielded about 3.2 t / ha.

Vilshanka - Вильшанка

Vilshanka was bred by Slava Mikhaylov: http://uaan.gov.ua/content/mihaylov-vyacheslav-grigorovich Derived from multiple individual selection of hybrid by crossing L.955/Chernyatka. Belongs to the Manchurian subspecies, suited for Ukraine. Plant height is 92-95 cm. Pods are attached 13-15 cm from base of stalk. Seeds oval, yellow, brown scar, medium, with white hilum. Thousand Seed Weight is 240-250 g containing 41-42% protein and 21-22% fat. Maturity in the Kiev region is in 100 to 105 days. Resistant to damage the most common diseases, as well as low temperature during flowering and fruit formation. Variety is recommended for cultivation in the forest-steppe regions of Ukraine. Yield achieved 30-35 t/ha in wide or narrow rows at seeding rates of 650-700 thousand viable seed/ha when grown with use of proper herbicides and agronomic techniques.

Info taken from: http://www.nbuv.gov.ua/portal/Chem_Biol/Sin/2011_100/306.pdf

Both Ukrainian varieties are marketed by either/or of these companies:

http://sanbinos.narod.ru/company/

http://novasoya.jimdo.com/

23-10 RY (local Manitoba variety)

Bred by Dekalb as a GENRR2Y. Plant is 66 cm in height compared to Elena and Vilshanka at 88 and 75 cm, respectively. Resistant to shatter compared to Elena and Vilshanka. Corn Heat Unit rating is 2325. Intermediate growth habit. Hilum color is black. Susceptible to cyst nematode. Purple flower color. Tawny pubescence color. Approximately 2600 seeds per pound. High protein content, average oil content.

Info taken from: https://www.dekalb.ca/Western/Products/Soybeans/Documents/23-10RY.pdf

Methods

Melita (Elva) Site

Plots were seeded May 15 at a depth of 3/4 inch. Fertilizer was side band at 58 lbs/ac as granular 11-52-0 MAP. All varieties were seeded with granular inoculant containing soybean rhizobia (Becker Underwood).

Herbicides used were Arrow (150 ml/ac @ 10 gal/ac) and Basagran Forte (0.91 L/ac @ 20 gal/ac). Basagran was used as a single rate June 17 and Arrow on June 12. Another application was sprayed July 19 with Centurion at a rate of 100 ml/ac (plus Amigo adjuvant). Plots were desiccated with Reglone at a rate of 0.9L/ac on Oct 1 after physiological maturity.

Plots were harvested Oct 10 with the Hege plot combine.

Results

There were no significant differences in yield and all other parameters in Elva (Table).

Table 1: Variety characteristics in 2013 plot trials in Elva, MB.

Variety	Company	Emergence	Plant HT	Pod HT	Maturity	Test WT		Yield	
		p/m2	cm	cm	days	g/0.5L	lbs/bu	kg/ha	bu/ac
23-10YR	Dekalb	28	63	10		323	52	1359	23
Elena	SoyaUK	31	71	12		340	55	1191	19
Vilshanka	SoyaUK	29	65	12		353	57	1187	19
	Grand Mean	47	66	11		339	54	1246	20.4
	CV%	26.2	18.7	18.4		4.3		7.8	
	LSD (p<0.05)	NS	NS	NS		NS	NS	NS	NS
	P value	0.717	0.717	0.389		0.158		0.156	
	R-squared	0.47	0.47	0.57		0.63		0.74	
	Signif?	No	No	No		No	No	No	No

Roblin Site

Treatments: 3
Replication: 3
Plot size: 1m x 5m
Test design: Randomized Complete Block Design
Seeding date: May 29
Fertilizer applied: Broadcast 40 lbs. P2O5, 10 lbs. K2O, 10 lbs. S
Pesticide applied: June 25- Basagran Forte and Solo
June 27- Basagran Forte and Solo
Harvest date: October 17
Product handling: Each individual plot harvested then dried. Once samples were dry, weight and moisture were recorded.

Prior to seeding, the fertilizer blend was broadcast with a Valmar applicator and incorporated with a heavy harrow. The soybean seed was inoculated with the proper Rhizobia and then seeded into tilled corn stubble. After seeding, but prior to emergence, the trial was rolled with a land roller to push stones in and assist with an easier harvest. Throughout the growing season, the trial was sprayed twice with Basagran Forte and Solo to control broadleaf and grassy weeds. A second application of Basagran Forte and Solo was required due to a rain event that occurred within two-three hours of the first application. Data such as plant counts, flowering, height and maturity ratings was recorded throughout the growing season.

All plots were harvested with a small plot combine. The seed was then dried and once the samples were dry, weight and moisture were recorded. All of the seed was kept for seed multiplication for future use.

Table 2: 2013 Russian Apical Dominant or Terminal Florescent Soybean Trial Results at Roblin, MB

Variety	Yield (kg/ha)	Plants per Meter^2	Days to Flower	Height (cm)
Vilshanka	3640	43	53	89
23-10RY	3469	77	54	77
Elena	2886	70	52	79
Grand Mean	3331	63	53	81
CV%	4.97	20.38	0.99	2.51
LSD	430.15	29.27	1.19	4.62
Sign Diff	Yes	Yes	Yes	Yes

Chart 1: 2013 Russian Apical Dominant or Terminal Florescent Soybean Trial Yield (bu/acre) at Roblin, MB

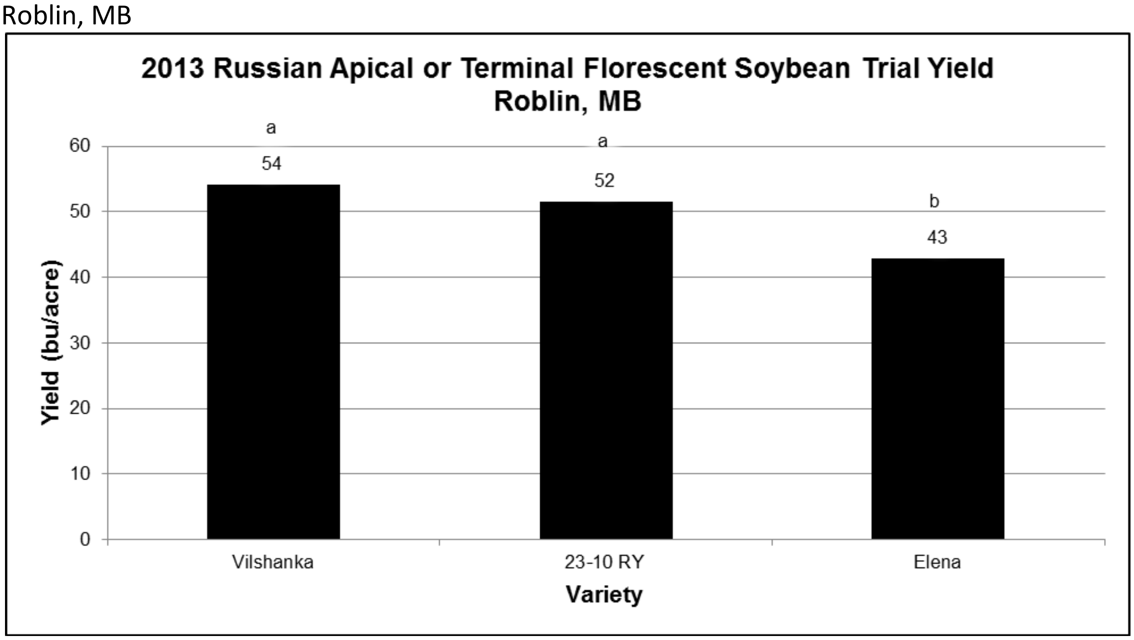


Table 4: 2013 Russian Apical Dominant or Terminal Florescent Soybean Trial Maturity Results at Roblin, MB

Variety	Sep.13	Sep.16	Sep.19	Sep.23	Sep.25	Sep.30	Oct.2	Oct.4
Vilshanka	1 YP*	13 YP*	80 YP*	100 BP*	38 BP*	73 BP*	92 BP*	98 BP*
23-10RY	-	2 YP*	13 YP*	22 YP*	30 YP*	53 YP*	90 YP*	90 YP*
Elena	1 YP*	9 YP*	47 YP*	63 YP*	95 YP*	62 BP*	78 BP*	93 BP*

* BP = %Brown Pod. This term refers to a pod that has turned brown in colour. At this stage of maturity, most if not all, of the leaves will have fallen off the plant and pod walls will be firm. A percent was given based on how much of the plot had brown pods.

* YP = %Yellow Pod. This term refers to a pod that has turned yellow or is still green in colour. At this stage, about half of the leaves will have fallen off the plant. A percent was given based on how much of the plot had yellow pods.

The lower the percent YP, the less mature the plot is. The higher the percent BP, the more mature the plot is. Ratings were taken every two to three days until the first killing frost in the fall and based on the rate of maturation, we can estimate what stage of maturity the soybeans will be once there is risk of a fall frost. The values shown above are based on the average maturity stage of all three reps.

The data parameters of most importance in this test are yield, maturity and height. The check for this test is 23-10RY. Vilshanka is similar in yield, significantly taller and earlier maturing than 23-10RY. Elena is significantly lower yielding than 23-10RY and Vilshanka. Elena is similar in height to 23-10RY and significantly shorter than Vilshanka. Elena is earlier maturing than 23-10RY and similar in maturity to Vilshanka.

Trial Comments

There were no shatter losses among the varieties as was observed in 2012 in Melita.

The terminal florescence characteristics were somewhat variable in expression among the Ukrainian Varieties. The variety 23-10 RY does not express this trait.

The Ukrainian varieties especially 'Vilshanka' appear to perform as good as the commonly grown local variety from Dekalb.

Apical dominance is defined as a phenomenon whereby the main central stem of the plant is dominant over the other side stems. Plant physiology describes apical dominance as the control exerted by the terminal bud over the outgrowth of lateral buds. (Wikipedia 2013) So in essence you have a plant that grows taller and narrower. The advantage to a plant growing taller is it will have more available sunlight for photosynthesis and yield potential is higher. The focus of seed production is on the upper portion of the plant and closer to the main stem. Temperature at emergence is important for determining height of the pod set as well. Warmer temperatures will promote rapid growth, a taller plant and the first flower will form higher up on the plant. In soybean production, location of seed set on the plant is very important for producers with stony and uneven terrain. It allows producers to set their combine headers higher and reduce potential harvest problems.

Another important attribute with apical dominant soybeans is they are non-GMO soybeans. This is important for IP (Identity Preserved) production for the human food market. In the global market a number of countries are demanding non-GMO soybeans for their human food markets. Japan and Europe markets are stable. North American and Chinese demand is rising. In order for IP production to take off, commodity prices need to reflect the value-added benefit for consumers and compensate producers for the extra cost/work that they will have to endure to grow the crop. Non-GMO production will require a more complex pesticide program. (Pearce 2013)

References

1. Dekalb. Dekalb Soybeans 23-10RY. March 22, 2012. https://www.dekalb.ca/Western/Products/Soybeans/Documents/23-10RY.pdf (accessed January 2, 2013).
2. Pearce, Ralph. "Hard decisions." Soybean Guide, October 2013: 20-22.
3. Soya UK Ltd. Soya. 2013. http://www.soya-uk.com/SoyaUKseeds/soya.php (accessed January 2, 2013).
4. Wikipedia. Apical dominance. September 16, 2013. http://en.wikipedia.org/wiki/Apical_dominance (accessed December 3, 2013).

Secan Soybean Variety Trial

Cooperators

- Secan Seeds – Brad Pinkerton

Objective

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

Photo: Brad Pinkerton of Secan (wearing hat) presented his trial on field day.

Introduction

The success of soybean varieties during their northwesterly expansion on the prairies is depended on early maturity, yield potential most importantly. 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. This trial was grown within close proximity to the MCVET soybean trials as well.

Methods

A soil test was taken prior to seeding the plots to determine background nutrient profiles. Trials were planted into a Stanton Loamy Sand north of Elva, MB. Plots were direct seeded into oat stubble from the 2012.

Soil Test			N	P	K	S	Organic Matter
Legal Land Location	Depth	pH	lbs/ac	Olsen ppm	ppm	lbs/ac	%
SE 36-3-28 W1	0-6"	8.1	10	2	83	12	1.9
	6-24"		18			24	
	0-24"		28			36	

Eight glyphosate tolerant soybean varieties were seeded into plots arranged in a randomized complete block design and replicated three times. Plots were seeded May 21, 2013 at a depth of 3/4". Final plot dimension was 1.44 m wide by 9 m long. Seed was inoculated with a granular soybean inoculant applied at 5 lbs/ac (Becker Underwood) with the seed furrow. Fertilizer was side band at a rate of 58 lbs/ac granular 11-52-0 MAP. There was no preseed burnoff. Soybean plots were rolled with a land roller just after seeding. An application of Maverick III glyphosate was applied June 17th at 0.76 L/ac at the first trifoliate stage of development. Plots were desiccated October 3rd with Reglone desiccant at a rate of 0.9 L/ac. Plots were harvested for seed yield on October 10th with a Hege 140 plot combine. Data collected included days to maturity, height, lodging, seed yield, and seed moisture content. 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 among height, days to maturity, and final yield (Table 1). There was no lodging in the trial. Four out of five Secan soybean varieties were exceptional yielders compared to the popular Dekalb variety 23-10 RY. 'Bishop' variety also matured at least 1 day earlier than all other varieties and had significantly higher plant height than many others. Secan has some promising varieties that are expanding the window on yield and maturity. Some of these varieties will be available for the 2014 season. Consult your local Secan dealer for availability.

Table 1: Varieties of soybean height, days to maturity, and final yield in the Secan soybean variety trial in Elva, MB.

Variety	Yield (bu/ac)	Days to Maturity	Height (cm)
SC2380R2	59.9	127.0	51.0
Chadburn R2	51.5	127.0	57.0
McLeod R2	50.4	126.0	64.8
Pekko	47.6	125.3	44.0
Bishop R2	46.3	125.0	61.2
SC12-999	45.6	125.3	48.8
SC12-997	41.2	126.0	59.3
Dekalb 23-10	39.4	126.3	43.8
CV%	6.9	0.6	10.7
LSD	5.8	1.1	10.1
R squared	0.85	0.64	0.77
Grand Mean	47.7	126.0	53.8
P value	0.0001	0.0513	0.0027
Significant?	Yes	Yes (p<0.10)	Yes

Biological and economic implications of volunteer canola in soybean

Cooperator

- University of Manitoba - Paul Gregoire (masters candidate) & Dr. Rob Gulden

Soybean are becoming an increasingly important crop in Manitoba and are currently ranked third behind wheat and canola based on seeded acreage. Volunteer canola is a common weed in canola growing areas. Volunteer canola originates from high harvest losses and a persistent seedbank that through developing seed dormancy can persist for several years in rotation. Few herbicides are available to manage weeds effectively in soybean production and volunteer canola, due to a lack of effective herbicide options, is a major weed in this important pulse crop. This raises a couple of questions:

1) How much yield loss can be caused by volunteer canola in soybean and what is the economic threshold of volunteer canola in soybean.
2) What crop and management practices are best before and in soybean to reduce the seedbank and impact of volunteer canola.

Methods

Field studies have been conducted to establish an economic threshold for volunteer canola in soybean. Each field study will assess the effect of increasing glyphosate-resistant, volunteer canola density on soybean yield loss. The experiments were conducted in soybean planted in narrow and wide rows and volunteer canola densities ranged 0 to 640 seeds m^{-2}. Volunteer canola plant recruitment varied. The studies were conducted in 2012 and 2013 at the Westman Agricultural Diversification Organization Research Farm near Melita, MB, the Ian N. Morrison Research Farm in Carman, MB, and the Richardson Research Farm at Kelburn, MB.

In addition to soybean yield, several other soybean response variables were collected. These include soybean densities, height, number of branches, biomass and leaf area at select sample dates. At harvest, final yield, seed moisture content and soybean seed size were determined. To determine volunteer canola seed contributions to the seedbank, volunteer canola biomass and seed return were collected at physiological maturity.

Standard mathematical and statistical approaches were used to determine economic thresholds from the yields obtained at various volunteer canola densities. These data were subjected to non-linear equation fitting to generate yield loss equations that can be used to calculate economic thresholds for volunteer canola in soybean. Examples of the outcome of this research can be found on the tables on pages 31 to 37 of the 2014 Guide to Crop Protection.

Preliminary Results

Table 1 is a summary of the model parameters for estimating yield loss in soybean in response to increasing volunteer canola density. The I value represents the % yield loss by each additional volunteer canola plant m^{-2} at low densities of volunteer canola and these varied from less than 1% to almost 5% per volunteer canola plant m^{-2}. Results suggest that there is no clear trend among I-values between wide- and narrow-row soybean production systems. The A values represent the theoretical maximum percent soybean yield loss observed within an experiment. These values ranged between 31 and 100% yield loss and this was, in part, influenced by total volunteer canola recruitment at these various locations (data not shown). The A-value results suggest that the potential for yield loss is greater in wide- than in narrow-row soybean. Initial action thresholds (density of volunteer canola that causes 5% yield loss) range between 1.1 and 13.8 volunteer canola plants m^{-2}. Although action thresholds appeared to be more variable in wide-row compared to narrow-row soybean. A more thorough analysis of the data is required to better understand the effect of row spacing on the action thresholds for volunteer canola in soybean.

Photo: Paul Gregoire speaking at field day about his trial in Elva

Table 1: Yield Loss Summary
I = Percent yield loss per weed per m^2
A = Percent yield loss, as weed density approaches infinity

Site Year		Narrow Row		Wide Row	
Year	Location	I	A	I	A
2012	Carman	not significant		not significant	
2013	Carman	1.70	58.7	0.42	100.0
2012	Kelburn	1.65	73.1	2.07	79.5
2013	Kelburn	1.37	80.3	3.47	69.8
2012	Melita	4.91	57.6	2.93	74.9
2013	Melita	2.93	31.0	0.41	43.8

Table 2. Action Threshold (5% Yield Loss)

Site Year		Action Threshold Plants m^{-2}	
Year	Location	Narrow	Wide
2012	Carman	not significant	
2013	Carman	3.2	12.5
2012	Kelburn	3.3	2.6
2013	Kelburn	3.9	1.6
2012	Melita	1.1	1.8
2013	Melita	2.0	13.8
MEAN		2.7	6.5
SEM		0.2	1.2

4R Phosphorous Management for Soybean in the Northern Frontier: Rate and Placement Effects on Plant Stand, Biomass, and Seed Yield

Cooperators

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Abstract

Very little research has been conducted to determine the best rate, source, placement, and timing of P fertilizer for modern soybean cultivars grown in the Canadian Prairies. Preliminary results of the first year of field studies at 8 locations in Manitoba showed that typical agronomic rates of seed row P did not decrease plant stand and seed yield at any sites; nor was seed yield increased at any site, even with Olsen P concentrations as low as 3 ppm.

Introduction

Soybeans areas are expanding northerly across the Great Plains region of North America. Over the last 15 years in Manitoba, Canada, soybean acreage has increased from 18,000 acres in 1998 to over 1 million acres in 2013. This increase in soybean acreage is due to a variety of factors, including the development of new varieties that are adapted to Manitoba's relatively short (95-135 frost-free days) and cool (2100-2500 corn heat units) growing season. Although Manitoba's soybean producers are proficient at inoculating their soybeans for maximum biological fixation of N, they have many questions about P fertilization and placement under Manitoba conditions. Most Prairie Canadian crops such as wheat, barley and canola respond more to banded (seed placed and side banded) P fertilizer than to broadcast applications. However, seed placed P is known to cause stand injury with some crops, including soybeans, at high rates of application.

Very little research has been conducted on P fertilization of soybeans in the Canadian Prairies and the results of that limited amount of research are inconsistent. As a result, little is known about the right source, right rate, right placement and right timing (4Rs) for P fertilization of modern soybean cultivars in this environment. For example, in field and growth chamber studies with Manitoba soils testing 2-5 ppm Olsen P, Bullen et al.

(1983) measured very large soybean dry matter and seed yield responses to P fertilizer, especially when the P fertilizer was banded underneath the seed row. However, in unpublished field studies conducted in 2005 and 2006 near Brandon, Manitoba, soybean dry matter and seed yield were not increased by P fertilization, regardless of fertilizer source or placement method (C. Grant, pers. communication). In both of these previous sets of studies, the seed yields of soybeans were much smaller than those typically harvested from current cultivars.

As a result of these questions, the following study was initiated to assess soybean response to rates and placements of P fertilizer, using contemporary cultivars in a Manitoba environment. Preliminary results from the first year of the study are presented as follows.

Methods

Field studies were conducted at 8 locations across southern Manitoba; Olsen extractable P concentrations at these sites varied between 3 and 44 ppm. Seeding equipment varied by site, with row spacings between 7 and 12"; openers were disk, knife or hoe and 5 sites had side-band capability. Soybeans (24-10RY) were planted for a target stand of 210,000 plants/acre. All sites were planted between May 22 and June 3, 2013. P fertilizer was applied as monoammonium phosphate (11-52-0). At 5 of 8 sites, 20, 40 and 80 lb P_2O_5/ac was applied in the seed row, as a sideband within 2" inches of the seed or surface broadcast prior to seeding and incorporated with seeding operations. At 3 of 8 sites, equipment limitations restricted treatments to rates of 20 and 40 lb P_2O_5/ac and seedplaced or broadcast placements, only. At the Brandon site, a randomized complete block experimental design was used; at all other sites, a split-plot design was used, with rate as the main factor and placement as a subfactor. Treatments were replicated either 3 or 4 times. Plant stands were assessed at 4 weeks after planting and, at 6 of 8 sites, biomass was harvested and analyzed for P uptake at R3 stage. Stand and yield data were measured at all sites and analyzed using ANOVA using SAS Proc Mixed.

Results and Discussion

Overall growing conditions in Manitoba were better than the average for most crops, so soybean yields at most sites were greater than the 10-year provincial average yield of 28 bu/ac (Table 2a, 2b). Seedrow placement of typical agronomic rates of fertilizer P (20 or 40 lb P_2O_5 per acre) did not decrease soybean plant stands, biomass or seed yields at any site (Tables 1-3, Figures 1-8). However, an extremely high rate of seed row P (80 lb P_2O_5 per acre) decreased plant stand and seed yield at Melita and Carberry, which are located on coarse and medium-textured soils, respectively. None of the fertilizer P rates or placements increased soybean seed or biomass yield, even at the three sites with less than 10 ppm Olsen extractable P.

Table 1a. Stand Counts (thousand plants/acre)										
Treatment	Brandon		Melita		Carberry		Beausejour		Arborg	
Control	179	A	250	A	97	A	165	A	186	A
20 SP	172	A	160	A	110	A	170	A	174	A
20 SB	199	A	172	AB	109	A	186	A	180	A
20 BR	169	A	214	AB	112	A	190	A	201	A
40 SP	187	A	163	A	90	AB	180	A	171	A
40 SB	167	A	155	AB	93	AB	168	A	168	A
40 BR	189	A	183	AB	100	A	141	A	162	A
80 SP	189	A	73	B	60	B	178	A	142	A
80 SB	192	A	177	AB	96	A	167	A	201	A
80 BR	177	A	245	A	95	A	197	A	192	A

For each site, means followed by the same letter are not significantly different (p= 0.05).
SP = seed placed P fertilizer; SB = side-banded P fertilizer; BR = broadcast P fertilizer.

Table 1b. Stand Counts (thousand plants/acre)						
Treatment	Roblin		Portage		St Adolphe	
Control	263	A	111	A	84	A
20 SP	253	A	107	A	74	A
20 BR	233	A	123	A	67	A
40 SP	202	A	87	A	84	A
40 BR	263	A	122	A	91	A

For each site, means followed by the same letter are not significantly different (p= 0.05).
SP = seed placed P fertilizer; SB = side-banded P fertilizer; BR = broadcast P fertilizer.

Table 2a. Seed Yield (bu/acre)										
Treatment	Brandon		Melita		Carberry		Beausejour		Arborg	
Control	35	A	59	A	52	A	57	A	35	AB
20 SP	32	A	56	A	54	A	60	A	40	AB
20 SB	33	A	48	AB	51	A	56	A	36	AB
20 BR	35	A	53	AB	47	AB	60	A	40	AB
40 SP	33	A	55	A	47	A	62	A	37	AB
40 SB	32	A	51	AB	49	A	59	A	36	AB
40 BR	34	A	56	A	53	A	62	A	39	AB
80 SP	27	A	38	B	37	B	64	A	36	B
80 SB	27	A	55	A	47	A	59	A	39	AB
80 BR	35	A	57	A	47	A	61	A	44	A

For each site, means followed by the same letter are not significantly different (p= 0.05).

SP = seed placed P fertilizer; SB = side-banded P fertilizer; BR = broadcast P fertilizer.

Table 2b. Seed Yield (bu/acre)

Treatment	Roblin		Portage		St Adolphe	
Control	23	A	47	A	66	A
20 SP	24	A	43	A	69	A
20 BR	25	A	47	A	63	A
40 SP	23	A	45	A	72	A
40 BR	24	A	45	A	67	A

For each site, means followed by the same letter are not significantly different (p= 0.05). SP = seed placed P fertilizer; SB = side-banded P fertilizer; BR = broadcast P fertilizer.

Table 3a. Midseason (R3 stage) Biomass Dry Matter (lb/acre)

Treatment	Brandon		Melita		Carberry		Beausejour		Arborg	
Control	4955	A	6285	AB	5562	A	5002	A	4412	A
20 SP	5721	A	5104	A	5278	A	4308	AB	4983	A
20 SB	4752	A	4596	AB	6190	A	4220	AB	4280	A
20 BR	4062	A	5564	AB	6236	A	4183	AB	4809	A
40 SP	4783	A	5047	AB	4531	A	4878	A	4753	A
40 SB	4285	A	2968	AB	5813	A	4535	A	4739	A
40 BR	4757	A	4995	AB	5990	A	3049	B	4026	A
80 SP	4942	A	2549	B	5387	A	4059	AB	3588	A
80 SB	5041	A	4091	AB	6599	A	4420	AB	4660	A
80 BR	5533	A	6164	AB	6134	A	4787	A	3823	A

For each site, means followed by the same letter are not significantly different (p= 0.05). SP = seed placed P fertilizer; SB = side-banded P fertilizer; BR = broadcast P fertilizer.

Table 3b. Midseason (R3 stage) Biomass Dry Matter (lb/acre)

Treatment	Roblin	
Control	6371	A
20 SP	5471	A
20 BR	6968	A
40 SP	6350	A
40 BR	6001	A

Means followed by the same letter are not significantly different (p= 0.05). SP = seed placed P fertilizer; SB = side-banded P fertilizer; BR = broadcast P fertilizer.

Figure 1: Melita, Loamy Sandy – 3 ppm Olsen P

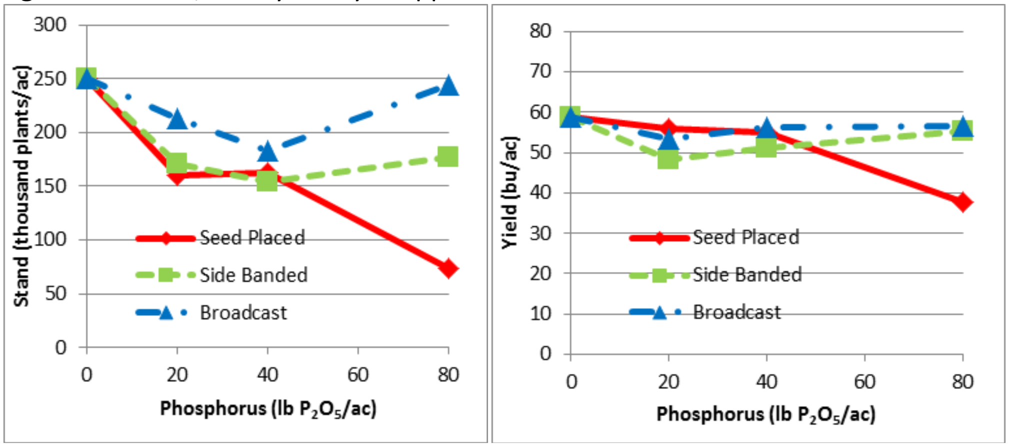


Figure 2. Brandon, Clay loam – 5 ppm Olsen P

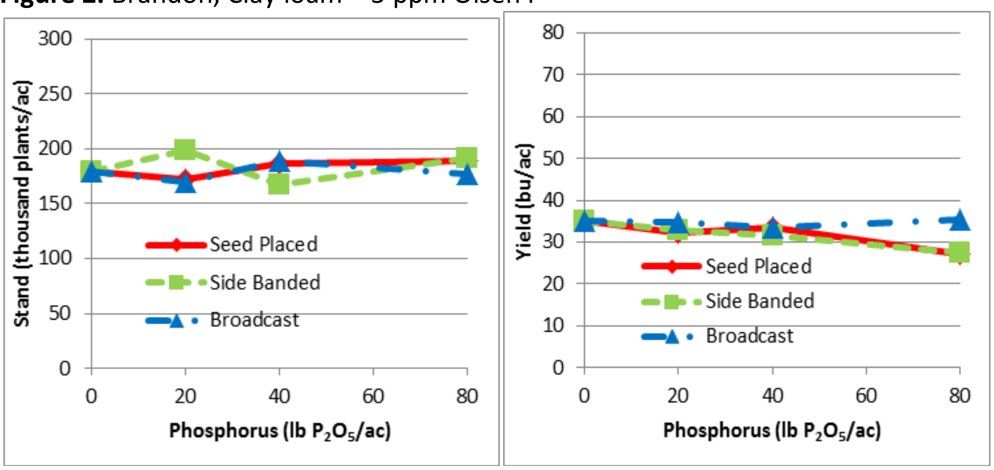


Figure 3. Roblin, Clay Loam - 7 ppm Olsen P

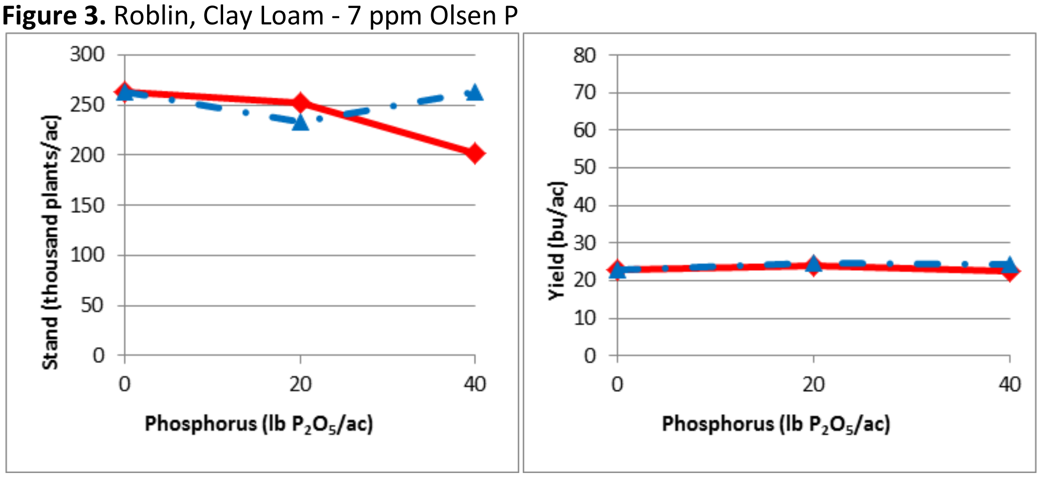


Figure 4: Beausejour, Clay – 8 ppm Olsen P

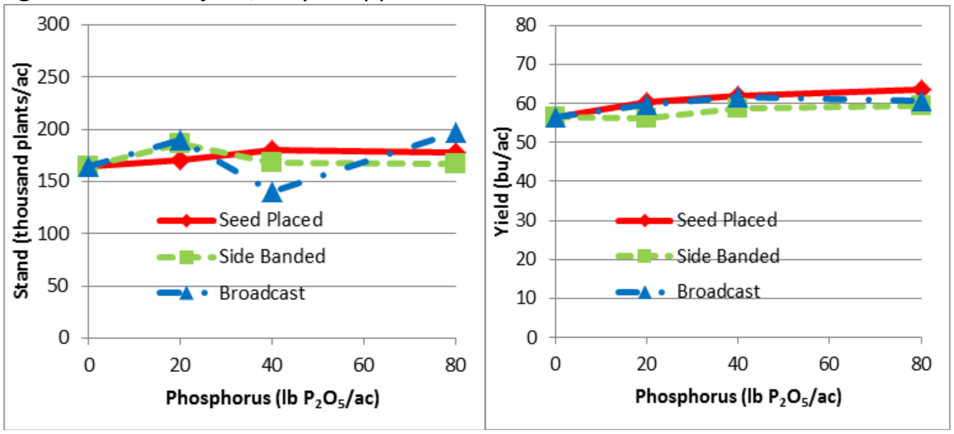


Figure 5: Arborg, Clay – 14 ppm Olsen P

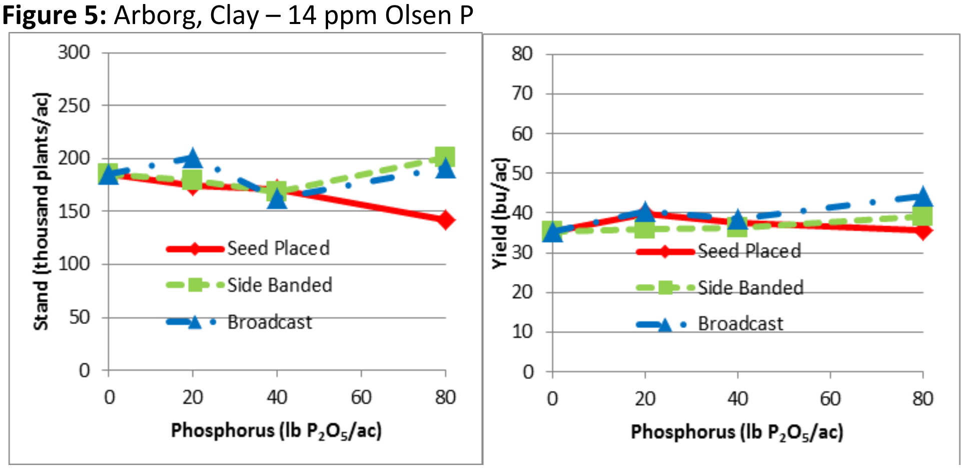


Figure 6: St Adolphe, Clay – 23 ppm Olsen P

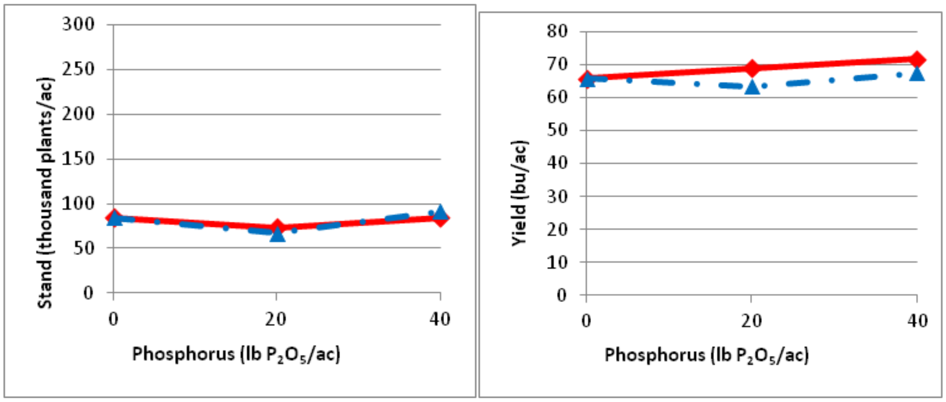


Figure 7: Portage, Clay Loam – 34 ppm Olsen P

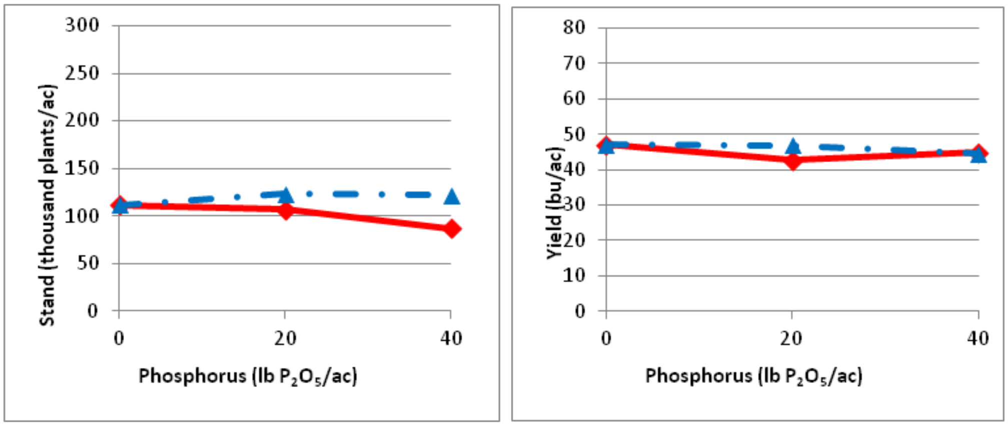
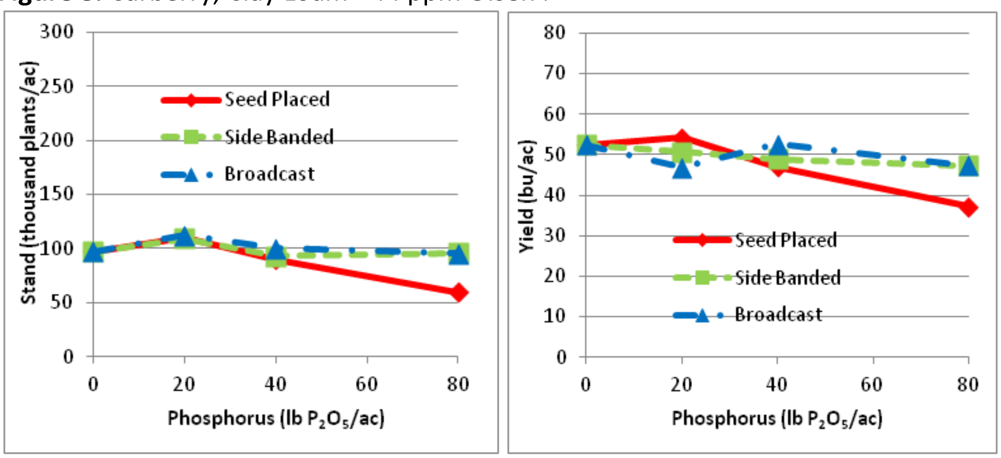


Figure 8. Carberry, Clay Loam - 44 ppm Olsen P



Conclusions

The lack of seed yield response to P and the high tolerance of soybeans to seedrow placed P was surprising. However, although these results are from a diverse range of field sites, they were collected over only one growing season. Therefore, as the study continues, we look forward to learning more about P fertilization for sustainable soybean production systems in Manitoba.

Photo Right: John Heard presenting some related research at the soybean plots near Elva on the WADO Field Day.

Acknowledgements

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1. Bullen, C.W., Soper, R.J. and Bailey, L.D. 1983. Phosphorus nutrition of soybeans as affected by placement of fertilizer phosphorus. Can. J. Soil Sci. 63:199-210.

Herbicide Screening and the Effects of Linuron Herbicide Rates for Buckwheat Production

Cooperators

- Manitoba Buckwheat Growers Association – Les McEwan
- Nestibo Agra – Mike Durand

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 also a Group 1 herbicide of which has caused herbicide resistance among several weed species including Wild Oats (1990), and Green Foxtail (1991) from former overuse 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 growing buckwheat can be a difficult to manage crop weed infestations to first time growers.

Linuron (Linuron 400 SC; United Agri-Products) had already been studied by Lee et al. (2001) shown to be promising for pre-seed used in buckwheat in addition to Methabenzthiazuron, and Alachlor. According to Manitoba crop protection guide there are multiple weeds targeted by Linuron that are often problematic in buckwheat such as red root pigweed, lambs quarters, and even wild buckwheat.

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 at a low and high rate. Minimal crop injury and to a lesser extent lack of stand reduction indicated that the use of Linuron might exibibit promising potential as a weed control option in buckwheat.

In 2013, WADO tested several rates of increasing rates of Linuron applied pre-emergent to buckwheat. The results of that trial are summarized in this report.

In addition, WADO tested some other *post emergent* products also being researched by other institutions including desmedipham/phenmedipham and topramezone. Wall and Smith in 1999 (AAFC) who used desmedipham with success. However WADO was unable to get desmedipham for testing (absent in North American Inventory) however this active was available in a blend from Betamix β (desmedipham + phenmedipham; Bayer Crop Science). Armezon (topramezone; BASF Canada) that have potential as well. Some other *pre-emergent* herbicides commonly used in preseed burnoff including Heat (saflufenacil; BASF Canada), SpikeUp (Tribenuron; NuFarm Agriculture), and PrePass (Florasulam; Dow Agrosciences) were also of interest to measure their residual effects on buckwheat.
Armezon is currently being tested by AAFC (Scott, SK) by Eric Johnson with some success in 2012 at lower rates without plant injury. Further testing on Armezon was also initiated again in 2013.

Methods

Plots were located north of Elva, MB on the legal land location SE 36-3-28 W1. Plot area for treatments was located in oat stubble that was pre-treated with glyphosate (Credit) at a rate of 1 L/ac just prior to seeding on June 6. Buckwheat was seeded 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^2 (63 lbs/ac) using the 'Horizon' variety provided by Nestibo Agra (Deloriaine, MB).

The area had been recorded not to have any residual pre-emergent herbicide applications that season. Spray treatments were commenced right after seeding on the same day. A hand held sprayer pressurized by CO_2 was used to spray each herbicide treatment. Four fan nozzles (8002VS) at 50 cm spacing were pressurized to 40 psi during application. Linuron (400 g/L) was applied with water at a rate of 10 gal/ac from product rate ranging from 0.25L/ac to 2.00 L.ac. Plots were allowed to grow through the spray treatments until frost in September to allow full potential of observations during various plant stages.

The Linuron application rate trial was arranged in a randomized complete block design, whereas the screening trial was laid out as single unreplicated plots. The water rate used to carry the products varied in the herbicide screening demo .

Results

There were no significant difference in plant height (at maturity), test weight or final grain yield among all treatments. Little weed pressure was present during the entirety of the trial. Despite hand weeding a few wild mustard plants from the hand weeded check, there was not a great enough weed issue to sample from a difference among treatments for a visible crop injury rating.

Table 1: Statistics on 2013 trial

Treatment	Height	Test Wieght	Yield	
	cm	g/0.5L	kg/ha	%Checks
Check-hand weeded	134	303.8	4614	100
Check-unsprayed	139	300.9	4468	97
0.25L/ac Linuron	131	306.3	4869	106
0.50L/ac Linuron	128	303.7	3860	84
0.75L/ac Linuron	133	307.5	4614	100
1.00L/ac Linuron	137	302.9	5053	110
1.50L/ac Linuron	139	302.7	4727	102
2.00L/ac Linuron	146	300.9	4416	96
CV%	8.7	2.8	9.3	
Grand Mean	136	304	4578	
LSD (p<0.05)	21	16	763	17
P value	0.71	0.97	0.13	
R-Square	0.48	0.12	0.63	

Conclusions

Based on results from this trial, Linuron appears to be a promising herbicide offering plant stand safety, no apparent effect on grain yield and potential to be used a low rates. However it should be cautioned that in herbicide screening plots in 2012 there was some injury at the 1.5 L/ac rate and not at the 0.75 L/ac rate. Perhaps environmental conditions such as excess moisture and high pH would have had an effect on the toxicity of the chemical on buckwheat stands.

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 is not good news in terms of seeking a minor use registration of the product in the future.

Herbicide Screening in Buckwheat

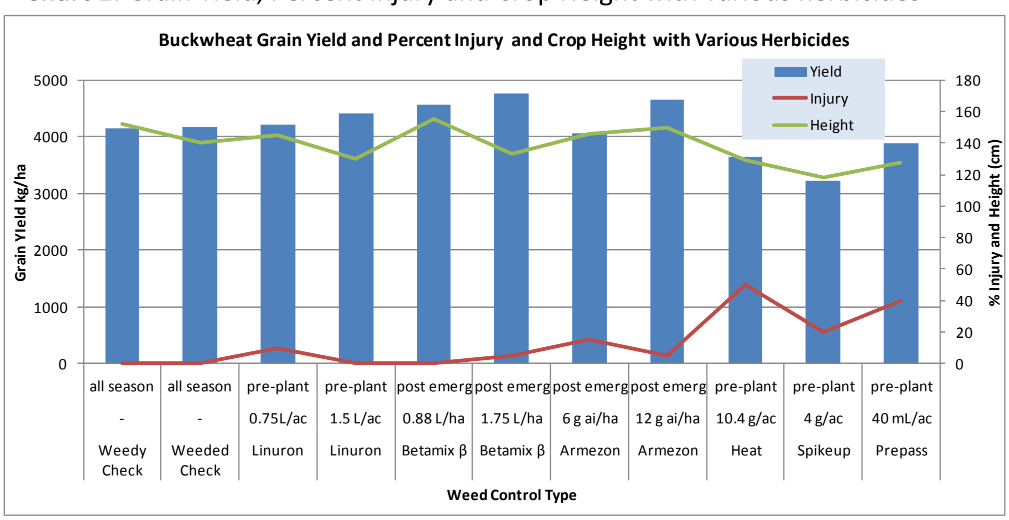
Methods of Application - Chart 1
Pre-emergent treatments applied June 6
Post-emergent treatments applied July 3

Product	Rate	Dose	Adjuvant(s) and Rate	Water Rate (gal UK/ac)	Timing	Actives
Weedy Check	-	-	-	-	all season	-
Weeded Check	-	-	-	-	all season	-
Linuron	0.75L/ac	low	none	20	pre-emerg	Linuron
Linuron	1.5 L/ac	high	none	20	pre-emerg	Linuron
Betamix β	0.88 L/ha	low	none	20	post emerg	desmedipham + phenmedipham
Betamix β	1.75 L/ha	high	none	20	post emerg	desmedipham + phenmedipham
Armezon	6 g ai/ha	low	28-0-0 UAN (first) and Merge (third) both @ 0.25%v/v	10	post emerg	topramezone
Armezon	12 g ai/ha	high	28-0-0 UAN (first) and Merge (third) both @ 0.25%v/v	10	post emerg	topramezone
Heat	10.4 g/ac	normal	Credit 0.5L/ac + Merge @ 0.20 L/ac	10	pre-emerg	saflufenacil
Spikeup	4 g/ac	normal	Credit 0.5L/ac	10	pre-emerg	Tribenuron
Prepass	40 mL/ac	normal	Maverick III @ 350 mL/ac (DMA salt type)	10	pre-emerg	Florasulam

Results

With the use of Linuron, Betamix β and Armezon, all three products appear to have minimal impact of injury and are able to sustain yields to those of the hand weeded checks. There was minimal weed infestation in the first place so the injury rating and height differences can be attributed solely to the herbicide injury among all products used. For now, Betamix β and Armezon can be further invested and information generated, if positive, will be used in an application for a minor use registration with PMRA. It was a fluke that Betamix β which has the extra phenmedipham component, which was not the intension of including of this investigation, was also exhibiting minimal impacts to buckwheat as well. Phenmedipham shows activity against pigweed and sow thistle which are problems in buckwheat production (Betanal label).
Use of pre-emergent herbicides including Heat, SpikeUp and Prepass resulted in both plant injury, reduced height and reduced grain yield. Therefore it is confirmed that used of these pre-emergent herbicides in buckwheat production is a negative influence in plant health translating into negative grain yields.

Chart 1: Grain Yield, Percent Injury and Crop Height with various herbicides



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Intercropping Winter Wheat and Hairy Vetch

Introduction

Hairy Vetch (*Vicia villosa* L.) is considered a winter annual and also noted as a biennial or perennial. It is popular among Canadian organic growers and progressive American cover crop system farmers. It's popularity is growing with experience on the Canadian Prairies as well. There is historical interest in the Ontario corn and dairy belt too. The plant is a fine stemmed, viney legume that is adapted to most soil types and is very competitive. The Hairy Vetch under our winter wheat plots grew about 100 cm, whereas Hairy Vetch on its own lodges and tangles profusely with a height of 30 cm, similar to a good crop of Laird Lentils. It apparently can contribute 60-120 lbs/ac nitrogen back to the soil from nitrogen fixation (Undersander *et al.* 1990). However, expectations of N-fixing from Hairy Vetch in our northern and shorter growing season would be less than that amount. Our observations with Hairy Vetch indicate the plant has good early and late season frost tolerance, but is poorly to moderately adapted for winter survivability in Manitoba. Pod maturity is uneven and prone to shatter. WADO has observed, if hairy vetch is planted during the normal spring seeding times of May, hairy vetch will grow profusely, flower in July and August, and generally fail to produce viable mature seed by frost. However, if planted in the fall like winter cereals, dormant planted, or planted very early in the spring, hairy vetch will produce viable seed in the Manitoba climate.

Canadian prairie producers generally had to import seed from deep in the United States as it was thought seed could not be produced in northern climates. However, some Canadian producers have found innovative ways to produce the seed like a winter cereal. In addition, recent advancements by Maul *et al*. (2011) in genetic phylogeny has determined important groups of hairy vetch across the world with distinctive characteristics such as earliness to flower, cold hardiness, and nitrogen fixation.

In 2009, WADO investigated the merits of intercropping winter wheat and hairy vetch. Those results indicated that modest hairy vetch seed could be produced when intercropped with winter wheat or sole cropped by itself. Hairy vetch seed production was directly related to winter wheat and hairy vetch seeding rates. Hairy vetch, despite growing among winter wheat stands, did not have a significant effect on winter wheat in that trial. That is, we can grow hairy vetch in winter wheat, produce hairy vetch seed, and still maintain a normal winter wheat yield at the same time. This significantly improved net returns per acre when intercropping was practiced.

In 2012 and 2013, WADO revisited those results with a simple trial of intercropping. Simply put, does hairy vetch affect winter wheat production? WADO also wanted to measure the sole crop output of hairy vetch seed production in comparison. This report is concerned with the 2013 results, or year 2 of the trial.

Methods

In the fall of 2012, treatments including plots of hairy vetch, winter wheat, and a combination of hairy vetch and winter wheat were seeded near Melita, MB on the legal land location of NE 36-3-27W1, a Leige loamy sand. Prior to seeding the area was burned off with a tankmix of glyphosate (Maverick) and Heat and Liberty herbicide at a rate of 1 L/ac, 4 g/ac, and 0.5 L/ac, respectively. The treatments were direct seeded in a randomized complete block design and replicated three times using a Seedhawk dual knife air drill with six rows at 9.5" spacing. Plots were seeded September 21, 2012 into rather dry conditions. Seeding depth was 0.5" deep. Target seeding rate was 100 lbs/ac for winter wheat (CDC Falcon) and 35 lbs/ac for hairy vetch (from producer, Allan McKenzie, Nesbit MB). Six month old granular pea-lentil inoculant (Becker Underwood) was seeded with both crops at a rate of 5 lbs/ac to promote hairy vetch nodulation. Fertilizer was sideband at a rate of 50 lbs/ac N (28-0-0 UAN) and 30 lbs/ac P (11-52-0 MAP). Plots were topdressed on May 14th with 50 lbs/ac N (46-0-0 Urea). Plots were kept weed free by spraying Achieve (and adjuvant Turbocharge 5L/100L) and Basagran Forte tank-mixed at a rate of 0.2 L/ac and 0.91 L/ac applied with 20 gal/ac water volume, on May 28, 2013. Plots were desiccated with Reglone herbicide at a rate of 0.91 L/ac with a water volume of 20 gal/ac August 20th , 2013. Harvest commenced September 11th for both crops. Data recorded during the seasons included soil temperature, spring emergence, seed yield, wheat FDK, wheat seed spout, wheat test weight, and wheat seed protein, . Harvest seed components were separated using a spiral cleaner (Seedburo, single 6'' spiral seperator). Data was analyzed with a two-way analysis of variance (ANOVA) using Analyze-it v 2.03 (Microsoft Corp.) statistical software. An economic analysis relating a theoretical cost of production (Appendix) to each treatment was applied and also analyzed.

Results

There were significant differences in hairy vetch spring emergence, wheat component yield, total yield and both gross and net incomes among treatments (Table).

Table 1: Spring emergence, grain yield and economic figures related to intercropping hairy vetch and winter wheat and their monocrop derivities in Melita, MB in 2013.

Treatment	Hairy Vetch	Wheat	Hairy Vetch	Wheat	Total	Gross	Net	COP*
	Spring Emergence (p/m^{2})		Yield (kg/ha)			Income ($/ha)		$/ha
Hairy Vetch	31	-	758	-	758	$ 4,167.39	$ 3,233.34	$424.57
Wheat	-	56	-	3924	3924	$ 1,338.14	$ 565.87	$351.03
Hairy Vetch & Wheat	14	47	438	2405	2843	$ 3,229.58	$ 2,190.55	$472.96
CV%	14	19	37	25	25	32	46	
LSD (p<0.05; 0.1)	8	NS	NS	1417	1417	$ 2,101.31	$ 1,134.70	
Grand Mean	22	51	3164	2508	2508	$ 2,911.70	$ 1,996.58	
P value	**0.020**	0.368	0.220	**0.008**	**0.008**	**0.047**	**0.057**	
Significant?	Yes	No	No	Yes	Yes	Yes	Yes	

*Cost of production assumptions summarized in Appendix

Hairy vetch emergence was significantly lower in plots grown with wheat than without. It is speculated that fall drought conditions exacerbate winter survival of hairy vetch in addition to the lack of moisture required to germinate in the fall for both crops. Winter wheat emergence was not affected by the presence of hairy vetch indicating it is a more competitive crop in terms of co-wintering together. However, hairy vetch seed yield was not affected by spring emergence issues or having a competitive crop like winter wheat. This was not observed in the 2012 WADO trial.

For the first time in WADO trial wheat yield was significantly affected negatively by the presence of the intercropped hairy vetch. Even though hairy vetch emergence was initially negatively affected by the presence of winter wheat, hairy vetch was able to outcompete for resources later on and affect wheat final yields. An having said that, intercropping hairy vetch with the wheat still proved to provide more income than without hairy vetch, despite the yield reduction experienced by wheat and the higher cost of production (COP) associated with intercropping.

Despite the reduction in yield in wheat, intercropping or sole cropping hairy vetch proved to be significantly more lucrative than just growing winter wheat. Hairy vetch as a sole crop was by far the most profitable crop and intercropping or sole crop winter wheat. This was the case as in the 2012 WADO trial as well.

Comments

Hairy vetch production is obviously more productive as a sole crop, however given the growth habit of hairy vetch, specialized equipment would be required to produce it as a sole crop. In sole crop production equipment such as land rollers, flex headers, side cutting bars, lifter bars may be required in order to bring the crop in properly. However, growing hairy vetch as a companion crop with winter wheat proved to be beneficial as a source of greater income per hectare and as a potential renewable local source for hairy vetch seed.

As a side note, hairy vetch seed has been reported to cause poisoning in cattle, horses and poultry (Government of Canada, 2009). Grazing fodder may prove problematic to livestock health due to hairy vetch seed that may have shattered to have been unthreshed or thrown over combine sieves. In addition, producers should be prepared to deal with volunteer hairy vetch in the next growing season and have a control plan and proper rotation for those seedlings. Hairy vetch has been tolerant to many herbicides such as Authority (sulfentrazone), Odyessy (imazamox & imazethapyr), Rival (trifluralin), and Basagran (bentazon). These herbicides are popular among many pulse crops.

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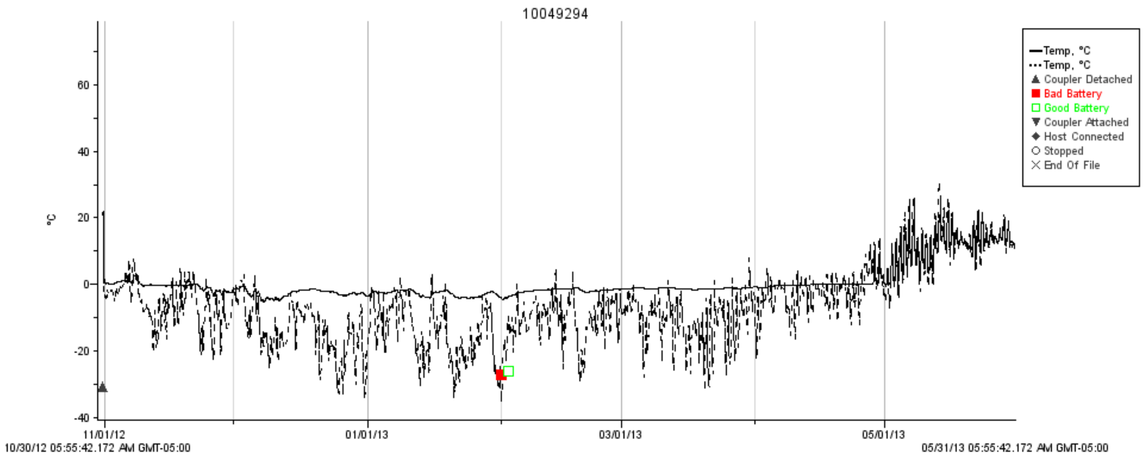
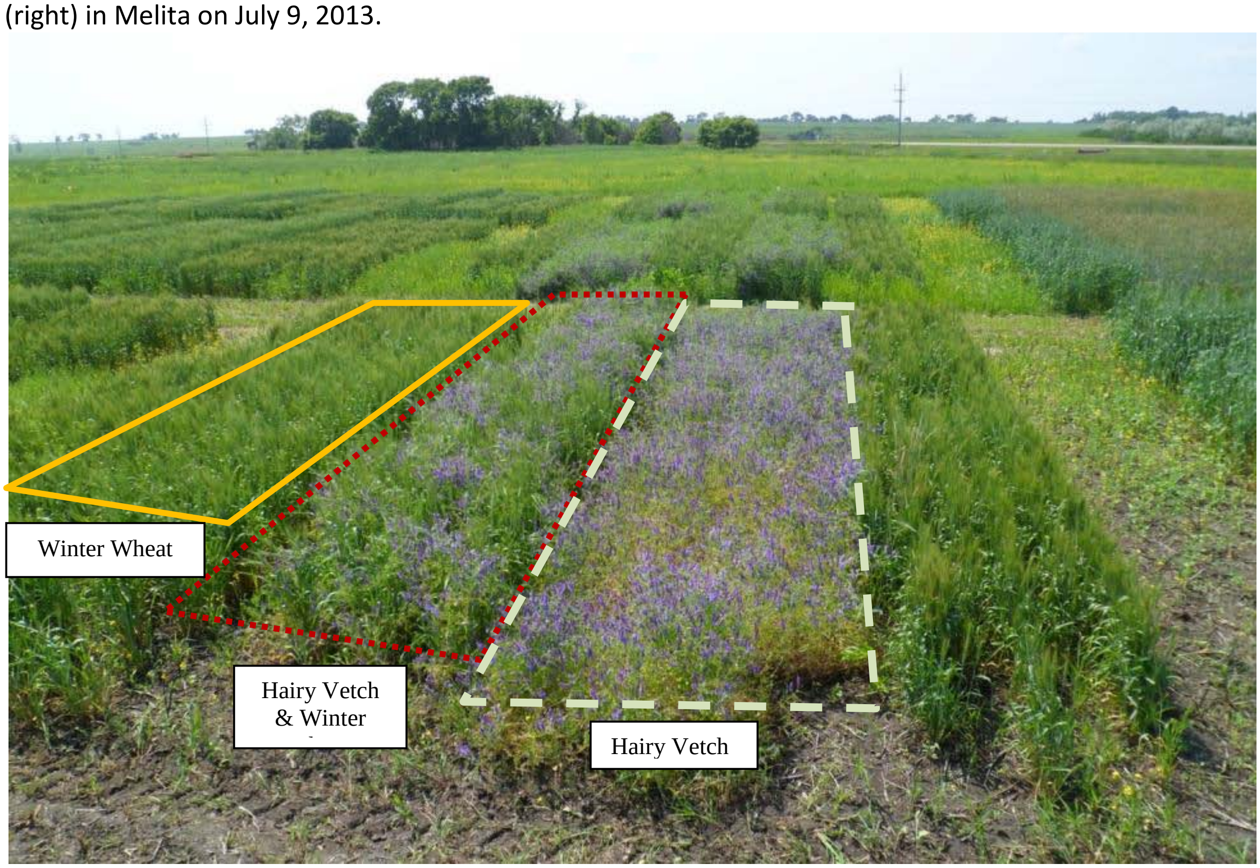


Graph 1: Soil Temperature of winter wheat and hairy vetch plots during the winter and spring months in Melita from November 2012 to June 2013. Air Temperatures (variable dashed line) reaching -35°C a few times in January 21 and February 1, however, large snow pack held soil temperatures (solid line on top) at bay between -1°C and -5°C.

Photo below: Plots of winter wheat (left), winter wheat-hairy vetch (middle) and hairy vetch (right) in Melita on July 9, 2013.



Hairy Vetch Cost of Production Assumptions

Assumptions per acre	per acre		
HV farm gate	$2.50/lbs	$ 5.50	per kg
WW farm gate	$7.76/bushel	$ 0.34	per kg
HV Seed Cost	$ 87.50	$ 216.13	per ha
WW seed cost	$ 22.00	$ 54.34	per ha
WW COP*	$ 312.66	$ 772.27	per ha
HV COP	$ 378.16	$ 934.06	per ha
WWHV COP	$ 400.16	$ 988.40	per ha
N- 100	$ 63.00	$ 155.61	per ha
P - 30	$ 15.90	$ 39.27	per ha
Cleaning Cost for HV in WW	$ 1.20	per bushel	
Achieve + Basagran	$ 46.19	$ 114.09	
*Used the 2013 WW COP Manitoba ,changed the herbicide cost to $46.19, then worked a $1.20 per bushel cleaning cost in for the WWHV.			
Achieve 2010 price	$19.43 per acre		
Basagran forte price	$29.41/L		

Appendix – Cost of Production

		Winter Wheat	
A. Operating Costs			
Seed & Treatment		$ 22.00	
Fertilizer		$ 78.00	
Herbicide		$ 7.22	
Fungicide		$ 16.25	
Insecticide		$ -	
Fuel		$ 16.15	
Machinery Operating		$ 8.00	
Crop Insurance		$ 10.76	
Other Costs		$ 7.75	
Land Taxes		$ 4.35	
Drying Costs		$ -	
Interest on Operating		$ 4.69	
Total Operating		$ 175.17	
B. Fixed Costs			
Land Investment Costs		$ 31.25	
Machinery Depreciation		$ 30.00	
Machinery Investment		$ 7.50	
Storage Costs		$ 3.52	
Total Fixed		$ 72.27	
Total Operating & Fixed		$ 247.44	
C. Labour		$ 26.25	
Total Costs		$ 273.69	
Estimated Farmgate			
Price $ per unit	bu	$ 7.76	bu
Price $ per tonne	t	$ 285.00	t
Yield per acre	bu	$ 58.00	bu
Gross Revenue / acre		$ 450.08	

Sunflower Intercropped with Hairy Vetch

Hairy Vetch (*Vicia villosa*) is considered a winter annual and also noted as a biennial or perennial. The plant is a fine stemmed, viney legume that is adapted to most soil types and very competitive. Vines can grow over 100 cm long when able to trellis, whereas Hairy Vetch grown on its own lodges and tangles profusely with a height of 30 cm, similar to a good crop of Laird Lentils but 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). Hairy vetch has become popular in organic plowdowns, and the cover crop cultures for this reason. However, expectations of N-fixing from Hairy Vetch in Manitoba's northern latitude and narrow growing season would be less than that amount. WADO's observations with Hairy Vetch indicate the plant has good late season frost tolerance, but a poor to fair potential for winter survivability. Root development is rather shallow and similar to field pea, which may make it a good candidate with deep rooted crops in intercropping systems. 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). However prior to seed production, hairy vetch feed quality is exceptional and is similar to alfalfa (WADO feed analysis, Oct 2008). 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.).

Intercropping sunflower and hairy vetch may have some similar objectives as in corn and hairy vetch. Compatibility in herbicide use, timing of physiological development of both crops, potential fall-winter grazing in sunflower fields, and differing root zones make these two crop ideal candidates for intercropping. Authority 480 herbicide (sulfentrazone) by NuFarm and FMC was registered for use in sunflower in 2011 in Manitoba is also compatible (unregistered) for weed control in hairy vetch according to observations by WADO (2009, 2011, 2013). 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.

WADO conducted an experiment with row cropped sunflowers and intercropped hairy vetch in 2013. In 2012, the same trial was conducted but seed yield was lost due to blackbirds.

Methods

A soil test was taken prior to seeding the plots to determine background nutrient profiles. Trials were planted into a Stanton Loamy Sand north of Elva, MB. Plots were seeded into oat stubble from the 2012.

Soil Test Legal Land Location	Depth	pH	N lbs/ac	P Olsen ppm	K ppm	S lbs/ac	Organic Matter %
SE 36-3-28 W1	0-6"	8.1	10	3	93	8	1.9
	6-24"		15			24	
	0-24"		25			32	

Trial area was pre-treated with a tank mix of Rival, glyphosate (Credit), Aim, and Authority herbicide at 0.65 L/ac, 1L/ac, 35 ml/ac, and 100 ml/ac, respectively, prior to seeding on May 17th . Plot treatments consisted of 30" row confectionary sunflowers (10" spacing, var. 6946) with and without hairy vetch interseeded (24 lbs/ac on 9.5" spacing) between the rows of sunflower. Sunflowers were direct seeded using an air seeding system with Seedhawk dual knife openers by directing three 9.5"rows into one 30" row. Hairy vetch was seeded and banded with granular phosphate in the adjacent rows to the sunflowers Hairy vetch was inoculated with pea/lentil granular Rhizobia (BeckerUnderwood). Both crops were seeded 5/8" deep in plots 1.44 m wide by 9 meters long. Plots were seeded May 28th. Fertilizer was sideband at a rate of 48 lbs/ac actual nitrogen and 30 lbs/ac actual phosphorous using liquid 28-0-0 UAN and granular 11-52-0 MAP. Arrow (Clethodim) herbicide was sprayed on June 27 at a rate of 150 mL/ac (plus X-factor surfactant) to control grassy weeds. A few wild mustard weeds had to be pulled per plot by hand.

A SPAD 502 meter (Spectrum Technologies) was used to measure leaf chlorophyll content in sunflower. Chlorophyll content can be correlated to potential yield. Readings were taken from each plot by sampling 5 random leaves per plot during R5.5 (mid-flower) stage of sunflower development. The second most new leaf was used. The five samples were calculated as a plot average.

Two 0.25 m^2 biomass samples of hairy vetch were taken from each hairy vetch treatment plot after harvest. Both samples were combined and sent to Central Testing Laboratories (Winnipeg, MB) for a wet chemistry forage test to determine protein content in order to determine nitrogen fixation accumulation. Composite soil tests were taken in the fall 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 Laboratores (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 Analyse-it 2.03 statistical software (Microsoft) when more than two treatments were compared, otherwise all other parameters were analyzed with a 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, accumulations of nitrogen from biomass residues. There were also significant differences in soil nitrogen levels at the 0-6" depth, and 0-24" depth totals, and total nitrogen in the system (biomass N + soil N) after harvest. These variations translated into significant differences in nitrogen economics but not when nitrogen economics were applied to grain harvest economics overall. It is likely the variation in seed yield was too great that N economics had little impact with comparing overall system economics. However, that being said, the value of the N benefit is similar to the cost of seed for hairy vetch. Intrinsic benefit may be realized in future rotation crop such as greater soil N residue credits produced from the hairy vetch in the preceding year as well as soil and ecosystem health and grazing day potential that could be utilized in real time after harvest. With just under a ton per acre of available forage a significant grazing period could be utilized. Moreover there were no significant negative impacts of intercropping sunflower and hairy vetch in terms of sunflower yield and test weight. There were also no harvest issues having extra biomass below the sunflower heads as the hairy vetch did not interfere with harvest of the head or the knife or pickup of the combine.

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

Treatment	SPAD	HV Biomass	N Biomass Residues	Height	Test Wt	Yield
	Mean	kg/ha	kg/ha	cm	g/0.5L	kg/ha
Sunflower	29.5	-	-	182	138	1681
Sunflower + HV	28.3	2000	49	190	137	1773
HV	-	3467	100	-	-	-
Grand Mean	28.9	2733	75	186	138	1727
P value (two-tailed)	0.23	**0.038**	**0.022**	0.491	0.799	0.887
Standard Error	0.9	481	14	11	5	610

Table 2: Total residual 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 under plots of hairy vetch and sunflower intercropping compared to their monocrop derivatives in Elva, MB in 2013

	lbs/ac				$ /ac	
	0-6"	6-24"	0-24"	total N system	N value	Gross Value
HV	16	9	25	114 c	$ 62.78 c	$ 62.78 a
Sunflower	6	6	12	12 a	$ 6.60 a	$ 485.81 b
Sunflower + HV	8	8	16	60 b	$ 33.02 b	$ 538.45 b
CV%	41.0	34.5	30.2	25.5	25.5	46.7
LSD (p<0.05; 0.1)	7.0	NS	9.2	36	$ 19.79	$ 385.24
Grand Mean	10	8	18	62	$ 34.13	$ 362.35
P value	0.088	0.444	0.095	***0.004***	***0.004***	***0.048***

Discussion

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

The potential for grazing sunflower 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. I vertical tillage unit or a discer may be required to manage such heavy and tangled residues. However with the development of seeding openers designed to managed thick thatches of biomass may prove beneficial in this concept.

Again, use of applied nitrogen fertilizers in Hairy vetch is likely unorthodox. 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. This may create a nutrient deficiency overall for sunflower. Results from the SPAD meter readings in this trial suggest otherwise. Specific nitrogen placement or slow release products may assist in proper nodulation in hairy vetch and sunflower nutrition.
Hairy vetch seeded in this trial was able to produce viable mature seed in substancial quanities (see photo). Volunteer seed banks of hairy vetch become of concern for the selection of the next crop. There are weed control options to control hairy vetch however 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 seedling the next growing season. Less seed would be produced if hairy vetch was planted later reducing time for the plant to produce seed in time before fall frosts.

A rain and wind storm hit the plot in September causing significant lodging not only in the monocrop sunflowers but in the intercropped sunflowers. Hairy vetch may have exacerbated this risk given the weight of the biomass climbing on the stalk of the sunflower (see photo).


V6 stage of sunflower and hairy vetch growing between rows of sunflower (2012 photo)


Hairy vetch climbing up the sunflower stalk @ R5.3


Hairy vetch flowers up close


Sole crop sunflower plot


Sole crop hairy vetch plot


Intercrop of sunflower and hairy vetch

Effect of Banded and Topdressed Nitrogen in Pea-Canola Intercrops

Background

Peas (Pisum sativum L.) are legumes that can fix atmospheric nitrogen with the symbiotic association with *Rhizobium* bacteria, but can also absorb soil nitrogen within the soil profile to facilitate proper growth. Producers typically plant peas on low nitrogen soils and inoculate with commercial based *Rhizobia* in order reduce fertilizer costs from using expensive applied commercial urea, ammonia, and nitrate fertilizers. Well nodulated plant can derive 50% to 80% of their nitrogen requirement under favorable growing conditions with the remainder coming from soil borne sources. Low nitrogen containing soils do little to affect the normal nodulation process, however prior to nodulation, plants may experience nitrogen deficiencies if soil levels are less than 10 lbs N/ac. A small amount of starter N fertilizer can reduce the effects of a N-deficiency. However, when combined levels of soil and fertilizer levels reach 18 to 37 lbs N/ac, any additional nitrogen will reduce nodulation. Excessive nitrogen levels past 45 lbs N/ac cause peas to become rather lazy and roots will choose to delay nodule formation and rather absorb excess nitrates for growth. Three to four weeks can pass before nodulation is fully restored. (Saskatchewan Pulse Growers)

Canola (Brassica napus L.) absorbs the nitrogen from ammonium or nitrate forms in the soil nitrogen pool. Consequently, canola is depended upon this nitrogen pool and usually requires the use of external applied fertilizers to fill this void. Applying nitrogen at seeding is common, however risks such as denitrification, leaching and immobilization can results and generally only 47% of applied nitrogen fertilizer is recovered by the plant (Lafond *et. al.* 2007). Timing of nitrogen uptake is critical to plant stage. Delayed application during these stages can reduce nitrogen losses associated with applying during seeding. This method comes with a risk of dry climatic conditions causing nitrogen fertilizer to fail to migrate with timely rains. Holzapfel *et. al.* (2007) suggests that in canola nitrogen can be delayed at least 30 days after seeding without yield reduction.

Intercropping, the process of growing two or more crops in the same place and at the same time, has been researched by WADO for several years. Initial research from WADO suggests that peas and canola prefer to be intercropped together in the same row rather than being separated into individual crop rows (2011, 2012). This may be explained by Sawatsky N (1987) who found peas to leak nitrogen form their root zones (rhizodeposition) accounting for 22-46% of the below ground N-budget. It is suspected that peas may be passing excess fixed nitrogen to canola that would have been unused in monocrop pea. Isotope nitrogen experiments would have to confirm this theory. Fustec *et al.* (2010) have described with the use of isotopic N^{15} associated with rhizodeposition in the transfer of nitrogen in intercrops of pea and barley (*Hordeum vulgare* L.), faba bean (*Vicia faba* L.) and forage rapeseed (*Brassica napus* L.), and common vetch (*Vicia sativa* L.) and fodder cabbage (*Brassica oleracea* L).

Interviews from several farmers in Manitoba and Saskatchewan over 17 field years of data suggest that the addition of nitrogen in the pea canola system is inferior to total grain production and or total land equivalent ratios (Chart 1). The addition of nitrogen may be related to the negative impact on nodulation formation in the legume component causing the pea to act more like a parasitic weed to the canola rather than mutualistic companion for resources.

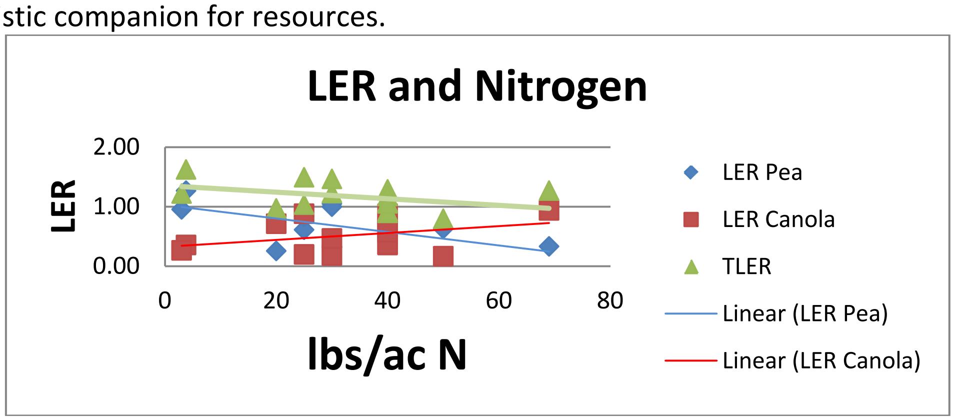


Chart 1: Land Equivalent Ratio (LER) of pea-canola components, and total yield with variable rates of nitrogen surveyed by WADO in 2013 from 17 producer fields between 2010-2013 in Manitoba and Saskatchewan.

WADO hypothesized that a timely addition of nitrogen to the pea-canola intercrop system could be delayed and topdressed later in development to insure proper nodulation in pea, reduced residual soil nitrogen balances by growing canola inducing a soil environment for maximum pea nodulation, and feed the canola system in time to produce a satisfactory canola crop providing a sufficient nitrogen supply for pod development. It is hypothesized that if peas have nodulated properly that the demand for applied fertilizers will be less by pea giving canola a competitive advantage in sourcing the majority of applied nitrogen. That is if pea N-fixing system and canola N-sourcing systems are working with less competition for nitrogen, then pea may be more willing to transfer fixed nitrogen to canola during later stages in development when nitrogen is more limiting. A trial was conducted in 2012 and 2013 to investigate this hypothesis. The results in this report are a two year summary of this experiment.

Methods

The trial was located near Melita, MB on NE 36-3-27W1 on a Liege loamy sand in 2012, and near Elva, MB on SE 27-3-28W1 on a Stanton sandy loam in 2013. A soil test was taken prior to seeding to account for the background nutrient values in the field. These values are summarized in Table 1.

Table 1: Soil test parameters prior to seeding the trial in Melita 2012 and 2013.

Site	Depth	pH	N lbs/ac	P ppm Olsen	K ppm	S lbs/ac
Melita 2012	0-6"	8.0	11	9	216	34
	6-24"		21			42
	0-24"		32			76
Elva 2013	0-6"	8.3	6	2	170	14
	6-24"		15			54
	0-24"		21			68

Plot treatments were arranged in a randomized complete block design and replicated three times. Plots were direct seeded mid-May with an air seeder using a SeedHawk dual knife air seeding system with 6 openers on 9.5" spacing. Plot dimensions were 1.44 m wide by 9 m long. Varieties included a CDC Meadow yellow peas and a '2012 CL' canola (Nexera). Seeding rates were 3.5 plants/ft^2 for pea and 38 seeds/m2 for canola. Planting depth of seed was 5/8". Peas were inoculated with granular based Rhizobia suited for peas and lentils (Becker Underwood). During seeding phosphate fertilizer was applied at a rate of 58 lbs/ac using granular 11-52-0 MAP. Nitrogen was sideband at seeding using liquid 28-0-0 UAN according to the specific treatment (see results; Table 2). Topdressing applications were applied when canola reached the 4.5 leaf stage in mid-June granular urea (46-0-0). Canola plants, at the 4.5 leaf stage, were sampled for chlorophyll content with a SPAD 502 Meter (Spectrum Technologies) during and after topdressing (two weeks later). During SPAD meter sampling the second newest canola leaf was sampled randomly in five places in the plot. Samples combined to form an average plot value. SPAD meter values would offer insight into the canola plant's demand for nitrogen where low values would indicate a greater need for nitrogen than higher values at the point in time.

Plots were kept weed free using Odyssey and Arrow herbicides applied at a rate of 17.3 g/ac and 150 mL/ac, respectively. Plots were harvested with a Hege 140 plot combine set for canola. Samples were cleaned and separated using a seed cleaner. Sample yields were adjusted for 10% moisture content in both crops.

The 2013 Data was subject to a two-way analysis of variance (ANOVA) using Agrobase Gen II statistical software. Coefficient of variation (CV), least significant difference (LSD), grand mean, and R-squared were calculated. A REML analysis was performed upon combining data from 2012 and 2013 to get a multi-year analysis.

Results

2013 Analysis

There were significant differences only in the percent change in SPAD meter reading in certain treatments [P<0.05] and canola yield [P<0.10) (Table 2). When nitrogen applications were exclusively made at seeding (trt 6, 10-12), increased nitrogen applications cause peas to reduce yield. This was likely from canola competition tended to yield greater as nitrogen increased. Applied nitrogen at seeding may have inhibited nodule formation restricting early nitrogen fixation reducing pea yield. When applications were exclusively made as a topdress (trt 6-9), canola yields and total yields remained fairly stable but did not increase significantly. When nitrogen applications were split (trt 1-5) pea yields responded slightly negatively to increase nitrogen balances, but total yield remained steady among all treatments.

Table 2: SPAD meter readings, and pea-canola component and total yield from various nitrogen application rates at seeding and later during topdressing.

Treatment	Applied N Rate lbs/ac		SPAD Meter Reading % of Check (6)			Pea	Canola	Total
No.	With Seed	Topdressed	Before	After	% Change	Seed Yield kg/ha		
1	90	0	39.4	43.7	10.9	984	536	1520
2	67.5	22.5	39.8	44.3	11.1	983	525	1508
3	45	45	38.0	44.9	18.1	1014	577	1591
4	22.5	67.5	40.8	43.7	6.9	1011	607	1618
5	0	90	39.1	45.5	16.4	1019	596	1614
6	0	0	39.7	42.5	7.4	985	439	1424
7	0	22.5	38.2	44.1	15.6	1101	538	1639
8	0	45	40.9	44.5	8.9	1000	535	1536
9	0	67.5	37.7	45.5	20.9	966	584	1550
10	22.5	0	41.3	43.2	5.4	1100	455	1555
11	45	0	39.5	40.7	3.5	1006	444	1451
12	67.5	0	38.9	42.6	9.5	1049	488	1537
	CV%		4.4	4.5	53.5	8.5	13.1	7.0
	LSD (p<0.05)		2.9	3.3	***10.2***	146	117	182
	R-Square		0.6	0.4	0.6	0.51	0.62	0.64
	Grand Mean		39	44	11	1018	527	1545
	P value		0.246	0.209	***0.035***	0.657	0.058	0.403

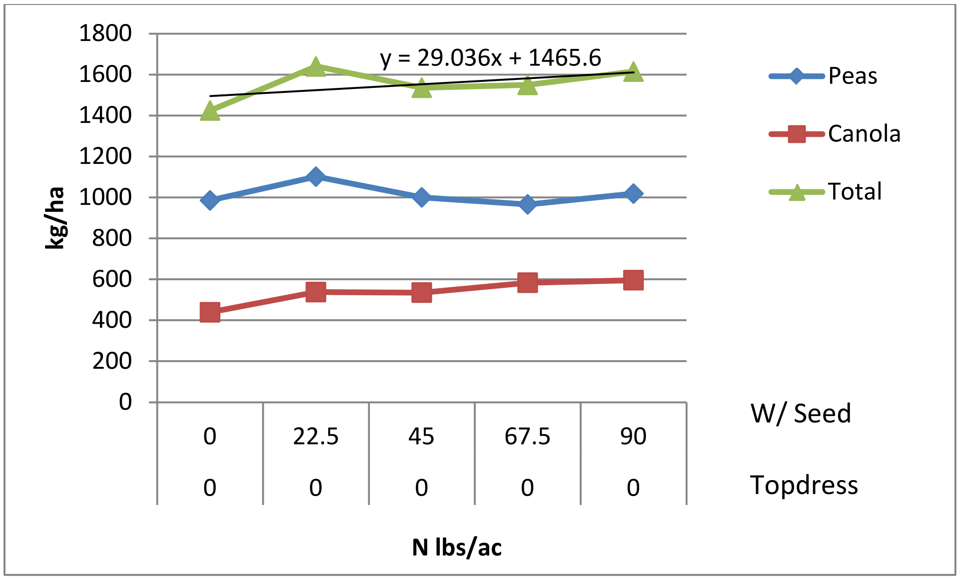


Chart 2: Total and component grain yield of pea and canola exclusively applied with variable rate of nitrogen at seeding.

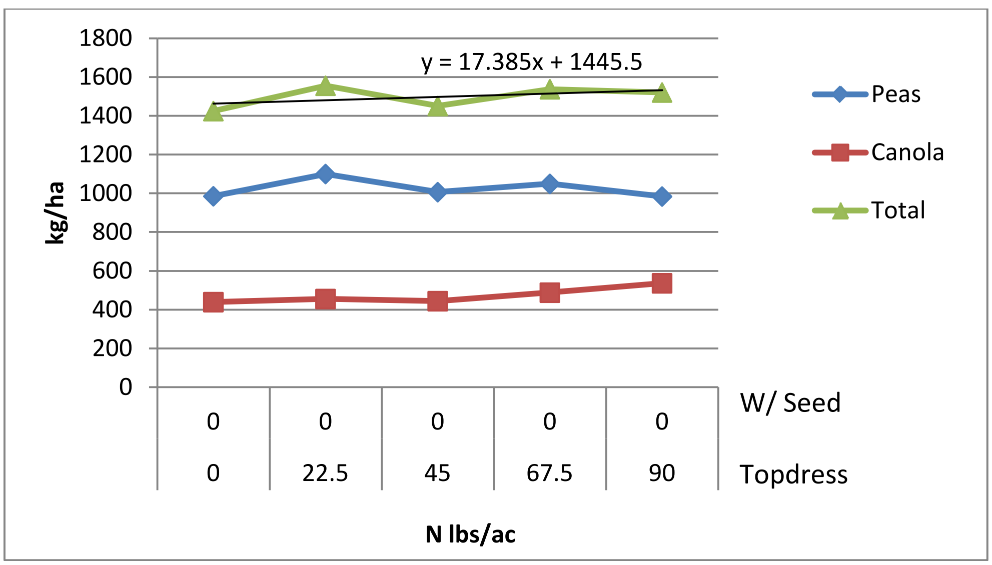


Chart 3: Total and component grain yield of pea and canola exclusively topdressed with variable rates of nitrogen.

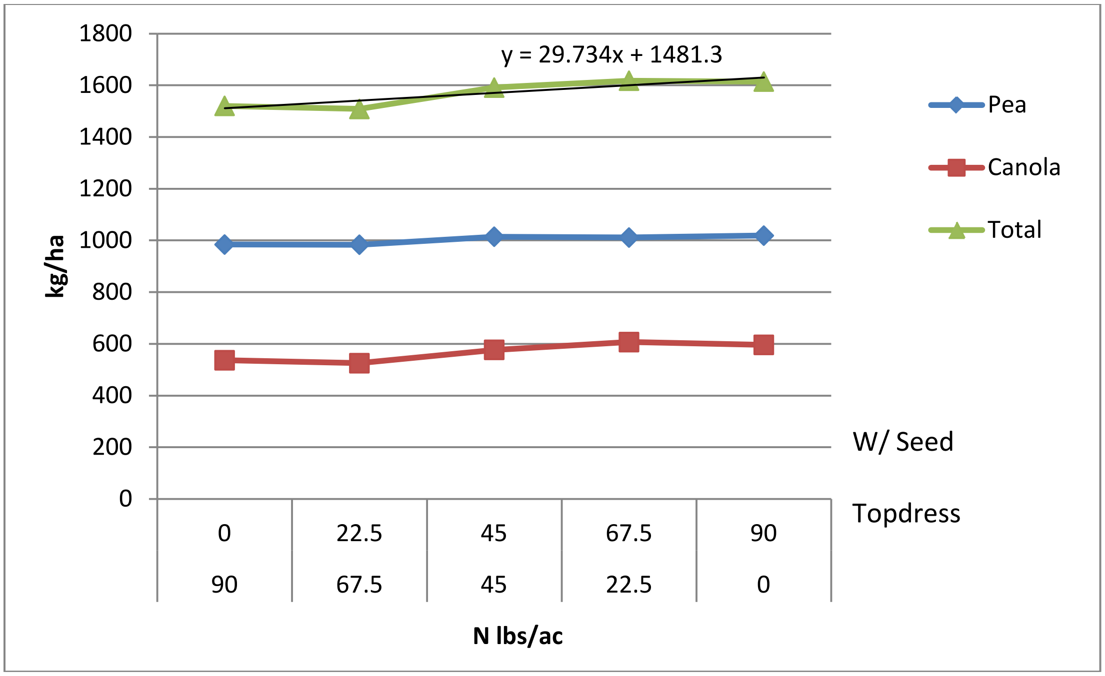


Chart 4: Total and component grain yield of pea and canola with variable amounts of nitrogen applied at seeding or topdressed.

Multi-Year Analysis (2012 & 2013)

There were significant differences with only the canola component response to nitrogen application (Table 3 and 4). This was not enough to affect pea or total yield. It would seem that despite the increase in canola yield, pea yields, though not significant, were depressed in a similar value thus not contributing to total yield in any positive or negative way (Chart 5 & 6). Canola nitrogen response was not as realized in combination with side banding nitrogen at seeding in combination with topdressing in later stands. A small trend favoring topdressing canola over applied nitrogen at seeding may have taken advantage of rainfall after application of topdressed nitrogen compared to side banded nitrogen that was at high risk to leaching from heavy rains after seeding (Chart 7). But again this did not translate into increased total yield but rather a depressed trend of yield with higher amounts of nitrogen applied at seeding.

Table 3: RELM analysis of crop components over two site years of pea-canola in Melita and Elva in 2012 and 2013.

Component	Wald statistic	TRT d.f.	F statistic	d.d.f.	P value	LSD (p<0.05)
Canola	33.05	11	3.00	27.2	**0.01**	**108**
Pea	6.94	11	0.63	6.7	0.762	NS
Total	9.24	11	0.84	3.7	0.635	NS
d.d.f - denominator degrees of freedom for approximate F-tests are calculated using algebraic derivatives ignoring fixed/boundary/singular variance parameters.						

Table 4: Mean pea-canola component and total yield from various nitrogen application rates at seeding and later during topdressing from 2012 to 2013 combined site years from Elva and Melita locations. Shaded nitrogen rates give a visual feel for the quantities of nitrogen applied.

Treatment	Applied N Rate lbs/ac		Pea	Canola	Total
No.	With Seed	Topdressed	Seed Yield kg/ha		
1	90	0	1136	667	1778
2	67.5	22.5	1166	775	1951
3	45	45	1129	761	1866
4	22.5	67.5	976	825	1842
5	0	90	1001	841	1882
6	0	0	1099	698	1829
7	0	22.5	958	858	1874
8	0	45	1163	663	1786
9	0	67.5	1056	809	1869
10	22.5	0	1167	716	1866
11	45	0	974	756	1743
12	67.5	0	1046	768	1814

Variation in trial results were experienced more in 2012 than 2013 (table 5) in both crop components and total yield.

Table 5: Crop component variance and standard error values of yield in pea-canola from Melita (2012) and Elva (2013) locations.

Year	Component	Variance	Standard Error
2012	Pea	52018	16080
	Canola	43053	11095
	Total	37685	11862
2013	Pea	7484	2260
	Canola	4708	1405
	Total	11566	3487

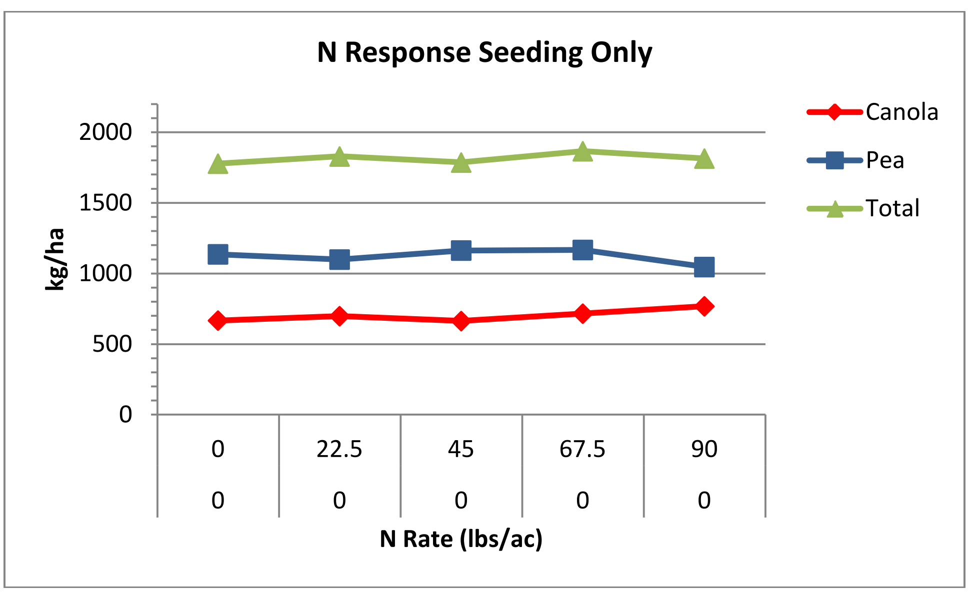


Chart 5: Total and component grain yield of pea and canola exclusively applied with variable rate of nitrogen at seeding of Elva and Melita locations combined.

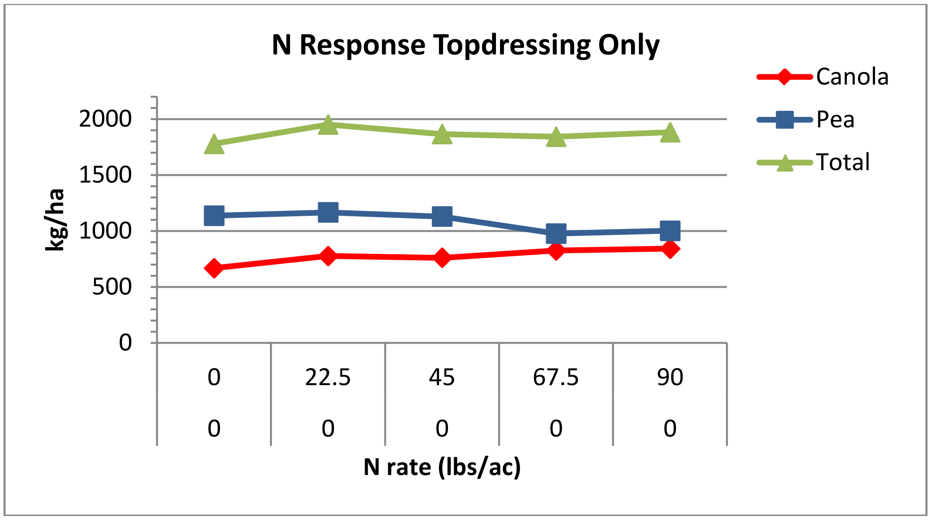


Chart 6: Total and component grain yield of pea and canola exclusively topdressed with variable rates of nitrogen of Elva and Melita locations combined.

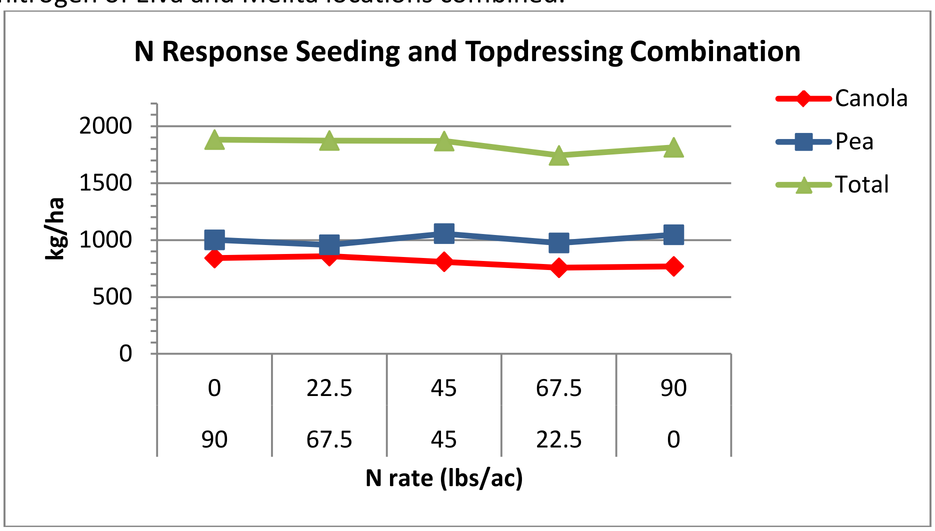


Chart 7: Total and component grain yield of pea and canola with variable amounts of nitrogen applied at seeding or topdressed of Elva and Melita locations combined.

Discussion

Topdressing as an attempt to satisfy canola yield potential and reduce risk of failure of nodule formation did not result in an improvement of total crop yield regardless of the rate compared to applying nitrogen exclusively at seeding. Nitrogen applications did appear to increase canola yield in 2013 but not 2012. Nitrogen applications at seeding usually resulted in a loss of yield in pea and an increase in canola yield slightly. Exclusive topdressed application of nitrogen caused inconclusive results in nitrogen response in both crops in both years. Visual observations did indicate a clear response relative to crop vigor in the field to nitrogen application in canola and likely caused the pea to be somewhat outcompeted.

Secondly during topdressing, some peas were dug up in plots containing 90 lbs/ac applied nitrogen and were compared to those that had not had applied nitrogen. Those plots with applied nitrogen had peas that were low in nodule formation while those plots without the application did have significant nodule formations in both 2012 and 2013. Based on this observation it is likely that pea nodulation was affected by nitrogen application. Pea roots in plots that were exclusively topdressed with high rates of nitrogen were not inspected after topdressing from failure of nodule formation. It is assumed exclusively topdressed plots would have sustained nodulation, but this should be confirmed in future experiments.

When nitrogen was applied exclusively at seeding, total yield of both crops tended to become unresponsive with increase nitrogen applications further supporting WADO's investigation into producer intercrop pea-canola fields with applied nitrogen reducing total yield and land equivalent ratios (Chart 1).
It is also interesting that canola failed to respond to applied low or nil rates of nitrogen significantly in both years despite the yield trend and visual observations during plant development. This may be evidence that canola was sourcing rhizodeposited free nitrogen from pea buffering the applied nitrogen response.

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WADO Cover Crop Project – After Flax Fibre Production

Cooperator

- Black Creek Farms (Ellis Seed Farm), just north of Wawanesa, MB

Background

In 2012, WADO took part in a flax fibre project near Wawanesa, MB at the Ellis Seed Farm. Flax fibre was grown in the summer of 2012 and left to rett (decompose) over winter. The fibre was raked and baled (June 14). However, this process extended well into June and few crops are available as a rotation this late in the year that can be seeded and still produce some sort of crop in time prior to the fall frosts.
Prior to seeding the land was cultivated twice (with as basket type harrow attached).

WADO decided to plant a cover crop mixture of spring wheat, yellow peas, berseem clover and tillage radishes. It was an attempt to gain some experience with cover cropping and also get rid of some old seed kicking around the shop. Seed was collected and mixed together prior to seeding. WADO had about 6 acres to
cover with seed so WADO staff used the following mix and rates:

- Spring Wheat – 30 lbs/ac
- Yellow Peas – 20 lbs/ac
- Berseem Clover – 10 lbs/ac
- Tillage Radish – 12 lbs/ac
- Pea Inoculant - 5 lbs/ac

This mixture was broadcast seeded on July 16th into unfertilized bare ground using a Valmar applicator toed behind a small tractor (Photo of mix in hand) at a ground speed of 5 mph. After seeding, the land was harrowed at 7 mph. Seed incorporation was excellent given the soil characteristics. A day later a substantial rain occurred July 18th of 34 mm followed by another 12 mm on July 21st. So moisture for emergence was not an issue. From seeding to tillage, approximately 86 mm of rain occurred.

The crop was roto-tilled September 18th. It was noted that there were flea beetles everywhere consuming the tillage radish leaves mostly causing the flowers of the radish to abort from browsing beetles. Radishes had a large root over 1" in diameter and 6 inches long. Wheat was in mid-flower. Peas were uncompetitive and weak. Berseem clover had a few leaves and appeared to have a good start. Peas and clover were fixing nitrogen. Volunteer flax from fibre production was also present but harmless. This stand would have likely been a great grazing field, however WADO was unable to organize a producer with animals in time.

Some wrapping of biomass was experienced during rototilling due to the wet conditions during the field operation. All radish roots were chopped at least once.

July 16th - Seeding/Harrowing

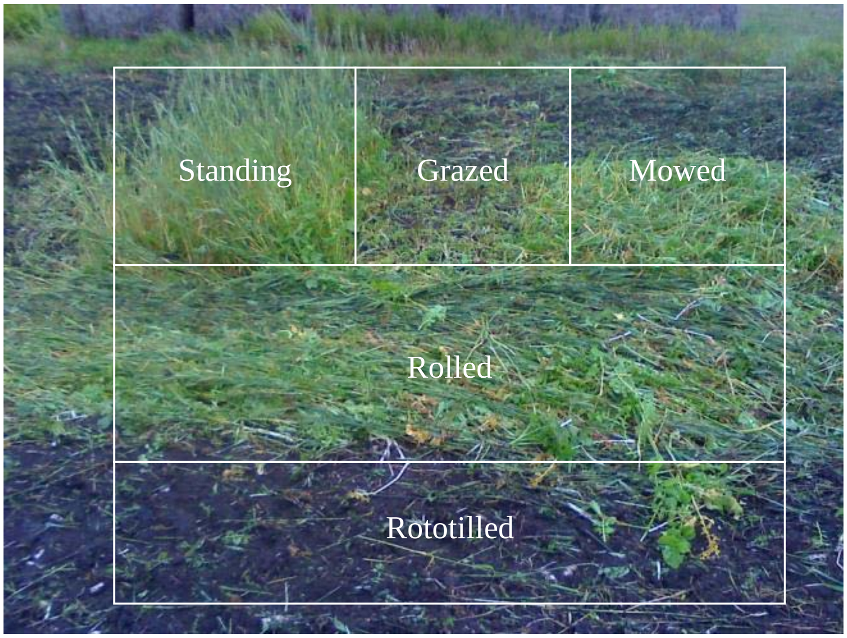
August 3 - Stand Assessment

August 25 –Stand Density Assessment. Notice size of radish tap root and nodules developed on pea. A lack of weed development given the competitive nature of the cover crop.

September 18 – Final Stand Assessment and Roto-tilling (termination). Notice the radish leaves full of flee beetle holes, side of radish root, and lack of weeds.

Deep soil pores were produced from the radish taproot. There was also a vast network of fine root hairs that were at the surface of the soil. Roto-tilling chopped all vegetation into bits about 3 inches long and incorporated it into the soil.

A small area was left with several small treatments performed the same day as rototilling. This area will be assessed in the spring of 2014 for regrowth of clover and radishes. Small treatments included a standing check, grazed, rolled, and mowed. As for the rest of the field the cooperator will be cropping the area for 2014.



What's Giant Ragweed Doing in Southwest Manitoba?

During the spray season of 2012, the Melita research field site was greeted by a new to WADO guest, a few plants of Giant Ragweed (*Ambrosia trifida* L).

Giant Ragweed is an annual plant in the aster family, native throughout much of North America. Its flowers are green and are pollinated by wind rather than by insects, and the pollen is one of the main causes of late summer hay fever. The plant is erect, growing to over 6 meter though 2– 3 meters is more typical. It is one of agriculture's most competitive weeds. (Wikipedia) Giant Ragweed has become a superweed resistant to glyphosate in many US states and the province of Ontario. In 2006, glyphosate resistance among several weed species was found in southern counties in Minnesota and since then has moved northwest into Central Minnesota and eastern North Dakota. No reports of giant ragweed resistance had been found in North Dakota. (Stachler J. Sept 16, 2012. Herbicide Resistance in MN and ND, Presentation available online : http://www.ag.ndsu.edu/weeds/herbicide-resistance-files/hr-maps-2006-12)

This is the first of its kind in the area, and had shown up randomly in our plot area (photos). Normally, giant ragweed does not grow on an annual basis in the southwest region in Manitoba. However it is often found around Morris, MB among the ditches there. It is speculated that the plants come from seeds that had floated north from state side during the 2011 flood along the Souris River.

WADO conducted a glyphosate resistance test on the few plants that were growing in the plots. One plant was left as an unsprayed check while other plants were sprayed on July 10th with a 1X, 2X, and 3X rate where 1X was equivalent to 1 L/ac using Maverick III glyphosate containing 480 g a.i./L). Plants were sprayed using a hand powered bottle sprayer normally used for house plants. Plants were assessed a couple weeks later after application. Observation of herbicide damage indicated that all treatments did in fact inflict severe damage on plants, however those at the 1X and 2X rates, the seed containing raceme did appear to survive while all leaves had browned off.

A giant ragweed plant separate from this experiment in the same field was previously sprayed with a two simultaneous applications of a 0.5X rate. Over a week went by and the plant showed no signs of harm. However a second application of a 1X application with a tank mix of Heat (10g/ac, sulflufenacil 70% WSG) did eventually kill the plant (photo right).

In 2013, Melita experienced another minor flood along the Souris River and many acres in the valley were not planted. WADO found even more plants in the same field, but generally there was on average a couple plants per acre. WADO drove upstream and found another population more dense about ¾ mile south of Melita (photo right). This patch would have resided along the shore of the 2011 flood. It seems as though that giant ragweed is here to stay. Unfortunately a popular snowmobile trail went right through this patch in the winter of 2013-2014. It is likely the seeds will be conveniently dispersed along this trail for the 2014 growing season.

Producers are encouraged to properly maintain fields with a proper crop and herbicide rotation. Many other weed species exist in Manitoba with various levels of resistance to other herbicides such as Group or Group 2 herbicides, some with multiple forms of resistance. Tank mixes of different chemical groups are a more effective way than increasing rates of a single chemical. Hand pulling small patches of suspected resistance is always the best control option.

FMC Chemical Demonstration

Cooperator

- Brad Ewankiw- FMC Account Manager, Manitoba

Site Information

Location: Elva, Manitoba Legal Land Location: SE 36-3-28W1

Background

Founded in 1883, FMC is a US based specialty chemical company which is now growing its business in Canada. FMC Corporation serves agricultural, industrial and consumer markets globally with innovative solutions, applications and quality products. The company employs approximately 5,000 people throughout the world. They are focused on providing solutions to issues faced by Canadian producers such as weed resistance in minor use crops with limited solutions. The FMC demo trial was set up to showcase some of the products they have available or will be launching soon in Western Canada.

The demo included the following products:

- **Authority Charge**, a new herbicide tank-mix available for peas, flax, sunflowers and chickpeas to control kochia, lamb's-quarters, redroot pigweed and wild buckwheat. Authority Charge includes the active ingredients sulfentrazone (group 14 residual herbicide) and carfentrazone (group 14 burnoff additive for glyphosate). Authority also has activity on other weeds such as cleavers.

- **Authority Supreme**, a combination of sulfentrazone and a new active ingredient, pyroxasulfone, which is not yet registered for flax and peas. Authority Supreme provides broad spectrum residual activity on many grass and broadleaf weeds, including wild oats, barnyard grass, green foxtail, yellow foxtail, lamb's-quarters, redroot pigweed, shepherd's-purse, stinkweed, wild buckwheat and many other species.

- **Focus**, a new group 15 and group 14 herbicide combination product for corn, soybeans, and in coming years, wheat. Focus is a combination of pyroxasulfone and carfentrazone and will be a much anticipated additional mode of action for grassy weed control in spring and winter wheat. With residual activity on wild oats, barnyard grass, green and yellow foxtail as well as many small seeded broadleaf weeds, Focus will be an interesting product for growers.

- **Command** (clomazone) is a group 13 herbicide which is already registered in Canada in soybeans and vegetable crops. In canola, it will bring a much needed additional herbicide option for cleaver control. Cleavers can be a difficult weed to control because it begins to germinate early in the year and continues in season. Clomazone is a residual soil applied herbicide which will provide long lasting control in combination with the canola herbicide system (Roundup Ready, Liberty Link, or Clearfield).

Objective

To demonstrate the efficacy of FMC's different chemical products to control different target weeds with different applications of herbicide treatments.

Methods

Treatments:	10 (Table 1)
Replication:	1
Plot size:	1.44 m x 9 m
Test design:	Demonstration
Seeding date:	May 22
Fertilizer applied:	86 lbs/ac N, 30 lbs/ac P
Pesticide applied:	As per prescribed

FMC representative place a time lapse camera in front of each plot to take a daily photo during the growing season. Those photos are available from FMC.

The various different types of crops were seeded into oat stubble. Chemical applications were applied as prescribed. Since this trial was for demonstration purposes only, it was not harvested.

Table 5. 2013 FMC Chemical Demonstration Treatments at Elva, MB

TRT	Crop	Herbicide Regime	Part 1	Part 2	Part 3
#1	Pea	Authority Charge + Glyphosate	Authority @ 118 ml/ac	Aim @ 15 ml/ac	Glyphosate (540) @ 500 ml/ac
#2	Pea	Authority Supreme + Glyphosate	Authority @ 118 ml/ac	Pyroxasulfone @ 72 g/ac	Glyphosate (540) @ 500 ml/ac
#3	Wheat	Focus + Glyphosate	Pyroxasulfone @ 72 g/ac	Aim @ 15 ml/ac	Glyphosate (540) @ 500 ml/ac
#4	Flax	Authority Charge + Glyphosate	Authority @ 118 ml/ac	Aim @ 15 ml/ac	Glyphosate (540) @ 500 ml/ac
#5	Flax	Authority Supreme + Glyphosate	Authority @ 118 ml/ac	Pyroxasulfone @ 72 g/ac	Glyphosate (540) @ 500 ml/ac
#6	Canola	Aim + Glyphosate	Aim @ 15 ml/ac		Glyphosate (540) @ 500 ml/ac
#7	Canola	Aim High Rate w/ Adjuvant + Glyphosate	Aim @ 30 ml/ac	non-ionic surfactant @ 5L per 1000L	Glyphosate (540) @ 500 ml/ac
#8	Canola	Command + Aim + Glyphosate	Command @ 135 ml/ac	Aim @ 15 ml/ac	Glyphosate (540) @ 500 ml/ac
#9	Sunflowers	Authority Charge + Glyphosate	Authority @ 118 ml/ac	Aim @ 15 ml/ac	Glyphosate (540) @ 500 ml/ac
#10	Sunflowers	Authority Supreme + Glyphosate	Authority @ 118 ml/ac	Pyroxasulfone @ 72 g/ac	Glyphosate (540) @ 500 ml/ac

Effects of Genetic Sclerotinia Tolerance and Foliar Fungicide Applications on the Incidence and Severity of Sclerotinia Stem Rot Infection in Argentine Canola

2013 Annual Project Report for the Saskatchewan Canola Development Commission (SaskCanola)

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Abstract

At three year study was initiated in 2013 by SaskCanola to evaluate genetic tolerance to sclerotinia stem rot and foliar fungicide applications for reducing sclerotinia stem rot infection in Argentine canola (*Brassica napus*) under field conditions. A secondary objective was to determine if, and under what conditions, foliar fungicide applications might be required even when growing a cultivar with genetic tolerance to sclerotinia. The field trials were conducted at Indian Head, Melfort and Outlook in Saskatchewan and Brandon and Melita in Manitoba. In general, conditions were cool through flowering and, despite the above average precipitation in June and July at several locations, sclerotinia incidence and severity was low and yields were typically above average. Even though disease pressure was low, preliminary results of this study suggest that, under these conditions, disease levels were frequently lower for the tolerant hybrid 45S54. Consequently, foliar fungicides tended to provide less consistent benefits with the tolerant hybrid. At locations where disease symptoms were observed, foliar fungicides reduced sclerotinia incidence and severity for the susceptible hybrid but only significantly increased seed yield of the 45H29 at Melita; however, similar trends were observed at both Brandon and, to a lesser extent, Indian Head. Foliar fungicides had no effect on seed yield at either Outlook or Melfort. There was no evidence of yield increases with fungicides when a sclerotinia tolerant hybrid (45S54) was grown; however, our results may have differed if disease pressure were higher. Furthermore, no benefits to a dual fungicide application over a single application were detected in any cases for either the disease ratings or effects on seed yield. This was the first of three years for this study and the field trials are to be continued at all five locations in 2014.

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 is highly variable depending on the specific environmental and weather conditions that are encountered. For example, in 2011 a total of 241 canola fields were surveyed and it was found that while 81% of the crops surveyed were affected by sclerotinia, percent incidence ranged from 0-91% and averaged 9.4% (Dokken-Bouchard et. al. 2012). In 2012, sclerotinia stem rot was observed in 91% of fields surveyed with incidence ranging from 0-95% with a provincial average of 19.0% (Miller et al. 2013). With respect to seed yield, one general 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 vary (Del Rio et al. 2007). At low levels of disease, sclerotinia incidence does not generally impact canola yields, likely a result of the plant’s ability to compensate provided that the pressure is not too high (Del Rio et al. 2007; Kutcher and Malhi 2010).

Past research on reducing the impacts of sclerotinia in western Canada has looked at many factors with varying levels of success. With the adoption of reduced tillage and no-till systems over the past two decades, many growers have expressed concerns of higher levels of crop residue resulting in increased disease and considered burning and tillage as potential solutions. However, Kutcher and Malhi (2010) showed that burning could actually increase sclerotinia incidence and that tillage had no effect on this disease and concluded that neither of these practices were effective or, considering the negative impacts on soil quality, desirable methods for managing sclerotinia. Similar research conducted at Melfort also concluded that tillage did not impact sclerotinia and, in addition, showed that crop rotation was not effective for reducing sclerotinia or the response to fungicide applications either (Kutcher et al. 2011). With respect to nitrogen fertility and landscape position, it makes sense that higher N rates would produce a denser canopy and greater chance of sclerotinia infection and that lower slope positions would retain more moisture thereby providing a better environment for disease to develop. However, while this can sometimes be the case, actual results are highly dependent on environmental conditions and the opposite can even occur under certain circumstances and low to moderate disease pressure (Kutcher et al. 2005). Also under low to moderate disease pressure, Brandt et al. (2007) observed larger fungicide responses at low seeding rates which, while somewhat counter intuitive, was possibly due to the extended flowering period allowing more time for the disease to affect the crop. They also detected slightly higher levels with hybrid versus open-pollinated canola (possibly due to a denser canopy) and, as expected, lower disease levels when a fungicide was applied. The fact that sclerotinia stem rot, and many other important crop diseases, are so difficult to manage using agronomic management tactics is likely attributable to the fact that most diseases and the resulting yield losses require specific combinations of soil conditions, weather and crop staging to cause significant infection.

Foliar fungicides have proven to be the most consistent and effective method of controlling sclerotinia; however, in many canola growing regions of the Prairies, annual applications are unlikely to be economically viable over the long-term (i.e. Kutcher et al. 2005; Brandt et al. 2007; Kutcher et al. 2011). For example in 2012 at Indian Head, where disease pressure was severe, fungicide applications resulted in average yield increases of 19% in small plot trials; however, field scale trials completed at the same location over the past five seasons, have rarely shown economic benefits (Chris Holzapfel, unpublished data). With this in mind, considerable resources have been invested towards developing practical methods of assessing the risk of sclerotinia in canola to help producers determine when and where fungicide applications are likely to be economical (McLaren et al. 2004). Petal tests to detect the overall level of inoculum present in a specific field have shown reasonably good correlations with sclerotinia infection; however, results are affected by the timing of the petal collection and the 3-5 day turnaround for results is prohibitive since, to be effective, fungicides must be applied before stem infection occurs (Turkington and Morrall 1993; McLaren et al. 2004). Risk assessment tables and weather based risk models can also help producers make better informed decisions as to whether or not to spray, but the reliability of such approaches is also hampered by our inability to accurately predict upcoming weather patterns on a site-specific basis (McLaren et al. 2004).

While significant variation in the susceptibility of individual cultivars has been previously documented (Bradley and Khot 2006), commercial cultivars that are considered tolerant to sclerotinia stem rot have only recently been introduced (Falak et al. 2011). Under severe disease pressure, these cultivars have exhibited at least a 50% reduction in sclerotinia relative to susceptible cultivars (Falak et el. 2011). When this study was initiated, Dupont-Pioneer was the only seed company offering sclerotinia tolerant canola cultivars; however, since that time, competitive hybrids have been introduced (i.e. L160S, Bayer CropScience). Sclerotinia tolerant canola hybrids have the potential to provide a first line of defense that may appeal to growers both in areas where disease pressure is high and annual fungicide applications have become commonplace and also to those in regions where infection levels are more variable and it is often difficult to predict whether or not a fungicide application will be beneficial. Because sclerotinia infection is not eliminated in tolerant cultivars, it is important to recognize that, even when using such cultivars, conditions will likely exist where foliar fungicide applications are still desirable and economically advantageous. Another benefit to combining tolerant hybrids with foliar fungicides is to help minimize the potential for pathogens to develop resistance – experience has shown that relying heavily on any single technology can be risky and unsustainable. This project aims to enhance our current understanding of the potential benefits and limitations that might be expected with both tolerant cultivars and foliar fungicide applications and to establish if, and under what conditions, foliar fungicide applications may be required when growing a cultivar with genetic tolerance to sclerotinia.

Objectives

The specific objectives of this study are:

1) To evaluate the effectiveness of genetic tolerance to sclerotinia and foliar fungicide applications for reducing sclerotinia stem rot infection in Argentine canola under field conditions.
2) To determine if, and under what conditions, foliar fungicide applications may be required when growing a cultivar with genetic tolerance to sclerotinia.

Methods

In 2013, field trials were initiated at five locations in Saskatchewan and Manitoba with two locations having access to irrigation and all of the locations having at least a moderate to high risk of sclerotinia developing in canola based on their climates. They were Indian Head, SK (50˚33’N 1 03˚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 increase the likelihood of sclerotinia developing at these locations. The canola at Indian Head, Melfort and Melita did not receive supplemental irrigation and the soil / plants were not inoculated with *Sclerotinia sclerotiorum* at any locations.

The treatments were a factorial combination of A) two canola hybrids and B) four fungicide treatments for a total eight entries. 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 was applied at both crop stages. The treatments were arranged in a Randomized Complete Block Design (RCBD) with four replicates.

Canola Hybrid and Foliar Fungicide Treatments

A. *Canola Hybrid*	B. *Foliar Fungicide Treatment*
1) 45H29 (susceptible)	1) Check (no fungicide)
2) 45S53 (tolerant)	2) Early (246 g Boscalid ha^{-1} at 20% bloom stage)
	3) Late (246 g Boscalid ha^{-1} at 50% bloom stage)
	4) Dual (full rate of fungicide at both stages)

Both hybrids were glyphosate tolerant and seeding rates were adjusted for seed size to target approximately 125 viable seeds m^{-2}. Seed from the same source was used at all locations with a slightly higher than normal rate chosen to promote dense crop canopies and increase the likelihood of disease. Tillage systems and seeding equipment varied (Table 1) with trials established on either summer fallow or cereal stubble and managed under no-till or reduced tillage cropping systems. Row spacing ranged from 20-30 cm and nitrogen (N) fertilizer was either side-banded or broadcast and incorporated prior to seeding (Outlook). Fertilizer sources were granular urea, monoammonium phosphate, potassium chloride and ammonium sulphate and the rates were intended to be non-limiting and balanced. Canola was swathed at Melfort, Outlook and Melita, pushed at Brandon and straight-combined at Indian Head. Pre-seed weed control was achieved either with tillage or herbicide applications and weeds were controlled in-crop with either one or two applications of glyphosate. Pertinent agronomic details and dates of field operations and data collection activities are provided in Table 1.

The response 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 size and percent green seed. Spring canola densities were determined by counting two separate 1 meter sections of crop row per plot when the canola was at approximately the 2-leaf stage and converting the mean values to plants m^{-2}. At the sites where sclerotinia was observed, a total of 100 plants per plot were rated on a scale of 1-5 (Kutcher and Wolf 2006). The values derived from these ratings were percent incidence of infected plants (MDI) and the overall mean disease severity rating for the plot (MDS). The rating scale that was used is described in Table 9 of the Appendices. Yields were determined from the harvested seed samples and are expressed as kg ha^{-1} on a clean seed basis and corrected to uniform seed moisture content of 10%. Seed size was determined by weighing and counting 1000-2000 seeds using automated seed counters and calculating 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.

For this first year of the study, data were analysed using a separate Mixed model for each location where the effects of hybrid (HYB), fungicide treatment (FUNG) and the interaction (HYB x FUNG) were considered fixed while the effects of replicate were considered random. The response variables analyzed were plant density, mean disease incidence (MDI), mean disease severity (MDS), seed yield, seed size and percent green seed. Least squares means were separated using Fisher's protected least significant difference (LSD) test. Contrasts were used to more closely evaluate fungicide effects on the individual (susceptible and tolerant) hybrids and to determine whether there were any significant benefits to dual over single foliar fungicide applications. All treatment effects and differences between means were declared significant at $P \leq 0.05$.

Table 6: Dates of selected field operations and data collection activities completed in SaskCanola sclerotinia study at various locations in 2013.

Field Operation / Data Collection	Indian Head	Melfort	Outlook	Brandon	Melita
Previous Crop / Tillage System	Spring Wheat / Zero-Tillage	Spring Wheat / Zero-Tillage	Spring Wheat / Reduced Tillage	Fallow / Conventional Tillage	Oat / Zero-Tillage
Pre-seed 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 $N\text{-}P_2O_5\text{-}K_2O\text{-}S$ ha^{-1})	130-35-18-18	60-20-10-10	82-20-15-0	0-0-0-0†	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^{-1})	June 24 (666 g glyphosate ha^{-1})	June 18	June 11	June 12
In-crop herbicide 2	June 27 (440 g glyphosate ha^{-1})	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 (pushed)	August 15
Combining	September 16	September 12	September 6	October 3	September 3

n/a – not applicable
†Soil test residual nutrients exceeded estimated crop requirements – fertilizer was not applied at this site

Results and Discussion

Weather conditions

Mean monthly temperatures and precipitation amounts for the 2013 growing season (May-Aug) are presented with the long-term (1981-2010) averages for each location in Table 2. While Brandon and Melita had close to normal temperatures and precipitation during this month, May was warmer and drier than average at the three Saskatchewan locations. In June, temperatures were closer to normal (slightly above normal in Manitoba) and precipitation was well above the long-term average at all locations except Outlook and Melita where precipitation was approximately normal. The plots at Outlook received 8 mm of supplemental irrigation in June. July was drier than average at all locations except Melfort and Melita which were both relatively wet in July. Outlook received approximately half its normal precipitation in July and 75 mm of water were supplied as irrigation during this month. While precipitation was variable across locations, all were cooler than normal in July. August was warmer and drier than average at all locations except Brandon where both temperatures and precipitation were close to normal. Again, the site at Brandon also received supplemental irrigation during flowering in order to ensure moist canopy conditions and increase the likelihood of sclerotinia stem rot developing; however, specific details of the irrigation schedule at this location are not available.

Table 7. Mean monthly temperatures and precipitation amounts along with long-term normals (1971-2000[†]) for the 2012 growing season at Indian Head, Saskatchewan.

Month	Year	Indian Head	Melfort	Outlook	Brandon	Melita
	---------------------------------- Mean Temperature (°C) ---------------------------------					
May	2013	11.9	12.0	12.9	10.8	11.2
	Avg.	10.8	10.7	11.8	11.2	10.7
June	2013	15.3	15.4	15.9	16.9	17.0
	Avg.	15.8	15.9	16.4	16.5	16.1
July	2013	16.3	16.4	17.5	17.9	18.7
	Avg.	18.2	17.5	18.6	19.1	19.3
August	2013	17.1	17.7	18.8	18.2	19.0
	Avg.	17.4	16.8	17.9	18.2	18.4
	--------------------------------- Total Precipitation (mm) --------------------------------					
May	2013	17.1	18.0	14 (0)	58.6	51.2
	Avg.	51.8	42.9	44	56.4	61.9
June	2013	103.8	96.9	68 (8)	122.9	78.4
	Avg.	77.4	54.3	64	78.8	76.4
July	2013	50.4	100.0	29 (75)	60.4	141.0
	Avg.	63.8	76.7	57	69.1	56.9
August	2013	6.1	10.6	33 (25)	70.0	24.0
	Avg.	51.2	52.4	38	63.4	43.2

[†]Environment Canada 2013

Crop Establishment

While fungicide treatments were not expected to affect emergence or plant populations, data were collected for explanatory purposes and analysed in the same manner as the other response variables (Table 10, Appendices). Overall, plant densities were lowest at Melfort, Indian Head and Outlook (49-64 plants m^{-2}) but were considerably higher at Brandon and Melita (149-159 plants m^{-2}). The site at Melfort was not well drained and the crop did suffer from excess moisture during the early part of June (saturated soil, but no standing water). This may have contributed to reduced plant populations, and did result in typical symptom of excess moisture; small plants with leaf discoloration typical of nutrient deficiencies. The crop did partially recover later when flooding was alleviated; however, the crop canopy was not very dense which likely made it less conducive to sclerotinia infection.

Plant populations were similar for 45H29 and 45S54 at all locations except Brandon where populations were slightly higher with 45S54 (170 versus 148 plants m^{-2} for 45H29). As expected, there was no interaction between hybrid and fungicide treatment on plant density at any locations. Plant populations were considered high enough to not limit yield at all sites and were considerably higher than the minimum recommended populations at Brandon and Melita. Again, slightly higher than normal seeding rates were used in order to increase the potential for a dense crop canopy and the subsequent development of sclerotinia.

Sclerotinia Incidence and Severity

Again, sclerotinia percent incidence (MDI) and average severity (MDS) were determined for each plot from ratings completed on 100 plants per plot. The results of the *F*-test for MDI (% of infected plants) are presented in Table 3 with both the main effect means and interactions for all sites where data were collected. On August 20 at Outlook, the check plots for both varieties along with the T1 fungicide treatment for 45H29 were rated; however, disease levels averaged only 0.5-1.25% incidence and no further ratings were completed. While there was a slight numerical reduction in disease incidence for 45H29 with fungicide and, without fungicide, infection levels appeared to be lower in 45S54, these data were not statistically analyzed and values were low enough that the disease was considered to be of little agronomic significance. At Melita, the canola was assessed on August 14, the day prior to swathing, but no disease symptoms were found and detailed ratings were not completed at this site. At Melfort, ratings were completed for all plots on August 27; however again, no symptoms of sclerotinia stem rot were observed and all plants received a rating of zero. Consequently, inferential statistical analyses were not possible or required for these data. At Indian Head, the overall average sclerotinia incidence was only 1.0% and not significantly affected by hybrid (P = 0.230); however, numerically, the levels were slightly lower in the tolerant variety (45S54). While a significant fungicide effect was detected for MDI (P = 0.012), no interaction between hybrid and fungicide treatment were detected (P = 0.661). On average, MDI was 2.75% in the untreated check, tended to be lower with the T1 fungicide application (1.63%) but was lowest at the T2 application and with a dual application (0-0.13%).

Table 8. Type III tests of fixed effects and least squares for the response variable mean disease incidence (MDI). Least squares means within column of fixed effect followed by the same letter do not significantly differ (Fisher's protected LSD test; $P < 0.05$).

Effect Variable	Indian Head	Melfort	Outlook	Brandon	Melita
	------------------------------ Mean Disease Incidence (%) ------------------------------				
Hybrid (HYB)	0.230 (ns)	–	–‡	0.133 (ns)	–‡
Susceptible (S)	1.5 a	0.00	–	13.2 a	–
Tolerant (T)	0.8 a	0.00	–	9.7 a	–
Std. Error	0.61	–	–	4.93	–
Fungicide (FUNG)	0.012 **	–	–	0.547 (ns)	–
Untreated (UT)	2.75 a	0.00	–	13.6 a	–
20% bloom (T1)	1.63 ab	0.00	–	12.1 a	–
50% bloom (T2)	0.13 b	0.00	–	10.9 a	–
Dual App. (2X)	0.00 b	0.00	–	9.1 a	–
Std. Error	0.75	–	–	5.18	–
HYB x FUNG	0.661 (ns)	–	–	0.038 **	–
S-UT	3.75 a	0.00	1.25	21.5 a	–
S-T1	2.00 ab	0.00	0.50	12.3 ab	–
S-T2	0.25 b	0.00	–	10.3 b	–
S-2X	0.00 b	0.00	–	8.8 b	–
T-UN	1.75 ab	0.00	0.50	5.8 b	–
T-T1	1.25 ab	0.00	–	12.0 b	–
T-T2	0.00 b	0.00	–	11.5 b	–
T-2X	0.00 b	0.00	–	9.5 b	–
Std. Error	0.96	–	–	5.64	–
AICC	113.0	–	–	181.1	–

*** $P \leq 0.01$; ** $P \leq 0.05$; * $P \leq 0.10$; ns – not significant

‡No or minimal symptoms of sclerotinia were observed at Outlook and Melita and therefore intensive disease ratings were not completed. Disease rating data from Outlook was not statistically analyzed.

While the HYB x FUNG interaction was not significant, the contrasts (Table 4) provided evidence of a stronger overall reduction with fungicide for 45H29 (P = 0.006) than for 45S54 (P = 0.192). The multiple comparisons suggested that the later fungicide application (40-50% bloom) was more effective for reducing MDI than the early application (20-30% bloom), but the contrasts did not detect any benefits to dual fungicide applications for either hybrid (P = 0.296-0.558). At Brandon, neither of the main effects were significant for MDI (P = 0.133-0.547) but there was a significant HYB x FUNG interaction detected (P = 0.038). Overall, MDI levels were higher at Brandon than at Indian Head, averaging 11.5% across all treatments. For 45H29 (susceptible), MDI was reduced from 21.5% to 9-12% with the various fungicide applications. For the tolerant hybrid (45S54), there were no significant differences in MDI amongst fungicide treatments and levels for all were similar to those observed with 45H29 when a fungicide was applied. Consistent with the results at Indian Head, the contrasts detected an overall reduction in MDI with 45H29 (*P* = 0.006) but not with 45S54 (*P* = 0.165) and no benefit to the dual application of fungicide over the single applications (*P* = 0.396-0.568).

Table 9. Predetermined contrasts evaluating selected treatment effects on canola sclerotinia incidence (%) in 2013 SaskCanola sclerotinia trials.

Contrast	Indian Head	Melfort	Outlook	Brandon	Melita
	--- p-values			--	
UN vs TR (All)	0.006	–	–	0.272	–
UN vs TR (S)	0.006	–	–	0.006	–
UN vs TR (T)	0.192	–	–	0.165	–
1X vs 2X (All)	0.252	–	–	0.396	–
1X vs 2X (S)	0.296	–	–	0.526	–
1X vs 2X (T)	0.558	–	–	0.578	–

Treatment effects on mean disease severity (MDS) along with least squares means for each site are presented in Table 5. Overall, the results were largely a function of, and paralleled those of MDI. Again, MDS at Outlook were not statistically analyzed and disease severity levels were negligible. Similarly, at Melfort, all MDS values were zero. At Indian Head, the effect of canola hybrid was not significant (*P* = 0.178), but MDS tended to be higher for 45H29 than for 45S54 (0.062 versus 0.026). The check versus treated contrasts supported this observation with p-values of 0.002 and 0.281 for 45H29 and 45S54, respectively. Consistent with the results for MDI, similar MDS was observed for single and dual fungicide applications (*P* = 0.314-0.559).

At Brandon, the HYB x FUNG interaction for MDS was significant (*P* = 0.039), but again the main effects for HYB (*P* = 0.352) and FUNG (*P* = 0.519) were not. The fungicide applications typically resulted in a significant reduction in MDS for the susceptible hybrid 45H29 but no differences in MDS were detected with 45S54 (Table 5).

Table 10. Type III tests of fixed effects and least squares for the response variable mean disease severity (0-5 MDS). Least squares means within column of fixed effect followed by the same letter do not significantly differ (Fisher's protected LSD test; *P* < 0.05).

Effect Variable	Indian Head	Melfort	Outlook	Brandon	Melita
	------------------------------ Mean Disease Severity (0-5) ------------------------------				
Hybrid (HYB)	0.178 (ns)	–	– ‡	0.352 (ns)	– ‡
Susceptible (S)	0.062	0.00	–	0.432 a	–
Tolerant (T)	0.026	0.00	–	0.334 a	–
Std. Error	0.018	–	–	0.161	–
Fungicide (FUNG)	0.014 **	–	–	0.519 (ns)	–
Untreated (UT)	0.111 a	0.00	–	0.485 a	–
20% bloom (T1)	0.063 ab	0.00	–	0.428 a	–
50% bloom (T2)	0.003 b	0.00	–	0.338 a	–
Dual App. (2X)	0.000 b	0.00	–	0.283 a	–
Std. Error	0.026	–	–	0.176	–
HYB x FUNG	0.437 (ns)	–	–	0.039 **	–
S-UT	0.165 a	0.00	0.050	0.813 a	–
S-T1	0.078 ab	0.00	0.025	0.408 ab	–
S-T2	0.005 b	0.00	–	0.263 b	–
S-2X	0.000 b	0.00	–	0.245 b	–
T-UN	0.058 b	0.00	0.025	0.158 b	–
T-T1	0.048 b	0.00	–	0.448 ab	–
T-T2	0.000 b	0.00	–	0.413 ab	–
T-2X	0.000 b	0.00	–	0.320 b	–
Std. Error	0.036	–	–	0.204	–
AICC	-44.6	–	–	30.9	–

*** $P \leq 0.01$; ** $P \leq 0.05$; * $P \leq 0.10$; ns – not significant

‡No or minimal symptoms of sclerotinia were observed at Outlook and Melita and therefore intensive disease ratings were not completed

Again, the contrasts supported this observation with significant differences between the untreated and treated plots for 45H29 (P = 0.006) but not 45S54 (*P* = 0.173; Table 6). Overall MDS was slightly, but not significantly, lower for 45S54 than for 45H29 at Brandon.

Table 11. Predetermined contrasts evaluating selected treatment effects on canola sclerotinia severity (0-5) in 2013 SaskCanola sclerotinia trials.

Contrast	Indian Head	Melfort	Outlook	Brandon	Melita
	-- p-values --				
UN vs TR (All)	0.003	–	–	0.264	–
UN vs TR (S)	0.002	–	–	0.006	–
UN vs TR (T)	0.281	–	–	0.173	–
1X vs 2X (All)	0.263	–	–	0.435	–
1X vs 2X (S)	0.314	–	–	0.617	–
1X vs 2X (T)	0.559	–	–	0.542	–

Table 7: Tests of fixed effects and treatment means for canola seed yield for each site are presented.

Table 12. Type III tests of fixed effects and least squares for the response variable seed yield (kg/ha). Least squares means within column of fixed effect followed by the same letter do not significantly differ (Fisher's protected LSD test; *P* < 0.05).

Effect **Variable**	**Indian Head**	**Melfort**	**Outlook**	**Brandon**	**Melita**
			Seed Yield (kg ha^{-1})		
Hybrid (HYB)	0.987 (ns)	0.293 (ns)	0.706 (ns)	< 0.001 ***	0.046 **
Susceptible (S)	3596 a	2241 a	3885 a	2346 a	4717 a
Tolerant (T)	3596 a	2101 a	3836 a	1932 b	4130 b
Std. Error	67.1	247.1	90.3	168.1	208.5
Fungicide (FUNG)	0.413 (ns)	0.551 (ns)	0.854 (ns)	0.150 (ns)	0.693 (ns)
Untreated (UT)	3510 a	2245 a	3836 a	2044 a	4150 a
20% bloom (T1)	3619 a	2060 a	3856 a	2012 a	4478 a
50% bloom (T2)	3635 a	2285 a	3803 a	2311 a	4603 a
Dual App. (2X)	3620 a	2094 a	3949 a	2188 a	4464 a
Std. Error	78.5	263.7	127.7	182.1	286.8
HYB x FUNG	0.950 (ns)	0.481 (ns)	0.995 (ns)	0.572 (ns)	0.111 (ns)
S-UT	3491 a	2472 a	3841 a	2148 ab	4005 bc
S-T1	3609 a	2005 a	3905 a	2313 ab	4554 abc
S-T2	3659 a	2304 a	3842 a	2511 a	5034 ab
S-2X	3627 a	2185 a	3960 a	2411 a	5273 a
T-UN	3530 a	2018 a	3838 a	1940 bc	4294 abc
T-T1	3629 a	2115 a	3813 a	1710 c	4367 abc
T-T2	3610 a	2266 a	3763 a	2112 abc	4172 abc
T-2X	3614 a	2004 a	3938 a	1966 bc	3655 c
Std. Error	97.4	294.1	180.3	207.1	400.0
AICC	332.7	375.2	332.5	316.7	387.2

*** $P \leq 0.01$; ** $P \leq 0.05$; * $P \leq 0.10$; ns – not significant

Overall, the effect of HYB was significant at Brandon (*P* < 0.001) and Melita (*P* = 0.046) but not Indian Head (*P* = 0.987) or Outlook (*P* = 0.706) [Table 8]. With relatively low disease pressure at all sites in 2013, the FUNG main effect on seed yield was not statistically significant at any locations, with *P*-values ranging from 0.150 at Brandon to 0.854 at Outlook. Reasonably high canola yields were achieved at all locations ranging from 2139 kg ha^{-1} at Brandon to 4423 kg ha^{-1} at Outlook, on average. The HYB effects were such that, when averaged across fungicide treatments, 45H29 and 45S54 yielded similarly at Indian Head, Melfort and Outlook, but 45H29 (susceptible) yielded 21% and 14% higher than 45S54 (tolerant) at Brandon and Melita, respectively. This may have been partly due to what appeared to be a slight differential response to fungicides whereby the yield increases at Brandon and Melita tended to be stronger with 45H29 than with 45S54. At Brandon, while neither were significant at the desired probability level, the p-values of the untreated versus treated contrasts were considerably lower for 45H29 (*P* = 0.116) than for 45S54 (*P* = 0.946). At Melita, these comparisons were significant for 45H29 (*P* = 0.047) but not for 45S54 (*P* = 0.637), indicating higher overall yields with fungicides for the susceptible hybrid but no observed benefit with the tolerant hybrid. The average yield benefit with fungicide for 45H29 was 12% at Brandon and 24% at Melita. At Indian Head, there was a slight, not statistically significant but reasonably consistent yield increase with fungicides; however, it was only 4% on average for 45H29 (*P* = 0.148) and 2.5% for 45S54 (*P* = 0.365).

Table 13. Predetermined contrasts evaluating selected treatment effects on canola seed yield (kg/ha) in 2013 SaskCanola sclerotinia trials.

Contrast	Indian Head	Melfort	Outlook	Brandon	Melita
	---	---	p-values	---	---
UN vs TR (All)	0.101	0.521	0.829	0.279	0.265
UN vs TR (S)	0.148	0.163	0.775	0.116	0.047
UN vs TR (T)	0.365	0.608	0.975	0.946	0.637
1X vs 2X (All)	0.925	0.630	0.441	0.826	0.826
1X vs 2X (S)	0.937	0.893	0.687	0.994	0.324
1X vs 2X (T)	0.957	0.418	0.488	0.750	0.222

Seed size (g 1000 seeds^{-1}) and percent green seed data were analyzed for all sites except Melfort and results are reported in Tables 11 and 12 of the Appendices. Thousand seed weight was significantly higher for 45S54 than for 45H29 at Indian Head, Melfort, Outlook and Brandon (*P* < 0.001-0.004). While not significant at the desired level, the same trend was observed at Melita (*P* = 0.080). Fungicide treatment did not affect seed size at any sites in 2013 (*P* = 0.299-0.987) and the HYB x FUNG interaction was not significant in any cases (*P* = 0.357-0.992). Similarly, percent green seed was not affected by hybrid at any sites (*P* = 0.347-1.000) and was always well below 2%. At Brandon, percent green seed was significantly higher in the T2 fungicide treatment; however, this is somewhat difficult to explain and fungicides did not affect green seed at any other sites (*P* = 0.395-0.881). The HYB x FUNG interaction was not significant at any locations (*P* = 0.184-0.946).

Conclusions

Overall, sclerotinia stem rot pressure was relatively low for canola in 2013 and the fungicide responses that were detected were relatively subtle; however, there was evidence of less disease and reduced benefits to foliar fungicide applications when a sclerotinia tolerant hybrid was grown. At Indian Head, the disease ratings indicated slightly but not significantly lower infection in the tolerant canola hybrid 45S54 compared to 45H29 and a greater reduction in disease with fungicide in the susceptible hybrid than with 45S54. At Brandon, while hybrid effects on MDI and MDS were not significant, disease tended to be lower for 45S54 and, again, fungicides only appeared to be more beneficial with 45H29. At Outlook, disease levels were considered too low to be of agronomic significance and were not statistically analyzed, but did appear to be slightly lower in the tolerant variety and with foliar fungicide application. At Melfort, all plots were evaluated but no disease was observed while, at Melita, no disease symptoms were observed and therefore detailed ratings were not completed. Focussing on seed yield, the two hybrids performed similarly at Indian Head, Melfort and Outlook, but 45H29 yielded higher at Brandon and Outlook. At these two Manitoba locations, there appeared a greater response to fungicide in the susceptible variety and this may have contributed to the observed yield difference between the two hybrids since most treatments did receive foliar fungicide. Despite the fact that no disease symptoms were noted, the strongest response to fungicide was seen at Melita where fungicide resulted in a 24% yield increase in the susceptible hybrid, but had no effect on yield in the tolerant hybrid 45S54. A similar effect was observed at Brandon and, to a lesser extent, Indian Head. At Outlook and Melfort, fungicide did not affect seed yield and there were no observed trends to suggest that fungicide may have increased yields for either of the two hybrids. This was not unexpected since little or no sclerotinia infection was noted at these two sites. Seed size was typically higher for 45S54 than 45H29 but was not affected by fungicide. Neither hybrid nor fungicide treatment had a consistent impact on percent green seed and, in all cases, percent green seed was well below the desired minimum level of 2%.

Overall, despite the low disease pressure, the preliminary results of this study suggest that, under the conditions encountered, disease levels were frequently lower with the tolerant hybrid than that of the susceptible check, 45H29. The results also suggest that foliar fungicides provided less consistent benefits when a tolerant variety was used. Under light to moderate disease pressure, foliar fungicides frequently reduced disease levels in the susceptible hybrid and, at some locations, increased seed yields. There was no evidence of significant yield increases with fungicides when a sclerotinia tolerant hybrid was grown; however, these results could likely differ under higher disease pressure. Furthermore, no benefits to a dual fungicide application over a single application were detected but, again, this might not apply under high disease pressure. This was the first of three years for this study and the field trials are to be continued at all five locations in 2014.

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Appendices

Table 14. 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		Lesion situated on main stems or branch(es) with potential to affect up to ¼ of seed formation and filling on plant
3	Upper	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

Table 15. Type III tests of fixed effects and least squares for the response variable plant density. Least squares means within column of fixed effect followed by the same letter do not significantly differ (Fisher's protected LSD test; $P < 0.05$).

Effect Variable	Indian Head	Melfort	Outlook	Brandon	Melita
	------------------------------- Plant Density (plants m^{-2}) -------------------------------				
Hybrid (HYB)	0.356 (ns)	0.950 (ns)	0.835 (ns)	0.012 **	ns
Susceptible (S)	55 a	49 a	63 a	148 b	141
Tolerant (T)	58 a	49 a	64 a	170 a	157
Std. Error	2.8	2.3	4.6	5.6	7.6
Fungicide (FUNG)	0.349 (ns)	0.986 (ns)	0.465 (ns)	0.671 (ns)	ns
Untreated (UT)	59 a	50 a	58 a	160	155
20% bloom (T1)	57 a	48 a	62 a	158	139
50% bloom (T2)	57 a	49 a	61 a	152	158
Dual App. (2X)	51 a	48 a	71 a	166	139
Std. Error	3.5	3.1	6.3	7.9	10.8
HYB x FUNG	0.926 (ns)	0.442 (ns)	0.489 (ns)	0.168 (ns)	ns
S-UT	58 a	54 a	52 a	137 b	150
S-T1	54 a	48 a	68 a	152 ab	130
S-T2	57 a	46 a	65 a	137 b	150
S-2X	50 a	48 a	65 a	167 ab	134
T-UN	60 a	46 a	64 a	183 a	160
T-T1	60 a	48 a	57 a	164 ab	148
T-T2	58 a	52 a	57 a	167 ab	167
T-2X	52 a	49 a	78 a	164 ab	155
Std. Error	4.7	4.3	9.1	11.1	15.3
AICC	190.8	187.1	201.2	230.2	245.4

*** $P \leq 0.01$; ** $P \leq 0.05$; * $P \leq 0.10$; ns – not significant

Table 16. Type III tests of fixed effects and least squares for the response variable thousand seed weight (g 1000 seeds^{-1}). Least squares means within column of fixed effect followed by the same letter do not significantly differ (Fisher's protected LSD test; $P < 0.05$).

Effect **Variable**	**Indian Head**	**Melfort**	**Outlook**	**Brandon**	**Melita**
	------------------------- 1000 Seed Weight (g 1000 seeds^{-1}) -------------------------				
Hybrid (HYB)	< 0.001 ***	—	< 0.001 ***	0.004 ***	0.080 *
Susceptible (S)	3.2 b	—	6.2 b	3.7 b	2.91 a
Tolerant (T)	3.8 a	—	6.5 a	3.9 a	3.15 a
Std. Error	0.05	—	0.05	0.07	0.13
Fungicide (FUNG)	0.299 (ns)	—	0.559 (ns)	0.987 (ns)	0.429 (ns)
Untreated (UT)	3.50 a	—	6.4 a	3.8 a	2.90 a
20% bloom (T1)	3.54 a	—	6.4 a	3.8 a	3.18 a
50% bloom (T2)	3.50 a	—	6.4 a	3.8 a	2.95 a
Dual App. (2X)	3.59 a	—	6.3 a	3.9 a	3.10 a
Std. Error	0.05	—	0.07	0.07	0.16
HYB x FUNG	0.699 (ns)	—	0.504 (ns)	0.992 (ns)	0.357 (ns)
S-UT	3.22 a	—	6.16 c	3.71 a	2.90 ab
S-T1	3.20 a	—	6.26 bc	3.73 a	3.15 ab
S-T2	3.22 a	—	6.28 bc	3.70 a	2.80 b
S-2X	3.28 a	—	6.13 c	3.76 a	2.80 b
T-UN	3.77 b	—	6.64 a	3.94 a	2.90 ab
T-T1	3.87 b	—	6.51 ab	3.93 a	3.20 ab
T-T2	3.79 b	—	6.46 ab	3.94 a	3.10 ab
T-2X	3.90 b	—	6.41 abc	3.95 a	3.40 a
Std. Error	0.07	—	0.10	0.11	0.20
AICC	-18.7	—	3.6	7.1	36.8

*** $P \leq 0.01$; ** $P \leq 0.05$; * $P \leq 0.10$; ns – not significant

Table 17. Type III tests of fixed effects and least squares for the response variable green seed (%). Least squares means within column of fixed effect followed by the same letter do not significantly differ (Fisher's protected LSD test; $P < 0.05$).

Effect Variable	Indian Head	Melfort	Outlook	Brandon	Melita
	-------------------------------	--------- Green	Seed (%) ---------	-------------------------------	
Hybrid (HYB)	1.000 (ns)	—	0.483 (ns)	1.000 (ns)	0.347 (ns)
Susceptible (S)	0.21 a	—	0.09 a	0.04 a	1.34 a
Tolerant (T)	0.21 a	—	0.05 a	0.04 a	1.11 a
Std. Error	0.08	—	0.04	0.02	0.17
Fungicide (FUNG)	0.881 (ns)	—	0.874 (ns)	0.026 **	0.395 (ns)
Untreated (UT)	0.20 a	—	0.03 a	0.00 b	1.31 a
20% bloom (T1)	0.18 a	—	0.06 a	0.03 b	0.84 a
50% bloom (T2)	0.23 a	—	0.06 a	0.13 a	1.44 a
Dual App. (2X)	0.25 a	—	0.09 a	0.00 b	1.31 a
Std. Error	0.09	—	0.06	0.03	0.24
HYB x FUNG	0.850 (ns)	—	0.184 (ns)	0.724 (ns)	0.946 (ns)
S-UT	0.15 a	—	0.05 a	0.00 b	1.38 a
S-T1	0.20 a	—	0.17 a	0.05 ab	0.88 a
S-T2	0.25 a	—	0.13 a	0.10 ab	1.63 a
S-2X	0.25 a	—	0.00 a	0.00 b	1.50 a
T-UN	0.25 a	—	0.00 a	0.00 b	1.25 a
T-T1	0.15 a	—	0.00 a	0.00 b	0.81 a
T-T2	0.20 a	—	0.00 a	0.15 a	1.25 a
T-2X	0.25 a	—	0.18 a	0.00 b	1.13 a
Std. Error	0.12	—	0.08	0.04	0.34
AICC	9.7	—	-5.9	-36.0	60.0

*** $P \leq 0.01$; ** $P \leq 0.05$; * $P \leq 0.10$; ns – not significant

Trials completed but no report completed in this reporting period

1. Intercropping Pea and Canola based on Row Orientation and Nitrogen Rates (3 year compiled report)

Trials that were terminated during the season and not reported

1. MCVET Canola PVCT – Elva – Overland Flooding
2. MCVET Confectionary Sunflower Variety Trial – Elva - Overland Flooding and Wind Damage
3. MCVET Barley Variety Trial – Melita - Overland Flooding
4. MCVET Winter wheat Variety Trials – Isabella, Boisevain, Reston – Winter kill and overland flooding
5. Preliminary and Advanced Food and Feed Barley Trials – Melita - Overland Flooding
6. Western Feed Grain Development Cooperative Variety Trail – Melita – Overland Flooding
7. Ducks Unlimited Canada Seed Treatment and Fungicide Trials – Isabella – Winter Kill