WADO

Westman Agricultural Diversification Organization

2011 Annual Report

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2011 Industry Partners

(Alphabetical Order)

Agriculture and Agri-Food Canada
Barker's Agri-Centre - Melita
BASF
Canada Manitoba Crop Diversification Centre- Carberry
Canadian Wheat Board
Cargill
DB Murray Ltd. (John Deere, Melita)
Ducks Unlimited Canada
Farm Genesis Group - Waskada
Great Plains Oil & Exploration / The Camelina Company – Cincinnati, OH
Indian Head Agricultural Research Foundation
Local GO Team Offices
Manitoba Agriculture Food and Rural Initiatives
Manitoba Corn Growers Association
Manitoba Crop Variety Evaluation Team
Manitoba Food Development Centre
Manitoba Forage Council
Manitoba Forage Seed Association
Manitoba Pulse Growers Association
Melita Rink Committee
National Sunflower Association of Canada
Nestibo Agra
Ontario Hemp Alliance
Parkland Crop Diversification Foundation - Roblin
Parkland Industrial Hemp Growers
Prairie Agricultural Machinery Institute - Portage
Prairies East Sustainable Agriculture Initiative – Arborg
Rural Municipality of Arthur
Seed Manitoba
Shape Foods - Brandon
Sustainable Oils LLC. – Bozeman, Montana
Terramax – Seedtec – Qu'Appelle Sk.
Town of Melita
University of Manitoba
University of Saskatchewan (CDC)
VBine Energy – Moosomin, SK
Viterra
Western Feed Grains Development Cooperative – Minto, MB
Winter Cereals Canada

Farmer Co-operators - Trial Locations:

Barker Farm- Melita
Allan Brown – Melita
Jim Anderson - Melita
Greig Farms – Melita
Dobbyn Farms – Melita
Boissevain Select Seeds - Boissevain
Elliott Bros. - Reston
Kendall Heise - Isabella
Bruce Cowling - Hamiota
Mark McDonald - Virden

Introduction

The Westman Agricultural Diversification Organization Inc. (WADO) manages a wide range of value-added and 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 Roblin (PCDF), Arborg (PESAI) and the Fed/Prov. Canada/Manitoba Diversification Centres (CMCDC) based in Carberry, Portage & 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/banker for many of the Ag Extension events held across the province in conjunction with other MAFRI staff and industry personnel. This is all part of WADO's goal of helping farmers and our rural communities do better.

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

WADO Staff

Scott Day P.Ag. (left), is the Diversification Specialist for MAFRI in Melita and is responsible for all activities associated with WADO such as project development, extension, and communications.

Scott Chalmers P.Ag. (right), is the Diversification Technician for MAFRI in Southwest Manitoba. Scott is responsible for summer staff coordination, plot management, data collection and analysis.

WADO had excellent Summer Staff for 2011, they were an important reason we were able to successfully handle almost 2000 plots throughout the SW region. A full salute goes out to the two main summer staff: Laird Lampertz (left) from Tilston, & Brett Teetaert (right) from Medora. We also had retired physics teacher Dale McKinnon from Deloraine work for WADO during later in the fall of 2011.

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:

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All WADO annual reports are posted at our new website: http://www.gov.mb.ca/agriculture/diversification/wado

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 2010. For 2011 Terry Wilkinson is stepping down and Brooks White from Lyleton will be joining the WADO board. Terry's interest and commitment to WADO was greatly appreciated.

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

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

2011 Weather Report and Data – Melita Area

Flood! As it seems every year, weather did not follow its normal pattern. Melita and most of the southwest Manitoba was inundated with precipitation. A late melt and heavy spring rains coupled with above normal snow fall soil moisture in much of Saskatchewan and North Dakota resulted in an unprecedented flood situation for those living in the

Souris, and Assiniboine river systems. Even producers far from river areas were impacted by overland flooding knocking out roads and gouging washouts in fields. Over 176% of normal rain fall fell for the Melita area between April 1 and June 20 rendering most fields unseeded. A hail storm passed through Melita with golf ball size hail June 2 mostly damaging houses and cars. Unfortunately the rains continued just past the seeding deadlines for crop insurance in most crops. As if by intension rains more or less stopped for the rest of the season making the season appear rather normal in finish.

Season Summary May 1 - September 1			
	Actual	Normal[1]	% of Normal
Number of Days	124		
Growing Degree Days	1518	1436	106
Corn Heat Units	2425	2338	104
Total Precipitation (mm)	320	303	106

Last spring frost occurred May 2 at -4.9°C and last fall frost was on September 15 at -2.5°C. Next fall frost after that did not occur until Oct 9 at -3.0°C.

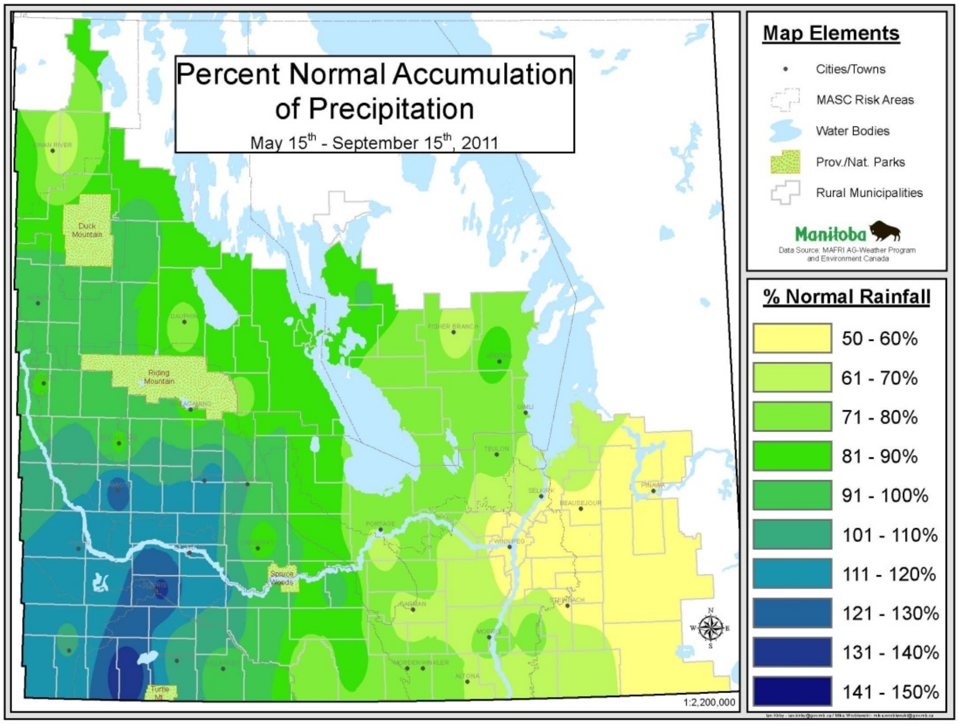
To calculate growing degree days (GDD), first determine the mean temperature for the day. This is usually done by taking the maximum and minimum temperatures for the day, adding them together and dividing by 2. The base temperature (0°C for cereals, 5°C for both alfalfa and canola) is then subtracted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

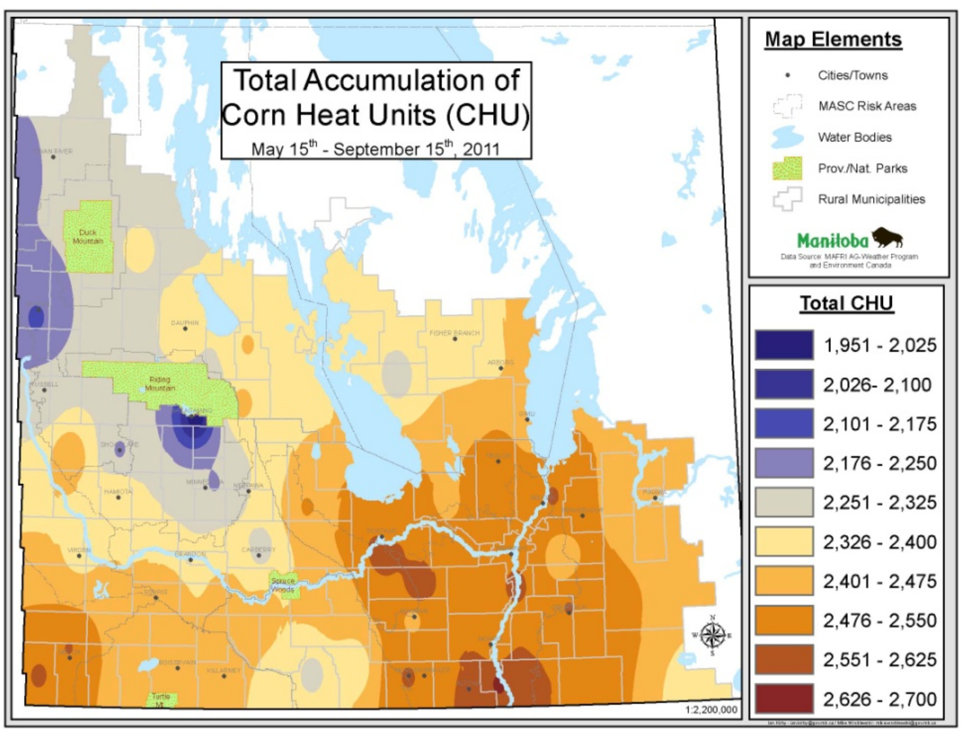
Corn heat units (CHU) are based on a similar principle to growing degree days. CHUs are calculated on a daily basis, using the maximum and minimum temperatures; however, the equation that is used is quite different. The CHU model uses separate calculations for maximum and minimum temperatures. The maximum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

In 2010, WADO purchased two new weather stations to collect trial site weather data at Melita (SW 8-4-26 W1) and Hamiota (NE-18-14-23 W1). These stations continued to run in 2011. During the winter months, of 2011 and 2012, these stations were taken down for maintenance and will be reinstalled in the spring of 2012. Continuous real time data recorded every 15 minutes and this can be viewed publicly at the following locations:

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

2011 Precipitation & Corn Heat Unit Maps





Melita - WADO 2011 Season Report by Month								
Month	April	May	June	July	August	September	October	Total
Precip (mm)	43	126	110	47	37	22	18	403
Norm Precip.[1]	34	55	77	68	52	47	32	365
Temp Ave°C	3	11	17	21	20	14	9	
Norm. Temp[1]	5	12	17	19	19	13	5	
CHU	29	305	594	779	728	453	211	2859
GDD	29	182	356	494	475	277	118	1785

Normals based on 30-yr averages, Environment Canada

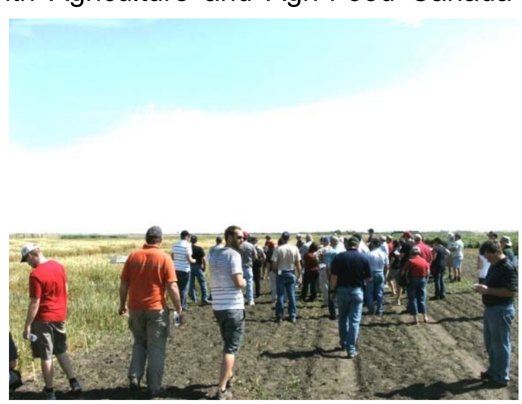
Special Thank You

WADO would like to send out a special thank you to the town of Melita, the RM of Aurthur, and those helpers from Melita School who helped during the flood. Their hard work paid off in saving many businesses from being overtaken by flood waters located close to the dyke including WADO's shed, Southwest Pontiac, Southwest Horizon School Division Shop, Tilbury Grain & Trucking Ltd., Prime Pump Industies Ltd., Gibson Auto, and DB Murray Ltd. Without this collaborative effort things would have been much different in the summer of 2011 for Melita.

WADO Tours and Special Events

Ag Days was the largest event WADO was involved in for 2011 (picture left). WADO attended the show with the rest of Manitoba's Diversification Centres featuring a booth showcasing new farming opportunities and possibilities.

Other tradeshows WADO participated in were: the Farm Focus Event in Boissevain, Deloraine Ag Show, Glenboro Ag Day, Ag in the City (Winnipeg) Crop Meetings in: Bottineau Ag Show, and MANDAK Zero Till Workshop. WADO also presented at a Hemp Growers Meeting (10 in attendance) in Waskada in collaboration with the Farm Genesis Group, flax processing meetings in collaboration with Shape Foods of Brandon, and camelina development meeting in collaboration with Linneaus Plant Sciences of Vancouver. In April, WADO partnered with Cargill and hosted a Spring Update Luncheon at the Melita Inn with over 60 in attendance. A meeting with Agriculture and Agri-Food Canada hosted in Brandon was used to illustrate to AAFC staff of the Diversification Centres activities and capabilities for future collaborative efforts.



Summer tours included the major on site tour in Melita (picture right) on August 23 where over 80 people attended. All plots at each site were showcased with a wide range of content on old and new crops, varieties, and demonstrations.

WADO would like to thank Barkers Agri-Centre for their continued support of WADO activities for land and shelter generally given short notice. WADO would like to thank Taylor Auctions for hosting the field day on their premises.

Understanding Plot Statistics

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

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

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

R-squared is a value of how "sound" the data really is. 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 2012' guide. Hard copies can be found at most MAFRI and Ag Industry Offices. A digital version is available online at www.seedmb.ca

Unfortunately for 2011, may trials were lost to excess moisture issues including the following MCVET trials:

Spring Wheat
Barley
Oats
Sunflower Post Registration Variety Trials
Corn
Lentils

Winter Wheat

Locations

Boissevain, MB
Cooperator: Wes Froese — Location: SE 27-3-20 W1
Previous Crop:Canola — Soil Texture: Clay Loam

Crandall, MB
Cooperator: Kendall Heise — Location: SE 35-13-25 W1
Previous Crop: Canola — Soil Texture: Clay Loam

Reston, MB (plot lost due to establishment issues)
Cooperator: Elliott Bros. — Location: NE 16-7-28 W1
Previous Crop: Canola — Soil Texture: Clay Loam

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 13 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. Plots were direct seeded September 4 between 6 at a depth of ½”. Total fertilizer applied was 88 lbs/ac nitrogen, and 30 lbs phosphorus in the form of granular 11-52-0 and liquid 28-0-0 as well as granular 46-0-0 (30 lbs N as spring broadcast, April 20). Plots were maintained for weeds with a broadleaf and grassy herbicide product at recommended timing and rates. Plots were harvested at full maturity in mid August. Grain yield was recorded by the HarvestMaster GrainGauge for total plot weight, moisture and test weight.

The Boissevain trial was terribly infected with fusarium. Samples were sent to the Canadian Wheat Board Lab in Saskatoon, SK for analysis of various sample quality parameters such as protein, test weight, fusarium infection, DON toxin level, midge damage, ergot and final grade.

Site Soil Tests

Depth	0-6"				6-24"	
Nutrient	N	P	K	S	N	S
Location	lbs/ac	Olsen ppm	ppm	lbs/ac	lbs/ac	lbs/ac
Reston	13	7	264	14	12	84
Boissevain	15	24	334	30	26	36
Crandall	13	5	206	18	27	36

Variety Descriptions

Variety	Yield % Check	Site Years Tested	% Protein + / - Check	Days to Maturity + / - Check	Height + / - Check	Resistance Level: Lodging	Common Bunt	Stem rust	Leaf rust	Fusarium[1] Head Blight	Relative[2] Winter Hardiness
Canada Western Red Winter											
CDC Buteo	100	63	-0.1	4	4	G	MS	I	I	I	VG
CDC Falcon	100	75	0	0	0	VG	MS	MR	MR	S	F
CDC Harrier	102	44	-1.0	4	8	G	MS	MR	MS	S	G
CDC Raptor	98	64	-0.2	4	3	VG	S	R	I	S	G
Flourish	99	6	0.2	0	2	VG	MR	I	I	—	F
McClintock	98	69	0.2	5	7	VG	MS	R	MR	S	F
Moats	102	6	0.4	0	6	G	MS	R	R	—	—
Canada Western General Purpose											
Accipiter	104	21	-0.4	3	3	VG	S	R	MR	—	G
Broadview	105	15	-0.4	1	2	VG	S	R	R	—	G
CDC Ptarmigan	104	36	-1.7	3	8	F	S	S	S	—	G
Peregrine	107	21	-0.5	2	10	G	S	I	MR	—	VG
Sunrise	110	15	-1.0	4	6	G	S	MR	MR	—	G
Varieties that have been supported for registration											
Canada Western Red Winter											
DH00W31N*34	106	15	-0.1	2	7	G	S	R	R	MS	F
Canada Western General Purpose											
DH99W18I*45	108	21	-0.1	2	6	VG	S	MR	R	—	F
DH99W19H*16	103	15	0.1	1	1	VG	S	R	R	MS	VG
CHECK CHARACTERISTICS											
CDC Falcon	81 bu/acre	75 site years	11.1% protein		26 inches						

1 Winter wheat varieties generally have poor genetic resistance to fusarium head blight. Earlier flowering of winter wheat relative to spring wheat may allow winter wheat to escape infection. The ratings provided are based on limited testing or performance in commercial fields.

2 All registered varieties have similar (good) winter hardiness if seeded at the optimum date into standing stubble where good snow cover can be assured. For the newer varieties of Flourish and Moats, there is limited information currently available. As these varieties are grown on more acres, a better understanding of relative winter hardiness will follow.

2011 WINTER WHEAT YIELD COMPARISONS

VARIETY	2011 Average Yield	2011 Yield: % of CDC Falcon — Arborg	Boissevain	Carman	Roblin	Stonewall	Winnipeg
Canada Western Red Winter							
CDC Buteo	95	102	101	82	93	97	98
CDC Falcon	100	100	100	100	100	100	100
Flourish~	99	96	103	100	98	97	102
McClintock~	98	102	99	89	125	83	94
Moats~	102	104	97	92	124	94	104
Canada Western General Purpose							
Accipiter~	103	107	100	96	114	92	108
Broadview~	106	107	111	107	102	99	110
CDC Ptarmigan	94	104	115	78	101	92	82
Peregrine~	105	106	104	101	123	87	108
Sunrise	101	99	111	92	105	93	110
Varieties that are being tested or proposed for registration							
Canada Western Red Winter							
DH00W31N*34	106	106	87	106	131	93	106
Canada Western General Purpose							
DH99W18I*45	110	100	90	102	143	112	111
DH99W19H*16	102	110	109	98	105	81	110
CHECK YIELD	**CDC Falcon (bu/ac)**	68	61	92	76	73	85
	CV %	6.1	4.8	4.3	6.4	4.7	8.7
	LSD %	-	12	8	8	15	7
	Sign Diff	No	Yes	Yes	Yes	Yes	Yes

~ Indicates a variety that is protected by Plant Breeder's Rights or a variety where protection has been applied for but not yet granted at time of printing.

Crandall and Reston sites were not published due to inconsistent establishment, low yield, and high variation in statistics issues. Only Boissevain was published in Seed Manitoba, however data for the Crandall and Restons sites is available in the table below. Crandall site did not exhibit significant yield differences.

Variety	Boissevain				Reston			Crandall			Average Yield
	kg/ha	bu/ac	%check	%Protein	kg/ha	bu/ac	%check	kg/ha	bu/ac	%check	kg/ha
Peregrine	4284	64	104	12.3	1824	27	107	2880	43	167	2996
McClintock	4090	61	99	13.1	1835	27	107	2993	44	173	2973
Sunrise	4577	68	111	11.7	1754	26	103	2482	37	144	2938
Broadview	4557	68	111	11.7	1645	24	96	2440	36	141	2881
DH99W19H*16	4490	67	109	12.7	1827	27	107	2273	34	132	2863
CDC Ptarmigan	4740	70	115	10.8	1491	22	87	2297	34	133	2843
Flourish	4253	63	103	12.4	1595	24	93	2439	36	141	2762
Accipiter	4117	61	100	11.8	1942	29	114	2102	31	122	2720
CDC Buteo	4154	62	101	12.0	1304	19	76	2623	39	152	2694
Moats	3983	59	97	12.5	1609	24	94	2473	37	143	2689
DH00W31N*34	3597	53	87	12.2	1806	27	106	2552	38	148	2651
CDC Falcon (check)	4119	61	100	11.9	1708	25	100	1727	26	100	2518
DH99W181-45	3699	55	90	11.8	1832	27	107	1736	26	100	2422
CV%	4.8				8.2			22.7			
LSD (p<0.05)	344	5	12		235	3	14	NS	NS	NS	
P value	0.00001				0.0012			0.22			
Grand Mean	4205	62	102		1706	25	100	2386	35	138	
R-Square	0.81				0.87			0.58			

Samples from Boissevain were sent to the CWB lab in Saskatoon for quality analysis. Test weight, protein, fusarium, DON levels and Midge damage all resulted in significant differences among varieties. Spouting and Egot were not signidficant. Midge results should be used with caustion due to the high CV.

Table: Winter wheat samples at Boissevain analyzed for quality parameters.

Variety	Test Weight kg/hL	Protein %	Fusarium %	DON ppm (0.1 detection limit)	Midge %	Sprouting %	Ergot %
Peregrine	76.6	12.6	3.8	5.1	0.2	0.0	0.0
CDC Buteo	76.3	12.4	5.7	9.3	0.3	0.5	0.0
DH99W18I*45	76.2	12.1	2.5	4.9	0.4	0.8	0.0
McClintock	75.2	13.8	11.1	11.2	0.7	0.2	0.0
Accipiter	74.6	12.3	8.3	11.1	0.6	0.2	0.0
S01-285-7*R	74.2	13.1	5.0	8.8	0.2	0.0	0.0
DH00W31*34	72.4	12.9	8.6	13.2	0.6	0.0	0.0
Broadview	72.2	11.9	12.1	12.3	0.2	0.0	0.0
CDC Falcon	72.2	12.1	9.8	9.9	0.4	0.0	0.0
CDC Ptarmigan	72.1	10.8	2.8	4.7	0.1	0.0	0.0
Flourish	71.6	12.8	18.9	16.5	0.5	0.0	0.0
Sunrise	70.4	12.0	5.9	4.9	2.0	0.0	0.0
DH99W19H*16	65.9	13.1	15.1	12.4	0.3	0.1	0.0
CV%	1.6	4.0	23.9	22.4	117.1	309.5	109.7
LSD (p<0.05)	1.9	0.8	3.4	3.6	1.0	NS	NS
P Value	<0.0001	<0.0001	<0.0001	<0.0001	0.0433	0.502823	0.218078
Grand Mean	73.1	12.5	8.4	9.6	0.5	0.1	0.0

Comments

Varieties in table proposed or tested for registration are derived from the Department of Plant Sciences at the University of Manitoba.

Sunrise is a soft red kernel type. CDC Ptarmigan, Accipiter and CDC Ptarmigan have soft white kernels typically high in starch and lower in protein than other winter wheats. Broadview, Accipiter and Peregrine are hard red kernel types. CDC Kestrel, CDC Clair, CDC Harrier, CDC Raptor and CDC Falcon all will be moved from the Canada Western Red Winter (CWRW) class to the Canada Western General Purpose (CWGP) class August 1, 2013. CDC Buteo, McClintock and Radiant are eligible varieties for the CWB's 2010-2011 CWRW select wheat contracting program. It is important to keep in mind the marketing limitations with some of these Winter Wheat varieties.

Plans are currently underway to test 14 winter wheat varieties in the 2011-2012 MCVET winter wheat trials. This includes W454 from AAFC Lethbridge which will be eligible for the CWRW class. W454 has been noted to have improved fusarium head blight resistance compared to currently available varieties. This is of particular interest to Manitoba farmers, especially if there is good yield potential under Manitoba growing conditions and the agronomic and disease package is suited to the production practices on their farm.

Peas

Partners
Manitoba Pulse Growers Association
Seed Manitoba

Site Location

Melita, MB
Cooperator: Alan Brown Location: SW 8-4-26 W1
Previous Crop: Spring Wheat Soil Texture: Sandy Loam

Soil Test

Nurtient	N	P	K	S
Depth	lbs/ac	Olsen ppm	ppm	lbs/ac
0-6"	6	20	171	8
6-24"	21			18
0-24"	27			26

Objective

To assess varieties of peas including green, yellow, maple, dun and silage types for yield potential in the southwest region of Manitoba.

Methods

The trial consisted of 21 varieties in plots that were 1.44 m wide x 8.5 m long. Varieties were randomized complete block design and replicated three times. A pre-seed burn-off was applied day of seeding with 2L/ac Credit 0.57 L/ac Rival and 0.75 L/ac Liberty as pre-emergent herbicide. Plots were direct seeded in wheat stubble at a depth of 1.25” on May 17. Seed was inoculated with Rhizobia and phosphate was applied at 30 lbs/ac from 11-52-0. Plots were maintained weed-free with Odyssey applied at a rate of 17 g/ac on June 14. Plots were desiccated August 19 with Reglone at a rate of 0.9 L/ac. Plots were harvested August 30. Data collected included plant emergence, height, and days to maturity and Yield. Plots were harvested for grain yield with a Hege plot combine. Test weight, sample moisture, and total plot weight were collected.

Results

There were highly significant differences among pea varieties (Table).

		Yield			
Type	Variety	kg/ha	lbs/ac	bu/ac	%Check
Yellow	CDC Golden	3361	2994	50	146
	Polstead	3260	2904	48	141
	Agassiz	3113	2773	46	135
	Hugo	2944	2622	44	128
	Sorento	2943	2621	44	127
	CDC Hornet	2882	2567	43	125
	CDC Meadow	2825	2516	42	122
	Argus	2662	2371	40	115
	CDC Treasure	2453	2185	36	106
	CDC Prosper	2348	2091	35	102
	Cutlass	2309	2057	34	100
Green	Cooper	2953	2630	44	128
	CDC Pluto	2647	2358	39	115
	CDC Patrick	2578	2296	38	112
	CDC Striker	2465	2196	37	107
	CDC Tetris	1967	1752	29	85
Maple	CDC Mosaic	2626	2339	39	114
Dun	CDC Dakota	3353	2986	50	145
Silage	40-10	2935	2614	44	127
	CDC Horizon	2056	1831	31	89
	Stella	1945	1732	29	84
CV%		11.4			
LSD (p<0.05)		509	453	8	22
P value		<0.0001			
Grand Mean		2696	2401	40	117
R-Square		0.75			

Comments

CDC Horizon, CDC Mosaic, CDC Dakota are varieties distributed by the Saskatchewan Pulse Growers, seed availability is scheduled for 2013. In previous years testing, these varieties were coded as 1681-11, 1816-4, and 2098-20.

Western Manitoba Soybean Adaptation Trial

Partners
Manitoba Pulse Growers Association
Seed Manitoba

Site Location

Melita, MB
Cooperator: Alan Brown — Location: SW 8-4-26 W1
Previous Crop: Spring Wheat — Soil Texture: Sandy Loam

Soil Test

Nutrient	N	P	K	S
Depth	lbs/ac	Olsen ppm	ppm	lbs/ac
0-6"	14	12	215	12
6-24"	12			36
0-24"	26			48

Recent research from Manitoba Agriculture, Food and Rural Initiatives has found that when moisture becomes limited, soybean plants shut down growth and force themselves into early maturity. Bean development is still finished but yields are lowered (unpublished data). In other words when soil moisture becomes limited in late summer soybean plants will hurry up maturity but reduce yields. This can be looked at two ways: the first point is if late summers become dry soybean yields can be reduced – probably more than many other crops we grow. However, the second point is that soybeans will still produce mature seeds in dry conditions and quality will be maintained.
The season of 2009 saw the first expansion of the soybean insurable acres into the more western part of the province. For more information about the areas of the province able to insure soybeans please visit the MASC website at: http://www.masc.mb.ca/

Objective

To evaluate and demonstrate soybean varieties in Southwest Manitoba.

Methods

Trials consisted of 12 varieties of glyphosate tolerant varieties arranged in a 3x4 rectangular lattice design. Varieties were replicated three times. Seed was inoculated with Rhizobia just prior to planting. Unfortunately, the third replication was lost to excess moisture, however statistical analysis was still sound even with two replications of each variety. Agronomic parameters for establishment and growing season are summarized in the table below.

Seeding Date	Plot Size	Seed Depth	Fertilizer Applied	Herbicides	App. Date	Harvest Date
19-May-11	12.96 m^2	1.25"	58 lbs/ac 11-52-0	NuGlo @ 1 L/ac	22-Jun-11	6-Oct-11
				NuGlo @ 0.6 L/ac	6-Jul-11	
				Basagran 0.5 L/ac	6-Jul-11	

Data collected included height, maturity date, and test weight. Plots were harvested with a Hege plot combine at full maturity. Composite samples were used to determine seed size and oil content (results available in 2012).

Results

	Yield				Height	Maturity
Variety	kg/ha	lbs/ac	bu/ac	% of Check	cm	days
32004	4565	4066	68	131	66	129
LS004R21	4262	3796	63	123	69	131
24-10RY	4148	3694	62	119	65	130
CFS11.3.01R2	4045	3602	60	116	63	131
CFS11.1.01R2	3956	3524	59	114	63	125
LS0036RR	3936	3505	58	113	64	129
EXP006RY524	3730	3322	55	107	71	131
900Y71	3678	3276	55	106	60	131
900Y61	3508	3124	52	101	59	129
NSC Warren RR	3476	3096	52	100	62	130
29002RR	3401	3029	50	98	60	127
23-10RY	3357	2990	50	97	54	126
CV%	5.3				9.4	1.6
LSD (p<0.05)	445	396	7	13	NS	NS
Grand Mean	3838	3419	57	110	62.8	129.0
P value	0.0016				0.424	0.145
R-Square	0.92				0.53	0.70

Faba Beans

Cooperators
Manitoba Pulse Growers Association
Seed Manitoba

Site Location

Melita, MB
Cooperator: Alan Brown — Location: SW 8-4-26 W1
Previous Crop: Spring Wheat — Soil Texture: Sandy Loam

Soil Test

Trial	Depth	N lbs/ac	P ppm Olsen	K ppm	S lbs/ac
Faba A	0-6"	6	20	171	8
	6-24"	21			18
	0-24"	27			26
Faba B	0-6"	10	19	218	6
	6-24"	24			18
	0-24"	34			24

Background

For the food market, the goal is to develop seed of appropriate size, shape and colour to meet market demands and to develop varieties which are low in vicine and covicine levels. For the feed market, work is centered on developing small seed, zero tannin varieties suitable for livestock feed, especially for feeding hogs and poultry.

Tannins act as a natural fungicide, but also decrease protein digestibility, palatability and feed intake. A key part of the current variety development strategy is to reduce the maturity requirement so that fababeans will be more specifically adapted to the short season areas of the black soil zone.

Fababeans can also be used for silage because of the large amount of biomass produced. One benefit of growing fababeans relative to other pulse crops is the possibility of leaving standing stubble for improved moisture retention in the reduced tillage system.
Canadian production is expected to increase as the new varieties are developed, with most of the increase occurring in the black soil zones of Alberta and Saskatchewan. Most of the increase in production is expected to be used in the Prairie Provinces for livestock feed. However, commercial feed mills need sufficient supply to make it economical for them to switch to using fababeans in feed rations. At the same time, producers need a price which is sufficiently attractive to grow fababeans. (Farmers of North America 2007)

This trial has a combination of zero-tannin, or feed, varieties and tannin varieties, which would primarily be used for food. As well, there are numbered varieties undergoing registration analyses.

Objective

Evaluate and demonstrate faba beans, including zero tannin varieties, as an alternative cash crop and high protein food source.

Methods

Two blocks of faba varieties each composed of 17 varieties were seeded in plot 1.44 m wide by 5 meters long. Varieties were arranged in a randomized complete block design and replicated three times. Field was harrowed then burned off prior to seeding with a mix of Liberty, Credit, and Rival herbicides at a rate of 0.75 L/ac, 2 L/ac, and 0.57 L/ac, respectively. Plots were established into spring wheat stubble and seeded at a depth of 1.25" deep. Seeds were inoculated with granular faba bean inoculant. Phosphate fertilizer was applied at an actual rate of 30 lbs/ac with granular 11-52-0. Weeds were suppressed with Basagran and Select herbicide applied June 22 at a rate of 0.91 L/ac 150 mL/ac with water rates of 20 gal/ac and 10 gal/ac, respectively. Application of Basagran was suspect at causing some flower abortion at this stage and may have reduce overall yield performance of each trial for the season. An inter-plot backpack application of Odyssey was used to control wild buckwheat between plots at mid flower. Plots were desiccated with Reglone and Nuglo at a rate of 1 L/ac each tank mixed on September 19. Plots were harvested September 26 with the Hege 140 plot combine. Data collected included heights and yield.

Results

There were significant differences in both trial blocks. Trial A had a relatively high coefficient of variation indicating that results should be considered with caution, while Trial B was relatively at an acceptable range.

Faba Bean A Trial - Zero Tannin Types				Faba Bean B Trial - Tannin Types			
	Yield				Yield		
Variety	kg/ha	lbs/ac	% of Check	Variety	kg/ha	lbs/ac	% of Check
Snowbird	4031	3590	100	FB 50-9	4330	3857	107
143-1	3771	3358	94	FB18-20	4225	3763	105
224-34	3595	3202	89	FB61-4	4196	3737	104
219-16	3538	3151	88	Melodie	4145	3692	103
219-18	3439	3063	85	228aS-24	4019	3580	100
176-2	3376	3007	84	FB136-14	3989	3553	99
FB80-17	3368	3000	84	186S-11	3941	3510	98
202-23	3204	2854	79	186S-21	3868	3445	96
138-1	3065	2730	76	FB50-43	3814	3398	95
221-5	3007	2678	75	CDC Fatima	3719	3313	92
FB34-2	2775	2472	69	Floret	3710	3304	92
FB128-4	2759	2457	68	FB9-4	3682	3280	91
FB34-7	2647	2357	66	Divine	3664	3264	91
NPZ 9-7220	2502	2228	62	FB 61-3	3500	3118	87
NPZ 9-7330	2488	2216	62	Tabor	3194	2845	79
NPZ9-7209	2399	2137	60	CDC SSNS-'	3146	2802	78
NPZ9-7207	1170	1042	29	187-8	3131	2789	78
CV%	17.1	15.2		CV%	11.2	10.0	
LSD (p<0.05)	854	761	21	LSD (p<0.05)	704	627	17
Grand Mean	3008	2679	75	Grand Mean	3781	3368	94
P value	<0.0001	<0.0001		P value	0.021	0.019	
R-squared	0.77	0.68		R-squared	0.65	0.58	

Conclusions

Fababeans have a multitude of uses. The seed can be harvested and processed as a locally grown protein for livestock or sold as a cash crop under contract. The fababean crop can also be used as a N fixing legume in a crop rotation or even as a silage crop.

Reference

Farmers of North America. "Ag Canada Outlook Buckwheat/Fababeans." Farmers of North America. December 14, 2007. http://www.fna.ca/index.php?option=com_content&task=view&id=341&Itemid=1%3E (accessed November 2, 2011).

Influence of Zinc applications on Cadmium uptake and growth parameters and yield in Flax

Cooperators
Shape Foods – Brandon MB
Agriculture and Agri-Food Canada

Site Location

Melita, MB
Cooperator: Alan Brown Location: SW 8-4-26 W1
Previous Crop: Spring Wheat Soil Texture: Sandy Loam

Background

With the expansion of the health food industry creating a safe food for consumption is important and an important marketing feature. Cadmium content in processed flax products or any food is a health concern, and an export issue. Cadmium accumulates in kidneys, where it damages filtering mechanisms. This causes the excretion of essential proteins and sugars from the body and further kidney damage. It takes a very long time before cadmium that has accumulated in kidneys is excreted from a human body. Other health effects that can be caused by cadmium are diarrhea, stomach pains and severe vomiting, bone fracture, reproductive failure and possibly even infertility, damage to the central nervous system, damage to the immune system, psychological disorders and, possibly DNA damage or cancer development. Production of flax is limited to very specific regions in North America. In southwest Manitoba, conditions for flax production are often optimal. Cadmium concentrations in our Manitoba soils range from 0.1 ppm in the extreme southwest (Melita region) to 0.6 ppm in the central regions near Carmen, Manitoba (Klassen R.A. et al. 2007). The higher levels can pose a risk of increased uptake by crops like Flax and Sunflowers. Finding an effective barrier to cadmium uptake in flax would be beneficial. Flax frequently does not strongly respond to fertilizers like other crops can. Flax seedlings are also very sensitive to seed placed fertilizer. Phosphorous is a nutrient that is difficult to get a response from in flax and is occasionally skipped in the production of flax. Use of monoammonium phosphate fertilizers has been found to contain variable concentrations of cadmium. Not only Cadmium from the phosphate fertilizer is released into the plant but phosphate fertilizers with even low cadmium levels seem to assist in increase Cadmium uptake in plant (Grant C.A. et al. 2007). This has caused some concern to the consumer food industry. Uptake of cadmium in plants is fairy mobile (compared to other heavy metals) and is well documented (Rivera-Becerril F., et al. 2002).

Application of Zinc fertilizer in durum has been found to decrease Cadmium uptake in grain. Eckhoff J. (2009) found that applied Zinc chelate at the boot stage did not affect grain yield characteristics but did affect uptake of Cadmium in grain by 25% and 13% in dryland and irrigated durum, respectfully. Jiao et al.(2004) found in a growth chamber study that application of zinc with phosphous fertilizers reduce Cadmium uptake in flax grain by 42%. It is hypothesized that application of zinc in flax under field conditions may have the same response as in durum.

A field trial was set up in Melita, Manitoba a the Westman Agricultural Diversification Organization in order to investigate the relationship between application of Zinc from a chelate and sulphate forms in two varieties of flax, Bethune and Nulin 50®, to the uptake of Cadmium and Zinc in those grain samples.

CDC Bethune is a standard flax variety across the prairies and is used an a research benchmark for this study. Nulin 50® is a high Linoleic acid variety of interest for potential use with Shape Foods Ltd.

Methods

Field

A 2x4 factorial design of plots 1.44 m wide by 8.5m long were seeded May 27 at a depth of ½". CDC Bethune and Nulin 50 varieties were used as the main plot treatment with a target plant density of 900 pl/m2, pre-calibrated by seed weight and germination values. Subplot treatments were randomized along with the main plot treatments. Treatments were replicated three times. Subplot treatments included the following:

1. Untreated Check
2. Foliar Zinc Chelate applied at 1.65 L/ac at pre-flower stage, 9% Zn EDTA solution (Nexus Ag Business, Inc.) density of 1.3 kg/L. (5.4 lbs/ac actual)
3. Zinc Sulfate 15 lbs/ac granular product applied with seed in row (36% Zn w/w) (0.4 lbs/ac actual)
4. Combination of 2 and 3.

Foliar application of zinc was made July 8 with a C02 powered fan nozzle sprayer pressurized at 40 psi. A mixture of 165 mL Zn chelate solution and 1 imp. Gal of water was used and sprayed at 10 gal/ac at 5 mph speed.

Plots were monitored for date of emergence, plant density, grain yield, grain test weight, and grain cadmium content. Plant density was measured by counting the number of plant in 1 m of row, twice randomly per plot, averages were calculated on a plants per meter basis and subject to ANOVA. Counts were taken after emergence but prior to the foliar application of zinc chelate.

Plots were harvested September 27 for grain with a Hege 140 plot combine. Data was analyzed with Agrobase Gen II statistical software using a factorial analysis of variance testing for interaction between main plots and subplots.

Cadmium Samples:

Seed samples were taken from plots for Cadmium content analysis. Seed samples were cleaned and packaged as is, with more than 25 g per sample needed for analysis. Seed samples were sent to Agriculture and Agri-Food Canada at the Brandon Research Centre. There they were analyzed for total Cadmium content in each plot treatment. Samples are subjected to a nitric/perchloric acid then a Graphite Furnace Atomic Absorption Spectroscopy with Zeeman background correction for analysis. This analysis analyzed the elements Cd, Cs, Cu, Fe, K, Mg, Mn, P, S, and Zn in both the roots and shoots. Element concentration values were subject to a two-way ANOVA with interaction.

Results

There were no significant differences among plant density, yield, or test weight among main plot or subplot effects. Use of zinc products or combinations of zinc applications had no response compared to the untreated check. Application of zinc sulfates at planting in the seed row did not reduce emergence from fertilizer burn, as chances likely were low due to high precipitation events before and after seeding.

Main Plot	Sub Plot	Plant Density p/m2	Yield kg/ha	Test Weight g/0.5L
Nulin 50		244	1225	324
	Untreated	265	1152	325
	Foliar Zn	232	1355	329
	Foliar Zn + Zn Sulfate	239	990	312
	Zn Sulfate	240	1404	329
CDC Bethune		228	1147	313
	Untreated	246	1189	311
	Foliar Zn	250	996	309
	Foliar Zn + Zn Sulfate	203	1128	312
	Zn Sulfate	213	1273	321
Combined	Untreated	256	1171	318
	Foliar Zn	241	1175	319
	Foliar Zn + Zn Sulfate	221	1059	312
	Zn Sulfate	227	1339	325
	CV%	19.5	19.6	4.0
	LSD (p<0.05)	NS	NS	NS
	Grand Mean	236	1186	319
Effect			*P value*	
Main Plot		0.413	0.421	0.062
Sub Plot		0.576	0.263	0.379
Main Plot x Subplot		0.758	0.309	0.584

Seed Sample Analysis

Although this study was mainly concerned with Cd, Zn, and P contents, it should be mentioned that there were significant differences in nutrient analysis among the *main plot* effect with Ca, K, Mg, and Mn. This is only due to variety differences between Nulin50 and CDC Bethune. Sub plot differences in Fe and Mn content were significant. There were no significant interaction between main plots and subplots in all nutrient levels.

Nutrient		Cd	P	Zn	S	Ca	Cu	Fe	K	Mg	Mn
Main Plot	Sub Plot	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
CDC Bethune		159.4	8159.2	47.0	2212.3	2507.0	6.4	72.6	10138.1	4324.9	24.9
	Untreated	162.7	8186.5	43.0	2165.8	2555.4	6.2	70.9	10101.8	4317.9	25.9
	Foliar Zn	177.2	8250.9	50.1	2226.5	2511.9	6.8	75.3	10319.1	4355.7	23.7
	Foliar Zn + Zn Sulfate	160.7	8034.8	51.0	2239.3	2474.7	7.2	76.0	10102.4	4297.9	24.1
	Zn Sulfate	137.1	8164.8	44.1	2217.8	2486.2	5.6	68.4	10029.0	4328.0	25.9
Nulin50		172.1	8211.9	50.1	2232.0	3101.5	7.2	75.7	9184.9	4589.8	29.3
	Untreated	174.8	8364.8	48.8	2280.9	3031.2	6.9	75.3	9358.4	4648.5	31.7
	Foliar Zn	171.8	8111.7	48.8	2164.9	3072.0	6.8	75.9	9121.0	4547.4	27.1
	Foliar Zn + Zn Sulfate	184.2	8192.7	55.2	2265.8	3115.9	8.5	80.1	9208.2	4573.0	28.2
	Zn Sulfate	157.8	8178.5	47.8	2216.2	3187.0	6.6	71.5	9051.8	4590.2	30.0
	Untreated	168.7	8275.6	45.9	2223.4	2793.3	6.6	73.1	9730.1	4483.2	28.8
	Foliar Zn	174.5	8181.3	49.4	2195.7	2791.9	6.8	75.6	9720.0	4451.6	25.4
	Foliar Zn + Zn Sulfate	172.4	8113.8	53.1	2252.6	2795.3	7.8	78.1	9655.3	4435.5	26.1
	Zn Sulfate	147.4	8171.7	45.9	2217.0	2836.6	6.1	70.0	9540.4	4459.1	28.0
CV%		15.9	2.0	7.9	3.8	2.7	15.1	5.2	1.9	1.9	4.0
Grand Mean		165.8	8185.6	48.6	2222.2	2804.3	6.8	74.2	9661.5	4457.3	27.1
LSD (p<0.05)	Main Plot	-	-	-	-	65.5	-	-	156.7	74.8	0.9
	Sub Plot	-	-	-	-	-	-	4.8	-	-	1.3
	Main Plot x Sub Plot	-	-	-	-	-	-	-	-	-	-
P Values	Effect										
	Main Plot	0.255	0.443	0.069	0.583	**<0.0001**	0.093	0.072	**<0.0001**	**<0.0001**	**<0.0001**
	Sub Plot	0.300	0.419	0.689	0.720	0.689	0.071	**0.017**	0.277	0.808	**0.0003**
	Main Plot x Sub Plot	0.689	0.340	0.096	0.378	0.096	0.758	0.833	0.215	0.585	0.306

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Exploring the merits of field pea-canola intercrops for improved yield and profit (2011 Report)

Agricultural Demonstration Of Practices and Technologies (ADOPT)
(Project #: 20100292)

Project Leader
Chris Holzapfel, MSc, PAg
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Collaborators
Scott Chalmers, PAg, Westman Agricultural Diversification Organization (WADO)
Melita MB

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Project Identification

1. Project title: Exploring the merits of field pea-canola intercrops for improved yield and profit

2. Project number: 20100292

3. Producer group sponsoring the project: Indian Head Agricultural Research Foundation (IHARF)

4. Project location(s): Field trials were located north of Indian Head, Saskatchewan (Indian Head heavy clay), south of Indian Head, Saskatchewan (Oxbow loam) and near Melita, Manitoba (Langvale sandy loam).

5. Project start and end dates: February 2011 to April 2013

6. Project contact person and contact details: Chris Holzapfel, Indian Head Agricultural Research Foundations, Box 156, Indian Head, SK, S0G 2K0, Phone: (306) 695-4200, Email: cholzapfel.iharf@sasktel.net

Objectives and Rational

7. Project Objectives: The primary objectives of this project were: 1) to gain experience with intercropping field pea with canola and demonstrate the potential agronomic and economic merits of this practice for the thin-Black soil zone of Saskatchewan, 2) to compare alternating versus mixed-row configurations for field pea-canola intercrops and 3) to demonstrate the effects of N fertility on the performance of pea-canola intercrops

8. Project Rationale: Large gains in both grain yield and land equivelant ratios (a measure of the productivity of intercrops versus monocrops on a per land area basis) have been reported on the prairies by both growers and researchers alike. Despite the logistic challenges of intercropping, particularly at harvest, there are growers in Saskatchewan who are interested in this practice as a means of increasing net profits and potentially reducing fertilizer and pesticide use in field pea and canola production. Research and demonstration is required to advance our understanding of the potential advantages and dissadvantages of pea-canola intercrops and to develop agronomic recommendations for growers who are interested in this practice.

Methodology and Results

9. Methodology: Two separate field demonstrations were conducted at multiple locations with very basic trials comparing field pea-canola intercropped systems with pure stands of the same two crops (Demonstration #1) along with a more complex, multiple factor demonstration evaluating the effects of row-crop type configuration (alternating rows of field and canola versus mixed rows) and nitrogen fertility (0, 33, 67 and 100% of canola recommendation) on the performance of field pea-canola intercrops (Demonstration #2). Demonstration #1 was conducted at two locations near Indian Head with contrasting soils (heavy clay versus loam texture) while Demonstration #2 was conducted at Indian Head (heavy clay) and Melita, Manitoba (sandy loam). The treatments included in each demonstration are presented in Table 1.

Table 1. Treatments evaluated in field pea-canola intercropping demonstrations completed near Indian Head, Saskatchewan and Melita, Manitoba in 2011.	
Demonstration #1: Intercropping Field Pea with Canola	
#	**Description**
1	Field Pea Monocrop
2	Canola Monocrop
3	Field Pea-Canola Intercrop – Alternating Rows
4	Field Pea-Canola Intercrop – Mixed Rows (loam soil site only)
Demonstration #2: Row-Crop Orientation and Nitrogen Fertility Interactions in Field Pea-Canola Intercrops	
#	**Description**
1	Canola Monocrop (0% of recommended N)
2	Canola Monocrop (33% of recommended N)
3	Canola Monocrop (67% of recommended N)
4	Canola Monocrop (100% of recommended N)
5	Field Pea Monocrop (no N applied)
6	Mixed Row Intercrop (0% of recommended N)
7	Mixed Row Intercrop (33% of recommended N)
8	Mixed Row Intercrop (67% of recommended N)
9	Mixed Row Intercrop (100% of recommended N)
10	Alternating Row Intercrop (0% of recommended N)
11	Alternating Row Intercrop (33% of recommended N)
12	Alternating Row Intercrop (67% of recommended N)
13	Alternating Row Intercrop (100% of recommended N)

For the intercropped treatments where the crops were arranged in alternating rows, N fertilizer was directed exclusively to the canola rows. Nitrogen fertilizer was applied evenly to all rows when the mixed row-crop configuration was used. Consequently, at any given N rate the quantity of fertilizer applied for an alternating row configuration was double that of the mixed row or canola monocrop treatments for a specific length of an individual crop row, but the total quantity of N applied equal when the entire plot area was considered. In Demonstration #1, the N rates used were half of those used for pure canola while, in Demonstration #2, N rates varied as per protocol. Granular monoammonium phosphate was side-banded with every row at the same rate for all treatments. The seeding rates used for each crop in the intercropped treatments were 67% of the rates used in the corresponding monocrops for both demonstrations.

Weather data for the 2011 growing season at Indian Head and Melita were estimated using the Environment Canada weather stations for each location. Plant densities and grain yields were measured at all locations for both demonstrations and above-ground biomass measurements were completed for Demonstration #2 only. For Demonstration #2, SPAD measurements were completed for the canola treatments at the early flowering stage at Indian Head and percent light interception (PLI) measurements were completed during full bloom for all treatments at Melita. For all demonstrations, the land equivalent ratio (LER) was calculated for the intercropped plots by dividing the intercrop yield of each crop by the yield of the pure stand for that crop and adding the quotient to that calculated for the other crop (Eq. 1). The LER is a measure of productivity that takes into account both the beneficial and detrimental interactions between crops whereby an LER greater than 1.0 indicates an advantage to intercropping and the opposite is true for values less than 1.0. For example, an LER of 1.25 would indicate that an area planted to two monocrops in equal proportions would require 25% more land to produce an equivalent total yield as the same area intercropped. Marginal profits will be estimated for each treatment once data from these demonstrations in 2012 is available.

Equation 1. Land Equivalent Ratio (LER).

$$LER = \left(\frac{intercrop1}{monocrop1}\right) + \left(\frac{intercrop2}{monocrop2}\right)$$

Response data for each demonstration were analyzed with SAS 9.2 using a generalized linear model (GLM) with Tukey's Studentized Range test use to identify differences amongst the means. In certain cases, predetermined contrasts were used to compare specific groups of treatments. All treatment effects and differences amongst means were declared significant at $P \leq 0.05$. For Demonstration #2, two separate analyses were completed. The first included all 13 of the treatments and was completed for total plant density, total above ground biomass and total seed yield. The second analysis only included the intercropped treatments and looked at the main effects of row-crop configuration (alternating versus mixed rows) and N fertility along with interactions between these two factors and was completed for all the response data and looked at individual contributions from field pea and canola.

10. Results

A summary of the 2011 growing season weather at Indian Head, Saskatchewan and Melita, Manitoba is provided in Table 2. At Indian Head, temperatures were below normal (30 yr average) from April through June, approximately normal in July and August and warmer than normal in September. Similar to Indian Head, early spring temperatures at Melita were also cooler than normal while late spring / early summer temperatures were approximately normal and August and September had above average temperatures. Both sites received well above average precipitation in late May and through June but conditions became drier later in the season. Spring flooding was an issue at both locations and, for Demonstration #2, one of the fours replicates were discarded at each site because of damage from excess moisture. The warm and dry conditions in July and August generally allowed the crops to recover reasonably well.

Table 2. Weather data for the 2011 growing seasons at Indian Head, Saskatchewan and Melita, Manitoba along with long-term normal (1971-2000) temperatures and precipitation levels.

	------------ Indian Head ------------				**------------- Melita 2011 -------------**			
	Temperature (ºC)		**Precipitation** (mm)		**Temperature** (ºC)		**Precipitation** (mm)	
Month	**2011**	**LT**	**2011**	**LT**	**2011**	**LT**	**2011**	**LT**
April	1.8	4.0	8	25	2.4	5.9	43	29
May	9.5	11.4	71	56	10.7	11.3	126	49
June	15.1	16.1	133	79	16.9	16.7	110	101
July	18.8	18.4	42	67	20.9	19.2	47	66

August	17.8	17.5	44	53	20.3	18.0	37	74
September	13.9	11.4	16	41	14.3	11.8	22	35
Avg. / Total	12.8	13.1	315	320	14.3	13.8	386	354

Demonstration #1 was a basic comparison of intercropped field pea and canola relative to the same two crops grown in pure stands. This demonstration was initiated at Indian Head in 2010 (heavy clay soil) and, as mentioned previously, continued at two locations with contrasting soils near Indian Head in 2011. Results summaries 2011 for Demonstration #1 are presented for the heavy clay site in Table 3 and the loam site in Table 4 while the results from the heavy clay site in 2010 are reserved for the appendices (Table 5).

At the Indian Head heavy clay site in 2011 (Table 3), while the F-test for total plant populations was not significant (P = 0.070), there was a tendency for higher plant populations in the intercropped treatment (84 plants m^{-2}) relative to the pure stands of field pea and canola (65-69 plants m^{-2}). This was expected due to the higher combined seeding rate that resulted from seeding each crop at two-thirds of the rates used in the pure stands and was similar to the results observed at this site in 2010 (Table 5). The F-test for total seed yield was significant (P = 0.009) and, at 3304 kg ha^{-1}, the intercropped treatment yielded higher than the pure stand of canola (2618 kg ha^{-1}) but not field pea (3119 kg ha^{-1}). The partial land equivalent ratio (PLER) values were 0.60 and 0.56 for canola and field pea, respectively, resulting in a total LER of 1.15. This means that for every two hectares of field pea and canola monocrops (1 ha of each), the same total amount of grain could be produced in only 1.7 hectares by growing the same two crops in an intercropped system. Overall, intercropping performed better on the heavy clay soils at Indian Head in 2011 compared with 2010 where the intercropped yield was approximately half way between that of the canola and field pea monocrops yields and the observed LER was 1.02 (Table 5).

Table 3. Analysis of variance (ANOVA) and treatment means for plant densities and seed yields in Demonstration #1 at the Indian Head heavy clay site in 2011. Treatment means in the same row followed by the letter do not significantly differ according to Tukey's Studentized Range (HSD) Test ($P \leq 0.05$). Mean land equivalent ratio (LER) values were not analyzed statistically.

Analysis of Variance / F-test

Effect	*Plant Density*	*Total Seed Yield*
Treatment	**0.070**	**0.009**
Replicate	**0.333**	**<0.001**
R-Square	**0.778**	**0.980**
CV (%)	**10.3**	**4.6**

Least Squares Means

------------ **Mono-Crop** -----------		--------------------- **Inter-Crop** ----------------------		
Canola	***Field Pea***	***Total***	*Canola (2/3 Rate)*	*Field Pea (2/3 Rate)*
---------------------------------- *Plant Density (plants/m²)* ----------------------------------				
64.9 a	**69.3 a**	**84.4 a**	39.4	45.0

-- *Seed Yield (kg/ha)* --				
2618 b	**3119 a**	**3304 a**	1535	1770
-------------------------------------- *Land Equivalent Ratio* -------------------------------------				
1.000	**1.000**	**1.152**	0.597	0.555

For the loamy soil site located south of Indian Head at Vale Farms, plant densities were significantly affected by the treatments (*P* = 0.009; Table 4). Because the effects of row-crop configuration were not being evaluated elsewhere at this location, alternating rows of field pea and canola were compared with mixed rows in this demonstration. Identical seed and fertilizer rates were used for both sites in this demonstration. While total plant densities for the alternating rows of pea and canola were similar to those of the two crops grown in pure stands (75-83 plants m^{-2}), higher plant populations were observed in the mixed row, intercropped treatment (112 plants m^{-2}). For canola emerging in this coarser textured soil, it is possible that NH_3 toxicity in the alternating rows may have reduced plant populations relative to the mixed row configuration; however, the N rates applied in the alternating row intercropped treatment were identical to those applied in the pure stand of canola on a per row basis. While the treatment effects on total seed yield were significant (*P* = 0.047), the coefficient of variation was high (17.2%) which was likely a result of the plots at this site being damaged by hail and heavy rain just prior to harvest. Despite the hail damage and observed yield variability, the results from this location were quite interesting. Overall, the intercropped treatments were the highest yielding; however, the only statistically significant difference observed was between the field pea monocrop (1408 kg ha^{-1}) and the mixed-row intercropped treatment (2344 kg ha^{-1}). While canola yields in the intercropped treatments were always less than half of the monocrop canola yield, the intercropped field pea yields were always at least as high as they were in the monocrop. While the hail damage at maturity resulted in shattering losses for the canola and would help to explain the low yields, damage appeared to be similar regardless across treatments. On the other hand, the peas were very ripe and badly lodged at the time of straight-combining and, in the intercropped treatments, the canola helped to keep the pea plants standing late into the season. Consequently, harvest for the intercropped treatments was easier than for the pure field pea stands and losses were likely lower which would, at least partly, explain the prominent yield benefit observed with intercropping for the field peas. With respect to the relatively low canola yields, while we might expect similar shattering losses between the pure stands and intercropped treatments, it was visually evident that the field peas were out-competing the canola throughout the growing season at this particular site.

Table 4. Analysis of variance (ANOVA) and treatment means for plant densities and seed yields in Demonstration #1 at the Indian Head Loam (Vale Farms) site in 2011. Treatment means in the same row followed by the letter do not significantly differ according to Tukey's Studentized Range (HSD) Test (*P* ≤ 0.05). Mean land equivalent ratio (LER) values were not analyzed statistically.

Analysis of Variance / F-test		
Effect	*Plant Density*	*Total Seed Yield*
Treatment	**0.009**	**0.047**
Replicate	**0.107**	**0.104**
R-Square	**0.863**	**0.78**
CV (%)	**10.5**	**17.2**

Least Squares Means							
---- Mono-Crop ----		**---------------------------- Inter-Crop -----------------------------**					
		------ Alternating Rows ------			**---------- Mixed Rows ---------**		
Canola	***Field Pea***	***Total***	*Canola*	*Field Pea*	***Total***	*Canola*	*Field Pea*
----------------------------------- *Plant Density (plants/m²)* ----------------------------------							
74.9 b	**77.4 b**	**82.8 b**	36.1	46.8	**111.5 a**	55.2	56.3
--------------------------------------- *Seed Yield (kg/ha)* --------------------------------------							
1716 ab	**1408 b**	**2129 ab**	620	1509	**2344 a**	542	1801
-------------------------------------- *Land Equivalent Ratio* ------------------------------------							
1.000	**1.000**	**1.643**	0.378	1.265	**1.685**	0.312	1.373

For Demonstration #2 which focused on row-crop configuration and management of N fertilizer in field pea-canola intercrops, the full results of the statistical analyses are reserved for the appendices (Tables 6-15) while simplified summaries are presented in Figures 1-8. When interpreting the bar graphs, the upper case letters above each bar denote statistical significance of treatment differences for the total values amongst all of the treatments (Tukey's Studentized Range test; $P \leq 0.05$) and the error bars are the standard errors of the treatment means from the same analyses. Land equivalent ratios were only analyzed for the intercropped treatments because, by definition, all monocrop treatments had an LER of 1.000. The lower case letters within the bars denote treatment differences within each crop type from Tukey's test in the second, factorial analyses of the results from Demonstration #2. Results from Indian Head are discussed first and are followed by the results from Melita and a general discussion of the combined results from both demonstrations at all sites.

At Indian Head in 2011, when all thirteen treatments were considered, total plant densities were significantly affected by treatment with a significant *P*-value for the F-test of 0.001 (Table 6). While there were no significant differences amongst the intercropped treatments (Figure 1; Table 7), there was an overall decline in plant populations with increasing N rates observed for canola monocrop treatments. While the most likely explanation for the observed decline is NH_3 toxicity and the wet conditions at seeding did compromise seed placement and seed-fertilizer separation, the side-banded N rates used in this study were typical for these soils (124 kg N ha^{-1} at 100%). Furthermore, no decline was observed in the alternating row intercropped treatments where, for any given rate, twice as much fertilizer was applied adjacent to each row of canola for a specific length of crop row. In general, total plant populations in the intercropped treatments were similar to those of the monocrops with only a few significant differences observed. Focusing on individual crops within the intercropped treatments, neither canola nor field pea establishment was affected by either row-crop configuration or N fertility level. Additionally, field pea and canola seedlings were established in approximately equal proportions for the intercropped treatments.

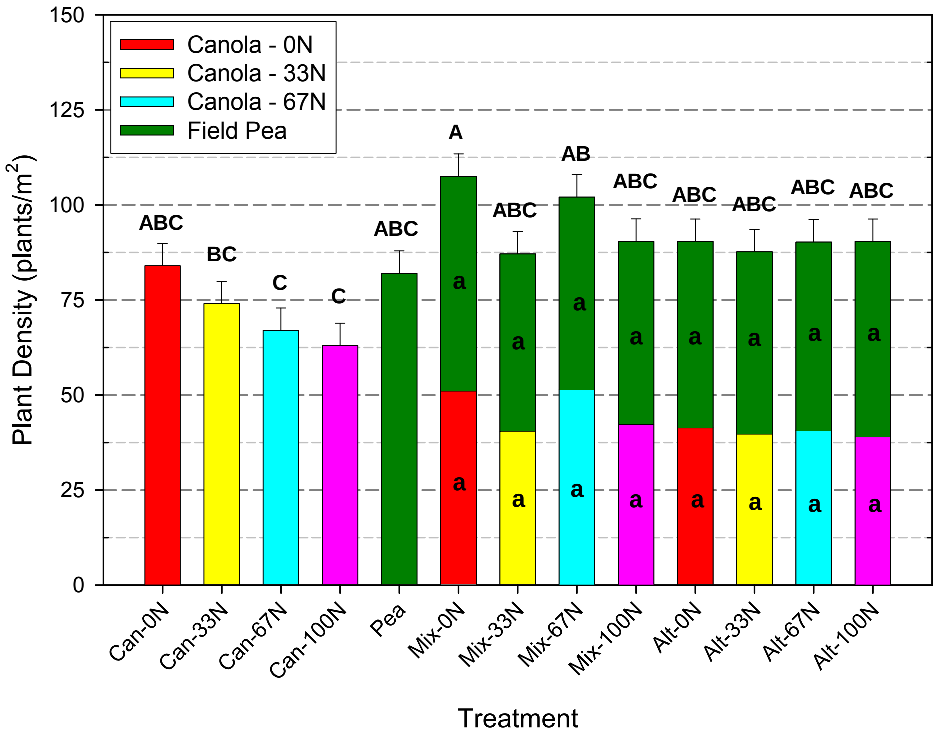

Figure 1. Treatment effects on the establishment of field pea and canola at Indian Head, Saskatchewan in 2011.

Above-ground biomass samples were collected from each plot approximately three weeks before swathing to assess the relative competitiveness of each crop for the different treatments. When all thirteen treatments were considered, total above-ground biomass yields were affected (P = 0.001)); however, relatively few significant differences were observed according to Tukey's studentized range test. The unfertilized canola monocrops yielded less total biomass than most of the treatments where 67% or more of the recommended N for canola was applied but total biomass yields were otherwise similar (Figure 2; Table 6). Focusing on the intercropped treatments (Table 8), field pea biomass yields were affected by row-crop orientation (P <0.001), but canola and total biomass yields were not (P = 0.1). Field pea biomass yields were higher for the mixed-row treatments (3199 kg ha^{-1}) than for the alternating row treatments (2228 kg ha^{-1}). Nitrogen level affected the total biomass yields (P = 0.011) along with the individual biomass yields of both canola (P < 0.001) and field pea (P = 0.049). Canola was the most responsive to N fertilizer application with total biomass yields at the 100% N level that were 260% higher than the unfertilized treatments. The overall total biomass yields at the 100% N level were 131% of the unfertilized check while, for field pea, the effect of N level on total biomass level was not clear and no specific treatment differences were identified despite the significant F-test.

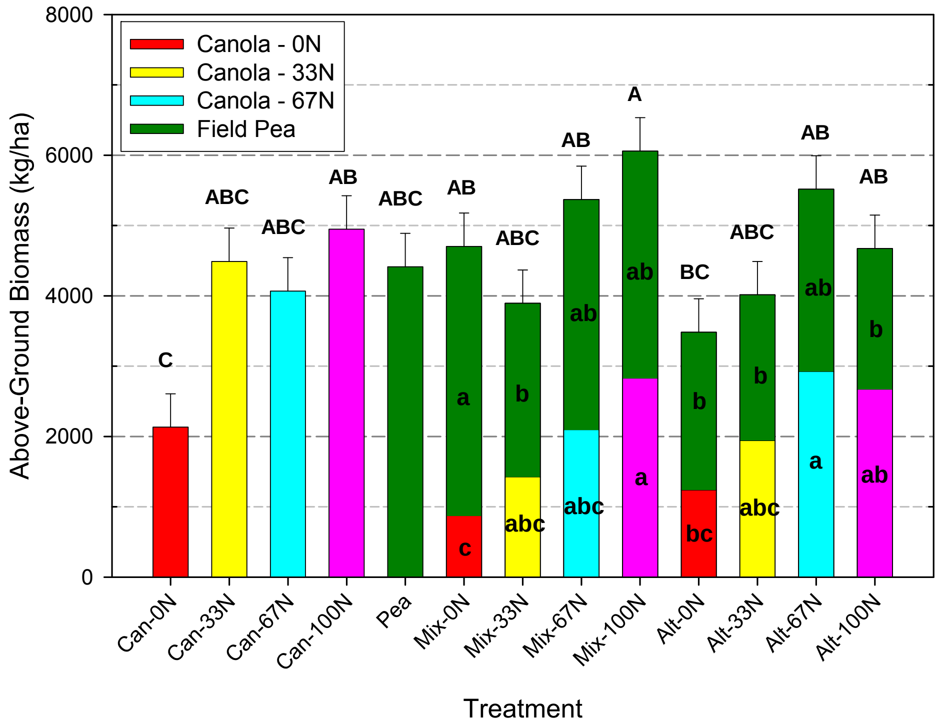

Figure 2. Treatment effects on the above-ground biomass yields of field pea and canola at Indian Head, Saskatchewan in 2011.

Not unexpectedly, the results for total seed yield followed patterns that were similar to those observed for biomass yield (Figure 3) and the overall treatment effects were significant ($P < 0.001$; Table 6). The unfertilized canola monocrop had a significantly lower yield than all intercropped treatments, the field pea monocrop and the 100% N canola monocrop. The intercropped treatments tended to have similar yields as the field pea monocrop and higher yields than the canola monocrop treatments but there differences were not always significant. Canola monocrop yields appeared to increase linearly with increasing N rate up to the highest rate used (123 kg N ha^{-1}). Specifically amongst the intercropped treatments, both the individual canola and field pea seed yields were affected by row-crop configuration ($P < 0.01$), but the total seed yield was not ($P = 0.067$). For canola, yields were higher with the alternating row configuration (1167 versus 979 kg ha^{-1}) while the opposite was true for the field pea where yields were higher with the mixed-rows (3199 kg ha^{-1} versus 2228 kg ha^{-1}). The slightly higher canola yields in the alternating row configuration could possibly be explained by increased N availability as N fertilizer was applied exclusively with the canola rows in this configuration. These contrasting effects resulted in the total yields of the two systems being similar (5006 kg ha^{-1} versus 4422 kg ha^{-1}). Regardless of the row-crop configuration, field pea seed yields in the intercropped treatments were not affected by N rate ($P = 0.424$) while canola yields were affected ($P < 0.001$) and increased with increasing N application rates (Table 9). At the highest N level, canola seed yields in the intercropped treatments were 211% of the unfertilized check. Total seed yields were also affected by N level ($P = 0.032$), but not nearly to the extent of the canola with the highest N rate producing 123% of the check and no significant treatment differences according to Tukey's multiple comparison test.

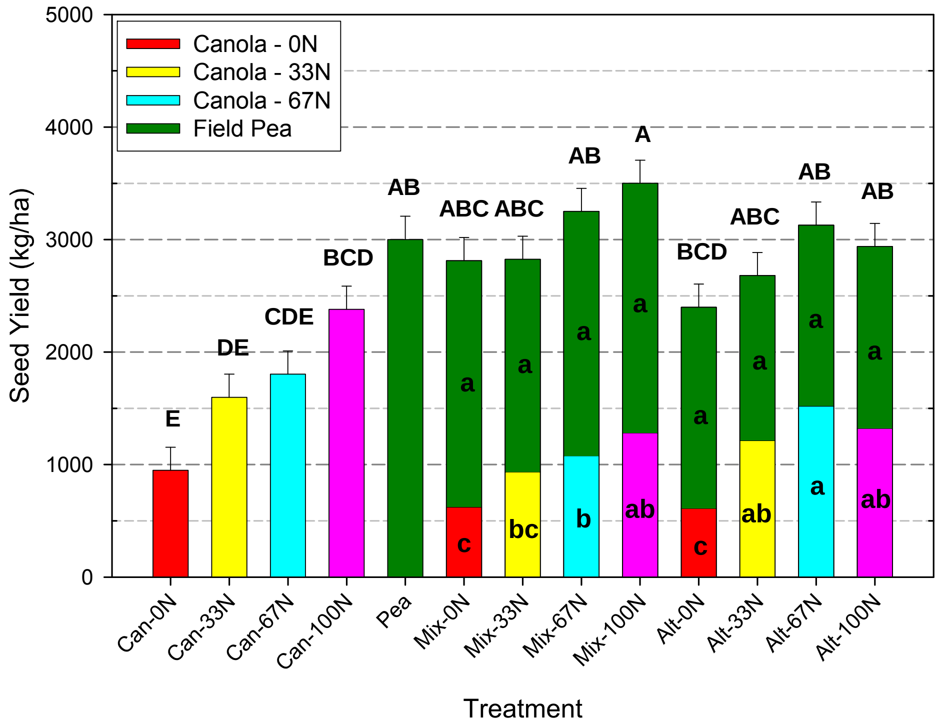

Figure 3. Treatment effects on the seed yields of field pea and canola at Indian Head, Saskatchewan in 2011.

By definition, all monocrop treatments had a precise LER value of 1.000, thus PLER and LER values were only analyzed for the intercropped treatments (Figure 4; Table 10). Partial LER was affected by row-crop configuration for canola (P = 0.003) and field pea (P = 0.002), but the overall LER values were unaffected (P = 0.334). Similar to the effects on seed yield, canola PLER was higher for the alternating row configuration (0.702 versus 0.597) while the PLER values for field pea were higher in the mixed rows (0.717 versus 0.551). The overall PLER values were similar with an overall mean of 1.314 for the mixed row configuration and 1.242 when field pea and canola were planted in alternating rows. While the PLER of field pea was not affected by N level or the interaction between row-crop configuration and N level (P = 0.971), both had a significant effect on canola PLER (P = 0.019-0.029). For the mixed row configuration, canola PLER was largely unaffected by N level with no significant differences across rates; however for the alternating row configuration PLER increased with increasing N levels up to where 67% of the recommended N rate was applied. While the canola PLER values did not increase with N fertilizer in the mixed row configuration, it is important to recognize that the actual yields did increase with increasing N thus N fertilization was still beneficial for the canola in the mixed row intercropping treatments. Partial LER values for canola at each N level were calculated using the canola monocrop at the corresponding N level; thus these values do not reflect differences in the actual canola yields at the various N rates. What the significant row-crop by N level interaction for canola PLER does imply is that the canola in the alternating row intercrop treatments was able to use the applied N more efficiently than the monocrop canola or mixed-row intercrop canola at any given N fertilizer rate.

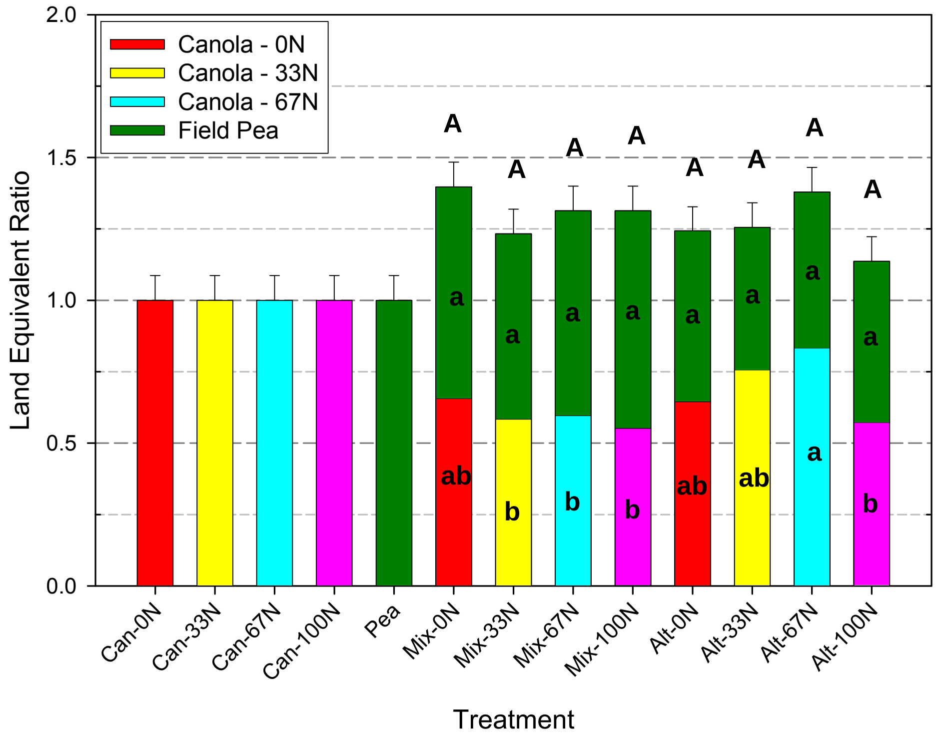

Figure 4. Treatment effects on the Land Equivalent Ratio (LER) for intercropped field pea and canola at Indian Head, Saskatchewan in 2011.

For the site at Melita, Manitoba, the overall F-test for total plant densities was significant when all treatments were considered (*P* = 0.015) but Tukey's studentized range test did not reveal any specific treatment differences (Table 11; Figure 5). The contrasts, however, revealed that the combined intercropped treatments had higher plant populations than the monocrop treatments (*P* = 0.001) and that the alternating row configuration resulted in a lower total number of plants than for the mixed-rows of field pea and canola (*P* = 0.019; Table 11). When the analysis was focused solely on the intercropped treatments, canola plant populations were not affected by row-crop configuration (*P* = 0.541) but both field pea populations (*P* = 0.002) and total plant populations were (*P* = 0.013). In both cases, plant populations were higher with the mixed rows of field pea and canola (Table 12). The overall F-test for nitrogen fertilizer rate was significant for canola plant densities (*P* = 0.051) but not for field pea densities (*P* = 0.088) or total plant densities (*P* = 0.013). Tukey's test did not reveal any specific differences amongst N fertilizer rates for canola, field pea or the combined densities and no distinct pattern was observed for the effects of N level on canola plant populations.

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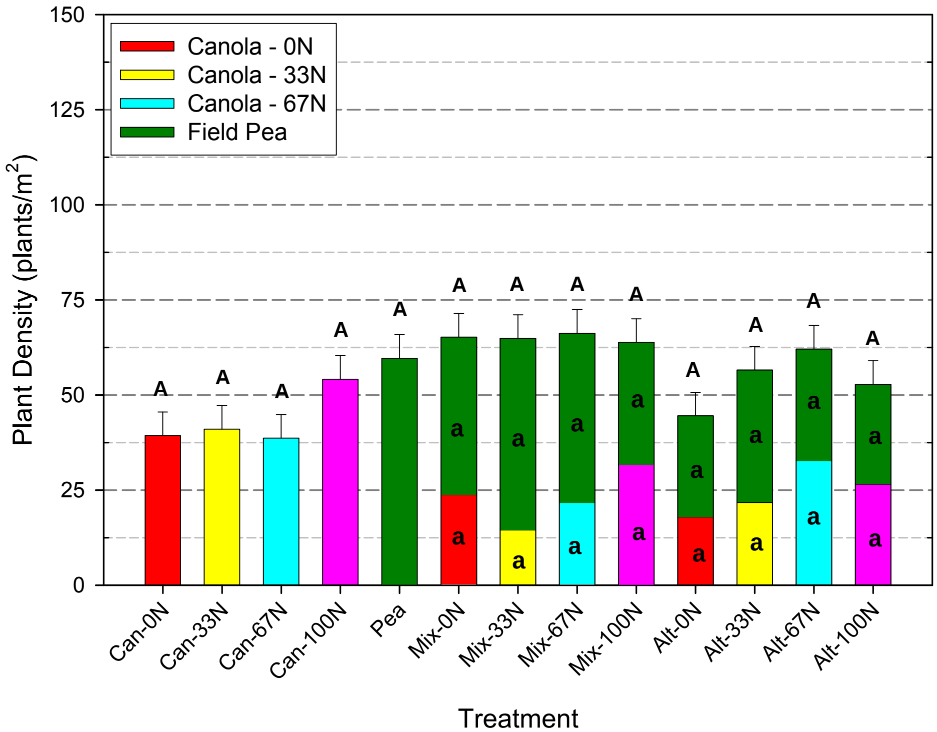

Figure 5. Treatment effects on the establishment of field pea and canola at Melita, Manitoba in 2011.

When data from all treatments were analyzed together, the overall F-test for total above-ground biomass was not quite significant at Melita (P = 0.054), nor were any differences between individual treatments identified with the multiple comparison test (Table 11). Nonetheless, contrast comparisons revealed significantly lower total biomass production in the alternating row intercropped treatments relative to the mixed-row treatments (P = 0.003) and also lower biomass yields for the combined monocrop treatments versus the combined intercrop treatments (P = 0.015). Looking exclusively at the intercropped treatments, canola biomass production was not affected by row-crop orientation (P = 0.433) but there was a significant interaction between row-crop configuration and N rate (P = 0.048). Both field pea biomass (P = 0.004) and total biomass production (P = 0.012) were affected by row-crop configuration and in both cases, higher biomass yields were achieved with the mixed rows. Nitrogen rate did not affect canola (P = 0.225), field pea (P = 0.749), or total biomass yields (0.975). As for the significant interaction observed for canola biomass yield, canola in the alternating row configuration appeared to be less responsive to N fertilizer than the canola in the mixed row configuration, which was in agreement with the results observed at Indian Head. Tukey's studentized range test did not reveal any significant treatment differences amongst the eight intercropped treatments (Figure 6).

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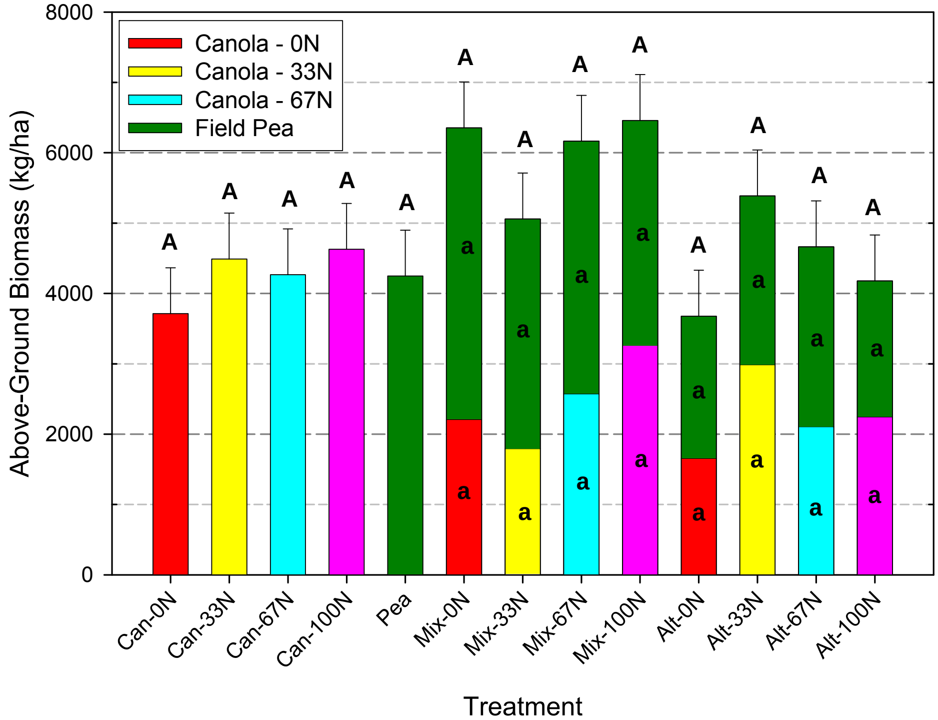

Figure 6. Treatment effects on the above-ground biomass yields of field pea and canola at Melita, Manitoba in 2011.

Overall, seed yields were lower at Melita than at Indian Head in 2011 (Figure 7). All thirteen treatments considered, total seed yield was significantly affected by the treatments at this site ($P < 0.001$; Table 11). While the canola monocrop did not respond to N ($P = 0.116$), at the 100% N level, the mixed row intercrop treatment yielded higher than any of the individual monocrop treatments and the overall intercropped check versus rest contrast was significant ($P = 0.017$). On average, intercropped canola in the alternating row configuration was responsive to N fertilizer ($P = 0.015$) while canola in the mixed row configuration was not ($P = 0.314$). Despite the relatively poor performance of the alternating row configuration at Melita, the overall total seed yields of the intercropped treatments were significantly higher than those of the monocrop treatments ($P < 0.001$). When the monocrop treatments were excluded from the analysis, canola seed yield was affected by both row-crop configuration ($P = 0.015$) and N fertilizer rate ($P = 0.014$) while field pea seed yields were affected by row-crop configuration ($P < 0.001$) but not N rate ($P = 0.608$). Similar to field pea which made up well over half observed intercropping yields, total seed yields were affected by row-crop configuration ($P < 0.001$) but not N rate ($P = 0.094$). Both canola and field pea yields were higher in the mixed rows although the field peas were much more sensitive to row-configuration with mixed rows yielding 276% higher than the alternating rows as opposed to only 123% for the canola. Total seed yields were 1045 kg ha^{-1} for the alternating rows of pea and canola and 2054 kg ha^{-1} with the mixed rows (Table 14). With regard to N fertility, there was an overall yield benefit to N fertilizer for canola with the top N rate yielding 151% of the check but no significant differences in seed yield were observed amongst the N rates for field pea or total seed yield.

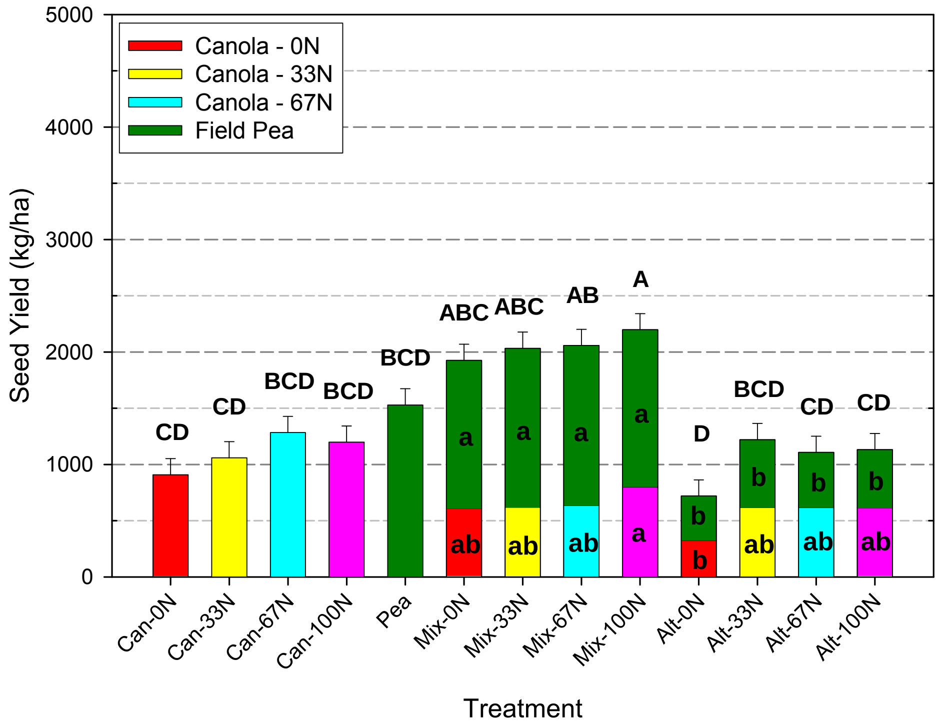

Figure 7. Treatment effects on the seed yields of field pea and canola at Indian Head, Saskatchewan in 2011.

Once again, PLER and LER values were only analyzed for the intercropped. Row-crop configuration had a significant impact on the PLER for both canola (P = 0.002) and field pea (P < 0.001) at Melita in 2011 and also on the overall LER of the intercropped treatments (P < 0.001). In contrast, N fertility level did not affect the PLER of canola (P = 0.110), field pea (P = 0.540) or total yields (P = 0.198); however, the interaction between row crop configuration and N level for canola PLER was significant at P = 0.05 which was similar to the results observed for Indian Head. Despite the significant interaction, inspection of the Tukey's test results for row-crop configuration by N rate did not reveal any distinct patterns (Figure 8). The only significant difference in canola PLER amongst the intercropped treatments was between the alternating row, unfertilized treatment and the mixed row, 100% N fertilizer treatment with the latter treatment having the higher PLER value (0.694 versus 0.374).

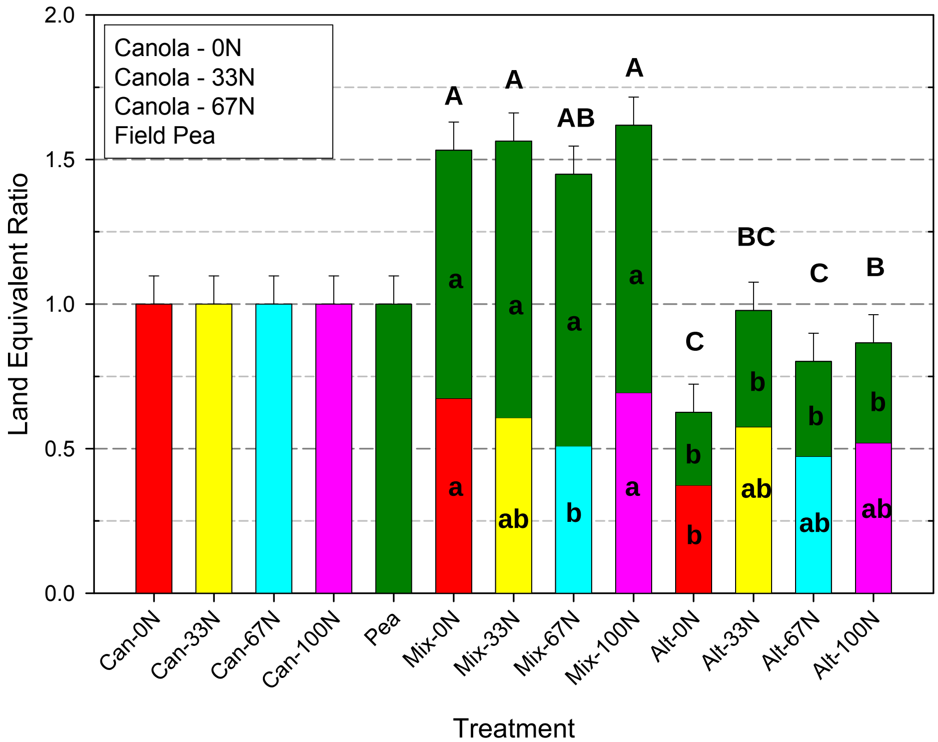

Figure 8. Treatment effects on the Land Equivalent Ratio (LER) for intercropped field pea and canola at Melita, Manitoba in 2011.

Overall, our results indicate that the potential advantages to intercropping field pea and canola are substantial and that producers who are interested in adopting this practice could benefit from doing so. As reported in previous studies, overyielding was observed to at least some degree in the majority of cases with the major exception being the alternating row treatments at Melita. On the heavy clay soils in 2011, LER values ranged from 1.15 in Demonstration #1 to as high as 1.40 in Demonstration #2, suggesting that every hectare of intercropped field pea and canola could produce as much total seed as 1.15-1.40 hectares of land managed using our traditional monocrops. However, this benefit to intercropping did not occur on the Indian Head heavy clay soils in 2010 where the observed LER was only 1.02. On the loam soil south of Indian Head, despite the challenges with weather and relatively low overall yields, the benefits to intercropping were even greater with an overall mean LER of 1.66. At Melita (light loam soil), the wet spring delayed seeding until late May and created stressful conditions for both crops; however an overall benefit to intercropping was still observed with an average LER of 1.18 for all of the intercropped treatments and an LER of 1.54 when the relatively poor alternating row treatments were excluded. The first year of results from this study indicate that pea-canola intercrops may perform better when both crops are planted in every row instead of in alternating rows, despite the ability to target the canola with the applied N fertilizer in the latter configuration. While the benefits to mixed rows were relatively subtle at Indian Head, they were pronounced and highly significant at Melita. With respect to N fertilization, field pea yields were generally unaffected by increasing the N rate while canola responded well to rates that were at least 67% of the recommended rate for pure stands of canola. When alternating rows of field pea and canola and banding all N fertilizer with the canola rows, it may be possible to reduce the applied N rates relative to mixed row plantings or when N fertilizer is applied in a separate pass (ie: fall band or spring broadcast/surface dribble application).

In terms of challenges that producers who are considering intercropping should understand, the first arises in successfully establishing a crop. In order to seed two crops and apply fertilizer in a single pass, a minimum of three compartments in the air cart are required, more if more than one fertilizer blend or a soil placed field pea inoculant is being utilized. While seeding equipment with this capability is becoming increasingly common on the Prairies, in some cases more than one pass may be required to seed both crops and apply all of the required fertilizer. Regardless of whether single pass seeding and fertilization is achievable, consideration must be given to choosing an appropriate seeding depth. A depth of less than 2.5 cm is optimal for canola while field pea seeds are generally placed as deep as 5-7 cm beneath the soil surface. For our study, a compromise was made and all crops were seeded at a minimum depth of 2.5 cm. While this appeared to work reasonably well in the wet springs of 2010 and 2011, at this depth the field peas would be at risk of running out of moisture before germinating if dry conditions were to persist after seeding and the canola may have emerged more evenly and vigorously had it been seeded slightly shallower. In an alternating row configuration, this can be easily rectified by manually adjusting the depth of every second opener on the drill in order to achieve the target depth for each crop. While this is not an option for mixed row plantings, a good solution can be to seed the canola normally and run the field peas through the fertilizer openers, with are generally already about 2.5 cm deeper than the seed openers. The problem that can arise in doing so is that all fertilizer must then be applied in the seed rows which could potentially limit the quantities that can be safely applied during seeding.

Weed control is not a major issue when field peas are grown with Imi tolerant (Clearfield®) canola and options such as trifluralin are available to control a limited spectrum of broadleaf weeds if a canola variety belonging to another herbicide system is preferred. One important factor to consider when choosing a canola variety is days to maturity. Our observation over the past two years has been that the field peas are ready to swath or harvest earlier than the canola and a compromise must be made when choosing a swathing or straight-combining date, generally resulting in the field peas being swathed or desiccated slightly later than optimal and the canola slightly earlier. Choosing a short season canola variety may reduce the overall yield potential (at least in a monocrop situation), but would most likely result in better timing of harvest operations for both crops. Seeding the field peas deeper than the canola with both crops being planted at their optimal depths may also delay emergence of the field pea relative to the canola and help bring the maturity dates of the two crop types closer together. With respect to harvest, either swathing or straight-combining are viable options for field pea-canola intercrops and for combining the machine can more or less be set for field peas with slightly less air to prevent losing too much canola over the top of the sieves. It is often noted that harvesting pea-canola intercrops is easier than pure stands of field pea as the canola helps to keep the field peas up off of the ground. A greater challenge arises after harvest since the two crops can not be stored together indefinitely as field peas are safely stored at moisture content of 16% while the minimum moisture content for canola is 10%. Separating off the combine can be achieved relatively quickly and inexpensively, but does require a modest capital investment for cleaning equipment and an extra auger. In addition, depending on the specific set-up that is utilized and the speed at which cleaning can be achieved, this process could slow down harvest to a certain extent. An alternative option is to put the harvested material directly into the bin and keep it aerated until it can be cleaned; however, this is only a temporary solution and running fans for prolonged periods will result in added expenses that may be avoided by cleaning directly off the combine. In any case, the growers who are seeing benefits to this practice have managed to find innovative ways of dealing with the logistic challenges of intercropping and, if the demonstrated benefits prove large enough and consistent enough to justify the extra management, growers will likely be rewarded for their efforts.

Supporting Information

12. Acknowledgements: Financial support for this project was provided by the Agricultural Demonstration of Practices and Technologies (ADOPT) program and the Saskatchewan Pulse Growers Association. Special thanks are extended to Scott Chalmers (Manitoba Food, Agriculture and Rural Initiatives) and the Westman Agricultural Diversification Organization for their participation and support. In-kind contributions were provided by BASF and Vale Farms. Finally thank you to all technical and summer staff who helped with this project at the different locations.

13. Appendices

Table 5. Analysis of variance (ANOVA) and treatment means for plant densities and seed yields in Demonstration #1 at the Indian Head Heavy Clay site in 2010. Treatment means in the same row followed by the letter do not significantly differ according to Tukey's Studentized Range (HSD) Test ($P \leq 0.05$). Mean land equivalent ratio (LER) values are presented but were not analyzed statistically.

Analysis of Variance / F-test

Effect	*Plant Density*	*Total Seed Yield*
Treatment	**0.001**	**<0.001**
Replicate	**0.637**	**0.221**
R-Square	**0.667**	**0.930**
CV (%)	**15.5**	**6.4**

Least Squares Means

Mono-Crop		**Inter-Crop**		
Canola	***Field Pea***	***Total***	*Canola (2/3 Rate)*	*Field Pea (2/3 Rate)*
Plant Density (plants/m^2)				
74.6 b	**76.5 b**	**102.6 a**	55.3	47.4
Seed Yield (kg/ha)				
2539 c	**3921 a**	**3400 b**	1111	2289
Land Equivalent Ratio				
1.000	**1.000**	**1.024**	0.437	0.587

Table 6. Summary of results (all treatments) for Demonstration #2 at Indian Head in 2011.

	Total Plant Density	Total Biomass	Total Yield
	Analysis of Variance		
Effect	*p-values*		
Treatment	0.001	0.001	<0.001
Replicate	0.582	0.971	0.026
R-Square	0.691	0.688	0.868
CV (%)	11.8	18.5	13.9
	Least Squares Means		
Treatment	*plants* m^{-2}	*kg/ha*	*kg/ha*
01. Canola (0 N)	84 abc	2133 c	949 e
02. Canola (33% N)	74 bc	4489 abc	1598 de
03. Canola (67% N)	67 c	4068 abc	1804 cde
04. Canola (100% N)	63 c	4949 ab	2380 bcd
05. Field Pea (0 N)	82 abc	4413 abc	3001 ab
06. Mixed (0 N)	108 a	4702 ab	2812 abc
07. Mixed (33% N)	87 abc	3893 abc	2824 abc
08. Mixed (67% N)	102 ab	5370 ab	3250 ab
09. Mixed (100% N)	90 abc	6058 a	3500 a
10. Alternating (0 N)	90 abc	3483 bc	2399 bcd
11. Alternating (33% N)	88 abc	4013 abc	2679 abc
12. Alternating (67% N)	90 abc	5517 ab	3128 ab
13. Alternating (100% N)	90 abc	4672 ab	2938 ab
Standard Error	5.9	474.8	206.0
	Contrasts		
Contrast name	*p-values*		
Canola check vs rest	0.028	<0.001	<0.001
Intercrop check vs rest	0.124	0.043	0.014
Mixed check vs rest	0.045	0.468	0.124
Alternating check vs rest	0.888	0.032	0.040
Mixed vs Alternating	0.100	0.095	0.043
Monocrop vs intercrop	<0.001	0.016	<0.001

Table 7. Effects of row-crop orientation (alternating rows of each crop versus mixed rows) and nitrogen fertility on the establishment of field pea and canola at Indian Head in 2011.

	Canola Plant Density	Field Pea Plant Density	Total Plant Density
	Analysis of Variance		
Effect		*p-values*	
Row-Crop (RC)	0.065	0.659	0.081
N Rate (N)	0.352	0.417	0.168
RC x N	0.604	0.382	0.297
Replicate	0.714	0.277	0.295
R-Square	0.420	0.401	0.535
CV (%)	17.3	10.9	9.9
	Least Squares Means		
Row-Crop		*plants* m^{-2}	
Mixed	46.3 a	50.5 a	96.8
Alternating	40.2 a	49.5 a	89.7
Std. Error	2.16	1.57	2.67
Nitrogen Rate			
0 N	46.2 a	52.8 a	99.0 a
33% N	40.1 a	47.3 a	87.4 a
67% N	46.0 a	50.1 a	96.1 a
100% N	40.6 a	49.8 a	90.4 a
Std. Error	3.06	2.22	3.78

Table 8. Effects of row-crop orientation (alternating rows of each crop versus mixed rows) and nitrogen fertility on the above-ground biomass of field pea and canola along with chlorophyll content (SPAD measurements) of canola leaves at Indian Head in 2011.

	Analysis of Variance			
	Canola Biomass Yield	**Pea Biomass Yield**	**Total Biomass Yield**	**SPAD (Canola)**
Effect	-------------------------------- *p-values* --------------------------------			
Row-Crop (RC)	0.100	<0.001	0.109	0.003
N Rate (N)	<0.001	0.049	0.011	<0.001
RC x N	0.477	0.159	0.262	0.942
Replicate	0.683	0.886	0.903	0.540
R-Square	0.758	0.754	0.632	0.761
CV (%)	27.0	17.0	17.8	6.8
	Least Squares Means			
Row-Crop	----------------------- *kg ha^{-1}* -----------------------			*n/a*
Mixed	1807 a	3199 a	5006 a	40.6 b
Alternating	2194 a	2228 b	4422 a	44.8 a
Std. Error	155.8	133.1	241.6	0.84
Nitrogen Rate				
0 N	1057 c	3036 a	4092 ab	37.6 b
33% N	1683 bc	2271 a	3953 b	42.2 ab
67% N	2511 ab	2932 a	5443 a	45.1 a
100% N	2750 a	2615 a	5366 a	46.0 a
Std. Error	220.3	188.2	341.7	1.18

Table 9. Effects of row-crop orientation (alternating rows of each crop versus mixed rows) and nitrogen fertility on the seed yield of field pea and canola at Indian Head in 2011.

	Analysis of Variance		
	Canola Seed Yield	**Field Pea Seed Yield**	**Total Seed Yield**
Effect	---------- *p-values* ----------		
Row-Crop (RC)	0.008	0.002	0.067
N Rate (N)	<0.001	0.424	0.032
RC x N	0.064	0.935	0.711
Replicate	0.998	0.097	0.162
R-Square	0.881	0.619	0.603
CV (%)	13.8	17.6	13.0
	Least Squares Means		
Row-Crop	---------- *kg ha^{-1}* ----------		
Mixed	979 b	2118 a	3097 a
Alternating	1167 a	1620 b	2786 a
Std. Error	42.8	94.8	110.4
Nitrogen Rate			
0 N	617 b	1989 a	2606 a
33% N	1074 a	1678 a	2752 a
67% N	1299 a	1890 a	3189 a
100% N	1302 a	1917 a	3219 a
Std. Error	60.6	134.0	156.2

Table 10. Effects of row-crop orientation (alternating rows of each crop versus mixed rows) and nitrogen fertility on the partial land equivalent ratios (PLER) of field pea and canola and land equivalent ratios (LER) of both crops at Indian Head in 2011.

	Analysis of Variance		
	Canola PLER	**Field Pea PLER**	**LER**
Effect	--------------------------------- *p-values* ---------------------------------		
Row-Crop (RC)	0.003	0.002	0.334
N Rate (N)	0.019	0.429	0.462
RC x N	0.029	0.971	0.415
Replicate	0.022	0.007	0.042
R-Square	0.777	0.697	0.514
CV (%)	11.1	16.8	11.7
	Least Squares Means		
Row-Crop	-------------------- *(Partial) Land Equivalent Ratio* -------------------		
Mixed	0.597 b	0.717 a	1.314 a
Alternating	0.702 a	0.551 b	1.253 a
Std. Error	0.021	0.031	0.043
Nitrogen Rate			
0 N	0.651 ab	0.668 a	1.319
33% N	0.670 ab	0.574 a	1.243
67% N	0.715 a	0.631 a	1.346
100% N	0.563 b	0.662 a	1.225
Std. Error	0.030	0.044	0.061

Table 11. Summary of results (all treatments) for Demonstration #2 at Melita in 2011.

	Total Plant Density	Light Interception	Total Biomass	Total Yield
	Analysis of Variance			
Effect	-------------------------- *p-values* --------------------------			
Treatment	0.015	0.003	0.054	<0.001
Replicate	0.814	0.002	0.060	0.070
R-Square	0.589	0.714	0.572	0.856
CV (%)	19.7	14.7	23.2	17.6
	Least Squares Means			
Treatment	*plants m^{-2}*	*%*	*kg/ha*	*kg/ha*
01. Canola (0 N)	39 a	62 ab	3713 a	909 cd
02. Canola (33% N)	41 a	59 ab	4490 a	1059 cd
03. Canola (67% N)	39 a	66 ab	4265 a	1284 bcd
04. Canola (100% N)	54 a	72 ab	4628 a	1199 bcd
05. Field Pea (0 N)	60 a	85 a	4248 a	1529 abc
06. Mixed (0 N)	65 a	83 a	6354 a	1926 ab
07. Mixed (33% N)	65 a	81 a	5059 a	2033 a
08. Mixed (67% N)	66 a	77 ab	6165 a	2058 a
09. Mixed (100% N)	64 a	84 a	6458 a	2198 a
10. Alternating (0 N)	45 a	50 b	3678 a	720 d
11. Alternating (33% N)	57 a	60 ab	5389 a	1221 bcd
12. Alternating (67% N)	62 a	70 ab	4662 a	1108 cd
13. Alternating (100% N)	53 a	63 ab	4178 a	1132 cd
Standard Error	6.2	6.0	652.1	143.9
	Contrasts			
Contrast name	-------------------------- *p-values* --------------------------			
Canola check vs rest	0.467	0.592	0.330	0.116
Intercrop check vs rest	0.231	0.227	0.576	0.017
Mixed check vs rest	0.977	0.728	0.547	0.314
Alternating check vs rest	0.090	0.046	0.170	0.015
Mixed vs Alternating	0.019	<0.001	0.003	<0.001
Monocrop vs intercrop	0.001	0.527	0.015	<0.001

Table 12. Effects of row-crop orientation (alternating rows of each crop versus mixed rows) and nitrogen fertility on the establishment of field pea and canola at Melita in 2011.

	Canola Plant Density	Field Pea Plant Density	Total Plant Density
	Analysis of Variance		
Effect	-------------------------------- *p-values*	--------------------------------	
Row-Crop (RC)	0.541	0.002	0.013
N Rate (N)	0.051	0.088	0.407
RC x N	0.125	0.717	0.502
Replicate	0.034	0.232	0.502
R-Square	0.649	0.655	0.521
CV (%)	29.4	23.6	15.9
	Least Squares Means		
Row-Crop	------------------------------- *plants* m^{-2}	-------------------------------	
Mixed	23.0 a	42.1 a	65.0 a
Alternating	24.7 a	29.2 b	54.0 b
Std. Error	2.02	2.43	2.73
Nitrogen Rate			
0 N	20.9 a	34.0 a	54.9 a
33% N	18.1 a	42.6 a	60.7 a
67% N	27.3 a	36.9 a	64.2 a
100% N	29.2 a	29.2 a	58.3 a
Std. Error	2.86	3.44	3.87

Table 13. Effects of row-crop orientation (alternating rows of each crop versus mixed rows) and nitrogen fertility on the above-ground biomass of field pea and canola along with percent light interception (PLI) of crop canopies at Melita in 2011.

	Analysis of Variance			
	Canola Biomass Yield	**Pea Biomass Yield**	**Total Biomass Yield**	**Canopy Light Interception**
Effect	------------ *p-values* ------------			
Row-Crop (RC)	0.433	0.004	0.012	<0.001
N Rate (N)	0.225	0.749	0.957	0.646
RC x N	0.048	0.668	0.238	0.269
Replicate	0.084	0.409	0.251	0.100
R-Square	0.608	0.542	0.541	0.709
CV (%)	27.3	32.5	24.8	15.3
	Least Squares Means			
Row-Crop	------------ *kg ha^{-1}* ------------			*%*
Mixed	2461 a	3548 a	6009 a	81.6 a
Alternating	2249 a	2228 b	4477 b	60.5 b
Std. Error	185.3	271.2	374.6	3.14
Nitrogen Rate				
0 N	1934 a	3082 a	5016 a	66.5 a
33% N	2391 a	2831 a	5223 a	70.6 a
67% N	2340 a	3074 a	5413 a	73.7 a
100% N	2754 a	2564 a	5318 a	73.4 a
Std. Error	262.1	383.5	529.8	4.44

Table 14. Effects of row-crop orientation (alternating rows of each crop versus mixed rows) and nitrogen fertility on the seed yield of field pea and canola at Melita in 2011.

	Canola Seed Yield	Field Pea Seed Yield	Total Seed Yield
	Analysis of Variance		
Effect	p-values		
Row-Crop (RC)	0.015	<0.001	<0.001
N Rate (N)	0.014	0.608	0.094
RC x N	0.114	0.953	0.536
Replicate	0.004	0.116	0.237
R-Square	0.771	0.900	0.898
CV (%)	17.9	21.1	15.2
	Least Squares Means		
Row-Crop	*kg ha^{-1}*		
Mixed	667 a	1387 a	2054 a
Alternating	544 b	501 b	1045 b
Std. Error	31.4	57.6	68.0
Nitrogen Rate			
0 N	469 b	854 a	1323 a
33% N	619 ab	1008 a	1627 a
67% N	626 ab	957 a	1583 a
100% N	708 a	957 a	1665 a
Std. Error	44.3	81.4	96.2

Table 15. Effects of row-crop orientation (alternating rows of each crop versus mixed rows) and nitrogen fertility on the partial land equivalent ratios (PLER) of field pea and canola and land equivalent ratios (LER) of both crops at Melita in 2011.

	Analysis of Variance		
	Canola PLER	**Field Pea PLER**	**LER**
Effect	-------------------------------- *p-values* --------------------------------		
Row-Crop (RC)	0.002	<0.001	<0.001
N Rate (N)	0.110	0.540	0.198
RC x N	0.052	0.985	0.407
Replicate	0.042	0.093	0.110
R-Square	0.740	0.882	0.898
CV (%)	15.6	23.3	14.3
	Least Squares Means		
Row-Crop	------------------- *(Partial) Land Equivalent Ratio* -------------------		
Mixed	0.621 a	0.919 a	1.541 a
Alternating	0.486 b	0.332 b	0.818 b
Std. Error	0.024	0.042	0.049
Nitrogen Rate			
0 N	0.524 a	0.555 a	1.079 a
33% N	0.592 a	0.679 a	1.271 a
67% N	0.492 a	0.634 a	1.126 a
100% N	0.607 a	0.635 a	1.242 a
Std. Error	0.035	0.060	0.069

14. Abstract / Summary: Farmers on the Prairies and research demonstrations alike have reported considerable benefits to growing more than one crop simultaneously on the same piece of land, or intercropping. For annual crop mixes, field pea and canola are two species that appear to grow reasonably together well and, with Imi tolerant (Clearfield®) canola varieties there are good weed control options available for this mix. Research demonstrations were initiated on contrasting soils in Saskatchewan and Manitoba to demonstrate and evaluate the potential merits and/or pitfalls of field pea-canola intercrops and to improve our ability to grow these two crops together successfully. Overall in 2011, these demonstrations showed a considerable yield advantages to intercropping, with overyielding occurring in the majority of possible cases and an overall land equivalent ratio (LER) of 1.343 when all possible sites were considered. At this time, the relative profitability of field pea-canola intercrops to pure stands has not been assessed. While there are some added costs associated with intercropping, they are relatively minor and the major impediments to adoption going forward are more likely to be due to logistic challenges rather than financial restraints. Aside from potential modifications to seeding equipment and a one time investment in cleaning equipment, the only added variable cost of intercropping comes from the process of separating the grain after harvest. Previous profit analysis of the 2010 data from Indian Head indicated that the cost of cleaning was inconsequential and profits closely mimicked the total yields of the treatments. Generally speaking, whenever overyielding is occurring the potential for higher profits is there. These demonstrations will be continued at all sites in 2012.

14. Budget Information:

Table 16. Budget information for ADOPT Project #20100292: Exploring the merits of field pea-canola intercrops for improved yield and profit.

	Year 1 ($)	Year 2† ($)	Year 3 ($)	Total ($)
Salaries and Benefits				
Students	1,500	1,500		3,000
Postdoctoral / Research Associates	1,500	1,500		3,000
Technical / Professional Assistants	2,500	2,500		5,000
Consultant Fees & Contractual Services	0	0		0
Rental Costs				
Land Rental	500	500		1,000
Materials / Supplies	1,500	1,500		3,000
Project Travel				
Field Work	500	500		1,000
Collaborations / Consultations	0	0		0
Other				
Field Day	1,000	1,000		2,000
Administration	1,000	1,000		2,000
Total	**10,000**	**10,000**	–	**20,000**

†Year 2 of ADOPT funds not yet allocated at time of reporting

Funding allocated to salaries and benefits applies to students hired to assist with data collection, technical staff to perform field operations and data collection activities and research associates to manage local activities for each site, compile and analyze data and report on activities. Rental costs are designated towards land rental / payment for demonstration sites while materials and supplies include all research supplies (ie: bags, tags and flags) and crop inputs along with maintenance/replacement costs of field and laboratory equipment. The only project travel funds allocated were designated to travel to and from field sites with vehicles and equipment. Additional funds were requested to help cover general costs associated with hosting the IHARF Crop Management Field Day in July and the IHARF Soil and Crop Management Seminar in February and an overall administration fee of ten percent of the total ADOPT funding allocated was applied.

Intercropping Pea and Canola under multiple row configuration and nitrogen rates

Introduction

Intercropping is the agricultural practice of cultivating two different crops in the same place at the same time (Andrews & Kassam 1976). In nature, plant species rarely are found as soul members in a population but rather are usually found as a diverse mix of different species (personal observation). Benefits of intercropping can lead to greater than expected yields compared to the sole crop. Reasons for additional yield may be the result of greater efficiency in the use of nutrients, light and water (Szumigalski & Van Acker 2008). Intercropping may improve pest control and provide structural support advantages when compared to each being grown as a sole crop. Intercropping is not a new concept and has been used by farmers for generations. However, recent improvements in farm machinery and individual variety characteristics and herbicide tolerance have once again tweaked producer's interests in intercropping.

Often, intercropping is not only measured by total yield of products, but as a total economical value (total $/acre) by combining each crop value, or by Land Equivalent Ratio (LER). The LER is a measure of how much land would be required to achieve intercrop yields with crops grown separately as pure stands. When the LER is greater than 1.0, over-yielding is occurring and the intercrop is more productive than the component crops grown as sole crops. When the LER is less than 1.0, no over-yielding is occurring and the sole crops are more productive than the intercrop. For example; a LER rating of 1.20 from an intercrop of pea-canola means it would take 20% more land to equal that final yield if each crop was planted as separate components.

Architectural design of intercrop fields to improve nutrient and light and production efficiency were investigated in this trial based on nitrogen rate and nitrogen-to-row placement. Row-to-crop arrangement was modified to observe crop responses. Nutrient efficiency focused on applied nitrogen within only the canola rows, while row arrangement of the individual crops (single, double, or mixed in the rows) was modified to determine the effect of row arrangement and crop-nitrogen responses. It is speculated that if inoculated peas can be starved of applied nitrogen by dividing to specific individual crop rows, the crop will be less likely to become in-efficient in its "fixing" of nitrogen. Therefore, improving the efficiency of the pea-canola system as a whole by having dedicated rows of each individual crop; compared to mixing everything together should provide even better economic results. In addition, dividing rows into individual crops will partition applied nitrogen to exclusively the canola rows where it will be better used economically. For example: a field of alternating rows of pea and canola, with canola rows only fertilized with nitrogen, could possibly result in a positive LER and yet use only half the nitrogen fertilizer compared to what is used in a monocrop or fully mixed field of canola or peas. The concept may even improve further by moving to double sets of alternating rows.

In 2009, WADO conduced a trial investigating the effects of pea and canola plant density on one another. Results indicate as expected that the higher the seeding rate for one crop over the other will favour grain production due to increased competition. Large grain production responses were found in all intercropping treatments compared to their soul crop components i.e., canola or pea grown by itself. The real question was; Why is it doing this? Was it better water use, something to do with light use, or was it better use of nutrients?

In 2010, WADO tried to understand the nutrient question a little more as well as attempt make canola and pea more efficient in utilizing and converting their nutrients better by dividing rows into individual crops. Canola received all the applied nitrogen while pea rows did not. Results were inconclusive since canola yields were statistically similar for all treatments despite changes in row orientation and applied nitrogen rates. Peas on the other hand were more responsive to row orientation and the effects of nitrogen applied to the canola rows relating likely to greater competition from canola on pea. Results were still stuck on weather row orientation or nitrogen rates were to blame.

Results from Indian Head, SK and Melita, MB (second study) in 2011, indicate that both row configuration and nitrogen applications played roles in their effect on intercropping performance. At Indian Head site, canola yields were favored by alternate rows, whereas pea yields were favored by mixed rows. Pea yields were not affected by N rates, whereas canola yields are. In Melita, intercropping configurations were favorable compared to monocrop treatments, specifically favoring mixed row configurations compared to alternate row configurations. As well, Melita peas were sensitive to row configuration but not nitrogen application.

In 2011, a trial was set up to understand nitrogen dynamics when comparing mixed, single, double and triple row intercropping scenarios compared to mono crop components. This was an attempt to better explain the results from the 2010 Melita experiments. Unfortunately, flooding inflated error into the results. However there were some trends to pay attention to. A yield advantage was achieved for mixed row intercropping only compared to all other options. A separate trial in cooperation with the Indian Head Agricultural Research Foundation was also planted with had a slightly different twist than the previous trial. Results in this report will be concerned with the previous study.

It was hypothesized that double row configurations would be most efficient with respect to canola-nitrogen use while preserving the physical interaction of pea and canola side by side. It is speculated that mixed row configurations would be less efficient with nitrogen use, as peas would become lazy in the presence of applied nitrogen, and would rather from canola, than fix their own. The triple row configuration would be less efficient as an intercropping system with the only reason being there would be fewer physical pea-canola crop interactions (light, water use, nutrient use)
Trial Main Objectives:

1. Observe and quantify effect of row configuration on component crop yield of pea and/or canola
2. Evaluate the response of nitrogen application in canola rows and its effect on component canola and pea yields
3. Evaluate the relationship between percent light interception to land equivalent ratios in pea-canola intercrop

Methods

Previous crop established in 2010 was spring wheat. Plot stubble was maintained with a spring harrow operation to deal with excess straw. On May 18 plot are was then sprayed with herbicides Rival (0.57 L/ac), Credit (2 L/ac) and Liberty (0.75 L/ac) tank mixed then sprayed with a water volume application rate of 10 gal/ac. Plots were seeded with a SeedHawk dual knife single side band plot seeder on May 19 near Melita MB on a Lagvale sandy loam (SW 8-4-26 W1). Six rows at 9.5” spacing were planted twice to result in a single plot 2.88 m wide by approximately 8.5 meters long. Plots were land rolled after seeding. Seed was placed ¾” below the furrow surface base. Fertilizer was side band 1” below and beside the seed. Crop treatments are as outlined in Table 1.

Table 1. Trial treatment descriptions with their corresponding row orientation, seeding rate, nitrogen fertility level in both the canola row and overall field (plot) area including peas.

Trt	Crop/Row Orientation	Crop Row and Nitrogen Placement Arrangement* (underscore = row gap)	Nitrogen Rate (lbs/ac)		Seeding Rate (lbs/ac)	
			Canola Row Equivalent	Overall Field	Canola	Pea
1	Peas Monocrop (Check)	P_P_P_P_P_P	0	0		221
2	Peas Monocrop	Pn_Pn_Pn_Pn_Pn_Pn	0	90		221
3	Canola Monocrop (Check)	CN_CN_CN_CN_CN_CN	90	90	5	
4	Canola Monocrop	Cn_Cn_Cn_Cn_Cn_Cn	45	45	5	
5	Canola Monocrop	CNN_CNN_CNN_CNN_CNN	180	180	5	
6	Peas & Canola Mixed	CnP_CnP_CnP_CnP_CnP_CnP	45	45	2.5	110
7	Peas & Canola Mixed	CNNP_CNNP_CNNP_CNNP_CNNP_CNNP	180	90	2.5	110
8	Peas & Canola Single Rows	CN_P_CN_P_CN_P	90	45	5	
9	Peas & Canola Single Rows	CNN_P_CNN_P_CNN_P	180	90	5	
10	Peas & Canola Double Rows	CN_CN_P_P_CN_CN_P_P	90	45	5	
11	Peas & Canola Double Rows	CNN_CNN_P_P_CNN_CNN_P_P	180	90	5	
12	Peas & Canola Triple Rows	CN_CN_CN_P_P_P	90	45	5	
13	Peas & Canola Triple Rows	CNN_CNN_CNN_P_P_P	180	90	5	

*P= Peas, C= Canola, n=45 lbs/ac Nitrogen, N=90 lbs/ac Nitrogen, NN=180 lbs/ac Nitrogen

Target seeded plant stand for canola was 100 p/m2 in the monocrop treatments. Variety 71-40 CL (Monsanto) was used. For peas, variety CDC Striker was used with a target seeded plant density of 75 p/m2.

Table 2: Spring pre-seed soil test. Sampled May 11th, across entire trial area.

Nutient	N	P	K	S
Depth	lbs/ac	Olsen ppm	ppm	lbs/ac
0-6"	10	18	229	6
6-24"	21			18
0-24"	31			24

All plots received 58 lbs/ac of granular 11-52-0 (MAP). Additional nitrogen was supplied by 28-0-0 (UAN liquid solution). Only canola or pea monocrop treatments and canola intercrop rows received applied nitrogen. This was accomplished by the use of ball valves located along fertilizer distribution lines, turned on when nitrogen was applied and turned off when denied to the pea rows. Fertilizer applications were pre-calibrated depending on the treatment being seeded so that applications between treatments would be pre-determined as outlined in Table 1. Peas were inoculated with proper Rhizobium (granular Nodulator®, Becker Underwood) applied at 5 lbs/ac and were not fertilized with additional nitrogen unless in mixed rows with canola (trt 6&7), or treatment 2 (check). Plots were kept weed free using a single application of Odyssey herbicide applied at 17 g/ac (plus Merge adjuvant) at a water spray volume of 20 gal/ac, when both crops reached three nodes of plant growth.

Data collected from plots included plant emergence (4 counts in 1 meter of row of each crop per plot), yield, grain moisture, and percent light intercepted. Percent light interception was measured with a Li-Core LI-191 quantum light senor (1 m long) on July 2. Crop stage during observation was approximatlety late flower. The probe was place under the crop canopy perpendicular to the seed row direction. Two measurements above the canopy and four measurements below canopy were observed per plot. Only the inside 8 rows of the plot were taken into account. Light units were µmoles s^{-1} m^{-2} for each reading measuring photosynthetic active radiation (PAR). Percent light intercepted (PLI%) was calculated as follows:

PLI% = [mean above canopy PAR / mean below canopy PAR] x 100

Plot were dessicated with Reglone herbicide at a rate of 0.91L/ac at maturity (canola reached 70% seed color change) applied August 19. Plots were harvested September 6 with a hege plot combine set to normal canola harvest settings. No shattering was present at harvest. Grain sample components were separated into individual crops. Final grain yield was calibrated to a final grain moisture content of 16% for peas and 10% for canola. Final grain yields were also converted to partial land equivalent ratios (PLER) for peas and or canola, which were combing into a total land equivalent ratio value using the following equation:

Total LER = Ia/Sa + Ib/Sb = partial LER peas + partial LER canola

Where total LER is the total Land Equivalent Ratio, I is the intercrop yield (in the rep), S is the sole crop yield (of the rep), and a and b refer to the crop components.

Data was analyzed with a two-way analysis of variance (ANOVA) using Analyze-it version 2.03 (Microsoft) statistical software. Coefficient of variation (CV%) was determined and Fisher's unprotected Least Significant Difference (LSD) at the 0.05 level of significance was calculated if the ANOVA was significant. P values were also included to illustrate the degree of statistical significance.

Results

Plant Density

There were highly significant differences in individual crop and total crop plant density (Table 3). This is not surprising as seeding rates were cut in half in mixed row treatments compared to all other treatments when comparing target seeding density within the seeded row. Other row orientations such as single, double and triple rows are responsible for artificially modify plant density in a given area, even though target plant-row densities would essentially were intended to be equal. These results simply show methods for plot establishment were on track despite the high coefficient of variation values (CV%).

Grain Yield & Land Equivalent Ratio

There were significant differences among treatments among yield of both individual crop components and total crop components (Table 3). In pea, here was little response to applied nitrogen except in the monocrop treatments when comparing within row orientation, despite a trend that peas increased yield with increase nitrogen application among row orientations. In general, intercrop peas yielded less than monocrop peas. Among the intercrop treatments, mixed row peas were superior to single, double and triple row peas. Usually in nitrogen response trials in peas, there is little response to applied nitrogen due to the majority of the nitrogen demand being supplied by rhizobial fixation. In canola, there was no significant difference in nitrogen response in monocrop treatments. In intercrop treatments, canola yielded less overall compared to the monocrop canola and appeared to benefit as row orientation shifted from single to double to triple rows, possibly due to nitrogen being more pertinent to those canola rows than pea rows nearby (Figure 1).

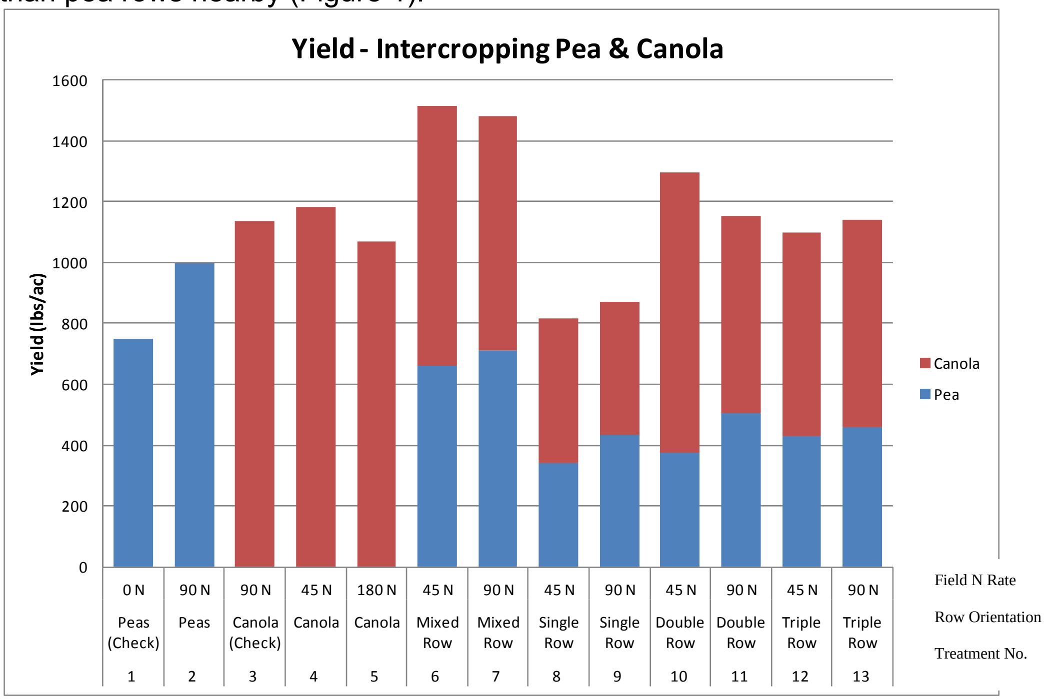

Figure 1: Total grain yield of crop components in monocrop and intercrop pea canola treatments under various row orientations and various field nitrogen rates.

Land Equivalent Ratios generally follow a similar result as did yield values but with greater smoothness (Figure 2). Mixed row orientation intercropping treatments illustrated superior over yielding characteristics compared to all treatments and were paired nearly identical despite the sizeable difference in applied nitrogen rate. Other than single row orientation intercrop treatments, all other treatments resulted in a land equivalent ratio greater than 1.00. Total LER generally increased in order of row orientation shifting from single to double to triple rows likely, again, due to nitrogen resources being used more efficiently by canola as those rows were grouped together in greater frequency and plant density.

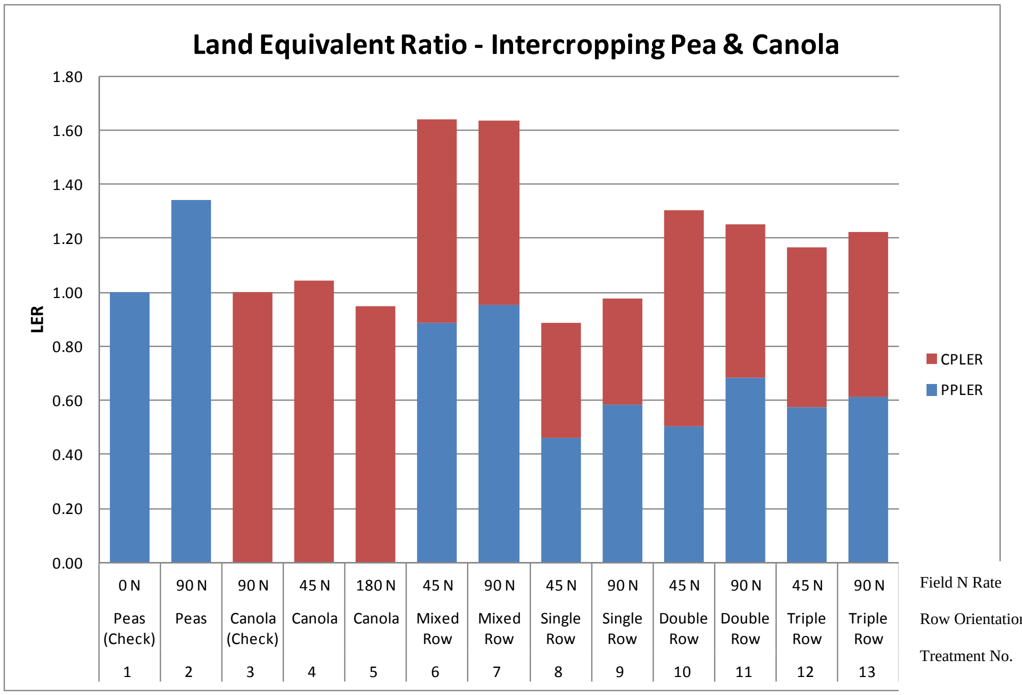

Figure 2: Total land equivalent ratio of crop components in monocrop and intercrop pea canola treatments under various row orientations and various field nitrogen rates.

Table 3: Percent light interception, plant density, grain yield and grain land equivalent ratio of pea and canola row orientation in monocrop and intercrop scenarios under various nitrogen rates within canola rows and overall field.

Trt	Crop/Row Orientation	Nitrogen Rate (lbs/ac)		Percent	Plant Density (p/m2)			Yield (kg/ha)			Land Equivalent Ratio		
		Canola Row Equivalent	Overall Field	Light Interception	Peas	Canola	Total	Pea	Canola	Total	PPLER	CPLER	TLER
1	Peas Monocrop (Check)	0	0	51	55.2	-	55.2	750	-	750	1.00	-	1.00
2	Peas Monocrop	0	90	75	60.0	-	60.0	997	-	997	1.34	-	1.34
3	Canola Monocrop (Check)	90	90	55	-	34.2	34.2	-	1135	1135	-	1.00	1.00
4	Canola Monocrop	45	45	55	-	45.5	45.5	-	1181	1181	-	1.04	1.04
5	Canola Monocrop	180	180	44	-	35.9	35.9	-	1069	1069	-	0.95	0.95
6	Peas & Canola Mixed	45	45	57	29.7	22.8	52.4	661	855	1515	0.89	0.75	1.64
7	Peas & Canola Mixed	180	90	66	34.8	21.0	55.9	712	770	1481	0.95	0.68	1.63
8	Peas & Canola Single Rows	90	45	48	19.7	14.0	33.6	343	475	818	0.46	0.43	0.89
9	Peas & Canola Single Rows	180	90	49	18.1	9.1	27.3	433	440	873	0.58	0.40	0.98
10	Peas & Canola Double Rows	90	45	52	30.0	21.4	51.4	374	924	1297	0.50	0.80	1.30
11	Peas & Canola Double Rows	180	90	51	21.9	11.0	32.9	506	649	1155	0.68	0.57	1.25
12	Peas & Canola Triple Rows	90	45	50	38.8	29.0	67.8	431	666	1097	0.57	0.60	1.17
13	Peas & Canola Triple Rows	180	90	60	36.2	20.4	56.7	458	685	1142	0.61	0.61	1.22
			CV%	20.1	21.6	28.5	20.9	16.9	23.7	17.4	17.9	23.0	16.0
			LSD (p<0.05)	NS	12.8	11.7	16.5	164	325	327	0.23	0.28	0.32
			Grand Mean	55	34.4	24.0	46.8	566	804	1116	0.76	0.71	1.19
			P value	0.1188	<0.0001	<0.0001	0.0004	<0.0001	0.0008	0.0014	<0.0001	0.0006	0.0004
			R-squared	0.67	0.85	0.82	0.75	0.89	0.73	0.71	0.88	0.75	0.77

Light Interception

There were no significant differences with percent light interception among all treatments (Table 3). Calculation using a Pearson correlation test correlated percent light interception with total grain yield ($p=0.0206$, $r=0.37$) total land equivalent ratio ($p<0.0001$, $r=0.60$) and total plant density ($p=0.0006$, $r=0.53$). Overall those treatments that were higher in overall plant density tended to intercept more light, generally related to greater total yield and greater land equivalent ratio.

Discussion

Typical nitrogen responses in canola monocrops were lacking and likely due to excess moisture conditions denitrifying and leaching nitrogen, while plants were stalling plant growth in water logged soils. Mixed row appeared to be the superior intercrop situation regardless of nitrogen rate. This may be due to a greater competition for resources such as moisture, when soil moisture conditions during establishment were far beyond access (~300% normal precip). Perhaps mixed rows were able to dry soils more efficiently to resume normal growth when others were still dealing with waterlogged soils.

A greenhouse study by Cortes-Mora et al. 2010 showed that common vetch and faba beans were responsible in transferring significant amounts fixed nitrogen to cabbage and rapeseed by amounts as large as 7.8 and 12% also leading to greater dry matter weight in those *Brassica* types as well as modification in root zone development compared to *Brassica* monocrops. That study may also explain why row orientation favoured yield in the mixed row situation compared to separating crop by individual rows. That is, perhaps canola to pea root interactions were more frequent and transferred greater amounts of fixed nitrogen from pea to canola. Perhaps a similar study performed by Cortes-Mora et al. 2010 should be applied to the canola-pea intercrop scenario.

Recent Producer adoption has shown great promise. Whetter D., 2011 observed in his field near Hartney, MB greater water use in intercrop field than in an adjacent field of monocrop canola, who also experienced unprecedented spring rain fall conditions. He also reported greater total yield in intercrop pea-canola than in monocrop canola fields. Van de Velde S., 2011 near Mariopolis, MB found greater yields as well in intercrop fields. This producer also swathed the crop with ease reporting little risk with both shatter issues and windrow blowing. Berlot T. 2011 near Winnipeg observed that when crop components are separated great amounts of storage volume was needed by 19% in order to store these crop separated compared to together. This would indicate that when samples are mixed (according to his sample ratio) there would be a 19% difference in bushel weight intercrop samples compared to their monocrop samples. An additional storage savings could be obtained if both samples are very dry and storable. Keeping this in mind, pea-canola samples may still spoil in storage even if both crop components are at maximum moisture levels as soul crops (Pea 16.0%, canola 10.0%). Producers should keep this in mind when storing these crops together.

Research with intercrop will continue in 2012 with WADO investigating the same trial. Once solid results are obtained, future research may dwell into topdressing nitrogen under specific intercropping situations in order to further partition nitrogen application within pea field, creating a more efficient pea (at fixing nitrogen) while responding to the nitrogen demand of canola slightly later than applications made at seeding (that may be less efficient when peas are intercropped).

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Camelina, Calendula, and Hairy Vetch Herbicide Screening Demonstration

Objective
To observe and record crop responses to pre and post emergent herbicides in Camelina, calendula and hairy vetch.

Background

The Westman Agricultural Diversification Organization has been working for several years now with Camelina, calendula and hairy vetch. There has been little available research and publication on herbicides that are available for weed control in these crops. WADO decided to screen some known and suspected herbicides as well as some burn-off tank mix products with glyphosate to understand their efficacy in these crops.

Methods

Seeded area was pre-treated with an application of 1 L/ac glyphosate July 29. All pre-emergent chemicals were applied the same day but after the seeding operation. Post emergent chemicals were appled after full emergence on Aug 17. In camelina, emergence was assessed Aug 24 only. Camelina, calendula and hairy vetch were seeded at ½" depth at rates of 6 lba/ac, 12 lbs/ac, and 35 lbs/ac, respectively. Table 1 summarizes the chemicals, timing, and rates according to each crop. Plots were assessed for emergence and pre-herbicicide application plant damage on August 16. Plants were counted in 1 meter of row six times for camelina and hairy vetch, and 8 times for calendula. Average plants per meter square was calculated from plant count means. Photos were taken September 22 of the plot progress (available upon request), and a plant damage rating was estimated.

Table 1: Pre-seed and post emergent herbicides used in calendula, camelina, and hairy vetch.

Calendula			
TRT	Herbicide	Preseed Rate	Post Emergent Rate
1	Check	-	-
2	Authority	100 mL/ac + Glyphosate	-
3	Assert	-	0.67 L/ac + pH adjuster 16.6 g/1 gal
4	Muster	-	12 g/ac + Agral90 @ 0.2 L/100L
5	Everest	-	11.5 g/ac + Agral90 @ 0.25 L/100L
6	Authority + Assert + Muster	100 mL/ac + Glyphosate	as above
7	Rival	0.5 L/ac + 1 L/ac Glyphosate	-
8	Heat	10 g/ac + 1 L/ac Glyphosate	-

Camelina			
TRT	Herbicide	Preseed Rate	Post Emergent Rate
1	Check	-	-
2	Pursiut (full)	-	85 mL/ac + Agral90 @ .25L/100L
3	Pursiut (half)	-	40 mL/ac + Agral90 @ .25 L/100L
4	Heat + Glyphosate	10.4 g/ac + 1L/ac Glyphosate	-
5	Cleanstart + Glyphosate	20 mL/ac + 1L/ac Glyphosate	-
6	SpikeUp + Glyphosate	4 g/ac + 1L/ac Glyphosate	-
7	Odyessy	-	17 grams/ac + Merg @ 0.5 L/100L
8	Rival	0.5 L/ac + 1 L/ac Glyphosate	-
Hairy Vetch			
TRT	Herbicide	Preseed Rate	Post Emergent Rate
1	Check	-	-
2	Pursuit	-	85 mL/ac + Agral90 @ .25L/100L
3	Odyessy	-	17 grams/ac
4	Basagran	-	0.91 L/ac
5	Bromoxynil	-	0.4 L/ac
6	Authority	100 mL/ac (preseed)	-
7	2,4-D Amine 500	-	0.3 L/ac

Results

Calendula

There were some obvious responses to herbicides in calendula. Plant emergence appeared to be affected by Authority, and possibly Heat herbicides. Plant damage was most apparent by use of Authority or in combination with Muster. Despite poor emergence in the Everest plot initially, emergence counts were taken prior to herbicide application, indicating there is appreciable plant safety to using this product in crop for weed control. Muster also applied after emergence counts were taken showed some growth abnormalities. Observation on Sept 22, indicated that Everest was the cleanest weed free plot compared to all other treatments, but may have delayed flower. Use of Rival, Heat, Everest, and Assert herbicides appear successful, and may warrant further crop safety field trials if this crop becomes successful in the market place.

Calendula						
TRT	Herbicide	Date of Emergence	Plant Emergence (p/m^2)	Plant Emergence St. Dev.	Aug 16 % Plant Damage	Sept 22 % Plant Damage
1	Check	06-Aug-11	33	26	0	0
2	Authority	08-Aug-11	5	10	30	40
3	Assert	07-Aug-11	22	21	0	0
4	Muster	05-Aug-11	4	5	0	30
5	Everest	06-Aug-11	4	10	0	0
6	Authority + Assert + Muster	07-Aug-11	2	2	30	50
7	Rival	07-Aug-11	33	25	0	0
8	Heat	07-Aug-11	16	18	0	0

Camelina

Despite the use of several pre-emergent herbicides there were no obvious visual differences on date of emergence. Plant emergence and plant damage was assessed

August 24 and illustrated that most all herbicides except Rival showed some degree of plant loss or damage.

Camelina						
TRT	Herbicide	Date of Emergence	Plant Emergence (p/m^2)	Plant Emergence St. Dev.	Aug 24 % Plant Damage	Sept 22 % Plant Damage
1	Check	2-Aug-11	46	12	0	0
2	Pursiut (full)	2-Aug-11	2	3	90	95
3	Pursiut (half)	2-Aug-11	1	2	90	95
4	Heat + Glyphosate	3-Aug-11	17	16	60	50
5	Cleanstart + Glyphosate	3-Aug-11	21	17	70	50
6	SpikeUp + Glyphosate	3-Aug-11	36	18	50	20
7	Odyessy	3-Aug-11	6	14	100	95
8	Rival	3-Aug-11	54	11	0	0

Hairy Vetch

There as obvious plant damage by 2,4-D Amine 500 and Bromoxinyl that was more or less expected to happen, however there was no definite value to those injuries established in literature. Use of hairy vetch in cover crops will lead to the use of chemical in crop to control or suppress this crop as if it were a weed. As expected as well, use of Pursuit, Odyessy, Authority, and Basagran were relatively safe, with Odyessy causing some stunting late in growth (15% on Sept 22).

Hairy Vetch						
TRT	Herbicide	Date of Emergence	Plant Emergence (p/m^2)	Plant Emergence St. Dev.	Aug 16 % Plant Damage	Sept 22 % Plant Damage
1	Check	05-Aug-11	97	48	0	0
2	Pursuit	05-Aug-11	112	44	0	0
3	Odyessy	05-Aug-11	76	24	0	15
4	Basagran	07-Aug-11	61	29	0	0
5	Bromoxynil	05-Aug-11	15	16	70	75
6	Authority	05-Aug-11	70	21	0	0
7	2,4-D Amine 500	06-Aug-11	26	16	80	100

Photos: (Left) Plot of weeds left to grow shows type of pressure crops were dealing with. Notice control in calendula plot in the left-top side (treatment 6). Photo (right) illustrates used of Everest in Calendula, note cleanliness of plot.

Seeding Depth Demonstration of Camelina, Canola, and Flax

Background

The excess moisture during the spring of 2011 presented many seeding issues for producers. For many, a crop must get into the ground in order to generate much needed revenue, however heavy implements such as seed drills often get stuck in the muck. For some crops, it is possible to broadcast (via Valmar or airplane) on the soil surface and lightly incorporate the seed with an implement such as a harrow bar or rotary harrow in order to achieve proper seed-to-soil contact. Oilseeds such as camelina, canola and flax have been successfully seeded by these means to produce a viable crop in these conditions.

A demonstration was initiated in June to demonstrate and measure the effectiveness of broadcast-incorporation compared to seeding at other deeper depths with canola, camelina and flax. Date of emergence and plant density were evaluated and recorded.

Methods

Plots 1.44 m wide by 8 meters long were seeded June 16 on a sandy loam on SE-18-4-26 W1. Crops were placed as plot reps with seeding depth increasing from east to west. A SeedHawk dual knife system was used to seed the plots. This system allows seeding depth to be accurately positioned and quickly switched by the placement of a pin. Plots were sideband with 70 lbs/ac nitrogen and 30 lbs/ac phosphorus. Varieties used for camelina, canola, and flax included Calena, 71-40 CL, and AC Sorrel, respectively. Seeding rates for camelina, canola and flax were 7 lbs/ac, 5 lbs/ac, and 33 lbs/ac, respectively.

Seeding depths were as follows:

1. broadcast
2. broad + chain behind
3. broadcast + land roller
4. 3/8"
5. 0.5”
6. 0.75”
7. 1”
8. 1.25”
9. 1.5”

Date of emergence, plant density, and plant stand were observed and recorded.

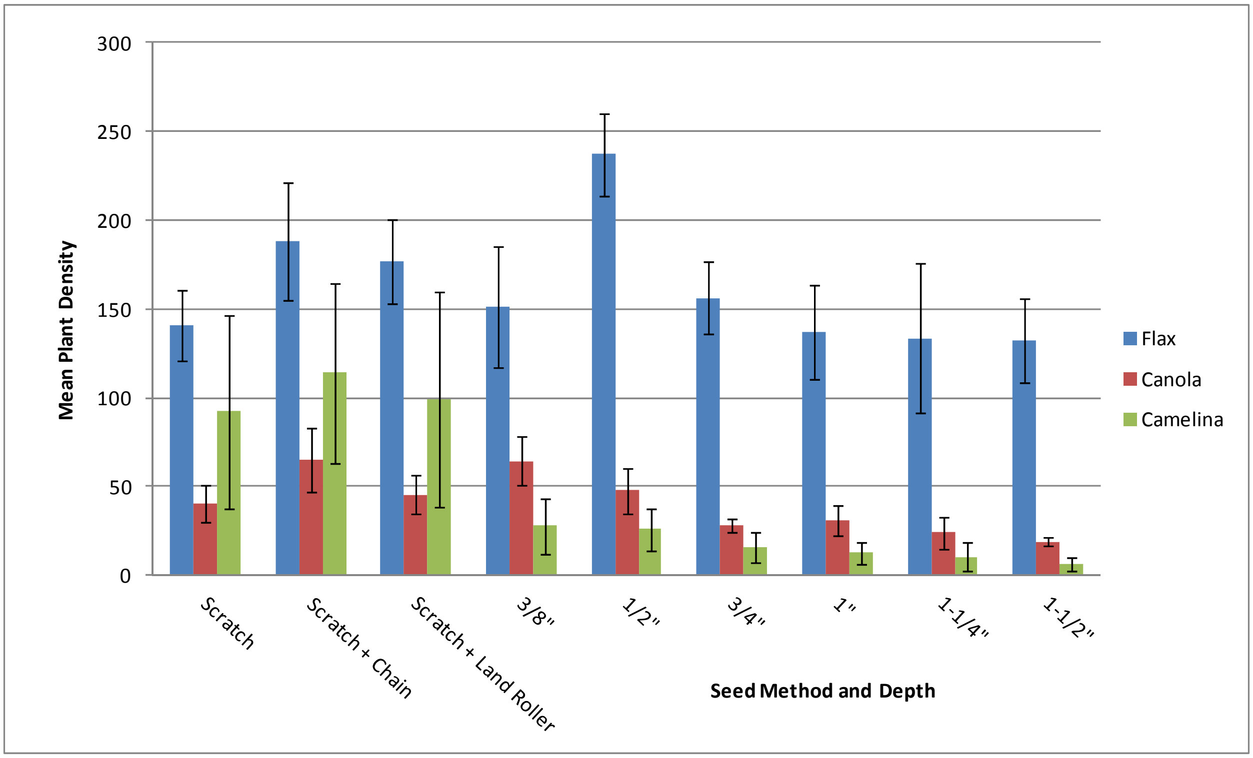
Results

Emergence was observed as a greater delay as seeding depth deepened. Camelina was the most sensitive taking over 12 days to emerge at the deepest seeding depth compared to only 5 days when scratched in. Flax and canola emerged relatively the same among crops and generally ranged from 3 to 9 days as depths got deeper.

Observed Days for Full Emergence after Seeding

	Scratch	Scratch + Chain	Scratch + Land Roller	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"
Flax	3	3	3	4	5	6	6	7	8
Canola	3	3	3	5	5	6	6	7	9
Camelina	5	6	6	7	8	8	9	12	12

Final plant density varied by crop. Flax was most resilient in final plant density despite the depth planted. Canola and Camelina were the most sensitive to planting depth with heavy reductions past ½" seed depths. Camelina greatly favored scratching in seed compared to drilling even at greater and including 3/8" depths.



Despite plant desity, the plant stand branched out and was able to fill in some of the gaps in the canopy. Observed plant stand values showed a similar trend as days to emergence and plant desity, that is, as depths deepen, plant stand reduces. Camelina was the least able to recover from low plant stands with only 10% being left at deep depths, while scratched plots were generally showing a decent stand.

Plant Stand @ Full Emergence

	Scratch	Scratch + Chain	Scratch + Land Roller	3/8"	1/2"	3/4"	1"	1-1/4"	1-1/2"
Flax	90	90	90	85	85	85	80	80	75
Canola	75	65	60	70	75	50	50	40	40
Camelina	90	80	75	25	20	15	15	10	10

Important Considerations

Seeding methods for Camelina have been limited in research. This demonstration shows that there is potential for scratching in seed to achieve a sufficient plant stand. Seeding Camelina at deeper depths may reduce final plant densities, plant stand, and therefore final yield.

Any broadcast seeding should be followed with a tillage or harrow operation to insure good seed-to-soil contact.

Seeding at deep depths can prolong emergence and later prolong final maturity. Producers should be careful to seed these crops shallow when seeding late in the season to insure minimum days to maturity is met.

WADO Urban Orchard Establishment Demonstration

West Souris River Conservation District - Tim Gompf
Town of Melita

In 2011, WADO committed to establishing an Urban Orchard in the town of Melita. WADO proposed to the Town of Melita an orchard to be located in the town property located between 55 Walter Thomas Drive and 49 Walter Thomas Drive. On July 13 2011, town council approved the request with a 10 year commitment as long as the land be maintained by WADO at all times to councils` satisfaction. Conveniently, a drainage ditch and a north shelter of trees is located on the site for the plantation's protection from the elements.

WADO purchased three trees of five varieties of each haskap, saskatoon and dwarf sour cherry from Prairie Plant Systems in Saskatoon, SK. Trees were planted temporarily in 2011 and cared for at the residence of Scott Chalmers, conveniently at 55 Walter Thomas Drive. The town property was assessed for power and communication lines prior to the site being sprayed and roto-tilled.

In 2012, the trees will be transplanted into plastic rows on town property (sponsored by the West Souris River Conservation District). Drip line irrigation will be installed, and grass planted between the rows will be maintained and mowed.

Varieties to be planted and showcased include the following:

Haskap
- Tundra
- Borealis
- Indigo Yum
- Indigo Gem
- Berry Blue

Saskatoon
- Martin

- Thiessen
- Smoky
- JB30
- Honeywood

Dwarf Sour Cherry
- SK Carmine Jewel
- Romeo
- Juliet
- Cupid
- Valentine
- Crimson Passion

This location has several advantages for this project. Advantages include the size of the lot, location in an undeveloped area, and it being clearly visible near a busy intersection. In addition, the orchard would be located beside the residence of Scott Chalmers. Scott works for WADO and this would make it much easier for him to conduct maintenance and tours of the site.

WADO sees this project as an opportunity for the town of Melita by means of hosting a point of interest in the community. It would also act as a unique green space, and reduce town maintenance by not mowing that part of the lot.

Plants will be staked with labels and be maintained weed free by WADO. Eventually signage and an information box would be set up for the demonstration. In the event of moderate wildlife damage, a gated wire fence may be erected to prevent future damage.

More information please visit Prairie Plant Systems website: http://www.prairieplant.com/
Production: http://www.gov.mb.ca/agriculture/crops/fruit/index.html
University of Saskatchewan Fruit Tree Program
http://www.fruit.usask.ca/

Industrial Hemp Trial – Dormant Seeded vs. Spring Seeded

Site Information

Location:	PCDF	Roblin , MB	
	WADO	Melita, MB	
	CMCDC	Carberry, MB	
	PESAI	Arborg MB	
Cooperator:	Parkland Industrial Hemp Growers Coop Ltd.,		Dauphin, MB

Background

Industrial hemp is grown for grain and fibre. It has been observed that certain varieties of hemp will volunteer and grow the next year from the shelling that occurs from the previous harvest. The plants that germinate are some of the first growth on the field in the spring, even before some of the hardy winter annuals like stinkweed and flixweed. These volunteer hemp plants seem to withstand multiple early frosts.

This project is to evaluate the potential of late fall seeding of hemp varieties and to evaluate their survival and potential yield production for grain and fibre. If a successful management plan can work into the hemp production cycle, it could help farmers spread out their workload and potentially increase both fibre and grain yields.

There are weather related risks involved, but if guidelines can be established that show potential yield increases of fibre and or grain from the fall seeding, there would be justification for farmers to utilize this management in their production cycle. Yield advantage may be enough to offset the risk of having to occasionally re-seed if the crop does not establish the following spring. These thresholds along with other agronomy factors need to be studied.

Objective

To evaluate the potential of late fall, dormant seeded industrial hemp vs. spring seeded in terms of fibre and grain yield.

Design, Materials & Operation

Treatments: 6 (3 varieties, seeded both in fall and spring)
Replication: 3
Test design: Randomized complete block design
Seeding date: Fall – November 2010; Spring – May 2011.
Fall seeding is done just days before complete soil freeze up

The plots are seeded to a target density of 250 plants/m^2. The trials were direct seeded into canola or wheat stubble. Starter fertilizer (12-52-0) was placed with the seed during planting. The fall seeded hemp trial was seeded late in the fall when soil temperatures had cooled down to under 5°C but just before freeze up. Traditionally, the last week of October or the 1st week of November is the proper time. It requires monitoring of the weather to determine seeding date.

To ensure hemp does not germinate and freeze through the winter, hemp needs to be seeded late enough to prevent germination. The plots were seeded shallow at about ½ inch depth. The same seeding rates and seed lots were used for both the fall and spring seeded plots. Hemp is daylight sensitive so regardless of time of seeding, varieties tend to mature at the same time. Therefore, both the fall and spring seeded plots were harvested for fibre and for grain on the same dates.

Table 1. 2011 Industrial Hemp Trial Dormant Seeded vs. Spring Seeded Trial Varieties Manitoba Locations

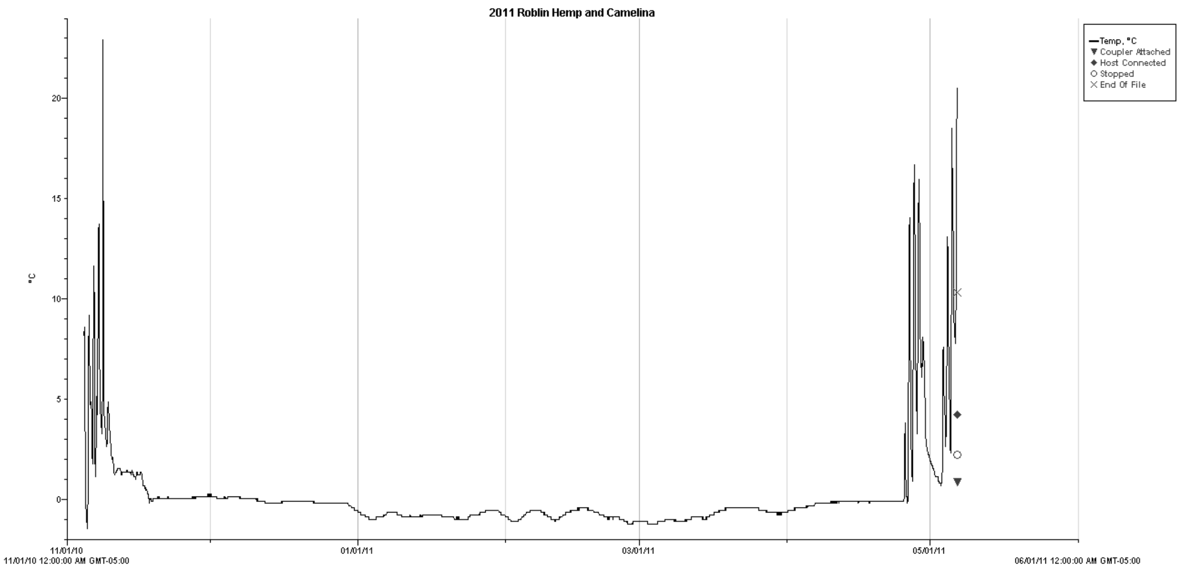
Alyssa	Delores	Petera

Results

All varieties at all locations did not emerge in the spring of 2011 with enough plants to salvage as a crop. The plots were abandoned.

Temperature

Chart 1. 2011 Hemp/Winter Wheat Trial – Soil Temperature °C – Roblin, MB



Roblin - A Hobo temperature data logger was buried in the soil at the 2 inch level at seeding time to monitor the soil temperature over the winter months. Over this period of time,(November 1, 2010 to May 1, 2011) the soil temperature was mainly in the -1 to 0°C range In early May we can see the soil temperatures started to warm up during the daytime. There was deep snow all winter which would contribute to the high soil temperature.

Plant Populations

By May 31, 2011 all of the 4 locations in Manitoba did not have hemp from the fall plantings that survived. All plots were destroyed.

In previous years, plant populations taken in the spring were quite variable firstly between varieties, and secondly, between fall versus spring seeded treatments. In 2 of the past 3 years, enough plants survived to make a good crop.

Important Considerations and Recommendations

To have successful dormant seeded hemp, you must plant just before freeze up. This would be possible on most farms as it would be the last field operation that would take place in most years the last week of October or first week of November. Hemp needs to be seeded into cold ground so it will not germinate in the fall.

It is important to seed shallow for hemp to get an early start in the spring. Seeding rates need to be high to ensure a good stand in the spring. Seeding rates need to be further evaluated.

Hemp can be one of the earliest plants/crops to start growing in the spring. Volunteer or fall seeded plants will withstand a lot of frost in the spring if conditions for hardening off are favorable. Not all of the plants will survive.

The type of stubble and ground cover may have an effect on the ability of hemp to germinate in the spring. Heavy cereal stubble may be too cool too long making it difficult for hemp to germinate and grow. Canola stubble with less trash may be more suitable. In the fall of 2010, the 4 research locations seeded hemp into canola and wheat stubble. The hemp crop did not grow in the spring of 2011 on either stubble type. Further research is needed to confirm this to evaluate the chance of survival.

Economics needs to be applied to the model to determine how many years of success are required to give enhanced yields that will mitigate the loss of reseeding in early spring.

The winter of 2010 to 2011 had a very heavy snow fall early in the season without extreme cold. The snow had an insulating effect and the ground did not freeze. These conditions were not favorable for hemp to survive. Also, the spring of 2011 was cool and wet. There was rain, cloud and poor drying conditions until June. By this time it could be that it was too late and the hemp seed had germinated and died.

Conclusions

Past years have shown increased yields of both fibre and grain through dormant seeding hemp. 2011 saw the first total crop failure. More research is required.

Hemp that does grow in the spring is one of the first plants to emerge and is relatively tolerant to spring frosts.

Snow cover appears to be important to hemp seed survival. An early, heavy snowfall (similar to 2010-2011) insulates the ground and prevents it from freezing up early. It appears this soil climate is not conducive to seed survival and germination the next spring.

Further research is needed to evaluate risk, number of years success might be realized, the types of stubble that might be most suitable and most importantly, the possible yield advantage of fibre and or grain yields that might be realized.

Fields utilized should have good drainage with minimal ponding areas. Similar to winter wheat, low areas in a field that are prone to ponding water in the spring will drown out the hemp.

Fall or dormant seeding hemp is not recommended at this time.

Industrial Hemp Plant Population Study

Site Information

Locations:	Gilbert Plains, Melita, Carberry, Arborg, MB	
Cooperators:	Parkland Industrial Hemp Growers	Dauphin, MB
	Plains Industrial Hemp Processing	Gilbert Plains, MB
	Gilbert Plains Consumers Co-op	Gilbert Plains, MB

Background

Plant population for any crop needs to be at an optimum density to ensure producers realize the highest returns. At present, the hemp industry recommends a seeding rate of 20 to 25 pounds per acre. The higher seeding rates are generally recommended for fibre production. The question is, what seeding rate recommendation can producers use to maximize their yield for grain, fibre or dual purpose production? The correct seeding rate and plant population recommendations need to be established to maximize yield and returns.

Objective

To evaluate target seeding rates and plant populations for optimum grain and fibre yield.

Design, Materials & Operation

Treatments: 8 (Table 1)
Replication: 4
Plot size: 1m x 5m
Test design: Randomized complete block design
Seeding date: June 1
Fertilizer applied: 25 lbs. actual P (11-52-0) and 80 lbs. actual N broadcast (urea 46-0-0)
Pesticide applied: None
Harvest date: Fibre – August 19; Grain – September 16
Product Handling: Fibre – 1m^2 sample from each plot cut, dried and weighed
Grain – remaining 4m^2 harvested, individually bagged and recorded

The plot area was cultivated, prior to seeding, as an early weed control measure. Nitrogen was broadcast using a floater applicator supplied by Gilbert Plains Consumers Co-op. The trial was seeded into fallow with 25 lbs. actual P applied with the seed. For the fibre portion of this trial, a $1m^2$ sample from each plot was cut and bound individually using a Mitsubishi rice harvester. Each sample was then dried, stripped of leaves and stems, weighed and recorded. The grain was harvested from the remaining $4m^2$ of each plot using a Hege plot combine. Each plot sample was individually bagged and weight recorded.

Table 17. 2011 Industrial Hemp Plant Population Study Treatments at Gilbert Plains, MB

25 plants/m^2	50 plants/m^2	100 plants/m^2	150 plants/m^2
200 plants/m^2	250 plants/m^2	300 plants/m^2	350 plants/m^2

Table 18. 2011 Spring Soil Nutrient Analysis from 0-24" Depth at the Gilbert Plains, MB Site **

	Estimated Available Nutrients	Fertilizer Applied (actual lbs)
N*	86 lbs/acre	85
P	20 ppm (high)	25
K	164 ppm (high)	0
S*	26 lbs/acre	0

* Nitrate – N * Sulphate - S

Results

Table 3. 2011 Industrial Hemp Plant Population Study Mean Planting Densities and Grain Yield (lbs/acre) at Carberry, MB, Gilbert Plains, MB and Melita, MB

Plants/m^2		Grain Yield (lbs/acre)			
Target Population	Emerged	Mean (3 sites)	Carberry	Gilbert Plains	Melita
25	11	522	735	177	655
50	17	680	952	416	671
100	28	855	1090	627	849
150	33	933	1030	834	935
200	52	1053	912	1376	872
250	58	955	963	989	913
300	58	1023	939	1268	862
350	76	1023	900	1190	980
CV %	23.9	19	6	30.4	12.8
GRAND MEAN	41.6	881	940	860	944
LSD	9.4	135	81	384	177

Table 3 summarizes plant emergence compared to the target seeding rate as well as the grain yield at the corresponding target plant populations. The grain mean yield increases with an increase in seeding rate and levels off at the 200 seeds/m^2 target seeding rate. At 200 seeds/m^2 seeding rate, the actual emerged plants are 52 per square metre.

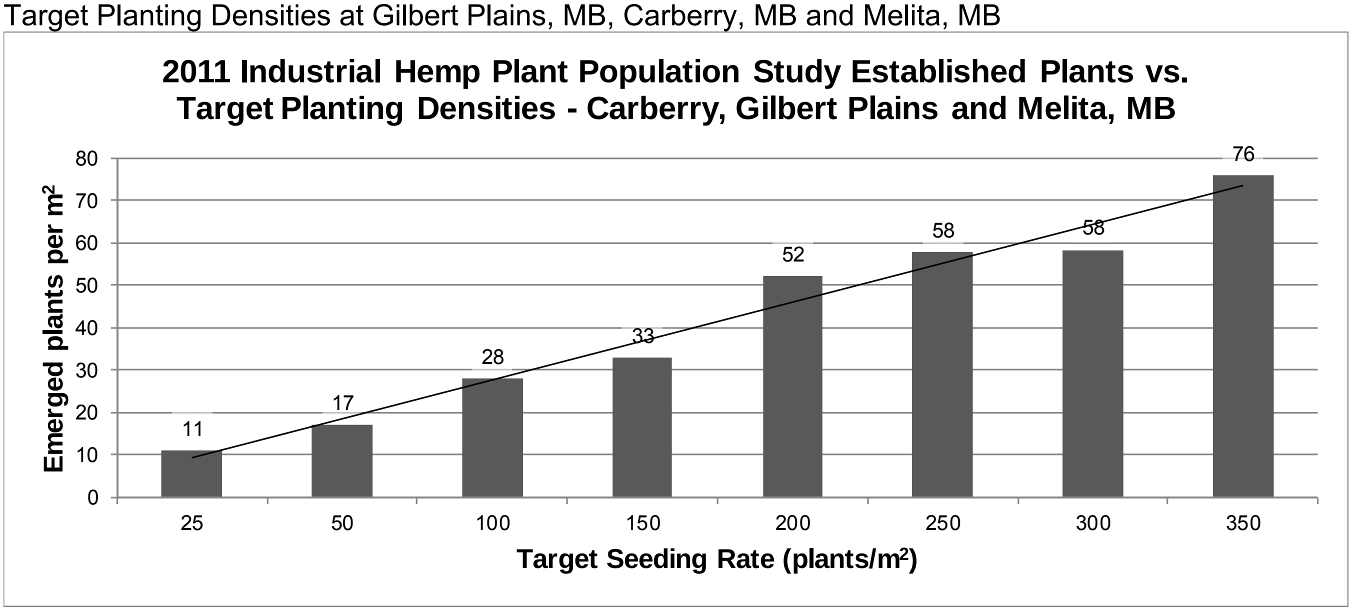
Plant counts were taken at all sites at approximately 3 weeks post-emergence. A significant rainfall event on June 13 gave the Gilbert Plains site approximately 29mm of precipitation. (Plant counts of 2 reps were taken July 7th at Gilbert Plains site; all reps were counted 3 weeks post-emergence at Melita.)

Table 19. 2011 Industrial Hemp Plant Population Study Mean Planting Densities and Fibre Yield (t/acre) at Carberry, MB, Gilbert Plains, MB and Melita, MB

Plants/m^2		Fibre Yield (tonnes/acre)			
Target Population	Emerged	Mean (3 sites)	Carberry	Gilbert Plains	Melita
25	11	0.85	1.34	0.32	0.90
50	17	1.19	1.83	0.76	0.98
100	28	1.45	2.07	1.14	1.15
150	33	1.63	2.29	1.51	1.09
200	52	2.07	2.16	2.50	1.54
250	58	1.87	2.34	1.80	1.48
300	58	1.91	2.12	2.30	1.31
350	76	1.92	2.10	2.16	1.48
CV %	23.9	28	26	30.4	28.8
GRAND MEAN	41.6	1.61	1.611	1.560	1.241
LSD	9.4	825	0.777	0.697	0.526

Table 4 summarizes plant emergence compared to the target seeding rate as well as the fibre yield at the corresponding target plant populations. The fibre mean yield increases and levels off at the 200 seeds/m^2 target seeding rate. The actual plant counts were 52 per square metre. The CV% is quite high so the information is not statistically valid.

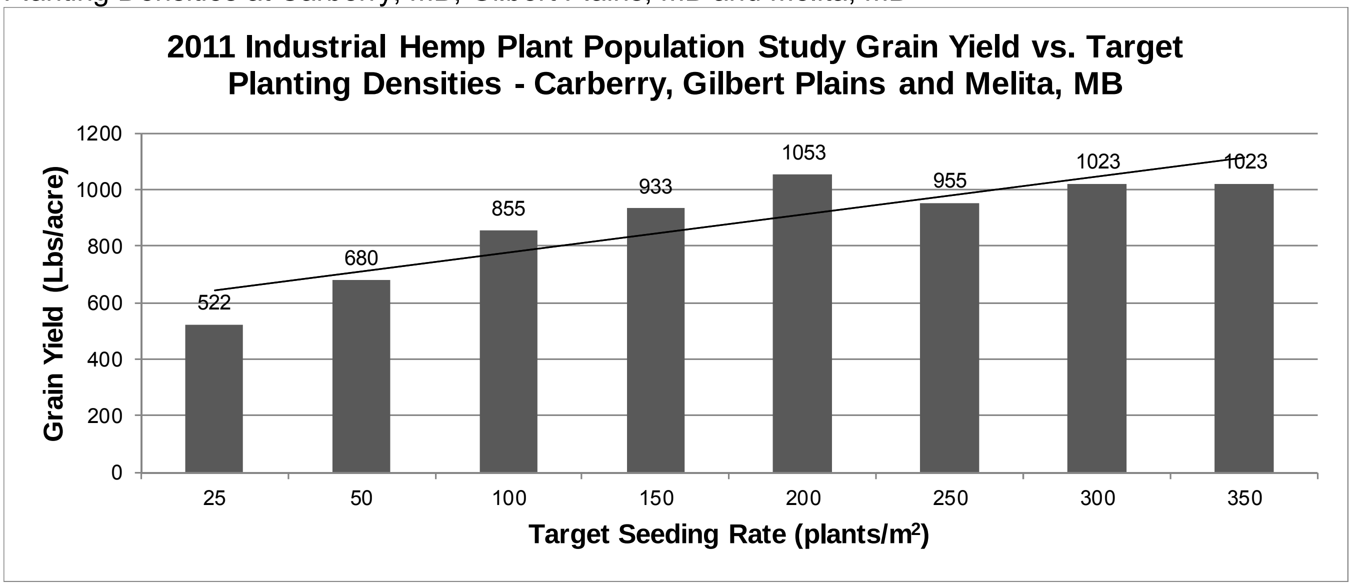
Chart 2. 2011 Industrial Hemp Plant Population Study Established Plants (m^2) vs. Target Planting Densities at Gilbert Plains, MB, Carberry, MB and Melita, MB



CV = 23.94%
LSD = 9.44
Sign Diff: Yes

The plant population does increase with an increased target seeding rate as expected. Approximately 20 to 25% of the seeds planted emerged. Hemp is a crop that has high variability in plant stand emergence. Factors such as weather, seeding depth and wet soils affect mortality leading to thinner stands.

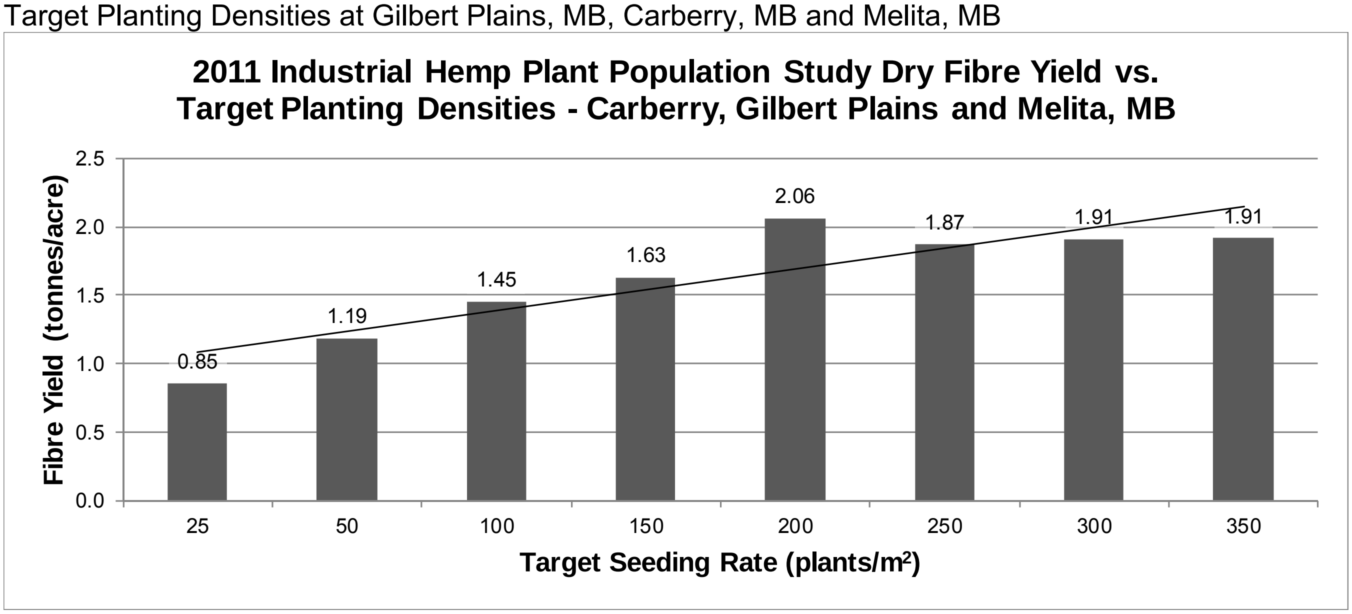
Chart 3. 2011 Industrial Hemp Plant Population Study Grain Yield (lbs/acre) vs. Target Planting Densities at Carberry, MB, Gilbert Plains, MB and Melita, MB



CV = 18.96%
LSD = 135.49
Sign Diff: Yes

Chart 3 shows a steady increase in grain yield as the target seeding rate increases. At a target seeding rate of about 200 plants/m^2, the yield plateaus and there is not a significant yield increase after that.

Chart 4. 2011 Industrial Hemp Plant Population Study Dry Fibre Yield (tonnes/acre) vs. Target Planting Densities at Gilbert Plains, MB, Carberry, MB and Melita, MB



CV = 28.49%
LSD = 0.37
Sign Diff: Yes

Chart 3shows a steady increase in fibre yield as the target seeding rate increases. At a target of about 200 plants/m^2, the yield stabilizes and there is not a significant yield increase after that.

Important Considerations and Recommendations

It should be noted that at low plant populations, hemp plants will compensate with larger seed heads. However, low plant populations result in increased weed pressure.

Grain yield maximized at a plant population of 50-60 plants/m^2.

The 2011 fibre yield data was quite variable so is not statistically valid.

Conclusions

Hemp grain yield increases as the target seed rate and plant population increases. In 2011 at a target of 200 seeds/m^2, with an actual plant population of 50 to 60 plants per square metre, the grain yield was optimized. In 2011, this same target seeding population gave the optimum fibre yield.

Industrial Hemp Seed Treatment Trial

Site Information

Locations:	Gilbert Plains, Arborg, Carberry, Melita, MB
Cooperators:	BASF Canada - Daymon Paley
	Bayer CropScience - Greg Momotiuk
	Gilbert Plains Consumers Co-op

Background

At present there are no seed treatments registered for use on hemp.

Most seed treatment products are fungicides or insecticides applied to seed before planting. Fungicides are used to control diseases of seeds and seedlings; insecticides are used to control insect pests. Some seed treatment products are sold as combinations of fungicide and insecticide.

Fungicidal seed treatments are used for three reasons: (1) to control soil-borne fungal disease organisms (pathogens) that cause seed rots, damping-off, seedling blights and root rot; (2) to control fungal pathogens that are surface-borne on the seed, such as those that cause covered smuts of barley and oats, bunt of wheat, black point of cereal grains, and (3) to control internally seed-borne fungal pathogens such as the loose smut fungi of cereals.

Seed treatments promote seedling establishment and plant health, helping to reduce losses in seed quality and yield due to many diseases and insects. The ability of seed treatments to control many fungal diseases has made them one of the biggest success stories of plant disease prevention. Seed treatments control fungi residing on the seed surface or inside the seed. They are also effective against pathogens that reside in the soil and cause seed rots, damping off and root rots. Most seed treatments do not control bacterial pathogens and none control seed-borne viruses.

It is always important to start with good quality seed. Examine seed lots carefully before purchase or when using stored seed. A seed laboratory can conduct standard seed quality tests at a low cost. Seed lots with low test weights, low germination rates or discolored kernels often produce less vigorous plants, even when this seed is treated. Poor quality seed may be damaged further by seed treatments. Seed treatment dosage and environmental conditions affect the ability of seed treatments to control target diseases and insects.

Using recommended rates and minimizing environmental stresses through good management practices will maximize the benefits of any seed treatment. Seed treatments may become less effective over time; plant seed as soon as possible after it is treated.

There are two main categories of seed treatments □ protectant (effective only on the seed surface) and systemic (effective within the seedling). Protectants help control pathogens that reside on the seed surface. In contrast, systemic seed treatments control seed□borne fungi that reside within the seed or infect the seed surface.

Industrial hemp has been observed to have a high mortality rate. In other words, of the seed that is planted, often 40 to 60% of the seeds do not end up as plants. To date there are no seed treatments registered for use on hemp.

Common seed treatment products were used for this trial that have a broad spectrum control and are systemic and have a contact mode of action. The trial was designed to evaluate the effect on plant population.

The products Gemini (BASF) and Raxil (Bayer CropScience) were used in this trial to get a sense of the potential of increasing hemp germination and seedling survival.

Gemini is a triazole fungicide that provides systemic broad spectrum protection against seed and soil born disease. Thiram is a dithiocarbomate fungicide with contact activity.

Raxil is a systemic triazole fungicide that provides broad-spectrum protection against seed and soil borne diseases. The active ingredient thiram is a dithiocarbomate fungicide with contact activity.

Objective

To evaluate seed treatment for optimum plant stand and grain yield.

Design, Materials & Operation

Treatments: 6 (Table 1)
Replication: 4
Plot size: 1m x 5m
Test design: Randomized complete block design
Seeding date: June 1
Fertilizer applied: 25 lbs. actual P (11-52-0), 80 lbs. actual N broadcast urea (46-0-0)
Pesticide applied: None

Harvest date: September 16
Product handling: Each plot individually bagged and weight recorded

Prior to seeding, the plot was sprayed with a glyphosate burn-off. Nitrogen was broadcast using a floater applicator by Gilbert Plains Coop. The trial was direct seeded into fallow with 25 lbs. actual P applied with the seed. All plots were harvested with a small plot combine. Each treatment was individually bagged and weight recorded.

Two seeding depths were used to simulate the extra stress from deeper seeding.

Table 1. 2011 Industrial Hemp Seed Treatment Trial Treatments – Gilbert Plains, MB

Gemini, seeded @ ½" depth	Raxil, seeded @ ½" depth
Gemini, seeded @ 2 ½" depth	Raxil, seeded @ 2 ½" depth
Untreated, seeded @ ½" depth	
Untreated, seeded at 2 ½" depth	

Table 2. 2011 Spring Soil Nutrient Analysis from 0-24" Depth at the Gilbert Plains, MB Site **

	Estimated Available Nutrients	Fertilizer Applied (actual lbs)
N*	86 lbs/acre	85
P	20 ppm (high)	25
K	164 ppm (high)	0
S*	26 lbs/acre	0

* Nitrate – N * Sulphate - S

Results

Table 3 summarizes the effects of seeding depth and seed treatment on plant stand, measured in plants/m^2. Plant stand variability was high (CV range 23-38%). There were no significant interactions between seeding depth and seed treatment. Seeding depth was significant at the Gilbert Plains and Carberry locations with greater seeding depth resulting in lower plant stand (data not shown). Seed treatment was significant at only 2 of 4 locations with seed treatments showing higher plant stands than untreated. The disease pathogen should be the only variable tested resulting in poor emergence. This would indicate the seed treatment was successful in increasing hemp emergence.

Table 3. 2011 Hemp Seed Treatment Trial Plant Count (plants/m^2) Means at Arborg, MB, Gilbert Plains, MB, Melita, MB and Carberry, MB

	Plants per Square Metre				
Treatment	**Sites Combined**	**Arborg**	**Gilbert Plains**	**Melita**	**Carberry**
Untreated	37.1	20	44	53	51
Gemini	51.9	21	27	70	96
Raxil	74.1	22	34	87	155
Alpha level	0.05	0.05	0.05	**0.1**	0.05
CV	41.9	26.3	33.1	38.3	34.9
GRAND MEAN	54.4	20.9	35.2	69.8	100.8
LSD	13.2	4.8	17.3	-	**30.6**

Grain Yield was not significantly affected by seed treatment. Seeding depth was significant at 0.1 level at the Gilbert Plains and Carberry locations (Delayed maturity? Less vigourous plants?) but no significant interaction between seed treatment and seeding depth was observed. Any reduction in stand as a result of untreated seed seemed to be compensated for by the plants by producing a larger head. This is consistent with other work being conducted on the effect of population on grain and fibre yield. Plant population for fibre yield is more important as preliminary work suggests a higher plant population does give higher fibre yields.

Table 4. 2011 Hemp Seed Treatment Trial Grain Yield (kg/ha) at Gilbert Plains, MB, Carberry, MB and Melita, MB

	Grain Yield (kg/ha)			
Treatment	**Sites Combined**	**Gilbert Plains**	**Carberry**	**Melita**
Untreated	1543	2178	909	1133
Gemini	1587	2279	895	1077
Raxil	1542	2260	825	1095
Alpha level	0.05	**0.1**	0.05	0.05
CV	18.7	18.1	12.2	7.9
GRAND MEAN	1557.6	2238.8	876.3	1101.7
LSD	171.6	289.5	93.2	-

Roots were dug up at all locations later in the season and washed to inspect for signs of root lesions or disease. All roots at all locations of surviving plants were observed as white in color and healthy without any sign of disease.

Important Considerations and Recommendations

Hemp has been observed to have a high mortality with 40 to 60% of the planted seeds not emerging or producing plants.

Hemp, under ideal conditions of warm soils and good moisture, will germinate and emerge from the soil in less than 5 days. Under these ideal conditions, seedling diseases are not as much of a problem.

Seedling stresses such as deep seeding, cool soils, excessive rain after seeding or other events benefit from seed treatments. It is not expected seed treatments will work in all circumstances.

Anything that will increase the number of seeds that emerge is a positive benefit to producers. Hemp seed cost is on average $2.00 per pound. For grain crops, a target of 100 seeds per square metre is used (approx seeding rate of 20 lbs/acre) and 250 to 300 per square metre is used for fibre only crops. Seed treatment cost is low at less than 5 cents a pound. If the farmer is able to reduce seeding rates by 10 to 20% by the use of seed treatments and still get the same population he will save 2 to 4 pounds of seed per acre or 4 to 8 dollars. For fibre production at a seeding rate of 50 pounds per acre he could seed 10 pounds per acre less seed for a savings of about $20 per acre.

Conclusions

Seed treatment on hemp may have an effect on seedling stand numbers under adverse growing conditions. This trial was inconclusive in 2011.

More work is needed to verify the hypothesis.

Seed treatments may be good insurance in years where seeding conditions are not optimal.

Industrial Hemp Variety Trial

Site Information

Locations:	PCDF	Gilbert Plains, Manitoba
	WADO	Melita, MB
	CMCDC	Carberry, MB

Cooperators: Parkland Industrial Hemp Growers
Plains Industrial Hemp Processing
Gilbert Plains Consumers Co-op

Objective

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

Design, Materials & Operation

Table 1. 2011 Industrial Hemp Variety Trial Design Summary at Gilbert Plains, MB, Melita, MB and Carberry, MB

	Gilbert Plains	Melita	Carberry
Treatments	10 (Table 1)	9 (Table 1)	9 (Table 1)
Replication	4	4	4
Plot size	1m x 5m (5m^2)	1.44m x 11.44m (16.5m^2)	1.2m x 7m (8.4m^2)
Seeding date	June 1	June 3	May 25

Seeding rate	250 plants/m^2	250 plants/m^2	250 plants/m^2
Fertilizer applied (actual lbs.)	25 lbs. P, 80 lbs. N	120 lbs. N, 30 lbs. P, 27 lbs. K	154 lbs. N, 30 lbs. P
Harvest date	Fibre – August 19 Grain – September 16	Fibre – August 26 Grain – September 9	Fibre – August 22 Grain - September 19

The plot area was cultivated, prior to seeding, as an early weed control measure. Nitrogen was broadcast using a floater applicator by Gilbert Plains Coop. The trial was seeded into fallow with 25 lbs. actual P applied with the seed. For the fibre portion of this trial, a 1m^2 sample from each plot was cut and bound individually using a Mitsubishi rice harvester. Each sample was then dried, stripped of leaves and stems, weighed and recorded. The grain was harvested from the remaining 4m^2 of each plot using a Hege plot combine, individually bagged and weight recorded. A 250g composite grain sample was sent to the lab for quality analysis.

Table 2. 2011 Industrial Hemp Variety Trial Varieties at Gilbert Plains, MB, Melita, MB and Carberry, MB *****

Alyssa	Canda	Delores
Anka	CRS-1	CFX-1
CFX-2	Finola	USO 14
Joey (Dauphin only)		

* Numbered varieties are advanced lines that are under evaluation for possible registration.

Table 3. 2011 Spring Soil Nutrient Analysis from 0-24" Depth at Gilbert Plains, MB, Melita, MB and Carberry, MB**

	Gilbert Plains		**Melita**		**Carberry**	
	Estimated Available Nutrients	Fertilizer Applied (actual lbs)	Estimated Available Nutrients	Fertilizer Applied (actual lbs)	Estimated Available Nutrients	Fertilizer Applied (actual lbs)
N*	86 lbs/acre	85	102 lbs/acre	120	16 lbs/acre	160
P	20 ppm (high)	25	12 ppm	30	13 ppm	30
K	164 ppm (high)		144 ppm	27	218 ppm	
S*	26 lbs/acre		30 lbs/acre		21 lbs/acre	

* Nitrate – N * Sulphate – S
** Analysis by Agvise Laboratories

Fibre Analysis

Background

Traditionally around the world, hemp has been grown for the fibre. The bast fibre is the long, strong fibres around the outside of the plant (often compared to "bark" of a tree) and comprise about 30 – 35% of the total plant make up. Hurd is the short fibre that is found in the middle of the plant and is the other major component of the stem.

To date, Canada has a very small fibre processing industry with small plants operating in Manitoba and Ontario. A large decortication plant (Parkland Industrial Hemp Processing – PIHP) is currently under construction in Gilbert Plains, MB.

The hemp fibre project aims to evaluate existing hemp varieties that may produce high biomass with a high fibre yield. This will give processors a baseline of production that can be expected from growing various varieties as a grain-only, fibre-only or dual grain-fibre crop.

Results

Plant Population

A target seeding rate of 250 seeds per square metre was used. Each variety's seeding rate was adjusted for % germination.

Table 1. 2011 Industrial Hemp Variety Trial Average Plant Population at Gilbert Plains, MB, Melita, MB and Carberry, MB

	Plants per square metre		
Variety	**Melita**	**Carberry**	**Gilbert Plains**
Alyssa	59	71	17
Anka	46	59	13
Canda	42	82	18
CFX-1	53	116	23
CFX-2	40	101	18
CRS-1	42	94	13
Delores	49	88	15
Finola	39	94	15
USO 14	46	88	15
Joey			9

Plant Height

Plant height is one characteristic that can enter into the decision of which variety a grower wishes to plant. Shorter varieties are more suited to grain production. Mid-height varieties may be suitable for both grain and fibre production while the tallest varieties may be suitable for fibre-only production.

Plant height measurements are taken from the variety trials close to harvest when the plants are no longer growing and the crop could be harvested as a fibre-only crop. The height is measured as the average height of the canopy by taking the height of 2-3 plants per plot and averaging the height.

Table 2 summarizes the average variety height from the trials for 2011. On average, hemp height was a little shorter this year.

Table 2. 2011 Industrial Hemp Variety Trial Average Plant Height at Gilbert Plains, MB, Melita, MB and Carberry, MB *

	Plant Height at Harvest (cm)*			
Variety	Average Height (cm)	Gilbert Plains	Melita	Carberry
Alyssa	133	149	84	167
Anka	154	159	126	177
Canda	131	100	121	171
CFX-1	116	103	107	139
CFX-2	120	92	133	135
CRS-1	132	138	106	152
Delores	141	138	123	163
Finola	95	73	106	106
USO 14	145	140	130	164
Joey	136	136		

*Average plant canopy height from Manitoba Variety Trials

Table 3 summarizes the average hemp height from variety trials since 1999. The variation of height recorded is summarized in the table by the inclusion of the minimum and maximum heights. More site years of data are desirable to give a good average under a variety of conditions. Year to year growing conditions have a significant effect on the height of hemp plants.

Table 3. 2011 Industrial Hemp Variety Trial Plant Height Summary at Gilbert Plains, MB, Melita, MB and Carberry, MB *

	Plant Height at Harvest (cm)*			
Variety	Average Height (cm)	Site Years Reported	Minimum Height (cm)	Maximum Height (cm)
Alyssa	180	20	84	240
Anka	183	12	126	239
Canda	140	5	100	185
CFX-1	120	5	103	144
CFX-2	122	5	92	146
CRS-1	138	5	106	185
Delores	157	9	91	215
Finola	96	7	73	120
Joey	151	3	131	185
Petera	233	10	183	297
USO 14	166	17	98	218

* Average plant canopy height from Manitoba Variety Trials 1999-2011

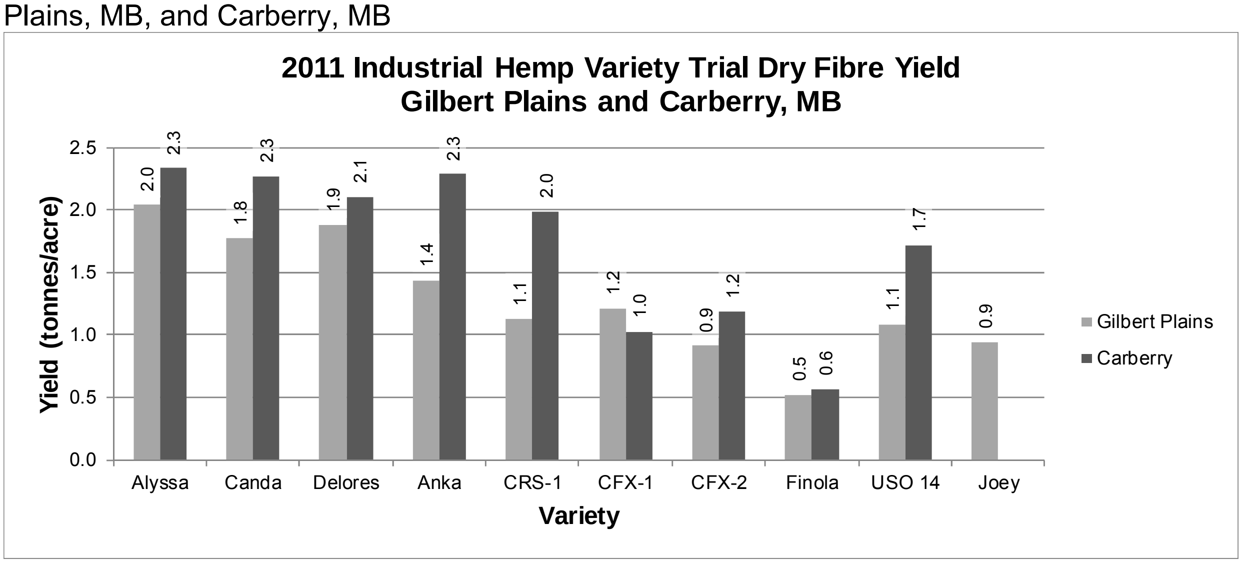
Table 4. 2011 Industrial Hemp Variety Trial Dry Fibre Yield (kg/ha)* at Gilbert Plains, MB, Carberry, MB and Melita, MB

Variety	Fibre Mean	% of Check	Sites	Gilbert Plains	Carberry	Melita
Alyssa	5407	100	3	5047	5766	3189
Canda	4995	92	3	4375	5616	3257
Delores	4924	91	3	4636	5212	3098
Anka	4597	85	3	3544	5651	3098
CRS-1	3848	71	3	2780	4916	2018
CFX-1	2766	51	3	2992	2540	1226
CFX-2	2593	48	3	2257	2929	1349
Finola	1347	25	3	1290	1404	928
USO 14	3463	64	3	2681	4245	2662
Joey	2335	46	1	2335		
CV				15.3%	11.7%	**34.3%** **
LSD				710	959	1163
Grand Mean				3194	4253	2314

* Stalks only – all short stems and leaves removed

** Melita had a higher than acceptable CV%, data is for information purposes only

Chart 1. 2011 Industrial Hemp Variety Trial Dry Fibre Yield (tonnes/acre) at Gilbert Plains, MB, and Carberry, MB



CV = 15.3% Gilbert Plains and 11.7% Carberry
LSD = 0.287 Gilbert Plains and 0.388 Carberry
Sign Diff: Yes at both locations

Table 5. 2011 Industrial Hemp Variety Trial Multi-Year Dry Fibre Summary Gilbert Plains, Carberry, and Melita, MB

			% of Alyssa			
Variety	Yield % of Check	Site Years Tested	2011 Yield	Gilbert Plains	Carberry	Melita
Alyssa	100	18	Alyssa	100	100	100
Anka	115	7	Anka	70	98	97
Carmen	116	7	Carmen	-	-	-
Petera	139	8	Petera			
USO 14	89	16	USO 14	53	74	83
Delores	103	5	Delores	92	90	97
Jutta	109	1	Jutta	-	-	-
Canda	96	4	Canda	87	97	102
Joey	91	1	Joey	46	-	-
CRS-1	82	1	CRS-1	55	85	63
CFX-2	48	4	CFX-2	45	51	42
CFX-1	48	1	CFX-1	59	44	38
Finola	26	3	Finola	26	24	29
CHECK CHARACTERISTICS			Alyssa (t/ac)	2.0	2.3	1.3
Alyssa	3.9	18	CV %	15.3	11.7	34.3
	t/acre	site years	LSD %	14	17	36
			Alyssa Sign Diff	Yes	Yes	Yes

Important Considerations and Recommendations

Farmers are encouraged to use long-term, multi-site data as a management tool to select varieties. The more site years, spread over more than one season, reflect more dependable 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.

Incorporating early and late maturing varieties will give farmers the opportunity to manage harvest workload by spreading out harvest dates.

Conclusions

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.

Grain Analysis

Background

Industrial Hemp has been licensed to grow in Canada by Health Canada since 1998. Since that time, grain processing and market development has lead the industry. There has been a steady market increase in the demand for grain production and processing. Presently there are 4 grain contractors and processors located in Manitoba. They are located in Winnipeg, Ste. Agathe, McGregor, and Rossendale.

Two major plant breeding programs have developed varieties suited for growing in Western Canada.

Results

1000 Kernel Weight

The 1,000 kernel (1,000 K) weight is a measure of seed size. It is the weight in grams of 1,000 seeds. Seed size and the 1,000 K weight can vary from one crop to another, between varieties of the same crop and even from year to year or from field to field of the same variety.
Because of this variation in seed size, the number of seeds and, consequently, the number of plants in a pound or a bushel of seed is also highly variable.

By using the 1,000 K weight, a producer can account for seed size variations when calculating seeding rates, calibrating seed drills and estimating shattering and combine losses.

Table 1. 2011 Industrial Hemp Variety Trial 1000 Kernel Weights at Gilbert Plains, MB, Melita, MB and Carberry, MB

	Spring 2011	Harvest 2011				
Variety	Seed (g)	Melita (g)	Carberry (g)	Gilbert Plains (g)	Average 1000 kwt (g)	Seeding Rate* (lbs/a)
Alyssa	18.6	17.0	19.0	19.0	18.4	24.7
Anka	15.9	13.5	17.0	17.5	16.0	21.5
Canda	21.2	18.0	21.5	20.5	20.3	27.3
CFX-1	17.8	15.5	18.5	18.0	17.4	23.4
CRS-1	17.1	16.0	18.0	19.0	17.5	23.5
CFX-2	15.5	15.0	17.0	17.0	16.1	21.6
Delores	20.0	15.0	19.5	20.0	18.6	25.0
Finola	12.3	11.0	14.5	14.0	12.9	16.9
USO14	16.8	15.0	18.0	18.0	17.0	22.8
Joey	18.4			18.5	18.4	24.7

* Seeding rate target was 100 seeds/m^2 at 95% germination and 30% mortality

Precision in seeding is important. Using the same seeding rate for all varieties is probably not the most efficient and cost effective decision. The variability in seed weight from year to year is something that could seriously affect a farmer's bottom line. A 1000 kernel weight and seed rate calculation is recommended for each variety each year.

Establishing a seeding rate using the 1000 kernel weight is an essential piece of the puzzle when it comes to making sure you are seeding properly given time and conditions afforded to you. Not compensating for large seed could result in a very thin stand, susceptible to more competition from weeds. Small seed on the other hand can mean extra cost for a higher seeding rate than required.

Table 1 shows that the average 1000 kernel weight in hemp in 2011 varies amongst varieties from 12.9 to 20.3 grams per 1000 kernels. Table 1 also shows that at a target seeding rate of 100 seeds per square meter, seeding rate would vary from 16.9 to 27.3 pounds per acre which would impact the producers seed cost somewhat.

Test Weight

Test weight is the measure of grain density determined by weighing a known volume of grain. In Canada's grain grading specifications, it is expressed in grams per 0.5 litre or kilograms per hectolitre. Test weight is a grading factor for many grains under the Canada Grain Act. Despite the name, test weight is not a measure of weight or quantity, but is a measure of density (a measure of mass in a given volume).

In the current Canadian grading system, test weight is assessed after dockage is removed and is expressed as kilograms per hectolitre, kg/hL (kilograms per 100 litres of volume), or as g/0.5L (grams per half-litre). This is the official measure in Canada, and the Official Grain Grading Guide issued by the Canadian Grain Commission specifies minimum test weights required to make grades for certain grains. A minimum test weight for hemp has not been determined to date.

The test weight concept was developed many years ago by the grain trade as a means of accounting for the varying densities of grain caused by weather and/or production practices. When grain density is lower than the accepted standard (low test weight), more volume is needed to store and transport a given weight of grain, thus increasing storage and transport costs.

Test weight is most often influenced by stresses that occur during the grain-filling period of the plant. Factors that decrease the rate or duration of grain fill can result in lower test weights at harvest. These stresses can be subtle or fairly dramatic. Included among these factors are drought, excessive soil moisture, nutrient deficiencies, lack of sunlight, temperature extremes, insect damage to leaf and stem tissue, frost, and hail. Grain moisture and test weight are related from the standpoint that as moisture increases, test weight decreases. There are also differences in hybrids and varieties.

There is a poor relationship between test weight and yield. The same test weight can exist across a wide range of yield environments and genetics. Similarly, there can be a wide range of test weight values across the same high or low yielding environment.

Test weight may be a consideration when selecting varieties, don’t make it the only one at the expense of other important characteristics such as yield and disease resistance.

Bushel is a volume measurement for grain commonly used to measure grain volume. It is the equivalent of 1.244 cubic feet (normally, a figure of 1.25 cubic feet is used) or 36.36873 litres (imperial bushel).

Test weights were done for all hemp varieties grown at the Gilbert Plains, Melita and Carberry variety trial locations this year. Minimum test weights have not been established for hemp.

Table 2. 2011 Industrial Hemp Variety Trial Test Weights (Grams/0.5 L) at Gilbert Plains, MB, Melita, MB and Carberry, MB

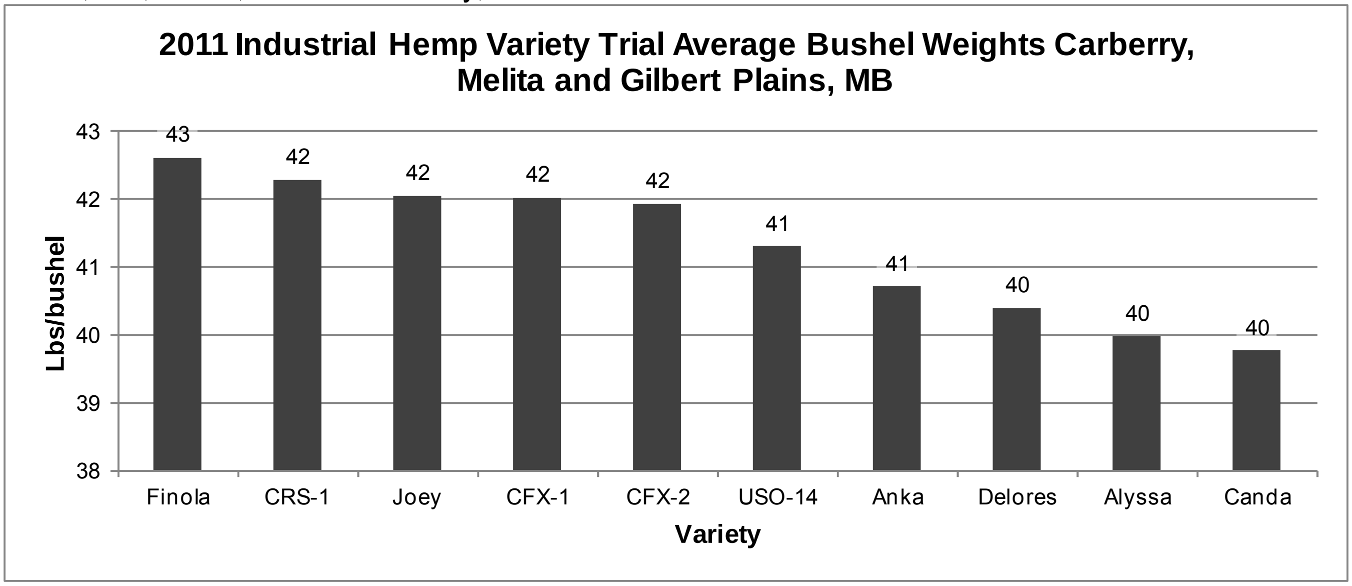
	Test Weight in Grams/0.5 Litre			
Variety	Carberry	Melita	Gilbert Plains	Average
Alyssa	262.2	233.2	252.5	249.3
Anka	273.6	229.2	258.7	253.8
Canda	266.6	229.2	248.1	248.0
CFX-1	271.9	243.3	271.0	262.1
CFX-2	275.4	249.0	260.0	261.5
CRS-1	273.2	249.0	268.8	263.7
Delores	268.8	225.7	261.3	251.9
Finola	278.0	245.0	274.1	265.7
USO-14	269.7	235.4	267.5	257.5
Joey			262.2	262.2

Table 3. 2011 Industrial Hemp Variety Trial Bushel Weights (Lbs/Bu) at Gilbert Plains, MB, Melita, MB and Carberry, MB

Bushel Weights - pounds per bushel				
Variety	Carberry	Melita	Gilbert Plains	Average
Alyssa	42.0	37.4	40.5	40.0
Anka	43.9	36.8	41.5	40.7
Canda	42.8	36.8	39.8	39.8
CFX-1	43.6	39.0	43.5	42.0
CFX-2	44.2	39.9	41.7	41.9
CRS-1	43.8	39.9	43.1	42.3
Delores	43.1	36.2	41.9	40.4
Finola	44.6	39.3	44.0	42.6
USO-14	43.2	37.7	42.9	41.3
Joey			42.0	42.0

Bushel weights did vary some from location to location. Moisture conditions at all locations at the beginning of the season were considered excellent. The season then turned dry which did affect yield and bushel weights. The average bushel weight for all locations and all varieties for 2011 is 41 pounds to the bushel. As the crop becomes more established, with more represented years and samples, a standard bushel weight will be established.

Chart 1. 2011 Industrial Hemp Variety Trial Average Bushel Weights (Lbs/bu) at Gilbert Plains, MB, Melita, MB and Carberry, MB



Grain Yields

Trial locations were at Gilbert Plains, Carberry and Melita. A trial was established in Arborg but was lost due to excess rain and wet fields. Yield is expressed as a % of the check.

Long Term Data

Always use caution when using minimal years of data. Varieties are tested over a number of years and are entered into the MCVET database for inclusion in the 2012 Seed Manitoba Guide. Environmental conditions vary so performance will be variable. The more site years, the more dependable the data.

Table 4. 2011 Industrial Hemp Variety Trial Grain Yield Summary (Seed Manitoba 2012) Gilbert Plains, MB, Carberry, MB and Melita, MB *

Comments:
A licence from Health Canada is required to grow Industrial Hemp.
THC testing for some varieties is required.
Please check Health Canada's List of Approved Cultivars (www.hc-sc.gc.ca) to determine status of varieties.

Variety	Yield % Check	Site Years Tested	2011 Yield	Gilbert Plains	Carberry	Melita
Alyssa	100	18	100	100	100	100
Canda	129	6	124	134	107	124
Delores	111	18	106	115	108	91
Anka	92	8	72	78	68	66
CRS-1	114	9	102	111	89	98
CFX-1	107	9	94	95	75	109
CFX-2	102	5	98	102	98	92
Finola	58	13	44	45	34	51
USO 14	74	16	69	68	72	67
Joey	145	3	115	115	-	-
			Alyssa (lbs/ac)	2192	928	1182
Alyssa (lbs/ac)	1179	18	CV%	14.1	15.2	16.7
		site	LSD%	19.7	24.6	21.6
		years	Sign Diff	Yes	Yes	Yes

* Reproduced from Seed Manitoba 2012.
Use single site data with caution.
The more site years indicate performance over a number of locations and years. 20 site years is a target.
CV% = Coefficient of Variation. A measure of random variation in a trial. A low CV is desirable.
LSD% = Least Significant Difference. Varieties must differ by the LSD% to be considered significantly different.
Further information refer to Seed Manitoba www.seedmb.ca.

Table 5. 2011 Industrial Hemp Variety Trial Grain Yield at Laird, Saskatchewan

Variety	GrainYield (kg/ha)	Grain Yield (lbs/acre)	Yield % CFX-1
CFX-1	1684.65	1503.02	99.98
CRS-1	1651.33	1473.28	98.00
CanMa	1517.70	1354.07	90.07
CFX-2	1437.35	1282.38	85.30
Finola	1427.33	1273.43	84.71
Delores	1235.00	1101.85	73.29
Alyssa	1202.52	1072.87	71.37
CV = 16.5%			

Important Considerations and Recommendations

Canadian varieties are showing significantly higher grain yields than the varieties that were originally introduced (e.g. USO 14). The trials this year did show variation amongst varieties and different responses to growing conditions in various locations in the province.

Farmers should use long-term, multi-site data as a management tool to select the best, yield stable varieties. The more site years, especially if they are over more than one season, the more dependable the data will be. 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. Early and late varieties will give farmers an opportunity to grow acres and spread out their harvesting due to different harvest maturities.

Conclusions

New adapted varieties from the Canadian plant breeding programs are now available and show promise of improved long term grain yields.

Variety specific contracts may be available as processors determine how seed size affects their quality standards.

Oil Analysis

Background

Essential Fatty Acids (EFAs) are necessary fats that humans cannot synthesize, and must be obtained through diet. EFAs are long-chain polyunsaturated fatty acids derived from linolenic, linoleic, and oleic acids. The term "essential fatty acid" refers to fatty acids required for biological processes, and not those that only act as fuel. There are two families of EFAs: Omega-3 and Omega-6. Omega-9 is necessary yet "non-essential" because the body can manufacture a modest amount on its own, provided essential EFAs are present. The number following "Omega-" represents the position of the first double bond, counting from the terminal methyl group on the molecule. Omega-3 fatty acids are derived from Linolenic Acid, Omega-6 from Linoleic Acid, and Omega-9 from Oleic Acid.

Gamma-linolenic acid (GLA) is an omega-6 fatty acid that is found mostly in plant based oils such as borage seed oil, evening primrose oil, and black currant seed oil and is also found in hemp. Omega-6 fatty acids are considered essential fatty acids: They are necessary for human health, but the body can’t make them -- they have to come through food. Along with omega-3 fatty acids, omega-6 fatty acids play a crucial role in brain function, as well as normal growth and development. Also known as polyunsaturated fatty acids (PUFAs), they help stimulate skin and hair growth, maintain bone health, regulate metabolism, and maintain the reproductive system.

GLA is found in hemp, borage oil, spirulina, black currant and evening primrose oil. Fish oil is another common source.

The hemp samples of each variety came from grain variety yield trials located at Gilbert Plains, Melita, and Carberry in Manitoba and Laird, Saskatchewan.

Oil extraction was conducted using the accelerated solvent extraction (ASE) method with hexane as a solvent. This automated method was optimized and replaces traditional soxhlet extraction.

Fatty acid composition was determined by methyl esterification of the fatty acids in the oil followed by analysis by GC-FID using a validated method. Results are expressed as a % of area by GC-FID.

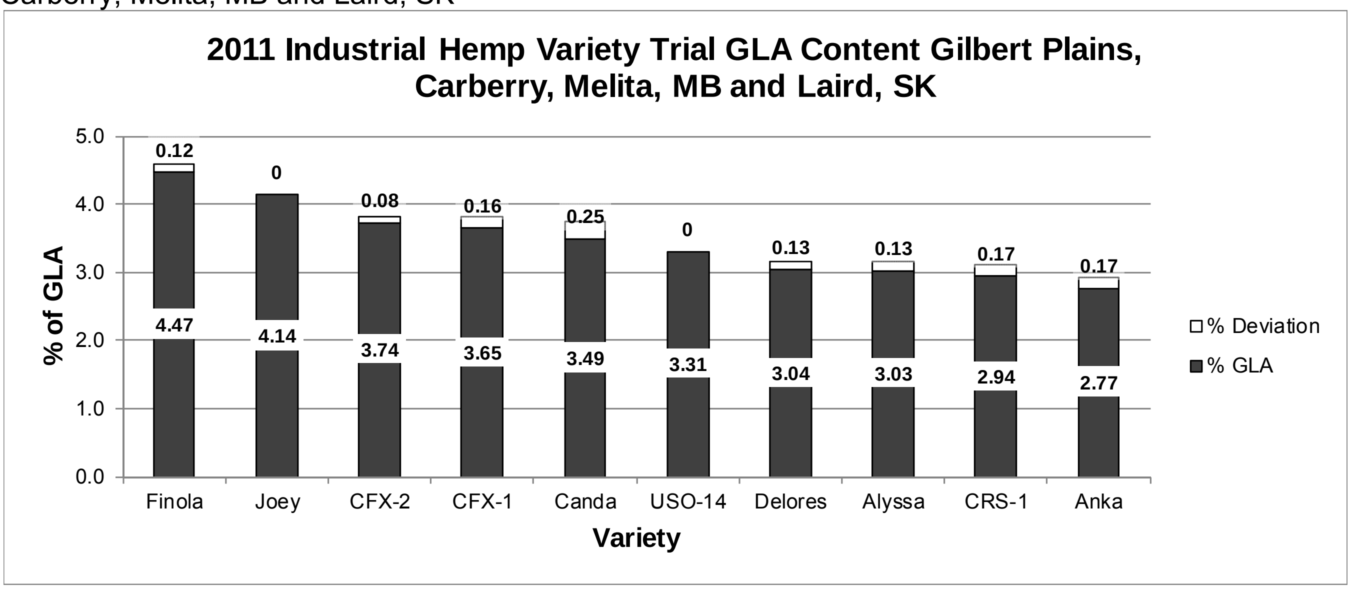
Analysis was done for Palmitic acid (PA), Stearidonic acid (SDA) - Omega 3, Oleic acid (OA) – Omega 9, Linoleic acid (LA) – Omega 6, Gamma-linolenic acid (GLA) – Omega 6, Alpha linolenic acid (ALA) - Omega 3. Oil percentage was also evaluated.

Hemp contains the perfectly balanced 3:1 ratio of Omega 6 (LA+GLA) to Omega 3 (ALA).

Results

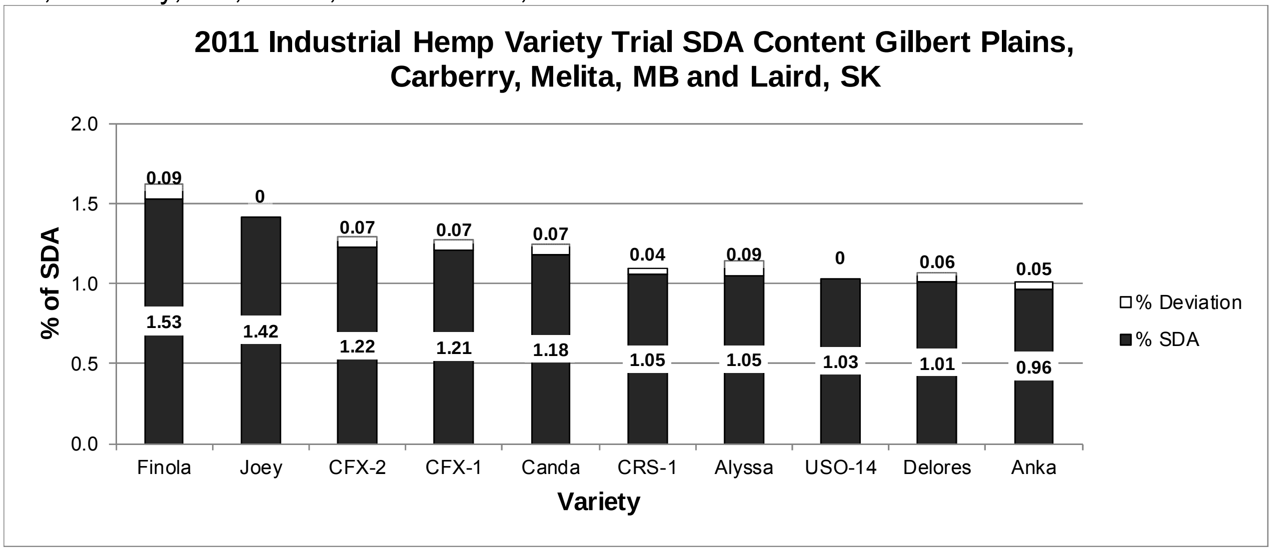
Gamma linolenic acid (GLA) - There are several different types of omega-6 fatty acids. Most omega-6 fatty acids in the diet come from vegetable oils in the form of linoleic acid (LA). The body converts linoleic acid (LA).to GLA and then to arachidonic acid (AA). GLA is thought to have anti-inflammatory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

Chart 1. 2011 Industrial Hemp Variety Trial GLA Content by Variety at Gilbert Plains, Carberry, Melita, MB and Laird, SK



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).

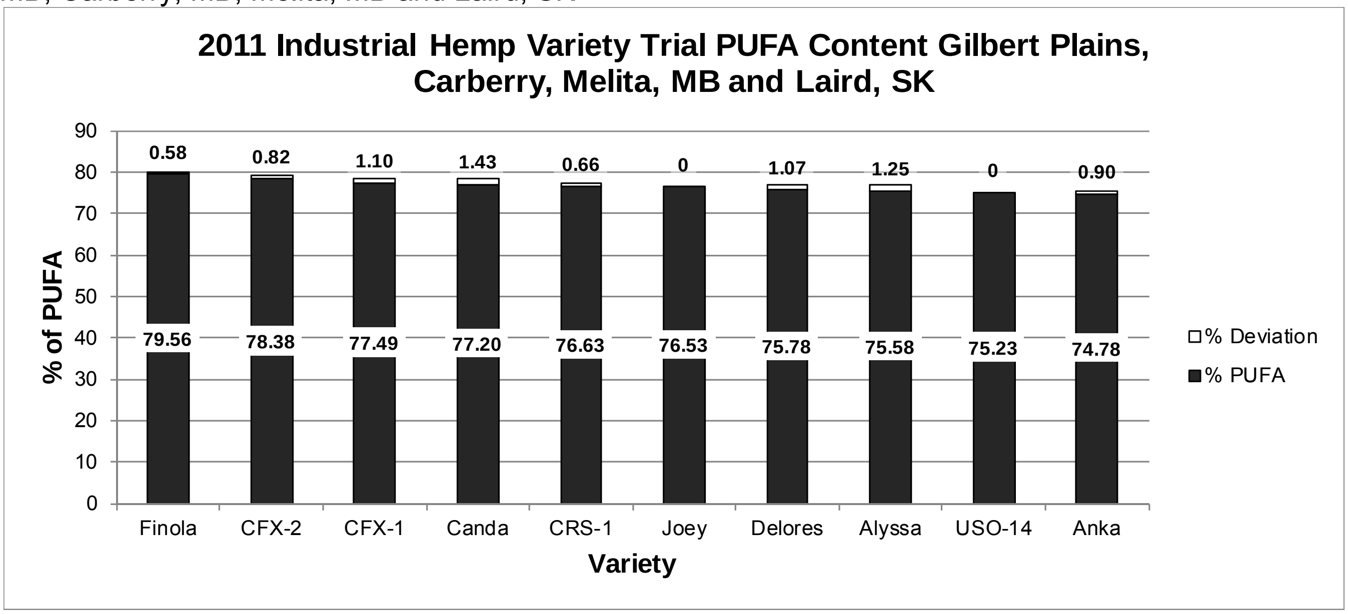
Chart 2. 2011 Industrial Hemp Variety Trial SDA Content by Variety at Gilbert Plains, MB, Carberry, MB, Melita, MB and Laird, SK



Polyunsaturated fatty acids (PUFA) are fatty acids that contain more than one double bond chain of carbon atoms. 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 cholestorel. Polyunsaturated fatty acids contain essential fatty acids (EFAs) like omega-3 and omega-6 acids. These are fatty acids that the body needs but can not produce. 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 they release a hormone which sends a signal to the brain when you are full.

Chart 3. 2011 Industrial Hemp Variety Trial PUFA Content by Variety at Gilbert Plains, MB, Carberry, MB, Melita, MB and Laird, SK



Oil Content

Chart 4. 2011 Industrial Hemp Variety Trial Oil Content by Variety at Gilbert Plains, MB, Carberry, MB, Melita, MB and Laird, SK

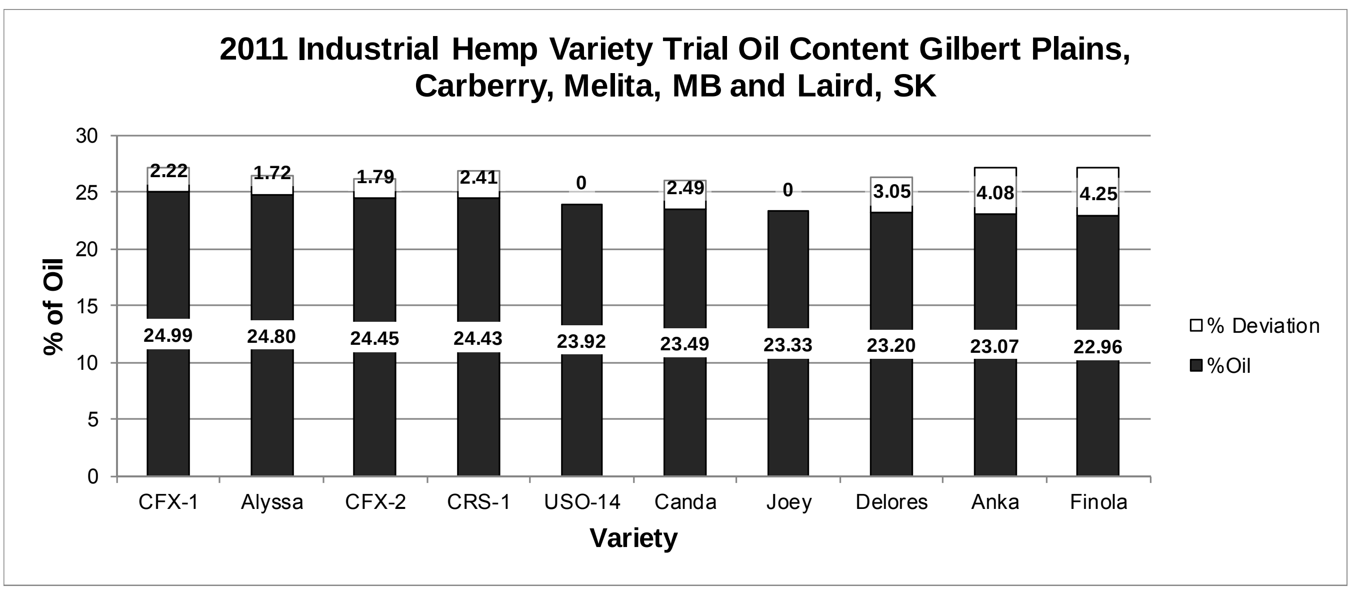


Table 1. 2011 Industrial Hemp Variety Trial Essential Fatty Acid Summary Chart with % Deviation at Gilbert Plains, MB, Carberry, MB, Melita, MB and Laird, SK

Variety	%GLA	Std Dev	%SDA	Std Dev	%PUFAs	Std Dev
Alyssa	3.03	0.13	1.05	0.09	75.58	1.25
Anka	2.77	1.07	0.96	0.05	74.78	0.90
Canda	3.49	0.25	1.18	0.07	77.20	1.43
CFX-1	3.65	0.16	1.21	0.07	77.49	1.10
CFX-2	3.74	0.08	1.22	0.07	77.88	0.82
CRS-1	2.94	0.17	1.05	0.04	76.63	0.66
Delores	3.04	0.13	1.01	0.06	75.78	1.07
Finola	4.47	0.12	1.53	0.09	79.56	0.58

Table 2. 2011 Industrial Hemp Variety Trial Oil Content Summary Chart with % Deviation at Gilbert Plains, MB, Carberry, MB, Melita, MB and Laird, SK

Variety	%Oil	Std Dev
Alyssa	24.80	1.72
Anka	23.07	4.08
Canda	23.49	2.49
CFX-1	24.99	2.22
CFX-2	24.45	1.79
CRS-1	24.43	2.41
Delores	23.20	3.05
Finola	22.96	4.25

Table 3. 2011 Industrial Hemp Variety Trial % GLA and % Oil Ranking Summary Gilbert Plains, MB, Carberry, MB, Melita, MB and Laird, SK

Variety	% GLA Ranking		Variety	% Oil Ranking
Finola	4.47		CFX-1	25.0
Joey	4.14		Alyssa	24.8
CFX-2	3.74		CFX-2	24.5
CFX-1	3.65		CRS-1	24.4
Canda	3.49		USO-14	23.9
USO-14	3.31		Canda	23.5
Delores	3.04		Joey	23.3
Alyssa	3.03		Delores	23.2
CRS-1	2.94		Anka	23.1
Anka	2.77		Finola	23.0

Important Considerations and Recommendations

The analysis and data presented represent a comparison of the fatty acid profile of the varieties of hemp that are currently being grown. The fatty acid profile is one of the factors to consider for producers and contracting companies when they are selecting a variety to grow and process.

Weather will play a role in the level of specific qualities in any one year and from year to year.

Farmers should use long-term, multi-site data as a management tool to select the best, yield stable varieties. The more site years, especially if they are over more than one season, the more dependable the data will be. 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. Early and late varieties will give farmers an opportunity to grow acres and spread out their harvesting due to different harvest maturities.

The hemp varieties used in this study were provided by Manitoba Diversification Centers' hemp variety trial research work. Locations were in Gilbert Plains, Melita, and Carberry. Also included is analysis from variety trial carried out by Hemp Genetics International at Larid Saskatchewan.

Canadian Hemp Trade Alliance (CHTA) http://www.hemptrade.ca/ helped coordinate this project and arrange for funding of the oil analysis.

"Funding for this project was supported by the Manitoba Agri-Health Research Network Inc (MAHRN) and made possible due to funding from the Governments of Manitoba and Canada through the Growing Forward, Strategic Innovation Fund–Advancing Agri-Innovation Program."

Manitoba Agri-Health Research Network

- Analysis was done at Loyalist College, Biosciences, Belleville Ontario by way of John Baker, M.Sc., P.Ag Sonehedge Phytomedicianals Inc. Sterling, Ont.
- Andrew Goulah, Technologist; Calum McRae, Research Assistant; Kari Kramp, PhD.
- License: from Hemp Directorate, Health Canada

Conclusions

Hemp seed has the unique feature of being one of the few plants that has Gamma-linolenic acid (GLA) an Omega 6 fatty acid. Hemp seed is also rich in stearidonic acid, the omega 3 fatty acid. More research is needed to determine how climate and varietal differences affect oil content and quality.

Flooded Trials 2011

Due to excess moisture experienced in the spring of 2011, may trials were planted but did not emerge or grow normally. Many plots were planted one day in excellent seeding conditions only to be ruined by the next rain. Here is an overview of those intended trials and their objectives:

Post Registration Confectionary and Oilseed Sunflowers Variety Trials

- Variety evaluation of a compilation of 11 oilseed and 10 confectionary varieties registered for growers. To be published in Manitoba Seed Guide. In cooperation with the National Sunflower Association of Canada.

Pre-Registration Experimental Sunflower Trial

- Variety evaluation of 30 high generation varieties from the USDA breeding program. In cooperation with the National Sunflower Association of Canada.

Yield Loss Relationships and Economic Thresholds for Kochia and Biennial Wormwood in Sunflowers

- A weed trial assessing populations of Kochia and Biennial wormwoord on the growth and yield of sunflower. In cooperation with the National Sunflower Association of Canada.

Sunflower Input Management Trial

- A trial consisting of assessing impact of herbicides, fungicides and insecticide on yield of sunflower. In cooperation with the National Sunflower Association of Canada.

MCVET Corn Trial

- Evaluation of 21 varieties of glyphosate or glufosinate herbicide tolerant grain corn. To be published in Manitoba Seed Guide. In cooperation of the Manitoba Corn Growers Association.

Intercropping Corn and Hairy Vetch

- Evaluation of intercropping the legume hairy vetch in corn for potential of increasing quantity and quality of grazing corn acres.

MCVET Lentils

- Evaluation of 22 varieties of lentils, some new from the U of S breeding programs. To be published in Manitoba Seed Guide. In cooperation with the Mantitoba Pulse Growers Association.

MCVET Wheat, Oats and Barley

- Evaluation of 25, 8, and 21 varieties of wheat, oats and barley, respectively, for yield and quality parameters. To be published in Manitoba Seed Guide.

Omega 3 Flax Trial

- Evaluation of Bethun, Nulin50, Carter, Lightning and Omega flax/solin varieties for grain yield and omega-3 fatty acid content. In cooperation with Shape Foods and Viterra.

Niger Seed Fungicide Trial

- Timing evaluation of Lance fungicide for control of Sclerotinia in Niger seed production. In cooperation with a Manitoba seed producer.

Buckwheat Row Cropping and Solid Seeded Trial

- Comparison of Manisoba, Horizon, Springfield, Koma varieties in 30” row crop and 9.5” row spacing for grain yield and quality parameters. In cooperation with Nestibo Agra

Camelina Rotation Trials (in cooperation with U of A and AAFC) in rotation with wheat, pea, winter wheat and canola.

- Exp 1: Determine how preceding crops influence the sustainability of camelina. Good agronomic practices will be used in both production years, however factors that cannot be controlled by producers (soil moisture, persistent weeds, etc) may affect the camelina production.
- Exp 2: Determine how camelina may influence following crops. This will be done as comparison of camelina's influence vs LL canola's influence on following crops. Camelina may be a replacement for canola in some areas so it is a good choice. Good agronomic practices will be used in both production years, however factors that cannot be controlled by producers (soil moisture, persistent weeds, etc) may affect the following crop's production.

AAFC Camelina Variety Trial

- Evaluation of 12 camelina lines produced from the AAFC breeding program in Saskatoon

Camelina Variety Trial

- Evaluation of 24 varieties of camelina from several companies including Sustainable Oils LLC, Great Plains Camelina Company, and Terramax.

Western Feed Grain Development Cooperative

- Evaluation of 16 early and 25 late planted varieties of feed wheats grown in cooperation with the cooperative. Plot locations in Hamiota and Melita. The coop is based at AgQuest in Minto, MB.

AAFC Barley Trials

- Evaluation of malt, food, hulless, and feed barley varieties developed at the Brandon Research Centre by Dr. Mario Therrien.

Flax Fiber Trial

- Evaluation of European fibre flax varieties under several seeding rates for fibre quantity and quality.

Hulless Oats Fertility Trial

- Nitrogen response of three hulless and one hulled oat varieties grown wuith three different nitrogen rates.

Is Sea-buckthorn an Invasive Species?

Cooperators:
Westman Agricultural Diversification Organization
Agri-Environment Services Branch – Indian Head, SK, Bruce Hesselink, Hamid Naeem

Invasive species are plants, animals or other organisms that are growing outside of their country or region of origin and are out-competing or even replacing native organisms. Since they come from ecosystems in other parts of the world, "unwanted invaders" escape their natural enemies. They have a distinct advantage over our native species whose populations are kept in check by native predators, competitors, or disease. Taken from: http://invasivespeciesmanitoba.com/site/

The common sea-buckthorn (*Hippophae rhamnoides*) is by far the most widespread of the species in the genus, with the ranges of its eight subspecies extending from the Atlantic coasts of Europe right across to northwestern China. Common sea-buckthorn has branches that are dense and stiff, and very thorny. The leaves are a distinct pale silvery-green. It is dioecious, with separate male and female plants. The male produces brownish flowers which produce wind-distributed pollen. The female plants produce orange berry-like fruit 6–9 millimetres (0.24–0.35 in) in diameter, soft, juicy and rich in oils. The roots distribute rapidly and extensively, providing a non-leguminous nitrogen fixation role in surrounding soils. Sea-buckthorn berries are edible and nutritious, though very acidic (astringent) and oily, unpleasant to eat raw, unless 'bletted' (frosted to reduce the astringency) and/or mixed as a juice with sweeter substances such as apple or grape juice. The fruit of the plant has a high vitamin C content – in a range of 114 to 1550 mg per 100 grams with an average content (695 mg per 100 grams) about 15 times greater than oranges (45 mg per 100 grams) – placing sea-buckthorn fruit among the most enriched plant sources of vitamin C. The fruit also contains dense contents of carotenoids, vitamin E, amino acids, dietary minerals, β-sitosteroland polyphenols. Nutrient and phytochemical constituents of sea-buckthorn berries may have potential effect in inflammatory disorders, cancer prevention or positive effect on bone marrow after chemotherapy or other diseases, although no specific health benefits have yet been proven by clinical research in humans. (taken from: "Seabuckthorn" Wikipedia[available online])

In the summer of 2011, the Agri-Environment Services Branch (AESB) was investigating the potential for the shrub sea-buckthorn as an invasive species. In June of 2011, AESB contacted WADO for local knowledge of sea-buckthorn plantings in the area that could be monitored. One of the oldest plantings sourced from the original PFRA was located at the Gerald D. Malaher Wildlife Management Area located a couple miles west of the Town of Melita, MB. According to McPhail (1983) this planting was in the early 1950's where a wide variety of other exotic species including sea-buckthorn were planted. According to AESB, this was one of the oldest sea-buckthorn plantings known in the prairies, so focus in its invasiveness was a perfect fit for the site. Preliminary results from the survey indicate that sea-buckthorn can spread up to 40 feet from the mother tree easily. However if planted next to cropland where land is regularly cultivated, it remains under control and would not spread more than 10 feet. In 2012, AESB would like to survey the area in radius of 4-5 km from the Gerald D. Malaher wildlife management area to assess any chance of sea-buckthorn that has emerged locally over the last 60 years from the original stand.

McPhail, K. 1983. "Our First Century. Town of Melita and Municipality of Arthur., Published by Melita-Arthur History Committee. ISBN 0-88925-288-2. Pg 46-47.

Photo: Sea buckthorn growing into ditch despite headland being swathed for hay extended from mother row in treeline, located a few mile south of Isabella, MB.

Vertical Wind Turbine Demonstration

Cooperators:
Manitoba Agriculture Food and Rural Initiatives
RM of Arthur
Prairie Agricultural Machinery Institute – Portage la Prairie
Westman Agricultural Diversification Organization
Solve Product Design - Winnipeg, MB
VBine Energy (Moosomin, SK; Winkler, MB)
WesTower Communications – St. Andrews, MB
Manitoba Hydro
LRB Electric - Virden, MB

Manitoba Agriculture, Food, and Rural Initiative's (MAFRI) small wind research project is to determine and demonstrate the technical and economic viability of small scale (less than 10 kilowatt) wind generation for Manitoba producers. To determine the viability, MAFRI funded a project to purchase and commission 4 wind turbines at diversification centers throughout Manitoba.

The project involved an investigation of all aspects of installing wind turbines for farm use including general research, turbine selection, energy calculations, payback analysis, securing permits, hiring contractors, assembling the towers and turbines and connecting to the power grid.

The unlike the horizontal axis turbines at Roblin and Arborg, the Melita tower is unique in that the turbine propeller turns about a vertical axis. The advantage of this is a low maintenance lower torque design. The propeller spins clockwise no matter the direction of wind. The generator itself is a 3-phase DC generator capable of producing up to 5 kW-hr of power. The power generated by the turbine is directed through a Gale-6 inverter in the WADO shed and is supplied back to Manitoba Hydro power grid through a reverse meter.

Initially postponed due to the potential of flooding, eventually the tower at Melita was erected in October 2011. Electrical work was finished and the turbine was operational by the fall.

Photo: Close up of generator, contains large magnets which move to the speed of the wind, and stator fixed in place containing coils poured in resin.

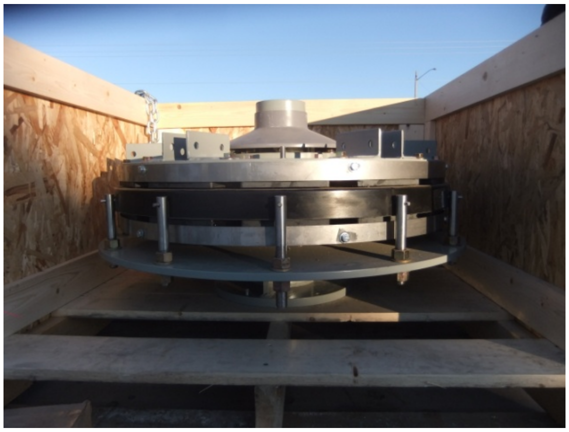


Photo (right): Base foundation, original hole was about 8 feet deep (already wired and poured with concrete), with a smaller square base on top approximately a 4 foot cube rebared to the larger base below. Tower wired in ready to be poured with concrete. Two weeks was needed to cure the base prior to erecting the tower unit.

Photo (Left): Tower was and in place prior to placement of the generator unit. Single person waits for correct alignment of bolt holes with a punch. Same person will wire the generator to the supply line wired to the tower.

Below: Reverse Meter incase generator produces a surplus amount of power.

Photo: Gale 6 inverter (box positioned on wall) with input power from tower on left wire, and output power on right wire leading to breaker box (right photo). “Toaster” dump load positioned on floor for excess power to be off-loaded in a wind storm.

Photo (left): Close up of inverter screen illustrating our first kilowatt of power being produced. Inverter converts the 3-phase DC power into a AC power for the grid. It also acts as a breaker box; when the grid fails to dump the wind power into the “toaster” in order to prevent electrocution to grid workers down the grid when infrastructure