Mackenzie Applied Research Association

2011 Annual Report

Box 646 Fort Vermilion, AB T0H 1N0
Phone (780) 927-3776

Table of Contents

2011 MARA Mission and Staff…….. Page 4

2011 Board of Directors…….. Page 5

MARA Membership…….……... Page 6

President's Message…….. Page 7

Research Coordinator's Message……. Page 8

ARECA , A Year in Review….…….Page 9

Regional Variety Trials: Cereals, Field Peas and Flax……..…….. Page 11

Demonstration of Integrated Control of Ascochyta Blight in Field Peas ... Page 22

Comparative Advantage of Different Inoculants in Yellow Peas……..Page 29

Pea Internode Length Trial…….Page 31

Canola –Pea Intercropping Trial…….Page 32

Precision Tools for on Farm Research……... Page 34

Effect of Different Sources of Nitrogen on Wheat and Canola…….……... Page 36

Conventional Vs Organic Management Trial…….Page 38

Swathing Vs Straight Cutting Canola...……..Page 40

Effect of Harrowing on Organic Oat Yield…….Page 41

Alberta Pest Monitoring Network……..... Page 42

Biennial Wormwood Post Emergence Control…….. ……. Page 44

Manure Management trial…… Page 46

Extension Events 2011…….……... Page 49

AOF Dugout Water Quality…….…….…… Page 52

Acknowledgements……..……... Page 79

Mackenzie Applied Research Association

The Mackenzie Applied Research Association is a non-profit, producer-driven organization that conducts applied agricultural research, demonstration trials and rural extension in Mackenzie County.

Our Mission

To serve producers within Mackenzie County by meeting the special needs that result from our unique climatic, geographic and soil conditions and to facilitate the transfer of best management practices to producers on reducing production costs, marketing strategies, alternative practices and environmental sustainability.

2011 Staff

Dr. Nasar Iqbal
Research Coordinator

Brendan VanPatten
Tyler D. Krahn
Research Technician
(May-October 2011)

#1, River Road
AAFC Experimental Farm
Box 646
Fort Vermilion, AB T0H 1N0

(780) 927-3776 phone
(780) 927-4747 fax
mara3@telus.net
www.mara.areca.ab.ca

2011 Board of Directors

Greg Newman (President)
Box 182 Fort Vermilion, Alberta T0H 1N0
Phone: 780-927-3807

Raymond Dyck (Vice President)
Box 682 La Crete, Alberta T0H 2H0
Phone: 780-928-2382

Manfred Gross
Box 707 Fort Vermilion, Alberta T0H 1N0
Phone: 780-927-4684

Larry Neufeld (Secretary/Treasurer)
Box 487 Fort Vermilion, Alberta T0H 1N0
Phone: 780-927-3715

Dicky Driedger (County Rep)
Box 773 La Crete, Alberta T0H 2H0
Phone: 780-928-3143

Kelly Friesen
Box 890 Fort Vermilion, Alberta T0H 1N0
Phone: 780-927-3058

Joe Unruh (Ag-Canada)
Box 126 Fort Vermilion, Alberta T0H 1N0
Phone: 780-927-3253

Brian Friesen
Box Fort Vermilion, Alberta T0H 1N0
Phone: 780-841-1527

Research Coordinator's Message

2010 has gone passed and it brought stability at MARA in terms of research program execution, improving financial position and staff retain ability. We got our funding increased from Agriculture Opportunity Fund , Alberta Environmentally Sustainable Agriculture Program although it was less than our expectation and will be working vigorously to diversify our funding sources. ARECA supplemental grant was very helpful in delivering program and staff professional training.

We were able to bring most of our projects to completion except few glitches. We seeded all the trials, managed well, collected data, harvested and reports were sent to all the funding agencies. On basis of feed back one can say MARA has another fruitful program this year.

On extension front MARA sign boards were prepared and fixed on 88 Highway and River Road. Organized water quality workshop and sustainable grazing workshop. Arranged MARA Annual Field in July in collaboration with the Mackenzie County . We brought Minister Frank Oberle and two subject specialist to speak on the occasion. More than 100 producers attended Annual Field Day and this indicates interest and confidence of the local producers in what we are doing. I take this opportunity to thank ASB members of Mackenzie County for their continuous financial and moral support and we will be making sincere efforts on our part to strengthen interactive relation with- producers of the County.

Scope of dugout water testing program was broadened this year and total of 41 dugouts from Fort Vermilion , La Crete, Rocky Lane and High Level area were tested for water quality at free of cost and results were made available to producers. To achieve objective of Peace Country Strategy articles were published in a newsletter "Peace Country Agriculture and Extension Update" and delivered to rural boxes of Peace region.

Our board of directors provided valuable advice to staff on MARA business. We appreciate all their hard work at board meetings and travelling as when required to advance the cause of MARA. Thanks to *James Giesbrecht* who as summer staff put efforts to have this program a success.

I would like to thank *Joe Unruh* from Agriculture Canada for his help. critical insight and it is always pleasure to work with him as team at experimental farm . I would like to express my appreciation for our members, board of directors, cooperating producers, government (federal, provincial and municipal), industry partners, ARECA staff, and all other those worked and contributed to the success of our association.

Nasar Iqbal
MARA Research Coordinator

A year in review...

Message from the Executive Director

2011 provided significant challenges for excess moisture but then the tap was turned off for a dry harvest. Marketing of barley and wheat poses uncertainty for Alberta producers but will likely offer opportunities for consideration of a new way of business. There has been change within the ARECA member Associations with the loss of Central Peace Conservation Society as a member of ARECA and merger of Southern Alberta Conservation Society and Southern Applied Research Association into Farming Smarter.

For **ARECA,** a strategic planning workshop in July offered the ARECA Board, Association Managers and ARECA representatives an opportunity to discuss where do we go from here. Four areas were highlighted and they include communication, financial training and administration. The **ARECA Board** of Directors convened for three Board meetings plus five being conference calls. Discussion has been about dispersement of Association equipment to other Associations, strategic planning, training fund, participation in FarmTech and membership fees.

A website Committee under the chair of Laura Gibney provided direction for refreshment of the **ARECA website**. Those revisions are being implemented with support from the Associations in terms of content and graphics. Our readership has continued to grow especially since it includes important announcements from Associations.

Regional Variety Trials are under the coordination of Alex Fedko with Alberta Agriculture and Rural Development (ARD) who replaced Gayah Sieusahai this spring. Alex works with ARECA and Associations to ensure the delivery of these trials throughout Alberta. This has ensured that producers can access unbiased, agronomic information for different cereal and pulse cultivars.

This is the last year for the **Regional Silage Variety Trial** with six Associations (Meghan Elsen coordinated the project) reporting on the nutritional value of annual crops for feed (silage, greenfeed and swath grazing). Six nutritional categories are reported including Crude Protein and Total Digestible Nutrients for different cereal cultivars – the information is available in the Alberta Seed Guide (seed.ab.ca). The project has been funded by the Alberta Beef Producers (ABP) and a request for continued funding from ABP is in progress.

ARECA and WCFA partnered with Canadian Rangeland Bison and Spring Creek Ranch to develop a 'made in Alberta solution' by the creation of a branded program that verifies environmental sustainability, animal welfare and food safety using a third party external audit system. With funding from ALMA, this project will review options to develop a system that is an all-encompassing, third party audited system with a consumer recognized brand or seal. This system will provide consumers assurance that issues such as wildlife habitat, rangeland health, riparian habitat, and manure are being managed in a responsible manner and animals are treated humanely from birth to slaughter. This

The **Energy Conservation and Energy Efficiency** project set out to examine energy use on Alberta grain farms. Two studies examined the relationship of tillage practices and energy consumption. The reports explore Energy Intensity Measures, Energy Output/Energy Input Ratios and Less Tillage Indices. These studies reveal a trend of increasing energy efficiency and related reductions in energy intensity in recent years. These trends are felt to indicate that the economic, environmental and sustainability benefits of energy efficiency are shaping producer decisions.

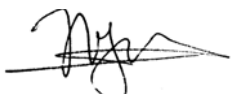
The potential for variable rate technology (VRT) to impact fertilizer use efficiency was studied on 6 farms in 2009 and 2010. The reports include an economic analysis of the impact of this technology on yield and fertilizer applications. Although the short run economic benefits of VRT are challenging, there are opportunities for gaining economic benefits in the long run. These will come from continuously improving knowledge of how fertilizer performance varies across a given field (under different environmental conditions) and continuously developing capabilities to vary crop inputs according to the specific needs of each unique zone. Funding for this project was provided by the Alberta Government.

ARECA hosted the first **"PRECISION AG 2.0: The Next Generation"** Conference at the Deerfoot Inn & Casino in Calgary, February 22-23 2012. As GPS and GIS is now everywhere, the next level is to understand how we can use this technology to make a profit and grow the industry. Topics covered included increased profitability and sustainability, protecting the environment, optimizing your use of agricultural inputs, data management, on-farm research and more. The conference featured...

- 2 full days with over 30 speakers & interactive breakout sessions
- Current information on practices and technologies being adopted by progressive farmers in Western Canada and abroad
- Topics for all skill levels and experience
- 35 tradeshow booths dedicated to precision agriculture
- Meet with progressive and innovative practitioners of precision agriculture

ARECA and Associations were involved in planning workshops such as Cow-Calf Economics, Advanced Agronomy Conference and Forage Agronomy Workshop. Additionally, funding applications were developed for swath grazing, data tools for precision ag and field efficiency and obstructions, barley 180, Regional Silage Trials and FarmRITE.com.

With sustainable and effective member associations, ARECA and Associations are respected leaders in applied agriculture research and extension. Our mission is to collaborate with member associations and partners to enhance delivery of reliable and unbiased applied agricultural research and extension. As we go forward in 2012, I wish to thank everyone for their contributions and efforts in 2011 - may we continue to build on our vision.



Ty Faechner, Executive Director

Regional Variety Trials: Cereals , Field Peas and Flax

Regional variety testing program is run in western Canada and very popular among the producers because they have chance to see how different varieties are performing under local conditions. Under the RVT program, different varieties of cereal grains, pulses and flax were grown at experimental farm to determine which thrives best in local agro-climactic conditions. Selecting variety is an important component of production process because it effects yield, time of maturity and resistance to diseases. Before selecting a crop variety it is beneficial to look into data from field trial in your particular area, reason behind is certain varieties behave differently in different set of agro-climatic conditions. The varieties that perform better in adverse conditions may perform better in optimum growing conditions.

The Regional Variety Trials are conducted throughout Alberta and parts of British Columbia. Each site is subject to different soil and climate conditions, therefore, the data is useful to local producers. The data is collected by Coordinator RVT, Alberta Agriculture and Rural Development and compiled for print in seed.ab.ca. MARA has been involved with the Regional Variety Trials since 1995.

The yield from small plot trial is generally higher than the field scale production level. In small plot trial effort is made to select a uniform and productive patch of land with ultimate objective of achieving a uniform crop stand. Input are also provided to produce optimum crop yield for specific soil properties but the relative performance of different varieties is likely to be similar under small plot and field scale conditions.

Objectives

- To collect agronomic data on yield, bushel weight, plant height, maturity and 1000 kernel weight of newly registered and existing varieties of Cereal and Pulse
- To publish the data for use by local producers.
- To familiarize producers with the newer varieties available to them.

Materials and Methods

The 2011 Regional Variety Trial consisted of 9 varieties of GP wheat, 19 varieties of hard red spring wheat, 19 varieties of 2- row barley, 8 varieties of 6-row barley, 6 triticale, 6 varieties of oat, 9 varieties of yellow peas and 4 lines of green pea and 5 varieties of Flax.

For each crop, the seeding rate was determined from the 1000 kernel weight of each variety. The site selected was summer fallow and soil samples were collected from the site and fertilizers were applied as soil test recommendations. Plots were seeded using a Fabro small plot seeder. Plots were planted at 6.5 meters in length with four rows 12 inches apart. Seeding depth for cereals varied from 1—1.5 inches, seeding . A fertilizer mix of 83-31-28 NPK was banded at a rate of 142 lbs/acre. Table 1 summarizes the crop management details.

Table 1: 2011 Regional Variety Trial Management Information

Crop	Seeding Date	Harvest Date	Previous Crop	Fertilizer NPK (lb/ac)	Herbicide
GP Wheat	May 16	September 20	Summer fallow	83-31-28 142 lbs/ac	Buctril M+ Puma
HRS Wheat	May 16	September 20	Summer fallow	83-31-28 142 lbs/ac	Buctril M+ Puma
2-Row Barley	May 16	September 15	Summer fallow	83-31-28 142 lbs/ac	Buctril M+ Puma
6-Row Barley	May 17	September 15	Summer fallow	83-31-28 142 lbs/ac	Buctril M+ Puma
Triticale	May 17	September 23	Summer fallow	83-31-28 142 lbs/ac	Buctril M
Oat	May 17	September 20	Summer fallow	83-31-28 142 lbs/ac	Buctril M
Field Pea	May 16	September 01	Summer fallow	0-11-5.2	Odyssey
Flax	May 17	September 23	Summer fallow	50-31-30	Buctril M

Cereal trials were replicated three times and flax and pea trials were replicated four times in a randomized complete block design. After plants were established, all plots were cut back to 5.5 meters in length by roto-tillage to ensured equal length of harvest. Throughout the growing season, field notes were recorded on height, maturity and lodging. Weed control consisted of combination of herbicides and hand rouging. Lodging of each plot was rated on a scale of 1-9 (1= Erect and 9 = Flat) prior to harvesting

Harvesting was done using a straight cut, small plot combine. Samples were air dried and sent through a clipper seed cleaner and then evaluated for yield, test weights and 1000 kernel weights.

Statistical Analysis

Crop yield averages (or means) of agronomic data are listed throughout the body of the data tables. The least significant difference (LSD) and the coefficient of variation (CV) are listed at the bottom. The LSD is given at the 5 percent error level and is an aid in comparing varieties. If the measured values of any two varieties differ by the LSD value or greater, they may be considered different with a confidence level of 95%. If the measured values are less than the LSD value, the differences may be due to random error rather than real differences.

Coefficient of variation (CV) is also included in the tables. This is given as a general measurement of the accuracy of each experiment. Lower CV percentage values indicate less experimental variation and greater reliability in results. Also this indicates that environmental conditions were uniform during the experiment and that the differences among varieties are due to treatment characteristics. High CV values indicate that non-treatment conditions are affecting the results of the replications, therefore making the experiment less statistically accurate. According to some statisticians a CV greater than 15 % is questionable and may not be accepted as statistically sound.

Table 2: General Purpose Wheat Agronomic Data

Varieties	Maturity (days)	Height (cm)	Lodging (1-9)	KWT (1000 gm)	KGHL	Protein (%)	Yield (bu/ac)
AC ANDREW	93	87	1	53	70.3	12.5	92.30
AC CRYSTAL	96	81	1	59	70.5	14.6	87.20
AC TABER	94	73	1	60	72.7	13.6	87.09
CDC NRG 003	92	81	1	58	70.3	14.6	89.48
CONQUER VB	101	84	1	60	73.3	16.0	93.45
HW 024	92	88	1	51.2	71.7	16.1	76.25
HY 985	92	81	1	64	72.0	15.7	84.97
MINNEDOSA	93	83	1	62	68.7	14.2	83.06
NRG 010	95	78	1	62	70.7	12.9	97.94
						CV	9.08
						LSD (P=0.05)	13.84

General Purpose wheat plots

HRS wheat Plots

Table 3: HRS Wheat Agronomic Data

Varieties	Maturity (days)	Height (cm)	Lodging (1-9)	KWT (1000 gm)	KGHL	Protein (%)	Yield (bu/ac)
5604HR CL	63.03	78	1	37.1	73.6	15.9	63.03
AC BARRIE	78.36	84	1	42.4	73.9	16.6	78.36
AC GOODEVE	77.44	84	1	38.7	73.4	16.8	77.44
AC MUCH-MORE	72.33	76	1	39.8	76.0	16.1	72.33
BW 433	73.06	89	1	42.9	73.9	17.30	73.06
BW 901	65.36	81	1	41.60	72.4	16.6	65.36
CRANBERRY	62.80	76	1	42.3	73.5	16.6	62.80
CDC KERNEN	79.15	93	1	41.9	74.6	17.0	79.15
CDC STAN-LEY	87.58	80	1	37.4	72.8	16.4	87.58
CDC THRIVE	83.44	91	1	43.5	73.9	17.1	83.44
CDC UTMOST VB	66.50	86	1	39.0	73.1	16.9	66.50
GLENN	71.80	86	1	40.7	75.8	16.6	71.80
KATEPWA	77.70	88	1	37.9	73.8	16.9	77.70
SHAW VB	85.71	88	1	38.4	72.1	16.9	85.71
STETTLER	75.90	83	1	42.1	72.8	17.5	75.90
UNITY VB	75.84	90	1	39.5	73.8	17	75.84
VESPER VB	59.46	90	1	43.4	72.5	17.4	59.46
WR 859 CL	74.01	79	1	41.30	74.1	17.0	74.0
						CV	13.57
						LSD at 0.05	16.26

Table 4: 2 Row Barley Agronomic Data

Varieties	Maturity (days)	Height (cm)	Lodging (1-9)	1000 KWT (gm)	KGHL	Yield (bu/ac)
AC METCALFE	90	75	1	44.7	62.0	131.61
BENTLEY	91	73	1	50.0	61.3	132.68
CDC AUSTENSON	93	86	1	46.7	61.30	149.04
CDC CARTER	88	66	1	42.0	72.3	79.92
CDC EXPLUS	88	74	1	41.3	71.3	108.16
CDC KINDERS-LEY	90	74	1	44.7	60.7	119.95
CDC MEREDITH	89	67	1	49.3	60.0	127.63
CDC POLARSTAR	90	69	1	46.7	61.7	110.28
CDC RESERVE	89	67	1	48.0	62.0	137.57
CERVEZA	90	71	1	48.0	60.7	150.54
CHAMPION	92	75	1	46.0	60.7	135.44
FB 205	88	93	1	56.7	63.3	124.07
GADSBY 75	89	75	1	54.0	61.7	118.05
HB 08304	89	81	1	49.3	74.0	149.02
MAJOR	86	64	1	45.3	58.0	123.62
MERIT 57	93	73	1	43.3	58.7	125.03
NORMAN	92	74	1	44.0	61.7	128.72
TR 07728	90	71	1	44.7	63.3	123.32
XENA	91	72	1	46.7	61.3	118.51
					CV	12.56
					LSD at 0.05	26.20

2-Row barley plots

Triticale plots

Oat plots

Flax Plots

Table 5: 6-Row Barley Agronomic Data

Varieties	Maturity (days)	Height (cm)	Lodging (1-9)	1000 KWT (gm)	KGHL	Yield (bu/ac)
AC METCALF	89	70	1	40.0	63.0	140.95
BT 584	87	49	1	38.7	58.0	84.19
CDC ANDERSON	86	51	1	38.0	58.0	74.41
CDC MAYFAIR	87	63	1	42.0	58.0	114.23
CDC CELEBRA-TION	86	58	1	39.3	60.3	84.26
CHIGWELL	87	58	1	38.7	58.7	66.00
STELLAR ND	86	63	1	43.3	60.0	88.08
VIVAR	87	51	1	40.7	57.3	80.53
					CV	12.49
					LSD (P=0.05)	20.14

Table 6: Triticale Agronomic Data

Varieties	Maturity (days)	Height (cm)	Lodging (1-9)	1000KWT (gm)	KGHL	Yield (bu/ac)
AC UL TIMA	99	104	1	46.7	68.7	106.61
BUMPER	100	94	1	46.7	69.3	97.63
PRONGHORN	101	101	1	44.0	67.0	118.14
T 200	100	94	1	42.7	70.7	119.71
T 204	101	90	1	42.0	66.7	103.41
TAZA	100	103	1	50.7	67.0	103.25
					CV	8.67
						17.06

Table 7: Oat Agronomic Data

Varieties	Maturity (days)	Height (cm)	Lodging (1-9)	1000KWT (gm)	KGHL	Yield (bu/ac)
AC BRADLEY	89	99	1	49.3	44.7	233.86
CDC BIG BROWN	90	108	1	53.8	49.3	252.41
CDC DANCER	87	96	1	47.6	48.0	213.50
CDC MINSTREL	87	96	1	53.3	46.0	214.66
CDC SEABISCUT	92	102	1	57.3	45.3	226.37
OT 2069	91	101	1	50.0	49.0	240.35
					CV	1.56
					LSD at 0.05	6.54

Table 8 : Flax Agronomic Data

Varieties	Height (cm)	Lodging (1-9)	1000KWT (gm)	Yield (bu/ac)
CDC BETHUNE	60.87	1	6.7	44.59
FP 2214	60.5	1	7.0	45.18
PRAIRIE THUNDER	55.38	1	7.6	44.21
FP 2270	60.5	1	7.9	50.02
PRAIRIE GRANDE	57.5	1	7.2	43.44
			CV	8.51
			LSD	5.96

Table 9: Field Peas Agronomic Data

Varieties Yellow Peas	Height (cm)	Lodging (1-9)	1000KWT (gm)	Yield (bu/ac)
ARGUS	60.62	5.25	314.95	50.60
CANSTAR	63.25	5.00	317.45	58.74
CDC 2093-22	65.50	4.75	289.75	59.62
CDC HORNET	70.62	4.50	280.35	74.55
CDC MEADOW	65.10	5.00	271.62	56.32
CUTLASS	56.60	5.50	285.40	52.68
HUGO	62.10	4.50	282.90	59.20
STELLA	52.62	6.25	260.57	49.67
THUNDER BIRD	60.25	4.50	261.05	70.35
			CV	16.20
			LSD at 0.05	13.73
Varieties Green Peas	**Height (cm)**	**Lodging (1-9)**	**1000KWT (gm)**	**Yield (bu/ac)**
CDC PATRICK	69.5	7.00	220.07	39.49
CD PLUTO	60.75	6.75	231.93	39.71
CDC 2235-4	68.87	6.25	297.65	44.53
CDC TETRIS	69.5	6.00	254.22	49.58
COOPER	66.00	5.50	321.47	52.37
			CV	9.81
			LSD at 0.05	10.17

Green Peas RVT

Yellow Peas RVT

Demonstration of Integrated Control of Ascochyta Blight in Field Peas

(Sponsored the Alberta Pulse Growers)

Alvin Eyolfson (BRRG), Kabal S. Gill (SARDA),
Nasar Iqbal (MARA), Keith Kornelsen (LARA)

Abstract

Ascochyta blight often occurs in association with Mycosphaerella blight and foot rot. This disease complex is a barrier to achieve high yield of field peas. Field demonstrations were conducted near Stettler, Fort Kent, St. Isidore, and Fort Vermillion, to monitor the effects of seed treatments and fungicide applications on the plant growth, pest issue, diseases, lodging and seed yield of field peas.

At Stettler, St. Isodore, and Fort Kent, reduction in field pea disease was noted with the foliar treatments. By later August the differences were less visual. Fungicide application appeared to provide yield improvement in some cases. In future, different timings and spraying twice should be demonstrated. This project documents the benefits of foliar fungicide spraying on field peas. This was a more common practice in 2011.

Background

Ascochyta blight (leaf and pod spot) is caused by the fungus called Ascochyta pisi. Infested seed and previously infected crop debris are sources for this organism. The fungus does not overwinter in soil. This disease is prevalent in Alberta and is especially a problem in cool and / or wet conditions. Disease infection may cause lodging of the crop, which was especially a problem in central and east central Alberta in 2010. Symptoms start with a brown speckling of the lower leaves, eventually spreading upwards to the newer leaves and pods.

Ascochyta blight often occurs in association with Mycosphaerella blight and foot rot. Two different fungi are responsible for this disease: Mycosphaerella pinodes and Ascochyta pinodella. These organisms may be found on seed, on crop residue and in the soil. This disease complex is a barrier to achieve high yield of field peas. Mycosphaerella blight may be found on the leaves and stems as purple spots. Foot rot symptoms usually appear on the stem near the soil surface as bluish-black discolorations. Both fungi thrive in wet environments. Mycosphaerella pinodes is an aggressive pathogen (disease-causing organism) causing yield losses of up to 75 per cent.

This project will demonstrate several agronomic practices such as using clean seed, seed treatments and timing of foliar fungicides. Disease rating, lodging, yield, and economics of crop will be evaluated.

Objective

To monitor the plant growth, pest issue, diseases and seed yield of Field peas.

To evaluate the effects of seed treatments such as Apron Maxx and Vitaflo 280 on disease level and yield.

To evaluate the effect of foliar fungicide treatments applied at different times on the Ascochyta levels, lodging and crop yield.

To communicate the results to local and other producers

Methods

CDC Centennial Field peas were used (donated by Lefsrud Seed Growers, Viking, AB). The seed size was smaller than usual for this cultivar with a 100 kernel weight of 212 gms. The germination rate was 96 %. The resulting seeding rate was 215 lbs/acre to give a target of 8 plants/ sq ft. The seed was treated with the help of the Alberta Agriculture research center in Lacombe.

	Pre seeding Herbicide	Seeding Date	Post seeding Herbicide	Fungicide Spray Date	Harvest Date
BRRG	RU,	May 13	Odyssey, June 7	July 15	Sept 14
LARA	Edge, Apr 27	May 12	Odyssey, June 21	July 11- Rep 1 July 13 – Rep 2	Sept 1
SARDA	Ru + May 12	May 18	Poast Ultra + Pursuit June 13	July 6 July 27	Sept 14
MARA	Conv tillage	May 20	Odyssey, June 23	July 18	Sept 2

Plots were arranged as shown in Figure below. Three different seed treatments were used and 5 different fungicides were applied. Plots 101,102 and 201, 202 were planted to see which if any of the seed treatments gave the field peas an advantage. Plots 103-107 were planted to see which of the fungicides showed an advantage. Plots 203-207 were planted to see if there is an advantage to use both a seed treatment and a fungicide to control disease.

Figure1. Plot Map

201 Trilex No Fung	202 No Seed TRT No Fung	203 No Seed TRT Bravo 500	204 No Seed TRT Lance	205 No Seed TRT Quadris	206 No Seed TRT Head-line	207 No Seed TRT Quilt
101 Vitaflo No Fung	102 Apron Max No Fung	103 Apron Max Bravo 500	104 Apron Max Lance	105 Apron Max Quad-ris	106 Apron Max Headline	107 A

Table 10: Precipitation by month (mm)

	2011 St. Isidore	**2011 Stettler**	**2011 Fort Kent**	**2011 Ft Vermil-lion**
May*	49.6	40	2	7.7
June	113.5	103	186.3	12.6
July	164.4	128	142.8	61
August	40.4	79	42.2	45
Total Rain	367.9	350	373.3	126.3

- Both the St Isodore site and the Stettler site were wetter and cooler than normal in the spring. The 4 month 30 year average rainfall for these locations is 223 to 244 mm.
- The LARA site location at Fort Kent had a wet July, saturating the soil. The poor yield here was reflective of the amount of disease present. These yields reflect what producers in the area experienced.
- The Ft Vermillion site was much drier than usual, especially in the spring

Seed Treatments

Apron Maxx RTA: (Syngenta Crop Protection, *Fludioxonil + Metalaxyl)*
Controls: In field peas, Seed borne Ascochyta, damping off caused by Fusarium spp., Rhizoctonia spp., and Pythium spp. Works with both contact and systemic activity due to two active ingredients.
Trilex A: (Bayer Crop Science, *Trifloxystrobin + Metalaxyl)*
Controls: Same as Apron Maxx
Foliar fungicides
Bravo 500: (Syngenta Crop protection Canada*, chlorothalonil);*
Controls: Anthracrnose and Ascpchyta in field peas
Bravo is a contact and protectant fungicide. More than 1 application may be needed
Headline EC : (BASF Canada, *pyraclostrobin)*
Controls: Mycosphaerella blight and powdery mildew in field peas
Headline has a protective and curative effect, and is also systemic movement within the leaf
Lance: (BASF Canada, *boscalid)*
Controls: Ascochyta blight, grey mold, and Mycosphaerella spp.
Lance provides a protective effect and best results are when in a preventative spray program.
Quadris: (Syngenta Crop Protection Canada, *azoxystrobin)*
Controls : Ascochyta blight, Mycosphaerella blight and Anthracnoce
Quadris is a preventative fungicide with systemic properties.

Quilt: (Syngenta Crop Protection Canada, *azoxystrobin +propiconazole)*
Controls: None are listed in the 2011 Blue book for field peas.
Quilt consists of two fungicides, both of which have systemic properties and have different modes of action. It has both preventative and curative activity.
Data and Observations

Plant Counts
Plant counts at St. Isidore ranged from 5.6 to 6.4 plants/sq ft. The seed treatments did not improve emergence.
At the Fort Kent site, crop establishment was very good, with plant counts over 10 plants/sq. ft.
At Stettler, crop emergence was also good, plant counts here were around 8 plants/sq ft.
The stand establishment at Fort Vermillion was rated at 50 % due to the dry conditions. Please see the photo in the appendix of this report.

Lodging Notes
Plant heights were not influenced by any of the fungicide treatments.
At both the LARA and Stettler, there was very little lodging in early August. However by late August ratings of plots with no foliar fungicides had very poor lodging ratings (8-9). The foliar fungicide plots had not lodged as severely with ratings of 7-8. CDC Centennial is a field pea cultivar with intermediate standability.

Disease Ratings
At both the Fort Kent and Stettler locations it was observed that the untreated plots were the worst looking by mid-August with little green growth left. Disease levels were high by August and differences in appearance were less as the month progressed. At early ratings, Bravo 500 was not much better than the check treatments at the Stettler and Fort Kent sites. It performed better in St. Isidore, showing a reduction in lodging. Quadris, Quilt, and Headline appeared to have the most effect in suppressing disease, across all of the sites. The disease was not diagnosed but was most likely caused by Ascochyta blight.

Table : Average yields (bu/acre) by treatment
Fungicides yields shown are for the average of seed treated and untreated seed. At the St. Isisdore, large rainfall events in June and July caused flooding of the west side and plot # 201 to 207 were were not harvested. Treat these results and observations with caution as they were from non-randomized locations. Differences could be from field variability.

Table 11: Average yields (bu/acre) by treatment

	BRRG Stettler	SARDA St Isidore	LARA Fort Kent	MARA Ft Vermil-lion	Mean 3 sites
Check	53	75.8	20	12.7	40.4
Apron Max treatments	68	75.8	22	18.3	46.0
Bravo*	62.0	80.2	23.5	16.0	45.4
Lance	69.5	79.6	17.5	17.2	45.9
Quilt	77.4	74.6	29.5	23.5	51.3
Quadris	79.9	79.4	24.0	26.8	52.5
Headline	73.9	84.4	28.0	30.3	54.1

Dis-cussion

BRRG - Stettler

Although 2011 was a wetter year than normal it was a much better year for field pea production than 2010. The rainfall fell on more days, with few days with large rainfall events. The result was less field flooding, and saturated areas were smaller. The Stettler site had some disease developing in early July at the time of spraying foliar fungicides. Fungicides did appear to provide a benefit both in terms of disease suppression, some reduction in lodging and an increase in yields. The seed treatments did not result in any visual differences. The untreated check was the poorest yielding.

LARA - Fort Kent

This was a tough year for field peas in the Lakeland area. Many local producers recorded lower than average yields this year. With the drought and cold weather in May and June and then the wet, wet weather in July it combined to weaken plants and create ideal disease conditions. The plots all seemed to come out of the ground with same vigor. The extreme cold and lack of moisture seemed to negate any benefits that may have been seen by using a seed treatment.

The crops all looked great at the beginning of August but then gradually began to fall and hit the ground.

The fungicide plots were greener longer and seemed to stand better than the plots without fungicide. Of the four plots without fungicide there did not appear to be any difference between the plots. The disease pressure was too high to see any difference here.

The plots sprayed with Headline appeared to have the most green on August 18 and were noticeable better in both reps than the other treatments. There was not any difference between plots in reps 1 and 2 or the seed treatment did not appear to make a difference in diseases affecting the crops at this late stage. Quilt and Quadris in both reps appeared to be better then Bravo 500 and Lance. The plots with no fungicide were easily the worst looking plots with no green on August 18.

SARDA - St. Isisdore

The seed treatments did not increase the emergence compared to no seed treatment. The height, lodging, seed yield, test weight and TKW from the use of Vitaflo 289 or ApronMax were similar. Compared to no fungicide application, the Bravo 500, Headline and Quilt fungicides indicated reduced lodging. Also, Bravo 500, Lance, Qaudris and Headline use appeared to increase seed yield over the no fungicide control, with relatively greater (8.6 bu/ac) benefit from Headline than the other fungicides (3.6 to 4.4 bu/ac). The Headline use also indicated relatively higher TKW than the other treatments.

MARA – Fort Vermillion

Fungicides were intended to be sprayed earlier, but rainfall made this impossible. No differences in disease level, was noted between treatments. The selected site was high spot and we started with little moisture and there was no rain till the 2'nd week of July and all this badly effected stand establishment. Perusal of data in table 11 shows that there was significant difference in yield between check and Headline.

Overall Summary

The trial found that this year if you were going to spend money on your field peas the fungicide was your best input. Although there did appear to be a difference between fungicides this would have to be replicated to be conclusive. This was a great year to show the effectiveness of fungicides as many producers in many areas were seeing substantial yield increases where fungicide was applied. Anytime you have those warm moist conditions throughout the growing season there is going to disease issues. With good crop prices it does not take a lot for the fungicide to pay off.

Communication Activities

Following were done to communicate the results to farmers, industry and public.:

- BRRG featured the project on the Stettler crop tour on July 20 to about 12 producers
- LARA had a tour on July 26, with only 9 producers attending due to rain
- SARDA organized an open house at the site on July 20, which was well attended by the farmers.
- The demonstration was presented to the 75 participants in the Alberta Soils Tour on Aug. 5.
- More than 70 Producers visited the trial on 29th July on MARA Field Day

Results included in the annual report of ARA's (sent to the ARA members and posted on the www. areca.ab.ca), with summaries included in newsletter and other presentation by the ARA's.

- Summary report on the project published in the newsletters.
- Plots layout and related information were made available at the site entrances for self-guided tours by during the July to Sept. period.
- There were signs installed near each site to promote the site for passing along producers and public

Acknowledgements

Funds for the project: Alberta Pulse Growers (APG), Alberta Government (Agriculture Opportunity Fund, AOF, of the Agriculture & Rural Development) and local municipalities.

The Fungicides were supplied by Bayer Crop Science, BASF Canada, and Syngenta Crop Protection Canada.

Figure 2 : The field peas at Fort Vermillon in drier conditions

Figure 3 : The Stettler field peas in mid-July

Comparative Advantage of Different Inoculants in Yellow Peas

Background

Fields Peas have important place in crop rotation and economic significance as well due to its nitrogen fixing capacity. Aside from not adding nitrogen for pea crop some producers view they can reduce nitrogen applications rates by about 15-20 % in following crop (wheat) and in second year by about 10 %. The nitrogen fixing capacity of field peas is greatly increased by adding inoculants. There are various commercial inoculants products available in the market and everyone claim that their product gives maximum yield but for sure these inoculant behave differently in different soil and agro-ecological conditions. The other aspect to consider is the inoculant and seed treatment compatibility. Applying the inoculant and seed treatment to the seed can affect the survivability of the inoculant. Manufacturer's recommendations in this regard should be followed.

Objective

- To determine the most suitable inoculant under local conditions and make this information available to producers of the area.

Materials and Methods

The CDC Meadow yellow pea was seeded on 16th May according to RCBD with three replications. The site selected for this trial was summer fallow. Fertilizer was applied was PK 11-52@ 44lbs/ac and seeded 1.5" deep with 12" row spacing. TagTeam, Soil Implant and Nitrastick were applied @ 2.70 lbs/ac, 5.00lbs/ac and 6 lbs/700 kg seed. Treatments included (T1) Soil Implant, (T2) Nitrastick, (T3) TagTeam, and (T4) Check. Reglone application was done on 16th August and combined on 1September. Data was collected on plant height, lodging, KWT and yield.

Results and Discussion

Results are presented in Table 12. Perusal of table showed that maximum yield in descending order was 67.29, 64.21, 60.61 and 53.94 bu/ac in Check, Soil Implant, TagTeam and Nitrastick respectively. Data regarding plant height, lodging and 1000KWT are also presented in the Table1. It looks bit odd that check has more yield as compared with all three inoculants and reason might be soil patch selected for this trial was summer fallow and there was sufficient nitrogen in the soil and different inoculants were not able to influence yield significantly. If we compare the yield of different inoculants then soil implant gave highest yield and this was followed by TagTeam and Nitrastick. Less lodging and height was also noted in Check.

.

Table 12: Comparative Advantage of Different Inoculants in Yellow Peas

Treatments	Height (cm)	Lodging (1-9)	1000KWT (gm)	Yield (bu/ac)
(T1) Soil Implant	91.50	7.00	262.30	64.21
(T2) Nitrastick	91.50	6.33	227.4	53.94
(T3) TagTeam	91.00	6.66	261.00	60.61
(T4) Check	90.50	5.5	241.15	67.29

Different Inoculants Trial

Pea Inter node Length Trial.

Field Peas are considered as choice crop for growing nitrogen on farm due to their higher nitrogen fixing capacity. Producers always interested in higher yield by providing the optimum inputs but feel very much constrained due to lodging because that makes the combining operation more difficult. Present studies were designed with the objective to see if seeding depth affects inter node length, stand ability and yield.

Materials and methods

Demonstration trial have one replication and treatments included CDC Meadow Peas seeded @ 192 lbs/ ac at 0.75 (T1), 1.5 (T2) and 3 inch deep (T3). Seeding was done on 22'nd May and Odyssey used as herbicide Plots were measuring 12x40ft and were later trimmed back to 36 ft. length. Fertilizer applied 0 -0-30-10 NPKS and soil implant was used as inoculant. Data about plant height, yield, 1000KWT and lodging. All the plots were sprayed with Reglone on 24 August and directly combined with small plot combine on September 9, 2012.

Results and Discussion

Results are presented in Table13. Results indicated deep seeded pea (3 inch deep) have comparatively higher yield as compared with the other treatments. Average yield was 48.88, 45.43 and 50.66 bu/ac in T1, T2 and T3, respectively. At for as lodging was concerned; it was difficult to establish any kind of relationship with seeding depth. The reason behind the higher yield in deep seeded (3 inch deep) might be due to moisture stress during early part of growing season and deep seeded peas were in better position to cope with that stress and this ultimately resulted in higher yield.

Table13: Effect of different seeding depth on pea productivity

Treatments	Yield bu/ac	1000TKW (gm)	Plant height (cm)	Lodging (1-9)
T1=Seeded 0.75"	48.88	320	88.60	6.0
T2=Seeded 1.5"	45.43	340	83.80	6.0
T3= Seeded 3"	50.66	340	90.20	6.0

Canola –Pea Intercropping Trial

Producers are always interested in some thing that can reduce production cost especially when fertilizer and other inputs costs are increasing on regular basis. One of producer of county came up with suggestion that we should conduct a demonstration trial in local condition.

Material and Methods

The CDC Meadow Peas and Canola variety 5535 CL was selected for this trial. This was single replicated trial and seeding was done with conserva-pak seeder with 9 inch row spacing. Plot size was 24X100 ft, Treatments included T1= Pea only @188 lbs/ac T2= Canola only @4.98 lbs/ac T3= Full seed rate pea + 1/2 seed rate Canola and T4= 1/2 Canola+1/2 Pea. Fertilizer applied for T1 was 30lb K+ 10 lb S/ac and for T2 NPKS 95-0-16-20 lbs/ac. Fertilizer applied to T3 and T4 was NPKS 40-0-30-15 lbs/ac on the basis of soil test recommendations. Odyssey was sprayed for weed control because it works both in pea and canola. This year there was moisture stress early in the season and 1st rain happened during 2'nd week of July. Just Pea were sprayed with Reglone and Canola and Pea + Canola were sprayed with Roundup before combining. Trial was combined with small plot combine and adjust for cylinder speed, fan and sieve were adjusted for Peas and need to travel slowly because lot of plant mass goes in. Canola and Peas were immediately separated with hand held sieves and dried according to normal procedure.

Results and Discussion

Careful view of the results presented in Table 14 indicated although just canola seems to be most favorable treatments but if we take into account the in puts costs then T4 1/2 Pea + 1/2 Canola because input cost even less than half. Field observations indicated that 1/2 Pea + 1/2 Canola was standing almost upright and there was minimal lodging as compared with all other three treatments. Yield obtained was 49.77, 59.15, 56.12 (37.95 Pea + 18.17 Canola) and 60.97 (30.35 Pea + 30.62) Canola in T1, T2, T3 and T4, respectively. Trial will be repeated next three years with three replications of each treatment. Figure: Pea Canola intercropping

Table 13: Pea canola intercropping

Treatments	Height (cm)	Lodging (1-9)	1000KWT (gm)	Yield (bu/ac)
T1= Full Rate Pea	88.60	8	372	49.77
T2= Full rate Canola	107.90	6	10	59.15
T3= Full pea + 1/2 canola	74.60 / 109.0	7 / 7	400 / 9.2	37.95 / 18.17
T4= 1/2 Pea +1/2 Canola	98.40 / 115.0	2 / 2	456 / 12	30.35 / 30.62

Left side of photograph is Full Pea +1/2 Canola (lodged) and right side is 1/2 pea + 1/2 Canola standing upright

Precision Tools for On Farm Research

Ken Coles, SARA; Alvin Eyolfson, BRRG; Andrea Fox-Robinson, GRO; Keith Kornelsen, LARA; JP Pettyjohn, SARDA; Nasar Iqbal MARA; Ty Faechner, ARECA; Darren Smith, Novozymes

Introduction

There is a significant interest by farmers in utilizing agronomic information that addresses spatial variability in Western Canada. This strong interest is due to rising input costs and the application of Variable Rate Technology (VRT) to optimize inputs for fields. Consequently, farmers are asking questions about how crops respond when inputs are varied across a landscape according to topography. This project will provide an opportunity to assess the influence of topography on phosphorus and nitrogen nutrients.

The method by which these questions can be answered on a practical, field-scale basis needs to be understood and documented so that producers can implement these methods on their farm. We have chosen to implement this research using farm-scale equipment and data collection techniques that with modest training can be applied by Alberta farmers.

Another benefit to Alberta's agriculture industry is the collection of applied, field-scale research from sites across different soil and climatic zones. The opportunity is that each of the co-applicants has a local/regional connection to extend the research information at a local and provincial level.

Objectives

This project has five objectives and they are:

1.Develop a sound understanding of the use of Global Positioning Systems (GPS) and Geographical Information Systems (GIS) in Precision Agriculture for performing field-scale experiments

2.Explore useful methods for analyzing and modeling variability of crop yield on a field-scale basis

3.Understand and document the options for precision agriculture in on-farm experimentation

4.Develop and deliver information about a new method of doing field-scale trials to producers through a variety of communication mediums

5.Assess agronomic inputs for spatial and temporal effects on crop yield related to topography

Materials and Methods

Experimental Design, Location and Treatments

Each Association that participated in the project contacted interested farm co-operators with the appropriate equipment. For this project, it was essential that farm co-operators own a combine with a crop yield monitor and functional global positioning system. Combines equipped with these devices are able to record variables such as geographical coordinates, grain flow rate, time, logging interval, distance traveled, swath width, grain moisture, and header status in intervals of one to several seconds. Precision agriculture is a combination of three technologies including a combine, global positioning system receiver, and crop yield monitoring system. While harvesting the crop, the crop yield monitor on the combine tracks and stores the geographic locations determined with a GPS receiver. The yield monitor also records the grain weight, flow rate, travel speed and harvest area. Crop yield data are collected every second with latitude and longitude as harvest occurs to produce a georeferenced map. The crop yield data is analyzed with GIS software to evaluate the responses of a crop to agronomic treatments.

MARA Results:

MARA participated in this research project , our cooperator this year again was Raymond Dyck who has this trial for consecutive 3 years. We seed both Canola and Pea trial but was able to combine canola only. Canola was seeded on 24 May and variety seeded was 7345 @ 3lbs/ac to 1/2 inch seeding depth. Combing was done on 26 September and data obtained from yield monitor and weigh wagon are presented in table 15.

Table 15: Use of Precision Tools For On Farm Research

Raymond Dyck (Cooperator)

Treatments (Canola)	Yield Monitor (bu/ac)	Weigh wagon bu/ac
Zero Nitrogen	27.60	23.92
50 % less N	37.70	36.29
Soil Test Recom-mendation	41.30	42.51
150 % of Soil Test Recommendation	42.80	43.03
Producer's Rate	40.00	40.96

Precision Canola Trial at La Crete

Effects of Different Sources of Nitrogen on Yield and Quality of Wheat and Canola

Background

Stabilized nitrogen technology uses urea-based fertilizers treated with a nitrogen stabilizer to improve their efficacy. Typical losses from urea use are reduced. Available stabilized nitrogen products include ESN and Agrotain coated urea. ESN is a controlled release fertilizer consisting of polymer coated urea. The polymer coating allows water to diffuse into granule, dissolving nitrogen within. The rate of N release is governed by the soil temperature. Because the N release is slower when seed placed in single shoot system, there should be less seedling damage while Agrotain treated urea prevents seedling damage by slowing the conversion of urea to ammonia through use of urease inhibitor and ammonia is a form of Nitrogen that causes seedling damage.

Some farmers do not have access to seeders that can place nitrogen at a reasonable distance from the seed because they have single shoot openers on their seed drill. Single shoot openers have benefits, such as lower draft and lower maintenance cost but they also cap seed placed fertilizer rates. These farmers are left with options like lower the nitrogen rates to avoid seed burn or either make a second pass to put down fertilizer or move to double shoot openers.

Objectives:

1. To demonstrate the effects of different nitrogen fertilizers (placed with seed and banded away from seed) yield and quality of wheat and canola.
2. To demonstrate to farmers alternative nitrogen sources that can obtain optimum yield without the purchase of an expensive seed drill.
3. Communicate information from the project to the producers and others.

Materials and Methods

Trial was laid out single replication trial and plot size was 24' X 100'. Wheat variety Intrepid seeded @ 123 lbs/ac and canola (CL5535) 5.21 lbs/ac at 9" with Conservapack disc seeder. Treatment for wheat include T1 (Urea blend 127-0-28-14 placed with seed@ 333 lbs/ac, T2 (ESN blend placed with seed @ 388 lbs/ac, T3 (Urea blend placed away from seed @ 388 lbs/ac and T4 (ESN blend placed away from seed @ 377 lbs/ac).While treatments for canola included T1 (Urea blend 113-0-26-27 placed with seed@ 328 lbs/ac), T2 (ESN blend placed with seed @ 326 lbs/ac), T3 (Urea blend placed away from seed @ 399 lbs/ac)

and T4 (ESN blend placed away from seed) @ 400 lbs/ac). Canola plots were sprayed with Reglone at recommended rates and both wheat and canola were straight combined with small plot combine.

Results and Discussion

Results regading wheat response to different sources of Nitrogen are presented in Table 16. ESN placed awayfrom seed have significantly less yield as compared with other treatments. Reults of Canola response are presented in Table 17. It seems that ESN nirtogen has pontential to be used espacially if you have single shoot seeder. It will worth mentioning that cost difference between stable nitrogen sources (ESN) and urea is about 5-6 cents/lb or about 5 dollars/ acre more than urea. On basis of results obtained during last three year it can be said ESN can be used safely by the producers with single shoot opener to get a better yield without investing in costly new seeders.

Table16 : Wheat Response to Different Sources of Nitrogen

Treatments	Height (cm)	Yield (bu/ac)	1000KWT (gm)	KGHL	Protein %	Lodging (1-9)
(T1) Urea placed with seed	9.3.60	42.04	42	61	13.8	1
(T2) ESN placed with Seed	88.10	59.86	44	70	15.30	1
(T3) Urea placed away from seed	89.70	57.05	42	72	15.70	1
(T4) ESN placed away from seed	89.70	60.05	38	71	16.00	1

Table17: Canola Response to Different Sources of Nitrogen

Treatments	Height (cm)	Yield (bu/ac)	1000KWT (gm)	Lodging (1-9)
(T1) Urea placed with seed	115.00	43.00	6.0	1
(T2) ESN placed with Seed	117.50	64.40	6.0	1
(T3) Urea placed away from seed	90.30	59.30	5.5	1
(T4) ESN placed away from seed	107.00	61.14	6.0	1

Conventional vs Organic Crop Management Trial

Background

According to Statistic Canada (2006) out of total 647 farms there are 21 certified organic producer, 4 in transition and 33 uncertified organic producers. Input cost (fertilizer, chemical and fuels) are rising dramatically. The combination of these factors as well as decreasing margins over the year has many producers questioning to which farm approach has the best potential to reduce risks and or increase profits on sustainable basis. Present study was designed to see which system has comparative advantage.

Material and Methods

The site selected for this trial was under grass for more than 5 years at experimental farm just beside 88 Highway and divided into four blocks measuring 370x82 feet. Plots were numbered Plot1, 2, 3 and 4 starting from West side. Pea CDC Meadow were seeded on 20 May @198 lbs/ac and wheat variety Intrepid was seeded with Conservapack seeder and to Plot 1 fertilizer NPK (20-24-28) was applied as per soil test recommendation and reason for low fertilizer application is last year crop was plowed under due to less germination in sod seeding The fertilizer application to Plot2 was NPK(77-21-17) lbs/ac. Half of the both organic Pea plots were harrowed. Data were collected on yield, 1000 KWT, height and lodging. This was second year and trial will continue for 3 years.

Results and Discussion

Results obtained are presented in the table 18. Yield results showed that conventional wheat in Plot 1 and 2 was 53.50 and 55.68 bu/ac. It was interesting to note that harrowing has positive effect on Pea yield on oat stubble and yield increase was 5.89 bu/ac. Harrowing don't have significant impact on the yield of Pea on Flax stubble. No significant lodging was observed in all four farming systems.

Table 18: Organic Vs Conventional Crops Management

Crop type	Yield bu/ac	1000 KWT (gm)	Height cm	Lodging (1-9)
Conventional Wheat (Plot1)	53.50	32	74.70	1
Conventional Wheat (Plot2)	55.68	34	67.00	1
Organic Pea Plot3 (Harrowed)	22.48	400	43.40	2
Organic Pea Plot3 (Harrowed) on Oat stubble	28.37	340	69.80	2
Organic Pea Plot 4 (Non harrowed)	22.10	400	68.50	1
Organic Pea Plot 4 (Harrowed)	23.39	400	57.90	2

Harrowed and non harrowed organic
Pea side by side

Swathing Vs Straight Cutting Canola

(Cooperator Brian Friesen)

The advantages of straight cutting compared to swathing of canola include lower fuel cost, saved time, reduced equipment wear and possibly higher yield. But straight cutting also has risks, especially the risk of increased yield losses due to seed pod shattering while the crop is standing. Agronomist John Mayko with canola council of Canada sound a note of caution " Espacially over the last 5 or 6 years with need to cut costs, more and more growers have been looking at straight cutting and many of them are trying it, having reasonable success, and continuing with it. But growers need to make sure that they have fields that are suitable for straight cutting. Growers who go into thinking ' I swath lasy year. Now this year I,m selling my swather and I,m going to straight cutt every thing' could end up with some disasters at their hand[1] . Keeping all this view a demonstration trial was designed to compare inherent risks and benefits of swathing vs straight cutting.

Material and methods

Producer seeded the canola and all inputs and the crop managemnt practices were carried out to get the maximum yield. Crop stand was good and there was no lodging. The width of swath was 28.5ft with an area of 2.01 acres while straight cutting was done with combine having 30ft header and combined area was 2.13 acres. Both swath and straight cutting strips were side by side in same field. Round up was sprayed before straight cutting.

Results and Discussion

The combing was done on 26 September 2011 and yield obtained was 42.10 bu/ac from swathing and 43.19 bu/ac. The moisture contents of swathed canola were 8.30 % while the straight cutt was sitting at 8.7%. This mean that there was 1.09 bu/ac more yield in straight combining as compared with swathing. The cost of round up application and swathing is almost same but there is additional benefits of weed control.

Harvesting and Storage Tips When Straight Cuttng

John Mayko outlines some harvesting and storage considerations for straight-cut canola: Generally he recommends that growers straight cut as soon as possible after the canola reaches nine to 10 percent moisture, because the longer the crop is standing, the greater the likelihood of hail, wind or other factors affecting it. Growers should ensure the sheet metal around the header mounts is in good condition to avoid losing seeds through cracks or holes. Usually in straight-cut canola, the seeds and pods are quite dry, but the stems are tougher and moister than they would be in a swathed crop. Some growers apply a desiccant, like Reglone (diquat), or a harvest aid, like Roundup (glyphosate), to dry down the crop before straight cutting. If growers do not dry it down, then the combine might require more power to handle the tougher stems. On the plus side, however, those tough, wet stems do not get broken up as much when they go through the combine. With less fine material, it is easier for the combine to separate the seed from the straw. So, often the sample will have lower levels of dockage than a swathed sample.

Growers need to have bins with aeration to cool down the grain properly and keep it in condition. If they bin the crop at higher moistures, especially greater than nine or 10 percent and especially if they are using bigger bins, they can have spoilage problems if the grain is not conditioned properly.

[1] Top Crop Manager

Effect of Harrowing on Organic Oat Yield
(Cooperator: Frank Bueckert)

Our county is one of the prime location for organic Oat production in Alberta. Weed management strategies are limited in organic oat cultivations as herbicide use is prohibited. Enhancing the crop competitive ability by integrating both cultural and mechanical weed control methods is a key strategy in managing weeds in such instances. Harrowing is one of these strategy and on basis of demonstration trial results last year that with harrowing a significant yield increase can be obtained. One of the organic oat producer was interested to put it to test at field scale level.

Methods and Results

Producer seeded the Oat in organic production system and on 16 June 2011 a one strip of 37Ft was harrowed to whole length of field with tine harrow as shown in the photograph below at 5-6 leaf stage. This year there was no rain until 2nd week of July and less yield was expected because of less availability of moisture for tillering. Combining of harrowed and non harrowed strip was done on 26 September with 6620 John Deere with 22ft header. Yield obtained in harrowed strip was 91.16 bu/ac as compared with non harrowed 84.72 bu/ac. Yield increase by harrowing was 6.44 bu/ac. The increase in yield may be attributed to increased tillers and setting back weeds due to harrowing. It will be good to repeat this trial on field scale level in a replicated trial.

A View of Harrowed Organic Oat Field

Alberta Pest Monitoring Network (APMN)

MARA participated in the provincial Pest monitoring Program Supported by AOF and Alberta Agriculture and Rural Development.

Objectives

1. To participate in pest monitoring program that covers whole Alberta.
2. To provide the most recent information to producers of the Mackenzie County
3. To help the network by providing baseline data and meet international trade demands

Methods and results

MARA during 2011 season survey only Bertha Armyworm in five canola fields selected in different parts of the county. Two traps were set at the edge of the field and checked once a week and as data entered at AAFRD's Ropin website, the pest risk map will change to reflect that information. This data is used to predict risk of pests to certain crops from daily forecast to overtime projections. Producers can see if there is an outbreak in there are and take appropriate actions.

Results and Discussion

Results obtained are presented in table on next page. The Bertha Armyworm overwinter as pupa and adults emerges from mid June until August. The larvae are normally pale green color and turn brown to black with yellow strips. Canola is the food of choice but also feed on flax, alfalfa, peas and corn. Diamondback moth does not overwinter in Canada but migrate in on southerly winds in may June. Female lay eggs on the upper surface of the leaves. Larvae are pale green and actively wriggle when they drop from on silken thread when disturbed. Diamondback moth are mainly found in Canola and Mustard field. Observation during last two year indicated that so far this not very serious pest for our county but continuous monitoring is key to check any outbreak. Pest survey are very important for producers because these serve as base for forecasting maps. These pests and diseases have significant impact on crop productivity. It is very important to have knowledge of proper time of year when scouting need to done and to know what you need to look far when you are out in fields. Other factors such crop rotation , selection of crop variety and weather play significant role in determining expected outbreaks. This year we have dry weather until 2nd week of July and as compared with last two years insect numbers almost double this year.

Results portrayed in table showed that Bertha Armyworm population increased significantly during last week of June and 1st week of July and then it started declining because most of the producers start spraying after these dates. To make decision about spraying one should keep in mind the economic threshold level which ranges from 11-34/m^2 larvae for Bertha Armyworm depending upon cost of spraying and price of canola.

Table 20: Alberta Pest Survey 2011

Observation Date	GPS location	Bertha Armyworm	
		Trap 1	Trap 2
22 JUN 2011	Lat. 58 20 25 N Long.116 02 03 W	9	2
22 JUN 2011	Lat. 58 20 25 N Long.116 04 53 W	30	45
22 JUN 2011	Lat. 58 14 08 N Long.116 11 00 W	3	3
22 JUN 2011	Lat. 58 09 43 N Long.116 09 21 W	26	7
22 JUN 2011	Lat. 58 25 09 N Long.115 58 51 W	6	1
29 JUN 2011	Lat. 58 20 25 N Long.116 02 03 W	141	70
29 JUN 2011	Lat. 58 20 25 N Long.116 04 53 W	77	310
29 JUN 2011	Lat. 58 14 08 N Long.116 11 00 W	152	180
29 JUN 2011	Lat. 58 09 43 N Long.116 09 21 W	294	168
29 JUN 2011	Lat. 58 25 09 N Long.115 58 51 W	32	4
11 JUL 2011	Lat. 58 20 25 N Long.116 02 03 W	350	360
11 JUL 2011	Lat. 58 20 25 N Long.116 04 53 W	125	494
11 JUL 2011	Lat. 58 14 08 N Long.116 11 00 W	320	204
11 JUL 2011	Lat. 58 09 43 N Long.116 09 21 W	N/A	307
11 JUL 2011	Lat. 58 25 09 N Long.115 58 51 W	84	53
15 JUL 2011	Lat. 58 20 25 N Long.116 02 03 W	81	27
15 JUL 2011	Lat. 58 20 25 N Long.116 04 53 W	8	15
15 JUL 2011	Lat. 58 14 08 N Long.116 11 00 W	47	10
15 JUL 2011	Lat. 58 09 43 N Long.116 09 21 W	N/A	7
15 JUL 2011	Lat. 58 25 09 N Long.115 58 51 W	8	7
22 JUL 2011	Lat. 58 20 25 N Long.116 02 03 W	55	50
22 JUL 2011	Lat. 58 20 25 N Long.116 04 53 W	25	54
22 JUL 2011	Lat. 58 14 08 N Long.116 11 00 W	30	58
22 JUL 2011	Lat. 58 09 43 N Long.116 09 21 W	N/A	31
22 JUL 2011	Lat. 58 25 09 N Long.115 58 51 W	20	15

Biennial Wormwood Post Emergence Control

Background

Biennial wormwood (*Artemisia biennis*) is an aggressive and prolific seed producing plant that has become a problem in many parts of Canada. According to one expert there is one weed coming along farmers in some province should watch. Biennial wormwood has been appearing in more fields in recent years[1]. The biennial produces the vegetative growth in the first year, and then sets seed in the second year. Seedlings that germinate in the fall are relatively easy to control with Glyphosate, however if these seedling overwinter and grow again the next spring they are bigger and harder to control. The weed which was more common in southern Alberta and Saskatchewan favors road side, rangeland, forage crops and hay fields, but also appearing more in zero till cropping system. It is one of the emerging weed of our county.

Objective

To find the most suitable herbicide, application rate and make these information available to the producers.

Materials and Methods

This was third year of this trial and field selected for has considerable biennial wormwood infestation. We waited by 2nd week of July , so there is early summer flush of 1-2" tall wormwood. Other weeds present at site included flex weed, lamb quarter, dandelion and horse tail etc. Ten different herbicides were tested for their efficacy to control wormwood. Treatments included T1 (Odyssey @ 17 gm/ac), T2(Glyphosate Transorb @ 0.33 l/ac), T3 (Glyphosate Transorb @ 0.66 l/ac), T4 (2,4-D Amine 500 @ 300 ml/ac), T5 (2,4-D Amine 500 @ 600 ml/ac), T6 no spray, T7 (Frontline A+B @ 40+280 ml/ac , T8 (Refine SG @ 12 gm/ac), T9 Basagran @910 ml/ac and T10 Prestige A+B 320+800 ml/ac. Each treatment was sprayed in 15 feet wide strip to a length of 60 meter with ATV mounted sprayer. Observations on weed mortality were recorded on July 30th.

Results and Discussion

The most effective herbicide seems to be Glyphosate @ 0.66 l/ac and it not only gave more than 90 percent control of wormwood and controlled all other weeds as well. The next best treatment

was also Glyphosate @ 0.33 l/ac. The results corroborate with the findings of other studies.

[1] Grainnews

Worm wood along with many common weeds such as sow thistle and dandelion can be controlled with fall glyphosate treatment. As thumb rule for many of these winter annuals and perennial weeds fall is the best time for effective control.

Over wintered Biennial Wormwood Plant

Manure Management Trial

Background

Livestock is an important component of the farming historically as well as in the present day farming. Manure management that includes composting have some advantages. If we compare the raw manure with bedding material with the compost, compost is more stable product since almost all the nutrient are in organic form and material is semi decomposed. Plants take up majority of nutrients in an inorganic form. Composting is good method of producing a more nutrient stable soil amendment with a lower moisture content and less volume compared with raw manures. The composted material can be hauled longer distances at less cost. It has less odor when applied, pathogens and weed seed are killed during the composting process if the temperature generated during the process were high enough.

Objective

To reduce odour, decrease haul able volume, accelerate decomposition and demonstrate benefits to local producers.

Material and Methods

One of the livestock producers of the area (Kelley Friesen) was Cooperator for this trial. Raw manure with bedding material was taken out from the pile and wind rowed them with help of tractor mounted blade. The manure smelled very badly and there was high amount of bedding material and very high moisture level. Material was windrowed in three rows. Cooperator turned upside down after 15-20 day time period. Samples from composted and raw manure pile were collected in December 2011 and got tested from the lab for their nutrient value.

Results

Observations of the wind rows piles showed that volume was reduced to about one third of orgional volume and data about the nutrient value of two types of manure are presented in Table 21. It can be noted from table that there is some loss of nutrients espacially nitrogen but there are nutrients which are readily available, odour was reduced which makes the hauling process cost effective. When raw manure is added to field it also competes with plants first by absorbing nutrient for better working of various organinsims involved in decomposition process and that effects the crop yield. Manure piles should be allowed to be decoposed by windrowing and then added to field.

Table 21. Comparison of Composted and Raw Manure Sample

Parameter	Units	MRL	Compost Sample	Raw Sample
Electrical Conductivity	mS/cm	0.01	4.51	6.76
Moisture	%	0.1	72	63.9
N-NH3 (Ammonia)	ppm	1	88.00	39.00
N-NO3 (Nitrate)	ppm	1	1930	19900
pH			7.50	7.50
Total Phosphorus	%	0.01	0.63	0.45
Total Kjeldahl Nitrogen	%	0.05	2.54	2.17
Total Organic carbon	%	0.01	25.9	36.8
Calcium	ppm	100	27900	28400
Magnesium	ppm	100	5800	5900
Potassium	ppm	100	17100	19000
Sodium	ppm	100	700	700
Organic matter	%	0.1	57.7	42.2
C/N Ratio			10.20	17.00

Windrowed pile from last year

Windrowed pile 2011

Extension Events 2011

The Mackenzie Applied Research Association organized various events in its efforts to be better connected with the producers and business community of the county. Following activities were organized during 2011-12.

- Annual General Meeting was organized on April 21st, 2011. Research Coordinator briefed the participant about results of the MARA 2010 research program and extension activities carried out in Mackenzie County. John Kanpp (Deputy Minister) Gust speaker spoke through Skype about "Present and Future of Agriculture in Alberta– Canada. Other Gust speaker Ty Faechner (Executive Director of ARECA) have presentation on on mandate and activities of ARECA and 17 producers attended event.

- MARA held its annual field day on July 29th in collaboration with Mackenzie County, AAFC and More than 70 producers attended field day. First presentation was given by the Research Coordinator about current MARA program and then the guest speaker Elaine Stebraattin (AARD) talked about Agriculture Entrepreneurship and value added marketing. Prof Brenda Frick (Uni. Of Sask.) talked about optimizing your rotation for nutrient management. Producers were then taken to field and got visited all the trials. Feedback and comments we got were quite encouraging.

- MARA in collaboration Cargill Manning organized a workshop on 8 Dec. 2011 and 11 producers attended the event. MARA Coordinator presented next three year MARA Research and extension program and got feedback from participants. Speakers from Cargill talked about Farm safety issues and grain marketing in light of development taking place in Canadian Wheat Board
- Water Quality Workshop has been planned on March 16, 2012 in La Crete and speakers will be coming to enlighten the producers about water quality issues and management strategy.

Extension Events Glimpses 2011

MARA Field Day July 29, 201

Guest Speaker at MARA Field Day

Guest Speaker at MARA Field Day

Guest Speaker at MARA Field Day

Extension Events Glimpses 2011

MARA Field Day

MARA Field Day Producers in Field

Producers enjoying sun!

Producers Enjoying Lunch at MARA Field Day

AOF Dugout Water Quality & Nutrient Runoff

Background

Dugout are earthen excavations designed to collect runoff and store it for use during drier times. Dugouts are water sources of necessity, not choice because of the uncertainty of filling caused by annual variation in precipitation , and the problem of maintaining water quality. Runoff water often bring dissolved and suspended material that are detrimental to water quality, including disease causing organisms, plant nutrients, pesticides, decomposed plant, algae material, suspended sediment, fuels, solvents, paints and soil minerals. The net result is of contaminated—loaded runoff is poor quality, dugout water. However, dugout water quality can be managed, improved and treated to meet farm needs[1]. It should be always kept in mind that surface water are unsafe for drinking unless treated. Some water born diseases and disease causing organisms include cholera, typhoid, E. coli and cryptosporidium.

Objective

Present studies were designed with following objectives

- Improve awareness of water quality in dugouts, nutrient runoff and pesticide residues.
- To promote importance of water testing and establish a baseline data for water quality issues in the county.

Materials and Methods

To improve awareness about nutrient runoff and dugout water quality 10 runoff water samples were collected on 2nd May, and tested 40 dugouts during September 2011 from areas of Fort Vermilion, High Level and La Crete. Five water samples were collected pesticide residues and all samples were put out in coolers and sent out to Exova laboratory in Edmonton next day for analysis of various pathogenic organisms, metals and routine analysis. The S1, S2, S3,... stands for sample 1,2,3….. and so on. Terms MAC stands for maximum acceptable concentration, AO as aesthetic objective and OG mean operational guidelines for water treatment plants.

Results and Discussion

Results pertaining to different parameter are presented in Table 1-7. Water samples from 41 dugouts showed that 7 samples have Aluminum above operational guidelines and 1 sample have Arsenic above MAC. 0ut of total 32 have Total coliforms above MAC limit while 26 have E.coli above MAC. Color was above esthetic objective in 35 samples and Turbidity above OG in 40 samples. pH was above AO in 20 samples, Sodium in 3 and Iron in 10 samples above AO.

[1] Quality Farm Dugouts

Manganese was above AO in 11, Chloride in 2 and Sulfate in 2 samples respectively. The total dissolved solids were above AO in 4 samples out of total. .

Dugout Management Practices

There are a great number of dugout mangement practices[1]. Many are known to be highly effective. Some techniques are common sense and donot require special or highly processed products or services. Other treatments involve chemicals and make use of commercial products. Some of the established practices include;

Continuous Aeration

Continous injection of supplementary oxygen is the single most effective practicefor maintaing and improving the water quality.

Sediment Control

Excavation of sediments from dugout, every five to ten years, is an effective technique for improving water quality and extending the life of dugout.

Vegetation Control

The routine maintenance of the area around dugout is important for maintaining water quality. Grass buffers and runways surroundings dugout should be mowedregularly. This prevents long grass from lying down and becoming ineffective as a sediment trap. Proper setback of shelterbelts ensures that the amount of fallen leaves is at minimum. If possible aquatic plats should be removed from dugout before they die and decompose. Annual cutting and removing of willows and volunter saplings every fall can make significant contribution to protecting dugout water.

Removel of Animals

Animals such as muskrat can create problem in dugouts by burrowing , house building and foraging for plant roots.This disturb the sediments and keep the water contantly turbid. The most effective way to remove muskrat is trapping or hunting.

Copper Sulphate

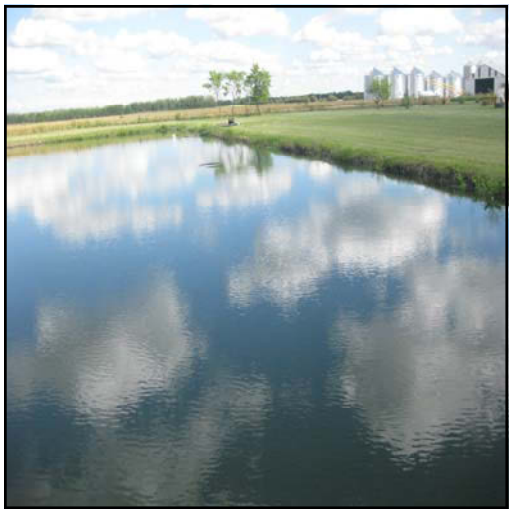
Copper sulphate, also known as blue stone, is perheps the most common chemical used to treat dugouts.Although copper is an essential elements for both plants and animals but at high concentrations, it can be toxic. Copper treatment can be very effective in controlling cyanbacteria. Copper sulphate treatment are most effective when done in early summer before large population develop. One should consult expert for proper application and dose.

Herbicides

Some herbicides are registered for use by the Canada Peat Management Regulator Agency to control aquatic weeds and algae. These compounds may only be used on privately owned reservoir where water does not flow in to other water bodies. Always follow the lable direction and use safe handling practices.

Fish

Fish are sometime added to dugout to improve water quality by eating aquatic plants. However, they may often compound dugout, water quality problems by making it difficult to use other chemical methods of algae and plant control.



Well managed dugout

Poorly managed dugout

Table1 1: Dugout Water Samples 2011

	S1	S2	S3	S4	S5	S6	S7	Guide-line
Tempera-ture *C	22.6	22.5	22.4	22.5	22.6	22.6	22.8	
Mercury	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001
Aluminum	0.037	0.013	0.065	0.026	0.213	0.276	0.024	0.1
Antimony	<0.0002	<0.0002	0.0003	<0.0002	<0.0002	<0.0002	<0.0002	0.006
Arsenic	0.0027	0.0018	0.0079	0.0045	0.0017	0.0016	0.0038	0.01
Barium	0.056	0.050	0.010	0.064	0.060	0.087	0.076	1
Boron	0.082	0.082	0.084	0.096	0.026	0.028	0.032	5
Cadmium	<0.0000 1	<0.00001	0.00002	<0.00001	0.00002	<0.00001	<0.00001	0.005
Chromium	<0.0005	<0.0005	<0.0005	<0.0005	0.0006	<0.0005	<0.0005	0.05
Copper	0.006	0.005	0.003	0.001	0.01	0.001	<0.001	1
Lead	<0.0001	0.0002	0.0001	<0.0001	0.0003	<0.0001	<0.0001	0.01
Selenium	<0.0002	<0.0002	<0.0002	<0.0002	0.0004	<0.0002	<0.0002	0.01
Silver	<0.0000 1	<0.00001	<0.0000 1	<0.00001	<0.0000 1	<0.00001	<0.00001	
Uranium	0.0011	0.0012	0.0023	0.0023	0.0012	0.0015	<0.0006	0.02
Zinc	0.001	0.10	0.001	0.001	0.002	0.002	<0.001	5
T.coliforms	36	6	13	4	97	18	<1	0
E-coli	36	1	1	2	93	11	<1	0
Colour	>60	>60	52	58	>60	5	28	15
Turbidity	9.2	4.2	2.3	3.3	8.3	1.5	4.4	0.1
pH	8.07	8.10	9.30	8.27	8.10	8.22	9.47	6.5-8.5
E-cond.	758	764	488	1010	325	224	297	
Calcium	81.2	80.6	19.7	44.9	46.5	28	16.3	
Magnesium	31	30.5	14.4	29	8.4	5.2	20.2	
Sodium	49.4	48.6	70.8	124	3.3	2.8	9.7	200
Potassium	5	4.8	9.8	9.1	9.3	12.6	10.6	

 (Continued on next page)

Table 1: Dugout Water Samples 2011

	S1	S2	S3	S4	S5	S6	S7	Guideline
Iron mg/L	0.12	0.17	0.08	0.15	0.30	<0.01	0.05	0.3
Magnesi-um mg/L	0.218	0.145	0.045	0.097	0.016	<0.005	0.028	0.05
Chloride mg/L	18.4	17.5	32.1	108	6.8	6.3	12.7	250
Fluoride mg/L	0.24	0.24	0.86	0.31	0.16	0.14	0.15	1.5
Nitrite-N mg/L	0.03	0.14	<0.01	<0.01	0.02	<0.01	<0.01	10
Nitrate-N mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	1
Nitrate & N-N mg/L	0.03	0.14	<0.01	<0.01	0.02	<0.01	<0.01	10
Sulfate (SO4) mg/ L	170	181	38.1	225	60.4	33.1	37.9	500
Hydroxide mg/L	<5	<5	<5	<5	<5	<5	<5	
Carbonate mg/L	<6	<6	29	<6	<6	<6	23	
Bicar-bonate mg/L	275	286	156	156	134	90	68	
P-alkalinity mg/L	<5	<5	24	<5	<5	<5	20	
T-alkalinity mg/L	226	235	176	128	110	74	95	
Total dis solids mg/ L	490	504	290	617	201	132	164	500
Hardness mg/L	331	327	108	231	151	91	124	
Ionic Bal-ance mg/L	104	98	105	99	93	97	104	

Table 2: Dugout Water Samples 2011

	S8	S9	S10	S11	S12	S13	S14	Guideline
Tempera-ture *C	22.7	22.7	22.6	22.6	22.6	22.8	23	
Mercury mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001
Aluminum mg/L	0.060	0.043	0.022	0.050	0.044	0.015	0.025	0.1
Antimony mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.006
Arsenic mg/L	0.0015	0.0018	0.0034	0.0051	0.0018	0.0014	0.0012	0.01
Barium mg/ L	0.049	0.061	0.134	0.048	0.134	0.065	0.044	1
Boron mg/ L	0.042	0.043	0.054	0.045	0.052	0.032	0.028	5
Cadmium mg/L	0.00065	0.00001	<0.0000 1	0.00002	0.00001	<0.00001	<0.00001	0.005
Chromium mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.05
Copper mg/ L	0.242	0.002	0.001	0.008	0.007	0.007	0.014	1
Lead mg/L	<0.0001	<0.0001	<0.0001	0.0004	0.0002	<0.0001	<0.0001	0.01
Selenium mg/L	0.0028	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.01
Silver mg/L	<0.0000 1	<0.00001	<0.0000 1	<0.0000 1	<0.0000 1	<0.00001	<0.00001	
Uranium mg/L	0.0015	0.001	0.0009	<0.0005	0.0022	0.0024	0.0009	0.02
Zinc mg/L	0.002	<0.001	0.006	0.027	0.001	0.004	<0.001	5
T.coliforms	<1	1	3	3000	147	13	37	
E-coli	<1	<1	2	<1	1	1	<1	
Color	45	12	35	38	55	20	15	15
Turbidity NTU	5.2	4.4	1.4	6	9.4	2.1	1.2	0.1
pH	8.38	8.22	8.15	8.12	8.54	8.28	9.04	6.5-8.5
E-cond. @25 C	600	386	507	196	463	252	156	
Calcium mg/L	71.5	43.3	35.7	18.8	37.5	27.5	11.2	
Magnesium mg/L	25.5	16.1	38.1	6.3	25.4	10.4	7.3	
Sodium mg/L	10.1	4.9	11.5	3.5	9.3	2.2	2.4	200
Potassium mg/L	12.4	7.9	14.7	15.8	25.1	10.6	9.7	

 (Continued on next page)

Table 2: Dugout Water Samples 2011

	S8	S9	S10	S11	S12	S13	S14	Guideline
Iron mg/L	0.01	0.05	0.15	0.27	0.29	0.04	0.06	0.3
Magnesi-um mg/L	<0.005	<0.005	0.150	0.026	0.137	0.012	0.005	0.05
Chloride mg/L	6.3	7.5	9	7.8	13	6	7.4	250
Fluoride mg/L	0.20	0.13	0.15	0.08	0.12	0.10	0.15	1.5
Nitrite-N mg/L	<0.01	<0.01	<0.01	0.38	<0.01	<0.01	<0.01	10
Nitrate-N mg/L	<0.005	<0.005	<0.005	0.012	<0.005	<0.005	<0.005	1
Nitrate & N-N mg/L	<0.01	<0.01	<0.01	0.39	<0.01	<0.01	<0.01	10
Sulfate (SO4) mg/ L	230	140	58.2	5.9	77	35.7	12	500
Hydroxide mg/L	<5	<5	<5	<5	<5	<5	<5	
Carbonate mg/L	<6	<6	<6	<6	<6	<6	9	
Bicar-bonate mg/L	94	47	267	103	176	115	48	
P-alkalinity mg/L	<5	<5	<5	<5	<5	<5	7	
T-alkalinity mg/L	77	39	219	84	144	94	54	
Total dis solids mg/ L	402	243	299	109	274	149	83	500
Hardness mg/L	284	174	246	73	198	112	58	
Ionic Bal-ance mg/L	99	100	99	98	103	93	98	

Table 3: Dugout Water Samples 2011

	S15	S16	S17	S18	S19	S20	S21	Guide-line
Tempera-ture *C	22.8	22.8	20.5	20.5	20.3	20.3	20.2	
Mercury mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001
Aluminum mg/L	0.082	0.010	0.031	0.029	0.011	0.066	0.221	0.1
Antimony mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.006
Arsenic mg/L	0.0036	0.0025	0.0010	0.0009	0.0027	0.0024	0.0019	0.01
Barium mg/L	0.143	0.082	0.170	0.165	0.078	0.078	0.119	1
Boron mg/L	0.045	0.032	0.065	0.063	0.048	0.049	0.028	5
Cadmium mg/L	0.00001	<0.00001	0.00001	<0.00001	0.00002	0.00003	0.00005	0.005
Chromium mg/L	<0.0005	<0.0005	0.0008	0.0008	0.0008	0.0038	0.0013	0.05
Copper mg/L	0.003	0.001	0.002	0.002	0.046	0.63	0.005	1
Lead mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	0.0002	0.0006	0.01
Selenium mg/L	<0.0002	<0.0002	<0.0002	<0.0002	0.0008	<0.0002	<0.0002	0.01
Silver mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	
Uranium mg/L	0.0008	0.0009	0.0024	0.0024	0.0022	0.0022	0.0011	0.02
Zinc mg/L	<0.001	0.002	0.011	0.010	0.003	0.012	0.006	5
T.coliforms	25	9	<1	23	6	<1	37	0
E-coli	3	<1	<1	<1	<1	<1	3	0
Color	48	45	15	25	45	>60	>60	15
Turbidity NTU	5.8	2.2	3.1	5.6	2.7	10.4	31.8	0.1
pH	8.42	8.55	8.16	8.78	8.68	8.05	8.61	6.5-8.5
E-cond. @25 C	235	312	537	266	340	948	166	
Calcium mg/L	27.5	34.8	60.6	24.3	31.5	74.9	15.8	
Magnesium mg/L	6.9	11.3	19.2	11.3	15.3	25.6	6.1	
Sodium mg/L	0.7	2.6	9.5	3.1	4.7	71.1	3.5	200
Potassium mg/L	18.8	21.8	11.9	12.8	13.8	6.8	10.9	

 (Continued on next page)

Table 3: Dugout Water Samples 2011

	S15	S16	S17	S18	S19	S20	S21	Guideline
Iron mg/L	0.20	0.16	0.09	0.16	0.06	0.25	0.50	0.30
Magnesi-um mg/L	0.029	0.062	0.022	0.009	0.025	0.211	0.037	0.05
Chloride mg/L	6.1	5.9	16.7	6.5	13	132	8.5	250
Fluoride mg/L	0.12	0.14	0.17	0.18	0.14	0.18	0.15	1.5
Nitrite-N mg/L	<0.01	<0.01	0.01	0.02	0.12	<0.01	0.01	10
Nitrate-N mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	1
Nitrate & N-N mg/L	<0.01	<0.01	0.01	0.02	0.12	<0.01	<0.01	10
Sulfate (SO4) mg/ L	2	32	93.2	47	50.7	143	13	500
Hydroxide mg/L	<5	<5	<5	<5	<5	<5	<5	
Carbonate mg/L	<6	<6	<6	<6	10	<6	<6	
Bicarbo-nate mg/L	136	152	171	84	95	141	71	
P-alkalinity mg/L	<5	<5	<5	<5	8	<5	<5	
T-alkalinity mg/L	112	125	140	69	94	116	59	
Total dis solids mg/L	130	183	295	146	185	524	93	500
Hardness mg/L	97	133	230	107	142	293	64	
Ionic Bal-ance mg/L	100	100	102	100	103	101	100	

Table 4: Dugout Water Samples 2011

	S22	S23	S24	S25	S26	S27	S28	Guide-line
Tempera-ture *C	20.2	20.5	20.5	20.4	20.2	20.2		
Mercury mg/L	0.0002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001
Aluminum mg/L	0.027	0.027	0.004	0.053	0.015	0.015	0.020	0.1
Antimony mg/L	<0.0002	0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.006
Arsenic mg/ L	0.0021	0.0050	0.0021	0.0042	0.0018	0.0018	0.001	0.01
Barium mg/ L	0.187	0.075	0.036	0.135	0.032	0.031	0.039	1
Boron mg/L	0.043	0.046	0.026	0.030	0.184	0.192	0.142	5
Cadmium mg/L	<0.0000 1	0.00001	<0.0000 1	<0.00001	<0.0000 1	<0.00001	<0.00001	0.005
Chromium mg/L	0.0008	0.0008	0.0007	0.0005	0.0018	0.0019	0.0059	0.05
Copper mg/ L	0.003	<0.001	0.012	<0.001	<0.001	<0.001	0.009	1
Lead mg/L	<0.0001	0.0001	<0.0001	0.0002	<0.0001	<0.0001	<0.0001	0.01
Selenium mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.01
Silver mg/L	<0.0000 1	<0.00001	<0.0000 1	<0.00001	<0.0000 1	<0.00001	<0.00001	
Uranium mg/L	<0.0005	0.0007	<0.0005	<0.0005	0.0012	0.0012	0.0051	0.02
Zinc mg/L	0.001	0.001	<0.001	0.002	0.003	0.003	0.001	5
T.coliforms	9	<1	1	12	27	<	1	0
E-coli	<1	<1	<1	1	23	<1	<1	0
Color	50	>60	20	>60	55	<5	15	15
Turbidity NTU	2.3	11	0.7	17.9	3.7	0.2	2.7	0.1
pH	8.24	9.70	8.74	9.14	8.70	8.06	8.21	6.5-8.5
E-cond. @25 C	304	358	265	187	1970	679	2260	
Calcium mg/L	39.2	16.9	22.4	16.4	47.1	86.5	144	
Magnesium mg/L	7.7	29.8	12	6.3	213	24.2	67.9	
Sodium mg/ L	2	11.4	10.1	1.4	74.8	17.9	241	200
Potassium mg/L	16.1	9.8	6.4	20.4	43.4	4.1	6.7	

 (Continued on next page)

Table 4: Dugout Water Samples 2011

	S22	S23	S24	S25	S26	S27	S28	Guideline
Iron mg/L	0.21	0.15	0.09	0.39	0.06	<0.01	0.04	0.3
Magnesi-um mg/L	0.023	0.034	0.018	0.092	0.017	0.008	<0.005	0.05
Chloride mg/L	2.6	14.7	9.4	2.4	44.3	12.7	258	250
Fluoride mg/L	0.13	0.24	0.22	0.19	0.18	0.28	0.4	1.5
Nitrite-N mg/L	0.01	0.02	0.02	0.01	0.03	0.11	0.06	10
Nitrate-N mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.02	1
Nitrate & N-N mg/L	0.01	0.02	0.02	<0.01	0.03	0.11	0.06	10
Sulfate (SO4) mg/ L	20	22	15	2	825	26	647	500
Hydroxide mg/L	<5	<5	<5	<5	<5	<5	<5	
Carbonate mg/L	<6	74	8	14	28	<6	<6	
Bicar-bonate mg/L	141	35	11	76	267	109	139	
P-alkalinity mg/L	<5	62	7	12	23	<5	<5	
T-alkalinity mg/L	116	152	104	86	266	336	114	
Total dis solids mg/ L	524	200	140	100	1410	373	1430	500
Hardness mg/L	293	165	105	67	993	316	639	
Ionic Bal-ance mg/L	101	104	102	100	102	95	102	

Table 5: Dugout Water Samples

	S29	S30	S31	S32	S33	S34	S35	Guide-line
Mercury mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001
Aluminum mg/L	<0.002	0.025	0.032	0.158	0.018	0.058	0.057	0.1
Antimony mg/L	<0.0002	<0.0002	<0.0002	0.0002	<0.0002	<0.0002	<0.0002	0.006
Arsenic mg/L	0.0015	0.0025	0.0033	0.0035	0.0020	0.0028	0.0037	0.01
Barium mg/L	0.022	0.054	0.038	0.030	0.059	0.176	0.090	1
Boron mg/L	0.066	0.057	0.071	0.057	0.048	0.052	0.073	5
Cadmium mg/L	<0.00001	<0.0001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.005
Chromium mg/L	<0.0005	<0.0005	<0.0005	0.0007	<0.0005	0.0059	0.0009	0.05
Copper mg/L	0.006	0.002	<0.001	0.190	0.001	0.003	<0.001	1
Lead mg/L	<0.0001	<0.0001	<0.0001	0.0001	<0.0001	0.0002	<0.0001	0.01
Selenium mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.01
Silver mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	
Uranium mg/L	0.0010	<0.0005	0.0011	<0.0005	0.0006	0.0009	0.0007	0.02
Zinc mg/L	<0.001	<0.001	<0.001	0.001	<0.001	0.001	<0.001	5
T.coliforms	<1	1	1	1	1	4	23	
E-coli	<1	<1	<1	1	<1	2	<1	
Color	50	18	18	36	16	56	56	15
Turbidity NTU	0.4	2.2	1.3	10.9	1.3	12.6	11.7	0.1
pH	8.48	8.38	8.37	8.62	8.32	8.62	8.53	6.5-8.5
E-cond. @25 C	1030	659	1280	683	383	1390	682	
Calcium mg/L	75.1	40.1	64.2	50.0	30.70	55.3	38.6	
Magnesium mg/L	60.2	33.4	76.7	34.7	19.9	43.8	43.5	
Sodium mg/L	61.5	44.2	101	33.0	14.4	152	45.9	200
Potassium mg/L	2.8	5.9	11.0	8.4	7.7	9.9	9.9	

 (Continued on next page)

Table 5: Dugout Water Samples

	S29	S30	S31	S32	S33	S34	S35	Guideline
Iron mg/L	<0.01	0.03	0.09	0.17	0.06	0.25	0.22	0.3
Magnesium mg/L	<0.005	0.024	0.007	0.015	0.030	0.086	0.093	0.05
Chloride mg/L	31.2	22.2	40.9	13.3	5.3	264	17.9	250
Fluoride mg/L	0.25	0.22	0.34	0.20	0.018	0.19	0.23	1.5
Nitrite-N mg/L	<0.01	<0.01	0.07	<0.01	0.04	<0.01	<0.01	10
Nitrate-N mg/L	<0.005	<0.005	0.095	<0.005	<0.005	<0.005	<0.005	1
Nitrate & N-N mg/L	<0.01	<0.01	0.016	<0.01	0.04	<0.01	<0.01	10
Sulfate(SO4) mg/L	394	174	430	263	46.3	88.6	77.7	500
Hydroxide mg/L	<5	<5	<5	<5	<5	<5	<5	
Carbonate mg/L	7	<6	<6	<6	<6	13	14	
Bicarbo-nate mg/L	128	155	243	70	171	216	314	
P-alkalinity mg/L	6	<5	<5	<5	<5	11	11	
T-alkalinity mg/L	116	127	199	58	140	199	280	
Total dis solids mg/L	694	396	844	436	208	733	402	500
Hardness mg/L	435	238	476	268	159	318	275	
Ionic Bal-ance mg/L	101	101	101	100	100	100	100	

Table 6: Dugout Water Samples

	S36	S37	S38	S39	S40	Guideline
Mercury mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001
Aluminum mg/L	0.006	0.106	0.087	0.207	0.021	0.1
Antimony mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.006
Arsenic mg/L	0.0016	0.0064	0.0066	0.0016	0.0018	0.01
Barium mg/L	0.042	0.060	0.059	0.126	0.087	1
Boron mg/L	0.114	0.10	0.103	0.047	0.048	5
Cadmium mg/L	<0.00001	<0.00001	<0.00001	0.00004	<0.00001	0.005
Chromium mg/L	0.0006	0.0007	0.0015	0.0009	0.0007	0.05
Copper mg/L	0.016	<0.001	0.001	0.036	0.032	1
Lead mg/L	<0.0001	0.0001	0.0002	0.0005	<0.0001	0.01
Selenium mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.01
Silver mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	
Uranium mg/L	<0.0005	0.0008	0.0007	< 0.0005	0.0017	0.02
Zinc mg/L	0.006	0.003	0.036	0.007	0.002	5
T.coliforms	2	1	<1	7	6	
E-coli	<1	1	<1	4	<1	
Color	16	54	>64	>60	32	15
Turbidity NTU	0.6	2.8	4.0	22.1	5.30	0.1
pH	8.27	8.19	8.08	8.08	8.70	6.5-8.5
E-cond. @25 C	651	1300	1310	331	321	
Calcium mg/L	63.4	92.0	89.5	47.9	33.0	
Magnesium mg/L	23.0	47.3	46.7	10.0	8.5	
Sodium mg/L	47.7	138	136	3.1	17.0	200
Potassium mg/L	6.6	14.1	13.8	10	16.6	

 (Continued on next page)

Table 6: Dugout Water Samples

	S36	S37	S38	S39	S40	Guideline
Iron mg/L	0.02	0.27	0.42	0.60	0.79	0.3
Magnesi-um mg/L	0.012	0.156	0.094	0.046	0.026	0.05
Chloride mg/L	9.1	77.1	76.5	1.9	8.3	250
Fluoride mg/L	0.23	0.19	0.18	0.11	0.19	1.5
Nitrite-N mg/L	<0.01	<0.01	0.01	<0.01	<0.01	10
Nitrate-N mg/L	<0.005	0.007	<0.005	<0.005	<0.005	1
Nitrate & N-N mg/L	<0.01	<0.01	0.01	<0.01	<0.01	10
Sulfate (SO4) mg/ L	137	232	334	46.7	26	500
Hydroxide mg/L	<5	<5	<5	<5	<5	
Carbonate mg/L	<6	<6	<6	<6	7	
Bicar-bonate mg/L	255	321	320	155	141	
P-alkalinity mg/L	<5	< 5	<5	<5	6	
T-alkalinity mg/L	209	263	262	127	127	
Total dis solids mg/ L	412	858	853	196	180	500
Hardness mg/L	253	424	416	161	120	
Ionic Bal-ance mg/L	100	103	102	102	110	

Table 1: Pesticide Residue Water Samples (continued)

Measured in ug/L	S1	S2	S3	S4	S5	Guideline
Bifenox	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Bromopropylate	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Butralin	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Carboxin	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Chinomethionate	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Chlorbromuron	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Chlordimeform	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Chlorobenzilate	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Clomazone	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Crufomate	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Cypermethrin	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Cyprazine	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Deltamethrin	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Demeton-s-methyl	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Dialifos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Dichloran	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Dimethachlor	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Dinitramine	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Diphenamid	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Ethofumesate	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Etrimfos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Fenamiphos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Fenson	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Fenvalerate	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Fluchloralin	<0.5	<0.5	<0.5	<0.5	<0.5	0.5

Table 1: Pesticide Residue Water Samples (continued)

Measured in ug/L	S1	S2	S3	S4	S5	Guideline
Heptenophos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Iprodione	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Metazachlor	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Methamidophos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Methoprene	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Myclobutanil	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Norflurazon	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Paraoxon	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Pebulate	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Propanil	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Propargite	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Propiconazole	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Pyridaben	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Tebuconazole	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Terbacil	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Tetramethrin	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Triadimenol	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Triazophos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Vernolate	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Aldrin	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
BHC AI	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
BHC BI	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
BHC DI	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Captan	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Chlorbenside	<0.1	<0.1	<0.1	<0.1	<0.1	0.1

Table 1: Pesticide Residue Water Samples (continued)

Measured in ug/L	S1	S2	S3	S4	S5	Guideline
Chlordane-cis	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Chlordane-trans	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Chlorfenson	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Chlorothalonil	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Chlorthal-dimethyl	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
DDD-o,p	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
DDD-p,p	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
DDE-o,p	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
DDE-p,p	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
DDT-o,p	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
DDT-p,p	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Dichlofluanid	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Dicofol	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Dieldrin	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Endosulfan l	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Endosulfan ll	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Endosulfan sulfate	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Endrin	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Folpet	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Heptachlor	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Heptachlor Epoxide	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Hexachloro-benzene	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Lindane	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Methoxychlor	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Mirex	<0.1	<0.1	<0.1	<0.1	<0.1	0.1

Table 1: Pesticide Residue Water Samples (continued)

Measured in ug/L	S1	S2	S3	S4	S5	Guideline
Nitrofen	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Permethrin-cis	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Permethrin-trans	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Procymidone	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Propachlor	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Quintozene	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Tecnazene	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Tetradifon	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Tolyfluanid	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Triadimefon	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
Vinclozolin	<0.1	<0.1	<0.1	<0.1	<0.1	0.1
TPP %	63	94	82	55	88	50-140
Acephate	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Aspon	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Azinphos-ethyl	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Azinphos-methyl	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Bromophos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Bromophos-ethyl	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Carbophenothion	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Chlorfenvinphos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Chlorpyrifos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Chlorpyrifos-methyl	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Chlorthiophos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Cyanophos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Demeton	<0.5	<0.5	<0.5	<0.5	<0.5	0.5

Table 1: Pesticide Residue Water Samples (continued)

Measured in ug/L	S1	S2	S3	S4	S5	Guideline
Diazinion	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Dichlofenthion	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Dichlorvos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Dicrotophos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Dimethoate	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Disulfoton	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
EPN	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Ethion	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Fenchchlorphos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Fenitrothion	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Fenthion	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Fonophos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Isofenphos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Malaoxon	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Malathion	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Methyl Parathion	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Mevinphos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Omethoate	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Parathion	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Phorate	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Phosalone	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Phosmet	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Phosphamidon	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Pirimiphos-ethyl	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Pirimiphos-methyl	<0.5	<0.5	<0.5	<0.5	<0.5	0.5

Table 1: Pesticide Residue Water Samples (continued)

Measured in ug/L	S1	S2	S3	S4	S5	Guideline
Profenofos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Pryazophos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Quinalophos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Sulfotep	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Terbufos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Tetrachlov-inphos	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
TPP %	63	94	82	55	88	50-140
Alachlor	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Atrazine	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Benfluralin	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Butylate	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Chlopropham	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Cyanazine	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Deethlatrazine	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Desmetryn	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Diallate	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Dichlobenil	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Diclofob-methyl	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Diphenyla-mine	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Eptam	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Ethalfluralin	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Fenoxaprop-ethyl	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Fluazifop-p-butyl	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Hexazinone	<0.5	<0.5	<0.5	<0.5	<0.5	0.5

Table 1: Pesticide Residue Water Samples (continued)

Measured in ug/L	S1	S2	S3	S4	S5	Guideline
Metalaxyl	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Metolachlor	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Metribuzin	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Pirimicarb	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Profluralin	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Prometryn	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Propazine	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Propyzamide	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Quizalofop-ethyl	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Simazine	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Simetryn	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Terbuthylazine	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Terbutryn	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Triallate	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
Triflurlin	<0.5	<0.5	<0.5	<0.5	<0.5	0.5
TPP %	63	94	82	55	88	50-140
3-Hydrxycarbofuran	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
Aldicarb	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
Alidcarb sulfone	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
Aldicarb sulfoxide	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
Bendiocarb	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
BPMC	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
Carbaryl	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
Carbofuran	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
Imidacloprid	<0.02	<0.02	<0.02	<0.02	<0.02	0.02

Table 1: Pesticide Residue Water Samples (continued)

Measured in ug/L	S1	S2	S3	S4	S5	Guideline
Methiocarb	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
Methomyl	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
Oxamyl	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
Promecarb	<0.02	<0.02	<0.02	<0.02	<0.02	0.02
Propoxur	<0.02	<0.02	<0.02	<0.02	<0.02	0.02

Table 1: Spring Runoff Water Samples

Temperature *C	21.7	21.9	22.2	22.3	22.3	22.3	22.3	
Mercury mg/ L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	,0.0001	0.001
Aluminum mg/L	0,095	0.035	0.086	0.024	0.087	0.020	0.049	0.1
Antimony mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.006
Arsenic mg/L	0.0011	0.0008	0.0013	0.0013	0.0012	0.0009	0.0012	0.01
Barium mg/L	0.043	0.035	0.047	0.045	0.055	0.029	0.043	1
Boron mg/L	0.046	0.043	0.061	0.054	0.047	0.040	0.049	5
Cadmium mg/L	0.00003	0.00002	0.00002	0.00003	0.00003	0.00001	0.00004	0.005
Chromium mg/L	<0.0005	<0.0005	<0.0005	0.0008	<0.0005	<0.0005	0.0006	0.05
Copper mg/L	0.002	0.001	0.002	0.002	0.002	0.002	0.003	1
Lead mg/L	0.0002	<0.0001	<0.0001	0.0001	<0.0001	<0.0001	<0.0001	0.01
Selenium mg/L	<0.0002	<0.0002	0.0004	0.0003	<0.0002	<0.0002	<0.0002	0.01
Silver mg/L	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	
Uranium mg/L	<0.00005	<0.0005	0.0020	0.0024	0.0010	<0.0005	0.0005	0.02
Zinc mg/L	0.007	0.004	0.009	0.008	0.004	0.004	0.007	5
Color	>60	>60	>60	>60	>60	>60	>60	15
Turbidity NTU	4.4	1.4	5.1	1.5	3.8	1.7	2.8	0.1
pH	7.66	7.55	7.74	7.68	7.78	7.71	7.66	6.5-8.5
E-cond. @25 C	187	172	424	374	315	142	551	
Calcium mg/ L	20.3	19.2	54.8	36.8	32.5	16.3	38.8	
Magnesium mg/L	5.4	6.1	13.5	11.4	9.4	3.8	17	
Sodium mg/L	1.8	1.3	5.5	11.7	12.5	1.7	46.8	200
Potassium mg/L	19.8	16.6	22.2	24.9	15	13.4	18.5	

(Continued on next page)

Table 1: Spring Runoff Water Samples

Iron mg/L	0.21	0.08	0.28	0.27	0.16	0.13	0.34	0.3
Magnesium mg/L	0.024	0.012	0.006	0.010	0.013	0.028	0.120	0.05
Chloride mg/L	3.4	1.9	9	21	20.2	2.9	14.4	250
Fluoride mg/L	0.12	0.11	0.11	0.12	0.09	<0.05	0.20	1.5
Nitrite-N mg/L	<0.01	<0.01	<0.01	<0.01	0.01	0.01	0.01	10
Nitrate-N mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	1
Nitrate & N -N mg/L	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	0.01	10
Sulfate (SO4) mg/L	11	8.4	98.3	55.7	37.4	3.8	148	500
Hydroxide mg/L	<5	<5	<5	<5	<5	<5	<5	
Carbonate mg/L	<6	<6	<6	<6	<6	<6	<6	
Bicarbonate mg/L	106	112	136	128	130	84	137	
P-alkalinity mg/L	<5	<5	<5	<5	<5	<5	<5	
T-alkalinity mg/L	86	92	111	105	106	69	113	
Total dis solids mg/L	110	109	270	224	191	83	351	500
Hardness mg/L	73	73	192	138	120	56	167	
Ionic Bal-ance mg/L	100	94	103	102	96	100	102	

Table 2: Spring Runoff Water Samples

	S8	S9	S10	Guideline
Temperature *C	22	21.8	21.7	
Mercury mg/L	<0.0001	<0.0001	<0.0001	0.001
Aluminum mg/L	0.328	0.644	0.043	0.1
Antimony mg/L	<0.0002	<0.0002	<0.0002	0.006
Arsenic mg/L	0.0016	0.0030	0.0014	0.01
Barium mg/L	0.056	0.070	0.032	1
Boron mg/L	0.196	0.037	0.037	5
Cadmium mg/L	0.00003	0.00004	0.00002	0.005
Chromium mg/L	0.0017	0.0027	0.001	0.05
Copper mg/L	0.002	0.003	<0.001	1
Lead mg/L	0.0002	0.0018	0.0001	0.01
Selenium mg/L	<0.0002	<0.0002	<0.0002	0.01
Silver mg/L	<0.00001	<0.00001	<0.00001	
Uranium mg/L	0.0007	0.0012	0.0006	0.02
Zinc mg/L	0.005	0.012	0.003	5
Color	>60	>60	>60	15
Turbidity NTU	22.3	85.4	8.6	0.1
pH	7.82	7.93	7.86	6.5-8.5
E-cond. @25 C	1190	519	491	
Calcium mg/L	67.1	45.2	47.4	
Magnesium mg/L	39.6	17	16.2	
Sodium mg/L	137	48.1	35.1	200
Potassium mg/L	13.6	5.5	6.2	

Table 2: Spring Runoff Water Samples

	S8	S9	S10	Guideline
Iron mg/L	0.40	1.84	0.94	0.3
Magnesium mg/L	0.089	0.689	0.589	0.05
Chloride mg/L	69.5	21.4	19.9	250
Fluoride mg/L	0.14	0.14	0.12	1.5
Nitrite-N mg/L	<0.01	0.04	0.02	10
Nitrate-N mg/L	<0.005	<0.005	<0.005	1
Nitrate & N -N mg/L	<0.01	0.04	0.02	10
Sulfate (SO4) mg/L	370	63	76.5	500
Hydroxide mg/L	<5	<5	<5	
Carbonate mg/L	<6	<6	<6	
Bicarbonate mg/L	203	238	204	
P-alkalinity mg/L	<5	<5	<5	
T-alkalinity mg/L	167	195	167	
Total dis solids mg/L	797	317	302	500
Hardness mg/L	330	183	185	
Ionic Bal-ance mg/L	99	101	98	

ACKNOWLEDGEMENTS

We appreciate the contribution of local producers, municipal, provincial and federal governments as well as local and regional business. The success of our research program depends on the dedication of numerous individuals contributing their expertise, time, land and equipment to assist our association in achieving its research and extension goals.

LOCAL COOPERATORS

Raymond Dyck
Frank Bueckert
Kelly Friesen
John Simpson
Manfred Gross
Brian Friesen

MACKENZIE COUNTY

Agricultural Service Board Chairman, Walter Sarapuk
Agricultural Fieldman, Grant Smith

AGRICULTURE AND AGRI–FOOD CANADA (AAFC)

George Clayton
Joe Unruh

AGRICULTURE OPPORTUNITY FUND

Fred Young (AOF Program Supervisor)

ALBERTA AGRICULTURE AND RURAL DEVELOPMENT

Alexander Fedko (RVT Coordinator)
Scott Meers (Insect Management specialist)

CIAM RADIO

Michael Sandstrom
Rose
Phil Peters
Kevin Wiebe

OTHER INDUSTRY GROUPS

Alberta Barley Commission (ABP)
Alberta Pulse Growers Commission (APGC)
Alberta Natural Health Agriculture Network (ANHAN)
Canadian Cattleman's Association (CCA)
Canola Agronomic Research Program (CARP)

AGRI-BUSINESS, CORPORATE SPONSORS AND LOCAL INDUSTRY

AFSC (Fort Vermilion)
Neufeld Petroleum (La Crete)
Cargill Manning Alberta
United Famers Association (La Crete)
Viterra (High Level)

AGRICULUTURAL RESEARCH AND EXTENSION COUNCIL OF ALBERTA (ARECA)AND MEMBER ASSOCIATIONS

Ty Faechner
Jacqueline Lavigne
Ashley Steeple

ALBERTA ENVIRONMENTALLY SUSTAINABLE AGRICULTURE

Dale Chrapko
(Environmental Programs Manager)

We apologize if we omitted anyone in our acknowledgements

ARECA Agricultural Research and Extension Council of Alberta

The Agricultural Research and Extension Council of Alberta (ARECA) is a not-for-profit, producer-driven organization working to enhance and improve agricultural operations through increased access to field research and new technology.

Made Up of 16 member Associations, ARECA acts as a strong, united voice for producers by speaking on their behalf to industry leaders and government representatives. Each member Association delivers programs and develops projects that address the concerns and priorities of producers in their specific regions.

ARECA's member Associations include:

- Alberta Conservation Tillage Society II (ACTS II)
- Battle River Research Group (BRRG)
- Chinook Applied Research Association (CARA)
- Foothills Forage and Grazing Association (FFGA)
- Gateway Research Organization (GRO)
- Grey Wooded Forage Association (GWFA)
- Lakeland Agricultural Research Association (LARA)
- Mackenzie Applied Research Association (MARA)
- North Peace Applied Research Association (NPARA)
- Peace Agriculture Research and Demonstration Association (PARDA)
- Peace Country Beef and Forage Association (PCBFA)
- Smoky Applied Research and Demonstration Association (SARDA)
- Southern Alberta Conservation Association (SACA)
- Southern Applied Research Association (SARA)
- West Central Forage Association (WCFA)

In addition to the work done in each of the regions, ARECA oversees province-wide initiatives including the Sustainable Grazing Mentorship Program, Regional Variety Trials, and the Energy Conservation and Energy Efficiency Project.

ARECA and its member Associations participate in and organize a wide variety of conferences and information sessions for producers. Some of these include:

- Western Canadian Grazing Conference
- The Alberta Forage Industry Network (AFIN) and the Forage Agronomy Update
- Workshops on age verification, riparian health assessment, ranching and marketing for women, crop strategy, energy efficiency, and more…
- Various farm and field tours

For more information on ARECA, the specific projects taking place in each of the regions or upcoming special events, please go to www.areca.ab.ca or call us at (780) 416-6046