2011

Cereal Research Report

Field Crop Development Centre (ARD)
& Lacombe Research Centre (AAFC)

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Government of Alberta

2010 Team Members

ALBERTA AGRICULTURE & RURAL DEVELOPMENT

Field Crop Development Centre

Susan Albers, Triticale Program
Mazen Aljarrah, Triticale Program
Monica Ban Matei, Triticale Program
Colin Bergen, Triticale Program
John Bowness, Barley Program
John Brown, Branch Head
Tim Duggan, Data Management
Donna Hand, Administrative Support
Christine Hanrahan, Computer Lab
Zhanna Hartman, Biotechnology/Pathology Program
Jim Helm, Head of Research
Laura Hoge, Germplasm
Michael Holtz, Biotechnology
Mark Howe, Research Farm Operations
Pat Juskiw, Barley Breeder
Yadeta Kabeta, Research Scientist
Krishan Kumar, Pathology Program
Elaine Lacroix, Centre Administrator
Susan Lajeunesse, Barley Program
Lyla Langford, Barley Program
Shan Lohr, Biotechnology Lab
Don Morehouse, Growth Facility
Joseph Nyachiro, Barley Breeder
Lori Oatway, Quality Lab
Mike Oro, Breeder Seed/Barley Program
Jana Riedler, Barley Program
Natalie Rosendal, Barley Program
Megan Rude, Barley Program
Don Salmon, Triticale Breeder
Bev Smith, Barley Program
Kristen Steenbergen, Biotechnology
Mary Lou Swift, Research Scientist/Feed Quality
Fran Teitge, Publications
Linda Vandermaar, Pathology Program
Carla Weidner, Barley Program
Donna Westling, Barley Program
Mandy Wilson, Germplasm/Pathology
Kequan Xi, Plant Pathologist
Shiming Xue, Biotechnology
Jennifer Zantinge, Molecular Biologist

AGRICULTURE & AGRI-FOOD CANADA

Lacombe

Jackie Busaan, Pathology Program
Deb Clark, Pathology Program
K. Neil Harker, Weed Management
Elizabeth Hartman, Agronomy Program
Larry Michielsen, Agronomy Program
John O'Donovan, Cropping Systems
Noryne Rauhala, Pathology Program
Patty Reid, Weed Program
T. Kelly Turkington, Plant Pathologist
Jennifer Zuidhof, Weed Program

Fort Vermilion

Joe Unruh, Agronomy Program

Beaverlodge

Owen Lee, Agronomy Program
Alanna Olson, Breeding Program
Kelly Olson, Breeding Program
Greg Semach, Agronomy Program

Lethbridge

Brian Beres, Agronomist

ALBERTA BARLEY COMMISSION

Mike Leslie, General Manager
Matt Sawyer, Chair
Darcy Kirtzinger, Policy & Research

Revised May 2011

Front cover photo: Nitrogen Use Efficiency test at Lacombe, 2010.

Don Salmon

Dr. Donald Frank Salmon, 59, of Lacombe County, Alberta, died suddenly on August 28, 2010.

Don was born in Birtle, Manitoba to Harold and Lillian Salmon. Don received his B.Sc. in Agriculture and his Ph.D. in Plant Breeding and Genetics from the University of Manitoba. After graduating, Don was employed by the Saskatchewan Wheat Pool, first as a Wheat Breeder in Zambia, Africa and then in Watrous, Saskatchewan.

In 1980, "Dr. Don" began his career with the Field Crop Development Centre in Lacombe, Alberta, Canada. His focus was on the development of winter and spring triticale varieties, and along the way this included improving winter wheat. He was instrumental in raising the profile of these crops in Alberta and across Canada. Don was highly regarded by the seed producers of Alberta and other growers of triticale, as he shared his knowledge with them and supported them in their efforts in crop improvement.

Don was highly respected within the international scientific community for his knowledge and efforts to increase utilization of triticale. He formed strong bonds with breeding programs in Oregon, Mexico, Australia, and others around the world. The germplasm he developed is in use globally and contributes to the provision of a stable food source in many countries.

Don's breeding efforts produced nine varieties of triticale that have been grown across Canada and internationally. The newest of his triticale varieties are highly productive reduced-awn types for livestock feed, livestock forage, and ethanol production. Don worked closely with Agriculture and Agri-Food Canada, to study the use of winter and spring cereal mixtures on the Canadian Prairies. Don worked to develop a production model for annual forage production using mixtures to improve the quality of cereal silage, and extend the growing season for grazing through underseeding of a winter cereal within a spring cereal crop taken for silage. He also worked to characterize the carbon balance of the winter cereal within the spring-winter mixture that was fundamental to the fall grazing potential and overwintering of the winter cereal. Currently Don was studying the use of winter cereals for swath grazing.

Don's contributions to the agriculture industry will not be forgotten. He will be missed by those in the industry and especially by his co-workers with the Field Crop Development Centre for his knowledge, his practicality, his sense of humor and most importantly his friendship.

Don is survived by his wife, Ferne Gudnason, his mother, Lillian Salmon, his brother and sister-in-law, Ray and Sandra Salmon, and their son, Tyson. Don had a deep love of horses that was shared by his late father, his brother and his nephew. Don's breed of choice was the Morgan. He served for many years as the ring master at Morgan horse shows in Alberta and was Zone Director for the Canadian Morgan Horse Association.

Contents

Mission Statement

The purpose and goal of the Field Crop Development Centre is:

> **The development of cereal crops through breeding, genetic, molecular, physiological and agronomic research with emphasis on high quality feed, fodder, and food crops, for the benefit of a viable and sustainable agri-food industry.**

Contact Us

We welcome any questions, comments or suggestions that could help us meet our goals and objectives.

Please address inquiries to:

Dr. James H. Helm
Field Crop Development Centre
5030 - 50 Street
Lacombe, Alberta T4L 1W8

Phone (403) 782-8696
Fax (403) 782-5514
E-mail james.helm@gov.ab.ca

Additional Information and Publications

- The 2011 Cereal Research Report and other Field Crop Development Centre publications can be found on the FCDC homepage on Ropin' the Web at http://www.agric.gov.ab.ca/app21/rtw/index.jsp. (Click on the INFORMATION tab along the top of the page, then click on MINISTRY INFORMATION found on the left hand side; INDUSTRY DEVELOPMENT; then under CROP DIVERSIFICATION, select FIELD CROP DEVELOPMENT CENTRE.)
- 'Triticale Production and Utilization Manual' – Copies are available at no charge by contacting the Field Crop Development Centre. The report is also posted on Ropin' the Web.

Introduction

Cereal Research

Since 1973, the Field Crop Development Centre of Alberta Agriculture & Rural Development has been involved in the development and evaluation of barley, triticale, and winter wheat cultivars for Alberta. The primary interest of this program has been the production of high yielding, high quality feed barley and triticale. Of particular interest has been the development of feed barley varieties with improved levels of protein and energy digestibility. Since 1979, barley lines have been evaluated for annual forage production as whole plant silage in addition to the selection for grain yield.

On January 1, 1993 Lacombe Crop Research became the Alberta center for barley research under an Alberta/Canada Barley Development Agreement. The Agriculture & Agri-Food Canada barley programs at Beaverlodge and Lethbridge were closed down or phased out. Dr. Robert I. Wolfe (now retired) was moved to Lacombe and the process to integrate the Beaverlodge breeding program into the Alberta Agriculture program began.

A new program for breeding two-row malting barley varieties began, with specific crosses for malting quality first made in 1992. Our goal in the malting program is to put good disease resistance and lodging resistance into a high quality malting type. In 2008, the first lines with malting quality were put forward for registration.

Barley Development

Condor hulless barley was the first barley having high digestible protein and energy to be released from the FCDC breeding program.

Falcon hulless barley was the first to combine the semi-dwarf genetics with the high feed value of hulless barleys. **Phoenix**, a two-row, hulless variety, was registered in 1993.

In 1995, a six-row early maturing, high yielding semi-dwarf feed barley, **Kasota**, was registered out of our program. **Tercel**, a 2-row hulless barley for the Abee growing area was registered in 1997. In 1998, two varieties were registered; **Mahigan**, a 6-row, semi-dwarf feed barley and **Jaeger**, a 6-row hulless variety.

Two barley cultivars were registered in 1999; **Niska**, a semi-dwarf 6-row, high yielding, smooth awn feed barley and **Peregrine**, a 6-row hulless semi-dwarf with good head retention and strong straw.

In 2000, two barley cultivars were registered; **Trochu**, a high yielding, smooth-awned 6-row feed barley and **Vivar**, a high yielding, 6-row semi-dwarf feed barley.

In 2002, two barley cultivars were registered; **Tyto,** a 6-row hulless barley with high grain and forage yield, strong straw, and good seed weight, and **Niobe,** a 2-row feed barley with good disease resistance, high yield, and slightly earlier maturity than CDC Dolly.

Manny was registered in 2003 and is a 6-row, high yielding feed type with superior scald resistance, smut resistance, and intermediate net blotch resistance. This is the best disease package available in a 6-row barley. **Ponoka**, also registered in 2003, is a 2-row feed type that also has superior disease resistance, with a resistant or intermediate resistance rating for all diseases in Alberta.

The barley variety of economic importance, **Sundre**, was registered in 2006. Sundre is a 6-row, smooth-awned feed barley with high grain and silage yields in central Alberta. In FCDC silage trials, Sundre outyielded the high yielding six-rowed varieties Vivar and AC Lacombe. It is a desirable multi-purpose variety for the livestock industry. Sundre has multiple gene resistance to scald.

In 2008, four barley lines were supported for registration. Three were registered and marketed. **Chigwell** is a six-rowed hulled feed variety. **Bentley** is a two-rowed hulled malting variety that should be available in 2011. **Busby** is a two-rowed hulled feed variety.

In 2010, the two-rowed hulled barley **Gadsby** was registered. **BT584**, a six-row semi-dwarf feed barley, was registered in 2011.

Varieties developed at the FCDC

	Variety	Year Registered	Characteristics
BARLEY			
	Empress	1982	6-row feed barley
	Abee	1982	2-row feed barley
	Samson	1985	6-row semi-dwarf
	Noble	1987	6-row feed barley
	Condor	1988	2-row hulless
	Falcon	1992	6-row hulless semi-dwarf
	Tukwa	1992	6-row semi-dwarf
	Seebe	1992	2-row feed barley
	Phoenix	1993	2-row hulless
	Kasota	1994	6-row semi-dwarf
	Tercel	1997	2-row hulless
	Mahigan	1998	6-row semi-dwarf
	Jaeger	1998	6-row hulless
	Peregrine	1999	6-row hulless semi-dwarf
	Niska	1999	6-row semi-dwarf
	Trochu	2000	6-row feed barley
	Vivar	2000	6-row semi-dwarf
	Tyto	2002	6-row hulless
	Niobe	2002	2-row feed
	Manny	2003	6-row feed
	Ponoka	2003	2-row feed
	Sundre	2005	6-row feed
	Chigwell	2008	6-row feed
	Bentley	2008	2-row malt
	TR05671	2008	2-row malt
	Busby	2009	2-row feed
	Gadsby	2010	2-row feed
	BT584	2011	6-row semi-dwarf
TRITICALE			
	Wapiti	1987	Spring triticale
	Pika	1990	Winter triticale
	Pronghorn	1996	Spring triticale
	Bobcat	1998	Winter triticale
	Tyndal	2005	Spring triticale
	Bunker	2005	Spring triticale
	Luoma	2008	Winter triticale
	Metzger	2009	Winter triticale
	Taza	2010	Spring triticale
WINTER WHEAT			
	W460	2011	Winter Wheat

Triticale Development

In order to diversify the cereals in Alberta, the Field Crop Development Centre program includes the development of varieties of spring triticale, winter triticale, and winter wheat.

Wapiti, a spring triticale, was registered in 1987 and **Pika**, a winter triticale, was registered in 1990. The spring triticale, **Pronghorn**, was registered in 1996. **Bobcat**, a winter triticale with high yield, shorter straw, short awnlettes and easy threshing was registered in 1999.

Bunker and **Tyndal** are two reduced-awn spring triticale varieties approved for registration in 2005 and which were released for seed production in 2006.

Two new reduced-awn winter triticale, **Luoma** (2008) and **Metzger** (2009), are currently under increase. In 2010 a new reduced awn spring triticale was approved and released as Taza.

The triticales have inspired a new interest in annual forage for both silage and pasture. The drought tolerance and disease resistance of triticale offers a significant advantage over oats and barley for forage production in drought prone areas. Triticale is also receiving some interest for industrial uses.

The winter triticales **Pika** and **Bobcat** have great potential as an annual pasture crop extending the fall grazing season for two months or more while equaling the growth rates received from good perennial pasture in mid-season. These are new markets for cereals and add diversity for the Alberta producer.

Winter Wheat Development

In 2011 we registered our first winter wheat (W460).

Research Project Breakdown and Objectives

Barley

Purpose: Through the process of genetic manipulation, the development of high yielding barley cultivars adapted to the many production environments of Alberta and which also have the resistance to disease necessary to support a sustainable barley production system. Further, to develop new cultivars of barley with specific quality to meet the needs of discriminating local and international markets.

Specific Objectives:

Breeding/Variety Development

1. Higher yielding cultivars
2. Improved end-use quality of barley
   a. Feed
      i. Energy digestibility for swine
      ii. Nutrient (starch, fiber, protein) degradability (rate) for ruminant species
   b. Food and malt
   c. Bio-industrial
3. Multiple disease resistant cultivars
   a. Scald resistance
   b. Net-blotch resistance
   c. Fusarium head blight resistance
   d. Surface-borne and loose smut resistance
   e. Stripe rust resistance
   f. Root rot resistance
   g. Spot blotch
   h. Stem rust – general & UG99
4. Early maturing cultivars
5. Post harvest
   a. Improving sprouting resistance/ dormancy
6. Special purpose barley cultivars
   a. Strong straw (lodging resistance)
      i. For production under irrigation and high fertility conditions
      ii. For direct combining
   b. Hulless cultivars
      i. High energy feed types
      ii. High quality protein feed types
      iii. Food types and nutraceuticals
   c. Annual forage cultivars
      i. Quality improvement: fiber digestibility
      ii. Yield improvement
   d. Abiotic adaptation
      i. Water use efficiency: drought tolerance
      ii. Nutrient use efficiency: nitrogen
7. Maintenance and improvement of a diverse germplasm collection for cultivar improvement

Integrated Crop Management

Purpose: Integrated Crop Management (ICM) enhances the development of crop production technologies that will lead toward a sustainable agricultural system of cereal crop production for the varied agro-climatic zones in Alberta.

Specific Objectives:

ICM Systems

1. Development of sustainable cropping systems in short season environments
   a. Seedling development
   b. Plant growth
   c. Nutrient use efficiency
   d. Soil health
2. Integrated crop production systems
   a. Manipulation of agronomic factors for improved emergence and yield
   b. Fertility
   c. Seedbed utilization
   d. Weed management strategies
   e. Disease management strategies
3. Emerging agronomic and crop protection technologies
   a. Nitrogen fertilization strategies
   b. Varietal response to manipulated agronomic factors
   c. Time and rate of fungicide
   d. Annual forages (e.g. triticale silage)

Crop Management Studies

1. Annual forage management studies to determine factors affecting biomass yields and nutritional quality
2. Tillage systems as a way of increasing yield and nutrient utilization of cereal crops

Triticale

Purpose: The development of high yielding and improved quality spring and winter triticale adapted to production over a range of agro-climatic conditions in Alberta and Saskatchewan.

Specific Objectives:

Spring Triticale

1. Higher yielding cultivars
2. Maintain good lodging resistance
3. Reduce plant height
4. Earlier maturity cultivars
5. High protein content and quality
6. Higher annual forage yielding cultivars
7. Awnless cultivars for green feed production
8. Post-harvest sprouting resistant cultivars
9. High test weight
10. Maintenance and improvement in disease resistance
11. Maintenance and improvement of drought tolerance
12. Maintenance and improvement of germplasm

Winter Triticale

1. Improved winter hardiness
2. High yielding cultivars
3. Snow mold resistant cultivars
4. High protein content and quality
5. High forage potential (conventional and spring-seeded)
6. Sprouting resistant cultivars
7. High test weight
8. Leaf disease resistance
9. Improved drought tolerance
10. Maintenance and improvement of germplasm

Winter Wheat

Purpose: The development of high yielding milling quality winter wheat (CWRW) adapted to the black and brown soil zones of Alberta.

Specific Objectives:

Winter Wheat

1. Improved winter hardiness
2. Higher yielding cultivars
3. Semi-dwarf cultivars
4. Snow mold resistant cultivars
5. Good milling quality (red or white)
6. Resistance to leaf diseases
   a. Tanspot
   b. Rusts
   c. Takeall root rot
7. Earlier maturing cultivars
8. Sprouting resistance similar to spring wheat
9. Improved drought tolerance
10. Maintenance and development of germplasm

Technology Transfer and Market Development

1. Publicize the results of research in a "farmer friendly" format on the website and in print
2. Circulate the *Cereal Research Report* to industry
3. Update technical information on Ropin' the Web
4. Develop new markets and improve existing ones for malt and feed barley
5. Continue awareness program with Alberta Barley Commission
6. Develop Communication Plan
7. Develop videos to demonstrate FCDC research & goals
8. Submit article ideas to *Barley Country*
9. Conduct farm tours as requested

RESEARCH PROJECTS 2011

Development of Improved Six-row Feed Barley Varieties for Alberta

Purpose:

To develop new varieties of six-row feed barley, which will enhance grain production and utilization in Alberta and northeastern British Columbia.

Reason for Project and Impact:

Six-row feed barley is one of a few critically important annual field crops in Alberta. Of the barley types, it has the best combination of yield, maturity, straw strength and barley leaf scald resistance. This is particularly important for the cooler, shorter growing-season areas. This superiority is a result of success in breeding to date, and is a strong indicator of potential for future advancements. Increases in production efficiency of feed barley will continue to have important economic ripple effects throughout the agricultural industry.

Procedure:

Through the use of conventional plant breeding methods, along with new technology, to develop varieties for Alberta:

a. Strong strawed semi-dwarfs that are earlier than Tukwa, have greater disease resistance, and yields equal to or better than Vivar.
b. Drought tolerant six-row feed varieties that have better scald and net blotch resistance than check varieties.
c. New early maturing six-row feed barleys with scald and smuts resistance, maturing as early as Olli and higher yielding than Kasota.

Summary of Results:

The program began in 1973 and to date has released 13 varieties, with the latest variety, BT 584 (name pending), released in 2011.

The varieties released from this program are: Empress, Samson, Noble, Tukwa, Mahigan, Kasota, Niska, Trochu, Vivar, Manny, Sundre, Chigwell and BT 584.

Tukwa, Mahigan and Kasota have in all ways met our goals of early maturing, scald resistant semi-dwarfs. Niska, Trochu and Vivar have made a gain in the area of test weight and kernel weight, with a higher percent plump kernels than other 6-row varieties. They also have high silage yields.

Sundre was registered in April 2006. It is a smooth-awned, multi-purpose, feed type with excellent scald resistance and superior grain yield.

Sundre and Manny have set a new level of disease resistance in 6-rowed barley. They also have good silage yield and strong straw (standability).

Straw strength, yield and disease resistance are the main goals of the program. However, a great deal of effort is aimed at the improvement of feed quality. In the six-row feed barley area, we target quality for the cattle industry in both grain and forage. A high percent plump grain and uniform kernel size are the primary selection criteria. Results can be seen in the varieties Niska, Trochu, Vivar, and Sundre which have kernel plumpness equal to two-rowed varieties.

Chigwell (BT577) was registered in 2008. It is a six-rowed, smooth-awned, hulled barley with excellent grain yield and agronomic traits equal to or better than the check cultivars Vivar or AC Rosser.

Development of Improved Two-Row Barley Varieties for Alberta

Purpose:

To develop new varieties of hulled, two-rowed barley, which will enhance grain production and utilization in Alberta and northeastern British Columbia.

Reason for Project and Impact:

Two-rowed barley is the preferred hulled barley type grown on almost 90% of the barley acreage in Alberta. This type is the preferred malting and feed barley both domestically and internationally. This crop has a tremendous impact on the livestock production sectors. An increase in production and utilization efficiency of two-rowed barley will have an important economic ripple effect throughout the agriculture industry.

Procedure:

Through the use of conventional and new plant breeding methods, develop varieties with the following traits:

a. Strong-strawed, high-yielding, two-row barley with multiple disease resistance (scald, net blotch, smuts, FHB, stripe rust, spot blotch, root rot).
b. Drought tolerant, high-yielding, two-row barley with multiple disease resistance.
c. Sprouting resistant, wide adaptation, nutrient efficient.
d. Good quality characteristics desired by the market place to enhance overall economic returns.

Summary of Results:

The program began in 1973 and has to date released eight varieties: Abee, Seebe, Niobe, Ponoka, Bentley, Busby, TR05671 and Gadsby. Seebe has scald resistance, is late maturing, and has excellent silage yields. Niobe has mid-maturity (similar to Harrington), good test weight, good disease resistance (intermediate to scald and net blotch and resistance to the surface-borne smuts) and good lodging resistance. Ponoka has an excellent disease resistance package for the western Prairies. It is similar in maturity to Seebe and combines high grain yields with high silage yield potential. Bentley is a high yielding malting line with good net blotch (spot-type) and spot blotch resistance. It also has great biomass yield potential for silage. TR05671 is a specialty malting line that was under market development with Rahr Malting. Busby is a high yielding feed variety. It is a potential replacement for Seebe with similar silage yields, and scald and stripe rust resistance, but six day earlier maturity and 10% higher grain yield. Gadsby is another feed variety with good scald resistance, but it is only two days earlier maturing than Seebe.

The project is currently selecting lines with strong straw, aimed at direct combining. There is also additional focus on getting Fusarium head blight resistance along with multiple disease resistance, using marker assisted selection.

Grain quality factors are also a focus of this project. For the cattle feed industry, grain quality factors include high starch content, percent plump and high test weight. For the monogastric feed industry, quality factors include digestible energy content and protein digestibility.

Development of Hulless High Feed Quality Barley Varieties for Alberta

Purpose:

To develop new varieties of barley that will enhance grain production and the overall value chain in Alberta.

Reason for Project and Impact:

New livestock genetics and bio-technology in the livestock industry create new demands for higher energy feeds. The concerns regarding environmental protection of our surface and ground water from pollution from concentrated animal wastes and the trend toward high nutrition in our foods have led to an increased interest in hulless barleys.

Procedure:

Through the use of conventional plant breeding methods along with new technology to develop varieties for Alberta.

a. To develop new strong-strawed, hulless barley varieties that have high digestible energy and protein in order to maximize feed efficiency in each of the classes of livestock (hogs, poultry, cattle).
b. To develop new drought tolerant, disease resistant, hulless varieties that have the nutritional value described in goal one.
c. To develop hulless barleys that meet new market demands in the food industry and in international markets, focusing on food types and nutraceuticals.
d. Incorporate sprouting tolerance into hulless barleys.
e. To develop hulless barley varieties with lodging resistance equal to or better than Tyto.
f. To develop hulless barleys that have good threshability traits.
g. To develop hulless barleys that have good malting quality.

Summary of Results:

We have registered seven hulless barley varieties: Condor, Falcon, Phoenix, Tercel, Jaeger, Peregrine, and Tyto. Peregrine has the strongest straw of any variety of barley now on the market and is aimed toward the hog producers of Central Alberta and the irrigated production areas where lodging is a problem.

Tyto was registered in 2002. Tyto is taller, higher yielding, and slightly later than Falcon, with 7% higher silage yield. Tyto has not replaced Falcon in the dairy silage market due to lower fibre digestibility. We are currently studying the genetics of this trait.

New selections for smut, scald and fusarium head blight resistance are presently being evaluated.

The project will continue to evaluate low phytic acid barley as an approach to reduce phosphorus pollution related to intensive livestock operations. In addition, this project is using more material in the breeding program with >85% protein digestibility.

Food quality characteristics of these barleys for the Japanese market are also being explored.

Barley Germplasm Creation and Maintenance

Purpose:

To maintain, describe and catalogue a large germplasm collection of barley while developing new germplasm through collection, hybridization and biotechnology techniques which will be useful in the development of new improved barley varieties.

Reason for Project and Impact:

The success of any plant breeding program depends on the gene resources available. With the great ecological diversity of the grain producing areas of Alberta it is essential that we maintain a broad genetic base in the germplasm for the program. We rely upon this project to incorporate new desirable genes for disease resistance and other economical traits into adapted germplasm to be used in the development of new improved varieties

Procedure:

New germplasm is introduced from breeding programs around the world and is grown in the field, evaluated for disease resistance, described and screened for quality traits, and other traits of potential importance. To develop new germplasm, the best of the introduced lines are selected and crossed with superior adapted varieties. This transfer of genes with resistance to scald, smut, net blotch, pre-harvest sprouting and other desirable traits will improve barley production in Alberta.

Summary of Results:

In 2010, germplasm was introduced from Syria, Australia and other breeding programs in Canada.

Nearly 1000 lines of advanced barley breeding material were screened for scald, spot blotch, net blotch, FHB , stripe rust, stem rust and leaf rust resistance.

Produced 145 new crosses to be grown out and evaluated for the FCDC breeding program.

Currently, over 6300 lines are maintained in our germplasm bank, and over 38,600 pedigrees have passed through the Lacombe screening program.

Genetic markers relating to scald resistance and dormancy are currently being screened and validated.

International disease screening includes stripe rust in Washington; stripe rust and stem rust and scald in Ecuador; leaf rust, leaf spot and leaf rust in Argentina; stem rust at Kenya; and FHB in Mexico.

Winter Breeding Nursery and Seed Increase Program

Purpose:

To more rapidly advance the large amount of genetic material created by the breeding programs by growing nurseries during the off-season in California and Oregon.

Reason for Project and Impact:

The use of winter nurseries facilitates the rapid advancement of large numbers of populations in a breeding program, at relatively low cost. This program advances the breeding material at a rapid pace, cutting one to six years off the development time for a new variety. In the winter cereals it guarantees at least one generation a year in advancement without loss of important germplasm and early generation material. The increases allow for more extensive winter hardiness screening in a shorter time.

Procedure:

The winter nurseries allow the breeder to accomplish a more rapid advancement of the breeding populations, reducing the amount of time required to develop a variety by one to six years.

a. To grow breeding lines of spring barley and spring triticale in southern California during the winter in order to advance the material two generations per year.
b. To grow segregating and pure lines of winter wheat and triticale at Hermiston, Oregon in order to increase seed and to harvest for next fall seeding which ensures a turnover of at least one generation per year.
c. To collect new germplasm from other research programs in the area of the winter nurseries.

Summary of Results:

Both of the winter nurseries at El Centro, California for barley and triticale, and at Hermiston, Oregon for winter cereals, are meeting all the project objectives at a low cost.

The karnal bunt problems in California have been cleared and the nurseries are in a karnal bunt-free area in the Imperial Valley. The program has been successful in working with CFIA to obtain import permits for the seed. Spring triticales which had been increased in New Zealand over the past few years are now shifted back to California.

Feed Grain Quality and Supply - Feed Quality Evaluation and Near-infrared Reflectance Spectroscopy

Purpose: This study continues previous research on the development of near-infrared reflectance spectroscopy (NIRS) as an accurate, rapid and cost effective tool for the determination of nutrients impacting economic value of barley for swine and poultry. This second phase is to develop similar calibration models to predict the nutrient quality of barley for ruminants as well as wheat, peas, canola, dried distillers grains and wheat by-products for swine, poultry and ruminants. In partnership with industry, this technology can be transferred to all stakeholders in the Canadian grain characterization system to assess value from producer to end-user.

Reason for Project and Impact: As the nutritional quality of feedstuffs can vary greatly, the need for a rapid and economic system that can measure this variation was identified. Development of an NIRS-based quality assessment system could be used in the grain-trading and feed manufacturing industries as well as in the genetic selection process.

Procedure: This project will span five year (2007 to 2012). Approximately 100 samples of each of the ingredients will be collected from breeding programs and farms across western Canada and distributed to the co-operators. These samples will be evaluated for feed quality traits using laboratory analysis (protein, fat, dietary fiber, starch, ash, beta glucan, pentosan, amino acid profile, gross energy), in-vitro and animal bioassays (apparent metabolizable energy and digestible energy for swine). Calibration models will be developed to determine each of these feed quality traits.

Summary of Results: Chemical, in-vitro and animal evaluation projects are ongoing**.**

Development of Molecular Biological Tools in Cereal Breeding

Purpose:

To identify genes, genetic markers and proteins attributing to cereal disease resistance and/or cereal quality, thereby assisting the selection and pyramiding of desirable traits into new barley varieties.

Reason for Project and Impact:

To allow breeders working at the Field Crop Development Centre access to new molecular tools. For example, the development and use of molecular markers for the selection of important traits will improve gene deployment, allow gene pyramiding and ultimately produce better quality varieties. Improved understanding of the molecular mechanisms behind disease resistance and crop quality may allow plant breeder to better design breeding and crop protection strategies.

Procedure:

Various molecular techniques will be developed and used to analyze barley lines carrying specific traits of interest from specific crosses. By comparing barley DNA and protein profiles, specific polymorphism can be identified and correlated to the trait of interest. These identified differences in DNA sequence can be adapted for use as a molecular marker. Putative molecular markers will be validated and those that prove reliable will be adapted into the breeding program. Various molecular techniques and methodologies will also be adapted to study cereal pathogens, in order to better predict their virulence and control disease.

Summary of Results:

Over the past year the biotechnology laboratory has been focused on the development of molecular markers to aid the selection of new lines with improved disease resistance (Scald and Fusarium Head Blight), dormancy and in vitro fiber digestibility.

Approximately 900 malt lines were screened for scald resistance utilizing the 4H marker previously identified in our lab, linked to Scald resistance. In 2007 and 2008, the 4H loci markers were significantly correlated with scald resistance and didn't appear to be significantly linked to any malt quality traits. Over the winter of 2009-10 our lab also confirmed the presence of scald resistance QTLs in malt barley breeding lines inherited from none cv 'Seebe' parents, located on the 5HL and 7HL. These additional QTLs were incorporated into phenotyping in the summer of 2010. A predictive rating was given to lines for scald resistance based on the presence or absence of QTLs linked to scald resistance and their individual affect.

It is a difficult process to select for a specific dormancy level/preharvest sprouting tolerance via phenotype. The dormancy trait is strongly influenced by the environment and controlled by multiple genes. Therefore, researchers have been interested in developing molecular markers to select for dormancy. Although several QTLs have been identified, very few functional molecular markers have been identified for use in breeding programs. Over the past 6 years, we have developed standardized tests to measure seed dormancy (SD) and preharvest sprouting (PHS) tolerance. We now use these tests to phenotype dormancy and PHS in barley breeding lines. In addition, we have identified several quantitative trait loci (QTLs) across the barley genome, linked to PHS and SD. This was done throught SSR genotyping and DArT analysis on genetic populations consisting of recombinant inbred lines (RIL) from a cross with the strong dormancy phenotype of Samson barley in its background. The most dominant QTLs were located near the 5H (centromere), 2HS, 4HS and 7HL. We are currently validating these QTLs for selecting slight dormancy without affecting malt quality. A final report for this

project was completed in 2009 for funding agencies, ACIDF and BMBRI and a final manuscript is in preparation.

Silage and green feed are important roughage components of ruminant diets. Two varieties, namely Falcon and Tyto, were identified as showing in consistnet difference in *in vitro* fiber digestibility (IVFD). In collaboration with Drs. Pat Juskiw and Mary-lou Swift, we plan to map QTLs linked to invitro fiber digestibility. SSR and DArT analysis will be used to map RIL populations with Falcon and Tyto barley in its background. Over the next two years, we plan to complete phenotyping and genotyping these populations, and identify QTLs and markers linked to improved fiber digestibility.

The Development of Improved Spring Triticale Cultivars for Alberta

Purpose:

To develop adapted spring triticale cultivars with early maturity, sprouting resistance and seed development, while retaining high levels of seed and forage yield under a range of Alberta environments.

Reason for Project and Impact:

Spring triticale has shown great potential as a drought resistant feed crop under dryland conditions on the Canadian prairies. It has also proved to be an excellent silage alternative to barley and oats in the parkland zone. Consequently it provides a potentially viable complement to the production of other cereal species as an animal feed. The spring triticale cultivar *Wapiti* was released in 1987 and *Pronghorn* in 1996. *Bunker* and *Tyndal* were released in 2006. *Taza* was registered in 2010

Procedure:

To develop new cultivars with improved agronomic performance compared to Pronghorn via the use of conventional and interspecific plant breeding methods.

a. To develop new cultivars with shorter days to maturity based on crosses incorporating early genes from spring wheat.
b. To develop improved levels of sprouting resistance through the use of available germplasm as well as crosses involving sprouting resistant spring wheats.
c. To continue screening for improved seed type, grain and silage yield.
d. To develop cultivars with reduced awn expression for feed and industrial uses.

Summary of Results:

New spring triticale lines are entered into Western Triticale Co-operative Tests with the potential for registration. Since Pronghorn is a significant improvement in maturity with good seed and forage yield, it has become the primary check cultivar in the breeding program.

Awnless or reduced-awn types are focused on to enhance usage in conserved forage production. All lines currently in the registration trials are of this type.

Two new varieties, Bunker and Tyndal were supported for registration in 2005. In 2006, Bunker was released to FarmPure Seeds Ltd. and Tyndal was released to SeCan for market development and distribution.

The Introduction, Development and Evaluation of Germplasm in Spring Triticale

Purpose:

To introduce, develop, and evaluate improved germplasm for genetic diversity, quality, maturity, seed development and sprouting resistance.

Reason for Project and Impact:

Although spring triticale has shown great potential in the brown soil zones for seed and in the black soil zones for forage, a number of deficiencies such as late maturity and sprouting susceptibility have limited progress. Improvements in these traits have not been incorporated in the presently adapted cultivars. Consequently, introduction and evaluation of new germplasm and the development of new triticale types through incorporating genes from adapted wheats should improve the degree of genetic variability and the chances of developing vastly improved cultivars. The development of reduced awn types are presently being evaluated.

Procedure:

Unique germplasm from on-going programs in Europe, the USA, Mexico (CIMMYT) and other Canadian programs are introduced and evaluated for adaptation potential. Furthermore, new germplasm involving adapted wheat and exotic rye germplasm is utilized in the production of new triticale germplasm via interspecific hybridization. Introduced and newly created germplasm is evaluated for maturity, height, lodging resistance, seed type, sprouting resistance, and subjected to a full plant description prior to its utilization in the breeding program.

Summary of Results:

Reduced-awn types, early maturity, and sprouting resistance has been successfully incorporated into the triticale germplasm and crossed into the material for variety development. Although feed and fodder is the primary concern of the program, lines with improved industrial potential are being evaluated as germplasm.

Crosses have been produced introgressing solid stem from spring wheat sources. The moderate resistance to FHB in Pronghorn is a major component of the breeding process. The new varieties, Bunker and Tyndal, are also included in the crossing program. Wide crosses were employed with spring wheat to incorporate waxy genes in to spring triticale. The F1's produced were crossed back to triticale in the fall of 2011. Further back and top cross will be employed in the summer of 2011.

The project is also screening for stripe rust resistance in Mexico and at Washington State, Pullman, as well as UG99 in South Africa and Ethiopia.

The Development of Improved Cultivars of Winter Wheat and Winter Triticale

Purpose:

To develop winter wheat and winter triticale cultivars with improved adaptation to the traditional winter cereal production areas as well as the high yielding areas of the black soil zone.

Reason for Project and Impact:

Efficient land utilization and erosion control are a few of the many advantages of winter cereals that are frequently quoted for the traditional production areas. However, in the black soil zones winter cereals provide an additional means of crop diversification. In particular they are generally earlier in maturity than their spring counterparts. However, cultivars presently adapted to the Canadian prairies are late maturing and susceptible to lodging under cool/high rainfall growing conditions. Furthermore, winter cereals are demonstrating a new potential as a source of grazing when spring planted (8,000 acres 1997) in both the brown and black soil zones. Pika, released in 1990, is the primary winter triticale grown on the prairies.

Procedure:

To develop cultivars of winter wheat and winter triticale through the use of conventional and interspecific hybridization (where appropriate) for the black as well as the brown soil zones of Alberta.

a. To develop winter wheat cultivars with earlier maturity and improved lodging resistance (semi-dwarf) and disease resistance in the black soil zone.
b. To develop winter triticale cultivars with earlier maturity, improved lodging resistance, shorter stature, improved seed type and improved sprouting resistance.
c. To evaluate advanced triticale lines for grazing potential prior to cultivar release.

Summary of Results:

Winter wheat advanced lines are currently under testing in the Western Cooperative Winter Wheat Trial. Reduced-awn winter triticale lines are in the advanced stages of testing. New support for this project has been achieved through a partnership with the Western Grains Research Foundation for the winter wheat.

The reduced-awn winter triticale 'Bobcat' was registered in 1999. Bobcat is being well accepted by producers, as is Pika. In 2008, the reduced awn variety Luoma was registered and in 2009 an additional line, Metzger, was also approved for registration.

In the winter wheat program, doubled haploids are being used as one of the tools to rapidly advance lines for variety release in both red-seeded and white-seeded types. Work is on-going to develop a doubled haploid system that will work in triticale with the first DH produced during the winter of 2006-2007. The doubled haploid line 00H050 was registered in 2011. 00H050 has high yield, good winter hardiness, as well as a good rust resistance, including stripe rust.

The Introduction, Evaluation and Development of Winter Wheat and Winter Triticale Germplasm

Purpose:

To introduce, evaluate and develop new winter cereal germplasm prior to its utilization in the breeding program.

Reason for Project and Impact:

Although both winter wheat and winter triticale are adapted to the severe winter conditions in the traditional winter wheat growing areas of the brown soil zone, they do not have the levels of cold tolerance similar to rye. Consequently the transfer of improved cold hardiness into both species is a benefit. Furthermore the transfer of earlier maturity from both the winter wheat and rye into triticale is important.

Procedure:

Introductions from Europe, the USA, and Asia are evaluated for adaptation. New germplasm lines in both species are created via interspecific hybridization to transfer traits from adapted wheats and rye into triticale, as well as using triticale as a bridge-cross in the transfer of cold tolerance from rye to winter wheat. All new introductions as well as genetic recombinants are evaluated for cold tolerance, maturity, seed type, quality, plant height and a range of specific plant characteristics prior to being used in the breeding program.

Summary of Results:

Reduced awn, sprouting resistance and winter hardiness have been improved in the triticale germplasm. Hardiness and seed colour have been the significant changes in the winter wheat germplasm.

An effort is currently underway to expand the winter wheat germplasm base by incorporating stronger gluten from spring types as well as new sources of resistance to powdery mildew, bunt and FHB. Approximately 39 crosses in the winter wheat carrying FHB resistance are in the system. A series of triticale x winter wheat and triticale x rye have been top-crossed with adapted local triticale during the winter of 2009-2010. The first top cross was to spring triticale and the second to winter triticale. These will be evaluated for winter hardiness in 2011.

The Identification of Advanced Barley, Spring Triticale, Winter Triticale, and Winter Wheat Lines with Improved Levels of Dormancy

Purpose: To identify advanced lines in the breeding programs that have the potential to withstand extended periods of rain during harvest.

Reason for Project and Impact: In general, the adapted varieties of winter wheat, winter triticale, and spring triticale are quite susceptible to extended periods of rainfall in the fall. A similar problem occurs in both malting and feed barleys. Consequently this project was initiated in 1982. Two pertinent articles were published in the Agronomy Journal in 1985 (77: 649-652) and 1986 (78: 863-867). An attempt was made to transfer sprouting resistance into hulless barleys and evaluation is presently underway.

Procedure: All lines in the advanced stages of yield testing and all lines in the barley crossing block are subjected to several and various sprouting tests over a period of years to ensure that potential new cultivars are identified on the basis of their capability to tolerate sprouting conditions during harvest.

Summary of Results: A series of hulless lines with good pre-harvest sprouting resistance are being utilized as parents in the barley program. For example, some of the barley lines expected to have desirable levels of seed dormancy and sprouting resistance have been crossed into the Falcon and Phoenix background.

Other barley lines have been developed to determine if the sprouting resistance gene(s) are different from those in B. Harvey's malt line TR118.

Significant improvements in dormancy have also been found in the triticale and winter wheat program.

In 2009, dormancy tests were conducted on whole seeds and intact spikes of the advanced yield trials of barley, triticale (spring and winter) and winter wheat. This report summarizes the results of seed dormancy ratings based on mean weighted germination index (WGERMI) and whole spike responses to sprouting based on spike sprouting index (SPIKESI). Whole seeds were germinated in controlled environment and WGERMI (0 – 1.0 scale, 0 = resistant/dormant and 1 = very susceptible) were determined. The spikes were tested in a rain simulator and rated (1 - 5 scale) taking into account the percentage of sprouted spikes each day for 8 days. The visual ratings were converted to SPIKESI. Both indices take into account the promptness of seed germination and spike sprouting.

The following scale is developed as a guide to describe the test materials. Many important agronomic traits such as sprouting resistance and drought resistance, are quantitative traits which are difficult to describe.

Response of spikes to sprouting, and germination of seeds:			
Designation	Response to sprouting	Weighted germination index **(WGERMI)** range*	Spike sprouting index (**SPIKESI**) range*
R	**Resistant**	**0 0 – 0.3**	**3.0 – 4.0**
MR	**Moderately resistant**	**0.4 – 0.5**	**4.1 – 5.0**
S	**Susceptible**	**0.6 – 0.7**	**5.1 – 6.0**
VS	**Very susceptible**	**0.8 – 1.0**	**> 6.0**

* Lower indices indicate higher levels of sprouting resistance or seed dormancy.

Results: Screening Barley and Winter Wheat Whole Seeds and Spikes

In 2010, spike sprouting and seed germination tests were performed. The results indicate there are variations in seed dormancy, and spike resistance to sprouting among genotypes and within crop species. Generally, the 6-rowed barley genotypes showed higher resistance to spike sprouting and seed germination compared with 2-rowed barley genotypes. However, the results indicate there are some two-rowed barley genotypes showing good levels of pre-harvest and seed dormancy.

Summary of dormancy trials conducted in 2010:		
Test	No. Lines Tested	No. of Checks / Reg. Varieties
B2Y4L	**21**	**4**
B2Y6L	**6**	**24**
B6Y4L	**16**	**4**
B6Y6L	**13**	**15**
BHY4L	**16**	**4**
B-Y5L	**19**	**6**
NRY3L	**5**	**4**
WRY3L	**14**	**4**
T-Y5L	**18**	**4**

Details of 2010 dormancy screening results are found in the "Summary Report of Seed Dormancy and Spike Sprouting Tests 2010."

Inheritance of Seed Dormancy Complex Trait in Barley

Purpose:

To determine the heritability of, and selection efficiency for, sprouting resistance in hulless barley and develop dormancy indices in a wide range of Canadian barley varieties.

Reason for Project and Impact:

Dormancy is an adaptive trait for plant species to survive harsh environments and is defined as the failure of viable seed to germinate under favourable environmental conditions. Moderate dormancy is desirable in barley, as a low dormancy level can result in pre-harvest sprouting (PHS) under wet swath conditions while a high dormancy level can cause inconsistent germination. Sprouted barley grain can result in poor seed germination, as well as low human nutrition and animal feed quality. It is a difficult process for breeders to select for a specific dormancy level via phenotype. The dormancy trait is strongly influenced by the environment and controlled by multiple genes. The utilization of molecular marker selection will allow breeders to select for dormancy or PHS tolerance independent of the environmental affects.

Procedure:

To make crosses between lines selected for dormancy and sprouting resistance (Samson derived) and the hulless cultivars Falcon/Phoenix and malt variety, TR118. Crosses will be advanced using single seed descent to determine inheritance of dormancy in non-segregating F6-F8 generations. Genetic populations will be characterized for dormancy and PHS, quality and using microsatelite marker analysis in order to map quantitative trait loci (QTLs) or genomic locations linked to dormancy and PHS.

Summary of Results:

Over the past 5 years we have developed standardized tests to measure dormancy and preharvest sprouting (PHS) tolerance. We then used these tests to phenotype dormancy and PHS genetic populations. We utilized microsatelite (SSR) analysis on a specific genetic dormancy populations and several dormancy related QTLS have identified. Amplified DNA samples were run on either agarose, denaturating and nondenaturating polyacryalmide gels, and Beckman-Coulter CEQ 8000 gene analyser. Data analysed using the QTL Cartographer Version 2.5 (Wang *et al*., 2006). The strong dormancy phenotype of Samson barley, is the result of multiple seed dormancy loci, and the most dominant QTLs were located on the 5H (centromere), 2HS, 4HS and 7HL. Many of the QTLs identified in the T89049007XTR118 confirmed previously identified loci linked to seed dormancy in other genetic populations. Two unique QTLs on chromosomes 2H and 4H were also identified and these QTLs may be good target QTLs for selecting slight dormancy without affecting malt quality. A final report for this project was completed in 2009 for funding agencies, ACIDF and BMBRI.

Evaluation of Potential New Cultivars of Wheat, Triticale and Barley in the National Co-operative Yield Trials

Purpose:

To assist in the pre-registration evaluation of potential new cultivars under conditions in Alberta.

Reason for Project and Impact:

In order to receive registration, cereal lines in Canada must be tested in the recognized co-operative tests for a minimum period of two years for barley and three years for wheat and triticale.

In order to carry out an adequate number of test sites in western Canada, all relevant breeding programs on the prairies provide sites and handle the appropriate tests. Consequently the Field Crop Development Centre at Lacombe has been providing test sites and data to the Prairie Registration Recommending Committees run under the Prairie Grain Development Committee.

Procedure:

All lines are evaluated for a range of agronomic and quality traits at Lacombe, Olds, Trochu, Morrin, and Calmar in Alberta for the following Co-operative Yield Trials:

Western Hard Red Winter Wheat (HRWW) Tests 'B' and 'C'
Central HRWW Tests 'B' and 'C'
Western Spring Triticale
Western Fall Rye
Western Six-row Barley
Western Two-row Barley
Western Hulless Barley
Western Forage Barley
Malting Barley Collaborative Test

Summary of Results:

Cooperative tests for two-row barley, six-row barley, forage barley, hulless barley, spring triticale, winter triticale, and winter wheat are grown at several locations.

The collaborative test for malting quality of two-row and six-row barley is grown at Lacombe.

FCDC staff sit as members on the Prairie Recommending Committee for Oat and Barley, the Prairie Recommending Committee for Wheat, Rye and Triticale. Each year many lines are evaluated at the field sites and select lines are put forward for recommendation. In 2011, 3 CWRS wheat, 2 CWRW wheat, 1 CRSR wheat, 1 CWA Durum wheat, 3 spring triticales, 0 two-row barley, 2 six-row barley, 1 hulless barley, 1 forage barley and 1 spring oats were supported for registration.

Root Rot Resistance Screening of Barley and Triticale Lines

Purpose: To carry-out a routine screening of germplasm of barley and triticale for symptoms of common root rot, and to use resistant lines in the germplasm development and breeding projects.

Reason for Project and Impact: Common root rot has been estimated to take an average of 10% from barley yields on a yearly basis. Levels of root rot appear to be increasing especially where feed grain or silage barley is grown continuously or in short rotation. Varieties with resistance to common root rot would increase crop productivity.

Procedure: Lines are deep-seeded in single row plots in the nursery area, which has been heavily inoculated with common root rot. Resistant and susceptible checks are grown every 10 plots. Lines are evaluated on the basis of discoloration of the subcrown internode.

Summary of Results: In 2010, approximately 475 breeding lines of barley were screened for common root rot resistance. Disease assessments of 345 test plots were also performed and included as part of the disease data package for the first and second year Cooperative Test entries and checks of the Western Co-operative Barley Registration Test.

Disease Resistance Screening of Barley, Winter Wheat and Triticale Lines

Purpose: To evaluate germplasm and advanced lines of barley for resistance to scald and net-blotch; evaluate spring triticale for resistance to leaf spots and FHB; and evaluate spring and winter wheat and triticale for stripe rust, septoria and powdery mildew resistance.

Reason for Project: Cereal leaf diseases reduce crop yield and quality on an annual basis. New varieties require improved disease resistance over check varieties in order to be registered.

Procedure: Advanced lines are tested in screening nurseries. Both barley and triticale are evaluated in inoculated tests for leaf spot diseases at Lacombe, Edmonton, Saskatoon, and Brandon. Barley and triticale are also screened for stripe rust resistance in the nurseries located in Washington State, Creston, BC and ICARDA/Mexico. Severity of diseases caused by natural infections are evaluated at Olds, Calmar, Trochu, Morrin, and Lacombe. Resistant lines that are identified by screening will be included in the germplasm creation project to accumulate disease resistance into adapted lines. Lab and field techniques are being modified and developed for improvement of screening efficiency.

Summary of Results: Scald of barley was found to be the major disease in all barley breeding sites with scald severity being an order of Calmar > Trochu > Lacombe > Olds. It is noteworthy that scald in the naturally infected breeding plots at the Calmar site was as severe as twice-inoculated hill plots in the Edmonton nursery. Net blotch and spot blotch were severe on a few susceptible cultivars/lines in Trochu and Lacombe. Assessments for foliar diseases of barley, wheat and triticale were made using a 0-9 scale during the late July to early August. While scald severity was assessed, other diseases such as net blotch and spot blotch of barley, when found to be 5 or higher in the 0-9 scale, were also noted to account for the interaction of multiple foliar diseases occurring on the same entries. Over 7,000 plots of barley, winter and spring wheat and triticale were assessed for foliar diseases in this season. This is a record number of breeding plots that were warranted for disease assessment as a result of high levels of disease development in central Alberta.

Lines identified as having superior resistance to diseases are being used in the breeding program. All of the new varieties developed since 1990 have higher levels of disease resistance. Research is being cooperatively carried out by Alberta Agriculture and Agriculture and Agri-Food Canada. The summarized results for screening stripe rust resistance in the Pacific Northwest and Ecuador for 2010 have been reported under the project "Integrated control of stripe rust of cereals in Alberta".

Large-scale hill plot nurseries to screen for resistance to scald were conducted at both Lacombe (AAFC) and Edmonton (AARD). The scald screening site at Edmonton was located on plot land at the University of Alberta. The screening site at Lacombe was inoculated once with infested straw from the 2009 Lacombe screening site and twice with a conidiospore suspension of several isolates. The Edmonton screening site was inoculated twice with a conidiospore suspension of one isolate sampled from the Calmar area, while both sites were irrigated to promote disease development. AARD breeding lines and currently registered varieties with resistance to scald were evaluated for scald resistance on July 6, 2010 and July 27, 2010. At Lacombe the AARD material had average ratings of 5.9 with a minimum rating of 0 and a maximum rating of 8.0 on a 0-9 scale. At Lacombe, approximately 1.2% of the breeding lines had ratings equal to 0, while

7.9% had ratings of greater than zero, but less than or equal to 3; 19.9% had ratings of greater than 3, but less than or equal to 5, while 71.0% had ratings of greater than 5. Very wet conditions at Lacombe, along with irrigation, promoted extensive disease development allowing differentiation between susceptible and resistant material. Scald screening data were tabulated and sent to cooperating breeding programs for their information and use regarding advancement of material and the genetics of resistance. At Lacombe, entries with ratings of >7 and from 6-7 can likely be considered susceptible and moderately susceptible, respectively . Check lines including Kasota, Manny, Ponoka, Seebe, Sundre, Tyto, Vivar, and Harrington had ratings of 6.5, 4.9, 6.4, 4.5, 3.5, 6.1, 7.2, and 7.4, respectively, at Lacombe.

In 2010, a spot-form net blotch nursery was set up at the Lacombe Research Centre with a total of 1188 hill plots representing material from the AARD Lacombe program as well as programs at Saskatoon and Brandon. Spreader rows of a susceptible line were used at the Lacombe site and all hill plots including spreader rows were inoculated with autoclaved rye grain, which was previously infested with several isolates of the spot-form net blotch pathogen. AARD breeding lines were evaluated for spot-form net blotch resistance on July 15 and August 5, 2010. Given good moisture conditions and a source of inoculum, reasonable disease development occurred during the growing season. On the second date at Lacombe the AARD material had average ratings of 6.0 with a minimum rating of 5.0 and a maximum rating of 8.0 on a 0-9 scale. Lines with ratings from 0-3 are generally considered to be resistant, while lines with ratings of >6 are moderately susceptible to susceptible, and lines with ratings of 4-6 have intermediate levels of resistance. Check lines had average ratings of 6.3 with a range of 5.0 to 8.0 on the 0 to 9 scale. Most entries likely had intermediate levels of resistance. Spot-form net blotch screening data were tabulated and sent to cooperating breeding programs for their information and use regarding advancement of material and the genetics of resistance.

In 2010, a net-form net blotch nursery was initiated at the Lacombe Research Centre with a total of 800 hill plots representing material from the AARD Lacombe program as well as programs at Saskatoon and Brandon. Spreader rows of a susceptible line were used at the Lacombe site and all hill plots including spreader rows were inoculated with autoclaved rye grain, which was previously infested with several isolates of the net-form net blotch pathogen. AARD breeding lines were evaluated for net-form net blotch resistance on July 14 and August 5, 2010. Although wet conditions occurred and plots were inoculated only intermediate disease development occurred during the growing season. On the second date at Lacombe the AARD material had average ratings of 3.1 with a minimum rating of 0 and a maximum rating of 5.0 on a 0-9 scale. Although only intermediate disease ratings were found, lines with ratings >4 were likely moderately susceptible to susceptible, and lines with ratings of < 2-3 may be resistant. Check lines had average ratings of 3.3 with a range of 2.0 to 4.0 on the 0 to 9 scale. Net-form net blotch screening data were tabulated and sent to cooperating breeding programs for their information and use regarding advancement of material and the genetics of resistance.

In 2010, a small spot blotch nursery was initiated at the Lacombe Research Centre with a total of 464 hill plots representing QTL material from the University of Saskatchewan Crop Development Centre program. Spreader rows of a susceptible line were used at the Lacombe site and all hill plots including spreader rows were inoculated with autoclaved rye grain, which was previously infested with several isolates of the spot blotch pathogen. Breeding lines were evaluated for spot blotch resistance on July 14 and August 6, 2010. Although wet conditions occurred and plots were irrigated only intermediate disease development occurred during the growing season. On the second date at Lacombe the breeding lines had average ratings of approximately 3.0 with a

minimum rating of 0 and a maximum rating of 4.0 on a 0-9 scale. Although only up to intermediate disease ratings were found, lines with ratings >3 were likely moderately susceptible to susceptible, and lines with ratings of < 2 may be resistant. Check lines had average ratings of 3.1 with a range of 2.0 to 4.0 on the 0 to 9 scale. Spot blotch screening data were tabulated and sent to cooperating breeding programs for their information and use regarding advancement of material and the genetics of resistance.

Integrated Control of Stripe Rust of Cereals in Alberta

Purpose: To gain a better understanding of the cereal-stripe rust pathosystem and thereby formulate integrated strategies using durable resistance and appropriate cultural practices. Information obtained will allow producers to implement integrated management for effective disease control.

Reason for Project And Impact: Stripe rust caused by *Puccinia striiformis* has been increasing in prevalence in central Alberta and wheat yield reductions reached 45% at Lacombe. There have been increasing calls from Alberta producers regarding disease identification and management. To prevent or reduce losses by this disease, research is needed to understand epidemiology of stripe rust in Alberta and formulate management strategies.

Procedure:

- Advance germplasm and cultivar development by screening for stripe resistance in international nurseries and central Alberta.
- Survey commercial fields for a better understanding of pathogen overwintering, inoculum sources, and disease development.
- Comparative studies of epidemiology of stripe rust between winter and spring field for a development of cultural practice for disease management.
- Determine pathogen host range, race structure and frequency in Alberta to formulate a strategy of developing genetic resistance.

Summary of Results: At the Pullman and Mt Vernon sites in 2010, 135 lines of winter wheat and triticale were screened in each of the nurseries. Sixty-seven and 20% of the lines in Pullman and Mt. Vernon, respectively, were found to be resistant based on ratings of 3 in infection type and 20% in severity or lower. Using the same criterion, 57.4 and 86.3% of 371 lines of spring triticale were resistant when evaluated in each of the Pullman and Mt. Vernon nursery, respectively. The majority (95.3%) and one third (34.4%) of 532 barley lines were resistant in the Pullman and Mt. Vernon nurseries, respectively, based on above criterion for the classification of disease reaction. There were 535 barley lines screened for stripe rust resistance in the Ecuador nursery, 2010. In addition to stripe rust infection, substantial levels of leaf rust, barley yellow dwarf and scald were found in the same entries in this nursery. About 20 lines were found to be resistant to all four diseases based on similar rating scales and cut-off points.

Screening results of this project have provided information on genetic resistance in the lines evaluated in the nurseries. Efforts are underway to incorporate stripe rust resistance into well-adapted advanced lines. Twenty-one crosses in winter wheat have been made for stripe rust resistance. The first FCDC winter wheat cultivar 00H050 (test name W460) has been recently registered. This is a high yielding line with moderate resistance to stripe rust in the stripe rust international nurseries during 2007 to 2009. Two-rowed barley has been produced by crossing to build up multiple disease resistant lines that have potential to release as new varieties. More crosses are planned to incorporate stripe rust resistance into six-rowed and hulless barley.

Sixty one *Puccinia striiformis* isolates collected primarily from central Alberta during 2007- 2008 and Creston during 2009 were identified to be *P. striiformis f.sp. tritici (Pst)* and *P. striiformis f.sp. hordei (Psh)* based on virulence on differentials and cultivars/genotypes under the artificial epiphytotic conditions. The two formae speciales had overlapping virulence on highly susceptible barley and wheat. Wheat differentials differentiated 38 Pst isolates into 19 races with most races consisting of

single isolates and two races consisting of 7 and 12 isolates. Pst race virulence spectra varied ranging from 7 to 17 wheat differentials. Resistance genes, Yr1, Yr5, Yr10, Yr15, Yr24, Yr28 and YrSP alone or in combination were immune or resistant. The remaining genes in the wheat differentials were found to be susceptible to all 19 Pst races. Twenty three Psh isolates were identified to belong to 18 Psh races with virulence on 3 to 10 barley differentials. Among the 18 races, fifteen races each consisted of a single isolate and the remaining 3 races each consisted of two or three isolates. The narrow virulence spectra, of Psh isolates identified in the present study compared with Pst is considered to be the result of fewer resistance genes deployed in barley. Inoculation of *P. striiformis* isolates onto local wheat and barley cultivars/genotypes varying in stripe rust resistance or susceptibility also resulted in the separation of two formae speciales. There were significant but low correlations in wheat stripe rust severity in the majority of test locations and years between the PNW and central Alberta. Similarity in virulence phenotypes and correlations in disease severity on wheat differentials between central Alberta and the PNW indicated the consistence in virulence of Pst populations between central Alberta and the PNW.

Breeding for Resistance in Barley to True Loose Smut (*Ustilago nuda*) and Surface-borne Smuts (Covered (*U. hordei*) and False Loose Smuts (*U. nigra*))

Purpose:

To evaluate germplasm and advanced lines of barley for reaction to true loose smut and the surface borne smuts and to incorporate the best resistance available into potential new cultivars.

Reason for Project and Impact:

Smuts of cereal crops reduce yield and quality. Disease resistance standards for registration of new varieties are increasing. Smut resistance will reduce the need for seed treatment and increase yield and crop quality of Alberta barley.

Procedure:

New cereal varieties require increased levels of disease resistance to meet the requirements for registration. This program is aimed at meeting these requirements.

a. To identify breeding lines that have resistance to the prevalent pathotypes of true loose smut and surface-borne smuts.
b. To identify genes that impart resistance, and to incorporate the resistance into new cultivars of six-row and two-row barley for both malt and feed.

Summary of Results:

Large numbers of lines are being screened annually by use of a field inoculation procedure for loose smut and vacuum inoculation for covered smut.

In 2010, approximately 644 barley breeding lines (two heads per line) from B-Y1 and B-Y4 were inoculated with loose smut using an airbrush inoculation technique. Inoculated plant material was grown in the growth room facilities at AARD Field Crop Development Centre, Lacombe and evaluated for resistance to loose smut.

In 2010, approximately 279 barley lines, including checks from the B-Y2 were inoculated with covered smut using a vacuum inoculation technique. Material was then planted in the field and screened for resistance to covered smut during the summer.

Surveying Cereal Diseases in Alberta

Purpose: To assess and evaluate the prevalence and level of the various cereal diseases in central Alberta. To identify and monitor the appearance of new or more prevalent diseases that may be affecting Alberta cereal crops. To assess the impact of various cropping practices on cereal leaf diseases.

Reason for Project and Impact: To provide sustainable management of leaf diseases, cereal producers, pathologists, agronomists, and breeders need an ongoing and clear indication of the changing disease situation in western Canada. Changes in pathogen virulence and prevalence will have a large impact on the management strategies used by farmers and the direction breeding programs take with regard to the development and utilization of disease resistance.

Project Goals: Results from ongoing cereal disease surveys will be used to:

- Establish and demonstrate the importance and impact of cereal leaf and root diseases in Alberta.
- Illustrate the importance of resistance for disease management.
- Identify and monitor the appearance or increased prevalence of new or changed barley and wheat pathogens.
- Assess the impact of changing cropping practices on cereal disease levels.

Summary of Results: A survey to document diseases of barley was conducted in 20 fields in Central Alberta from August 4-9, 2010. Growers were contacted for permission to access their land, with the evaluation being done at the late milk to soft dough stage. The fields were traversed in a diamond pattern starting at least 25 m in from the field edge, with visual assessment made of 5 penultimate leaves at each of 5 locations that were at least 25 m apart. Leaf diseases were rated for percentage leaf area diseased (PLAD) with scald, netted net blotch and other leaf spots. Common root rot (CRR) was assessed on sub-crown internodes using a 0-4 scale where 0=none, 1=trace and 4=severe. Other diseases, if present, were rated as a percent of the plants affected. Following the survey, a representative tissue sub-sample of diseased plant parts collected at each location was cultured in the laboratory for pathogen isolation and identification.

Growing conditions in Central Alberta were wet and cool for May, June and July. August was somewhat dryer than the other months, but crop maturity was delayed. Disease development was relatively high throughout the region.

Scald (*Rhynchosporium secalis*) severity ranged from 0.1 to 6 % in 12 fields, while 2 fields had a PLAD rating between 40% and 60%, and 2 fields had a rating between 60 and 80%, with all remaining fields having no scald. As with scald, there was more netted net blotch (*Pyrenophora teres* f. *teres*) observed throughout the survey region compared to 2009, and PLAD ranged from 0.1% to 10% in 10 fields, while three fields had a rating of 36%, 68%, and 84% respectively, with the remaining fields having no netted net blotch. Other barley leaf spots, primarily diagnosed as spotted net blotch (*P. teres* f *maculata*), were found in 95% of the fields surveyed. The severity of these other leaf spots ranged from 0.1% to 21%. *Alternaria* spp. were also isolated from sub-samples of tissues exhibiting spotted net blotch symptoms.

Common root rot of barley (*Cochliobolus sativus* and *Fusarium* spp.) occurred in all of the surveyed fields, at similar levels to those in 2009.

There was no stripe rust (*Puccinia striiformis*) observed in any of the commercial barley fields that were surveyed.

Variety Resistance to Scald of Barley

Purpose:

To determine scald reactions of barley cultivars across western Canada and to provide insights into the probable mechanisms that have rendered resistance ineffective. Also, to determine the rate of development of new pathogen races and monitor the composition of known races in relation to resistance and susceptibility of barley cultivars.

Reason for Project and Impact:

Scald of barley is prevalent in central Alberta and this disease has caused considerable yield and quality losses in this region. Rapid changes in scald races have rendered some cultivar resistance ineffective. A previous study showed that resistance remained in a few cultivars such as Seebe, Kasota, Mahigan and CDC Dolly. Many cultivars were found to have an increase in susceptibility as a result of extreme variability in virulence of *R. secalis*. Resistance in cultivars was found to be location dependent, indicating an uneven development of *R. secalis* races in Alberta. The objective of this long-term study is to continue monitoring race variation in relation to cultivar resistance. This information is essential for host gene deployment that aims at maintaining a relatively balanced equilibrium between host and pathogen. Effective breeding programs and gene deployment should, in turn, prolong the life of cultivar resistance.

Procedure:

Barley cultivars and differentials are grown in hill plots across Alberta to evaluate scald reactions. Virulence genes of the scald pathogen derived from DNA sequence information will be identified.

Summary of Results:

In the race variation test to monitor the scald situation, twenty-five barley cultivars/differentials were grown in hill plots of six locations in central Alberta. The hill plots in all locations were naturally infected, except for the Edmonton site which was inoculated twice using a mix of two scald pathotypes. Scald developed in all tests except for the Morrin site for which no assessment was made. Scald severity was rated using a 0-9 scale at the soft dough stage in five locations/tests. The Trochu and Calmar site had higher mean severity (4.5 and 4.3), respectively, with intermediate severity (3.4) for Edmonton, and a lower mean severity (2.5) for Olds and Lacombe. The Spearman correlation test showed that the rank of cultivars/differentials in scald severity was significantly correlated among locations, indicating overall cultivar resistance across central Alberta. However, there were substantial differences in ranking for individual locations with some resistant cultivars being ranked to be more susceptible at Calmar than the other locations, suggesting that virulent strains of the scald pathogen developed at Calmar, which is considered to be one of the hot scald spots in central Alberta. To determine if virulence pathotypes developed, the scald fungus was isolated and inoculation was done using a set of scald differentials in a greenhouse test. Preliminary analysis showed that the scald isolates from Calmar appeared to have intermediate to high levels of virulence.

Leaf samples were taken from various test sites and virulence genes of the scald pathogen derived from DNA sequence information will be identified. The mechanisms of changes in virulence of the scald pathogen based on DNA sequence between historical and current isolates will be compared. Guidelines for the deployment of resistant cultivars for scald management will be provided based on the information on a determined association between the virulence genes in the pathogen and the breakdown of resistance genes in barley cultivars.

Barley Resistance to Fusarium Head Blight (FHB)

Purpose:

To investigate techniques for screening barley for resistance to Fusarium head blight (FHB) and study the resistance mechanism to FHB and DON accumulation.

Reason for Project and Impact:

Fusarium head blight incited by *F. graminearum* has caused considerable quality and yield losses in wheat and barley in the eastern prairie region of western Canada. In Alberta FHB has not been extensively present in the field but sources of resistance/tolerance are required for the development of resistant/tolerant cultivars to prevent FHB epidemics from occurring. Laboratory screening techniques will allow researchers to screen for tolerance in Alberta, and may be more effective than field screening in early generation screening. Laboratory screening will also allow us to do more detailed genomic and proteomic work than can be done using conventional field screening.

Procedure:

A series of experiments will be carried out to investigate techniques for the identification of barley cultivars resistant/tolerant to FHB. The protocols of attached leaf and seed germination assays are being refined by testing the optimal palnt growth stage, leaf position, inoculation and sampling techniques under growth room / *in vitro* conditions.

qPCR is being used to determine the amount of fungal DNA in a specified leaf segment after punch inoculation and to see the correlation between the fungal DNA concentration and resistance / susceptibility.

Summary of Results:

The techniques have shown cultivar differences in lesion size, % infection, and DON accumulation. Measurement of lesion length and DON level using ELISA proved to be relatively accurate and effective in genotype rankings. These protocols may be helpful for rapid and reliable identification of resistance independent of the interaction between genotype by environment on the expression of resistance, thus providing alternative approaches for the selection of FHB resistance in barley.

Results showed that qPCR assay to measure the fungal DNA in infected leaf samples can be an affordable, accurate, and time-saving tool that could be utilized in breeding programs for early detection of *F. graminearum* infections.

Furthermore, there is no risk of introducing *F. graminearum* to the environment, which is another advantage of using these techniques over traditional field screening methods. More than one FHB resistance trait should be measured to establish the genotypic potential for FHB resistance. Our goal is to apply *in vitro* FHB resistance assays that determine the type of FHB resistance. This will aid the barley breeder's ability to incorporate multiple FHB resistance genes in new varieties.

Developing Crop Varieties with Enhanced Nitrogen Use Efficiency

Purpose: To develop baselines for nitrogen use efficiency (NUE) of barley in Alberta and protocols for enhancement of this trait through breeding and genetic transformation.

Reason for Project and Impact: Scientists have long recognized the need to develop crops that absorb and utilize nutrients more efficiently. This is important for two reasons. First, the use of commercial fertilizers accounts for one of the major costs associated with the production of high yielding crops. Second, the environmental damage associated with excessive N is significant. Increasingly, the production of crops with a high demand for nitrogen is on the rise and increasing livestock production is generating more nitrogen in manure. The focus of this program will be to optimize nutrient utilization in the crop plants using genetic tools.

Procedure: Using the FCDC long-term data as well as on-going germplasm evaluation under field conditions, the genetic variability for NUE in the barley germplasm will be determined. Dr. Good's Laboratory at the University of Alberta will develop transformation protocols for barley and, if successful with the transformation, will assess barley lines with different constructs for NUE under hydroponic conditions.

Summary of Results: Analysis of the FCDC long-term data and field experiments during the years 2007-2009 showed that there is significant genetic variability in NUE of spring barley. Nitrogen use efficiency varied across locations and years, but genotypes had up to 25% differences in NUE at a specific environment. Cultivars Vivar and Xena were relatively N efficient, produced higher yield per unit of available N and removed more N per unit area in the grain as compared to the others.

In 2010, we evaluated 25 barley germplasm obtained from the FCDC breeding program, the US (University of Minnesota), Australia, and the International Centre for Agricultural Research in the Dry Areas. Among these, I09501, I 09502, I09505, I08128 and Vivar were high in NUE. Three of these (I09502, I09505 and Vivar) and two toehr newer cultivars (Sundry and Bentley) were intercrossed to pyramid NUE genes and develop superior lines. These populations will be grown out in the field in the summer of 2011 and we will select and advance the best lines from each population.

Developing small grain cereals with enhanced forage quality and yield

Purpose:

To improve feed efficiency through improved forage yield and quality of small grain cereals. Through assessment of forage quality of current germplasm of triticale and barley, develop NIRS calibrations that will be used in the selection of new lines with improved forage quality.

Reason for Project and Impact:

Little information is known about the range in i*n vitro* Fibre Digestibility (IVFD) that exists within our small grain cereals and what affects growing conditions may have on fibre digestibility. This project is aimed at assessing the triticale and barley germplasm at FCDC for fibre digestibility and determining genotype and environment affects on the expression of IVFD. This project hopes to improve IVFD by 10% and biomass yields by 5% in barley and triticale.

Through this combination of improved fibre digestibility and biomass yield, feeding should be more efficient and more animals should be supported by the same land base. If 30% of the backgrounding ration is silage then feed efficiency should go up by 3%. This means that animals should get to finishing weight in 3% less time, with savings in input costs due to that more rapid turn around time—saving approximately five days in a 160 day backgrounding operation or approximately $9.50 per head (Manitoba Agriculture, Food and Rural Initiatives, 2003 Guidelines). The savings to the backgrounding industry in Alberta could be $20 million; in BC $10 million. As well there should be 3% less through-put or manure produced also resulting in savings associated with less manure. Savings to the cow/calf operator will depend upon the amount of the ration that is greenfeed, haylage and/or silage. Up to 10% less feed may be needed per cow/calf pair. For the dairy industry milk productivity per cow could increase by 2.5 L per day for an estimated savings in BC and Alberta of $80 million.

Procedure:

Using long-term biomass samples of barley and triticale, develop NIRS calibrations for fibre, protein and fibre digestibility. Using advanced yield trials, validate calibrations. Determine the relationship of fibre traits with other desired agronomic traits (dry matter biomass yield, grain yield, grain quality, lodging resistance). If differences due to genotype can be identified then we can select for differences in fibre digestibility and perhaps break undesirable linkages if needed. Develop NIRS calibrations for silage quality that can be used in the breeding program at FCDC for the selection of plant types with desirable quality traits. Develop populations to determine the genetics of fibre digestibility and its improvement.

Summary of Results:

This project began in 2008 and will produce results over the next four to five years. In 2008, approximately 300 samples from 2005, 2006 and 2007, were sent for determination of fibre digestibility. On average Falcon has about 8% better fibre digestibility than Tyto. This appears to be a genetic factor in Falcon. Head rows from a Tyto/Falcon cross were grown out in 2008 for increase, and in 2009 small plots were grown out for silage harvest, and quality determination. The quality of the 2009 harvest was confounded by severe drought conditions in July and August that caused premature ripening of the crop. As well, 6 populations of Falcon crosses will be grown out in 2011 for evaluation of IVFD. A NIRS calibration of fibre digestibility has been made, and will be further refined with data collected over the next few years. In 2010 and 2011, recombinant inbred lines were again grown out to assess the genetic potential of breeding for improved IVFD.

Comparison of the impact of monocultures, rotational diversity, mixtures, and intercropping on disease and sustainable crop production

Purpose: To determine the compare and contrast the effects of monocultures, mixtures, intercropping and rotational diversity, on crop health, disease levels, productivity and quality in a cereal silage production system.

Reason for Project and Impact: Silage producers whether they are meeting on-farm needs or local market needs will often need to look at continuous cereal production, which leads to productivity issues related to diseases & perhaps weeds. Mixtures and intercropping research (especially mixtures in Lacombe) have been looked at, but typically only for a single year at a time, i.e. trial locations change each year. It would be unique to look at the impact of mixtures and intercropping on the same plot area for several years in a row.

Procedure: The experiment will be conducted over a three-year period at Lacombe and Lethbridge, AB and was started in 2008. Treatment combinations included the following: rotation/diversity treatments (three year rotation sequence):

1) Continuous Barley same variety each year - Sundre 3 years in a row
2) Continuous Barley different varieties each year – Year 1 Trochu (6 row), Year 2 McLeod (2 row), Year 3 Sundre (6 row)
3) Continuous production of a mixture of three barley varieties - same varieties each year – Year 1,2, and 3 Xena (2 row), Stockford (hooded), Sundre (6 row)
4) Continuous production of a mixture of three barley varieties - different varieties each year:
   - Year 1 Mcleod (2 row, rough awn), Dillon (hooded), Trochu (6 row, smooth awn);
   - Year 2 CDC Dolly (2 row, rough awn), AC Rosser (6 row, smooth awn), Vivar (6 row, rough awn);
   - Year 3 Xena (2 row), Stockford (hooded), Sundre (6 row)
5) Continuous production of an intercrop (barley, oat, and spring triticale) - same varieties each year – Year 1, 2, and 3 AC Mustang (oat), Bunker (Triticale), Sundre (Barley)
6) Continuous production of an intercrop (barley, oat, and spring triticale) - different varieties each year:
   - Year 1 AC Morgan (oat), Pronghorn (Triticale), Trochu;
   - Year 2 SW Betania (oat), AC Ultima (Triticale), McLeod;
   - Year 3 AC Mustang (oat), Bunker (Triticale), Sundre
7) Continuous production of an intercrop (barley, oat, and spring seeded winter triticale) - same varieties each year - Year 1, 2, and 3 AC Mustang (oat), Bobcat (Winter triticale), Sundre
8) Continuous production of an intercrop (barley, oat, and spring seeded winter triticale) - different varieties each year:
   - Year 1 AC Morgan (oat), Pika (winter triticale), Stockford
   - Year 2 SW Betania (oat), WT005 (winter triticale), Xena;
   - Year 3 AC Mustang (oat), Bobcat (Triticale), Sundre

Summary of Results:

Research sites were conducted at both AAFC Lacombe and Lethbridge with the third rotation year being done for the rotational diversity/mixture/intercropping disease management trial and the third repeat of the weed competition trial. Flooding at AAFC Lethbridge resulted in the disease management trial having to be reseeded in mid-summer with data collection well into the fall.

In 2010, scald development was limited on Sundre in all treatments at Lacombe and Lethbridge; Sundre has a very good level of resistance to scald, caused by *Rhynchosporium secalis*. However, low levels of scald were observed, especially at Lacombe perhaps suggesting that the scald pathogen is starting to adapt to the scald resistance in this variety. Higher levels of scald were observed on some of

the other barley varieties, especially at Lacombe. Very significant levels of net form net blotch developed on Sundre at Lacombe in 2010, with lower but still moderate levels at Lethbridge, while the severity of other leaf spots were generally low at both sites. Total leaf spot severity was computed from values for scald, net blotch, and other leaf spots and then analyzed. Overall, total leaf spot levels were significantly higher in continuous Sundre treatment compared with all other treatments at both locations, except at Lacombe for the flag leaf-2 samples where continuous Sundre was not significantly different from the continuous barley different varieties and continuous production of a mixture of the same barley varieties. The lowest levels of total leaf spots at Lacombe occurred for the continuous barley treatment with a mixture of varieties that changed each year or the intercropping treatment (either spring or winter triticale) where the varieties changed each year; all other treatments had intermediate and similar levels of total leaf disease. At Lethbridge the continuous Sundre treatment had the highest total leaf spot severity compared to all other treatments. The continuous barley different varieties each year treatment had the second highest level of total leaf spots, where levels were lower than the continuous Sundre treatment, but higher than the all remaining treatments. The remaining treatments at Lethbridge had similar disease levels.

Total disease severity was also averaged over all barley varieties in each plots and then analyzed. At Lacombe, average total leaf spot levels were significantly higher in continuous Sundre treatment compared with most other treatments, except the other continuous barley treatments. The lowest levels of total leaf spots at Lacombe occurred for the intercropping treatments (either spring or winter triticale) where the varieties changed each year; all other treatments had intermediate and somewhat similar levels of disease. At Lethbridge the continuous Sundre treatment and the continuous barley different variety treatment had the highest total leaf spot severity compared to all other treatments. The remaining treatments at Lethbridge had similar disease levels.

Crop biomass assessments were also taken and at Lacombe in 2010 and were significantly lower for the continuous Sundre treatment compared to all other treatments. The highest crop biomass yields tended to occur for the continuous intercrop with different or the same oat and triticale (spring and winter) varieties, while the remaining treatments had intermediate crop biomass levels. At Lethbridge no significant treatment effects for crop biomass occurred and this may be due to this site being reseeded in early July and this likely had a significant impact on crop growth prior to harvesting in the fall. Silage yields on a wet basis were significantly affected by the rotational/diversity treatments at both Lacombe and Lethbridge. At both sites in 2010 silage yields on a wet basis were significantly lower for the continuous Sundre treatment compared to most other treatments. The highest silage yields on a wet basis tended to occur for the continuous intercrop with different or the same oat and triticale (spring and winter) varieties, while the remaining treatments had intermediate crop biomass levels. Similar trends occurred for silage yields on a dry weight basis at Lacombe, while at Lethbridge differences were not significant at P=0.05 (P=0.08)

The influence of monocultures, rotational diversity, mixtures, and intercropping on weed competitiveness and crop productivity

Purpose:

To determine the compare and contrast the effects of monocultures, mixtures, intercropping and rotational diversity, on competitive ability with weeds, and crop productivity and quality in a cereal silage production system.

Reason for Project and Impact:

Enhancing crop health via mixtures or intercropping may also have implications for weed management. Different varieties or crops may occupy different ecological niches within the field and thus potentially compete with weeds in different ways. Spring seeded winter cereals may also provided enhanced weed management via a different plant architecture compared with spring cereals. Vegetative growth of spring seeded winter cereals may provide more shading of the soil surface as well as direct competition for emerging weeds.

Procedure:

Separate experiments will be conducted each year over a three-year period at Lacombe and Lethbridge, AB and were started in 2008. Treatment combinations included the following:

1) Single Barley variety - Sundre each year
2) Mixture of 3 barley varieties - Xena (2 row), Stockford (hooded), Sundre (6 row)
3) An intercrop of barley, oat, and spring triticale - AC Mustang (oat), Bunker (Triticale), Sundre (barley)
4) An intercrop of barley, oat, and spring seeded winter triticale- AC Mustang (oat), Bobcat (Triticale), Sundre (barley)

A model weed (volunteer canola) will be seeded just prior to seeding across all plots to assess the competitive ability of each of the treatments.

Summary of Results:

During the growing season the following data was collected: crop and model weed emergence counts; lodging, crop and model weed biomass, and silage yields. None of the treatments had an effect on crop or weed biomass, or wet or dry silage yields.

The impact of herbicide and fungicide timing on barley leaf disease severity and crop productivity

Purpose: To assess the impact and interaction of herbicide and fungicide application timings and fungicide rates on barley leaf disease levels, weed competition, and crop productivity.

Reason for Project and Impact: Barley malt and feed grain producers are increasingly looking at combination herbicide/fungicide applications at early crop growth stages and well before the flag leaf emergence stage. The main perceived advantage of this practice is in relation to convenience in relation to one pass weed and disease control. However, little scientific information exists regarding this practices, while some earlier research done at AAFC Lacombe/Beaverlodge/Melfort indicated that fungicide application should be delayed until the flag leaf emergence stage. The proposed research is unique as it will evaluate the practice of one pass weed and disease control in relation to effective economical weed and disease control and whether combination applications at an early crop growth stage compromise efforts related to disease management. Herbicide and fungicide application strategies for producers to maximize both weed and disease management will be developed.

Research Plan of Work: Locations: Lacombe, Scott, and Melfort

Model weed: A model weed (volunteer tame oat) will be seeded just prior to seeding across all plots to assess the competitive ability of each of the treatments. 100 seeds per m^2 of tame oat (AC Morgan) seeded before the barley AC Metcalfe is seeded

Fungicide/herbicide combinations 10):

1) Check no fungicide, herbicide applied at 2-3 leaf stage of crop
2) Check no fungicide, herbicide applied at 5-6 leaf stage of crop
3) Half rate fungicide at 2-3 leaf stage, tank mixed with herbicide (fungicide/herbicide combination applied at 2-3 leaf stage of crop)
4) Half rate fungicide at 5-6 leaf stage, tank mixed with herbicide (fungicide/herbicide combination applied at 5-6 leaf stage of crop)
5) Full rate fungicide at Flag leaf stage, only herbicide applied at 2-3 leaf stage of crop
6) Full rate fungicide at Flag leaf stage, only herbicide applied at 5-6 leaf stage of crop
7) Half rate fungicide and herbicide applied at 2-3 leaf stage of crop and full rate of fungicide at Flag leaf stage
8) Half rate fungicide and herbicide applied at 5-6 leaf stage of crop and full rate of fungicide at Flag leaf stage
9) Half rate fungicide and herbicide applied at 2-3 leaf stage of crop and half rate of fungicide at Flag leaf stage
10) Half rate fungicide and herbicide applied at 5-6 leaf stage of crop and half rate of fungicide at Flag leaf stage

Summary of Results: In 2010, penultimate leaf samples were collected for assessment of leaf disease severity, while weed biomass was also assessed. Plots were harvested and grain yield and kernel quality assessed. At each of the sites penultimate leaf disease severity was significantly higher for the 2-3 or 5-6 leaf stage no fungicide, herbicide only treatments and the combination herbicide and half rate fungicide

treatments at the 2-3 or 5-6 leaf stage compared to all other treatments. Yield and thousand kernel weight, plumpness and bushel weight tended to be highest for those treatments where the fungicide treatment included a flag leaf stage application. Thins were not affected by treatments at Lacombe and Melfort, while at Scott they tended to be lowest for those treatments where the fungicide treatment included a flag leaf stage application. Model weed biomass was very low and generally not influenced by the treatments due to effective herbicide applications at each of the sites. Preliminary results suggest that for malt barley, fungicide applications should include a flag leaf stage timing to ensure protection of upper canopy leaves, thus contributing to enhanced yield and grain filling. The experiment will continue for two more years with additional sites in 2011 and 2012.

Factors affecting net blotch and scald inoculum levels on stubble.

Purpose:

Determine the impact on stubble borne inoculum of barley leaf disease levels in the previous growing season as manipulated through variety resistance and fungicide, and to assess the disease response to a range of net blotch inoculum levels in varieties with different resistance levels.

Reason for Project and Impact:

This collaborative project with colleagues in Western Australia provides a unique assessment of the impact that variety resistance, variety rotation, and their interaction with fungicide application have on the inoculum potential and level of disease development from barley stubble. Little if any information exists regarding the interaction of these factors in relation to the inoculum producing ability of disease infested barley residues.

Procedure:

Locations: Lacombe

Seeding rate: Certified Xena and Busby seed at 150 seeds/m2

Variety(s): Xena (susceptible cultivar) and Busby (resistant cultivar)

Treatments: A combination of variety and fungicide set up over a 2 year time frame:

Treat.#	Var. 1st yr/Fungicide 1st yr	Var. 2nd yr/Fungicide 2nd yr
1	Xena/No	Xena/No
2	Xena/Yes	Xena/Yes
3	Xena/No	Xena/Yes
4	Xena/Yes	Xena/No
5	Busby/No	Busby/No
6	Busby/Yes	Busby/Yes
7	Busby/No	Busby/Yes
8	Busby/Yes	Busby/No
9	Xena/No	Busby/No
10	Xena/Yes	Busby/Yes
11	Xena/No	Busby/Yes
12	Xena/Yes	Busby/No
13	Busby/No	Xena/No
14	Busby/Yes	Xena/Yes
15	Busby/No	Xena/Yes
16	Busby/Yes	Xena/No

Experimental design: 16 treatment combinations set up as a RCBD with 3 factors (2 varieties, 2 fungicides, and four variety rotation sequences) with 4 replicates = 64 plots

Summary of Results:

The study presents a unique opportunity to look at the impact of variety resistance, variety rotation, and their interactions along with fungicide application on the inoculum potential of infested barley residues. Strategies for producers to limit the inoculum producing ability of disease infested barley residues, while improving crop health and crop competitiveness will be developed and these will also help to reduce input costs. 2010 was the establishment year with the test year being in 2011.

Effect of nitrogen rate on quality, yield and yield components of new malting barley varieties and management of nitrogen fertility/ nitrogen management in malting barley using optical sensors and split applications of nitrogen

Purpose:

To determine the quality, yield and yield component responses of several of the newer malting barley varieties to various rates of nitrogen, b) develop an algorithm to estimate yield potential in malting barley using optical sensor-based measurements and c) determine the nutrient use efficiency of the varieties.

To validate the application algorithms developed to date in malting barley using small plots in order to predict the best nitrogen rate possible to optimize malting barley quality and yield.

Reason for Project and Impact:

Preliminary research results from a malt barley project that was completed in 2009 indicate that the negative impact of nitrogen on modification and end-quality of CDC Copeland is less than that of AC Metcalfe. This suggests that malting barley varieties may vary in their response to nitrogen. Several new malting barley varieties are under development by various barley breeders in western Canada. Their relative responses to nitrogen are presently unknown and need to be assessed relative to established varieties such as AC Metcalfe. The results of the study will provide and enhanced knowledge and understanding of proper nitrogen management. This will provide producers with a novel approach to balancing the desire for maximum crop yield and meeting the malting quality targets of the malting and brewing industries. Possible outcomes include an enhanced ability of malting barley growers to fine tune the rate and timing of N application to optimize both malting barley yield and quality.

Procedure:

Locations: Two field experiments were conducted in Alberta, Saskatchewan and Manitoba, at 7 locations representing the different soil zones in western Canada: Lethbridge and Scott, SK (Dark Brown), Lacombe, AB and Brandon, MB (Black), Indian Head, SK (Thin Black) and Beaverlodge, AB and Fort Vermilion, AB (Grey Wooded).

Experiment 1. Effect of increasing nitrogen rates on yield and quality of several malting barley varieties

Treatments:

Variety – AC Metcalfe, Bentley, CDC Meredith, Norman, Merit line (5)

N rate – 0, 30, 60 90, 120 kg N/ha. (5)

Experiment 2. Nitrogen management in malting barley using optical sensors and split applications of nitrogen

Treatments:

1. Check plot - no nitrogen added
2. N Rich strip: Rate of N required to produce 2x the average rate for the area and adjusted for residual Nitrate N.
3. Farmer Practise rate: Based on residual N level and adjusted for soil moisture conditions at time of seeding, area, soil type and malting barley using the recommendations from the FARM PHASE II program in use by Enviro-Test Labs or any other program of choice.

4. Reduced N rate: 66% of rate used in Farmer Practise treatment and no further nitrogen applied.
5. 50% of Farmer Practise Rate at seeding and the balance 50% of N applied at the 5-6 leaf stage in cereals and mid-bolting stage in canola using UAN as a surface dribble.
6. 66% of Farmer Practise Rate at seeding and the balance 34% of N applied at the 5-6 leaf stage in cereals and mid-bolting stage in canola using UAN as a surface dribble.
7 50% of Farmer Practise Rate at seeding and the balance of the N applied using the application algorithm developed for the GreenSeeker optical sensor at the 5-6 leaf stage.
8. 66% of Farmer Practise Rate at seeding and the balance of the N applied using the application algorithm developed for the GreenSeeker optical sensor at the 5-6 leaf stage..

Summary of Results:

Previous research conducted by the team indicated that AC Metcalfe and CDC Copeland, the two most widely grown varieties in western Canada, responded differently to increasing nitrogen rates. At relatively high nitrogen rates, CDC Copeland accumulated less protein than AC Metcalfe, and as a consequence, modified better under relatively high nitrogen rates. Field experiments were conducted at 7 locations (Fort Vermilion, Beaverlodge, Lacombe and Lethbridge, AB; Scott and Indian Head, SK; Brandon, MB) across western Canada in 2010 to determine the response of 4 new barley varieties (Bentley, AC Major, CDC Meredith, Merit 57) to increasing rates of nitrogen fertilizer ranging from 0 to 120 kg/ha. AC Metcalfe, the most widely grown malting barley variety in western Canada, was included in the study as a standard. Unfortunately, the experiment at Lethbridge was discontinued for this year due to excessive spring rainfall and flooding of plots. Results to date indicate some variability among locations but some general trends were also evident. At most locations, all of the newer varieties produced higher seed yields (17% on average) than AC Metcalfe. As expected, grain yield increased with increasing nitrogen rates. There were also differences in protein concentration among the varieties. In general, Bentley, Merit 57 and Meredith had lower protein than AC Metcalfe or Major, and with all varieties, protein increased with increasing nitrogen rate. However, with the exception of Beaverlodge, the variety x nitrogen interaction was not significant. All varieties resulted in relatively plump seed (>80%) but Bentley, AC Metcalfe and Meredith tended to have the plumpest seed The results suggest that some of the new varieties are relatively high yielding and tolerate nitrogen fertilizer relatively well by limiting protein accumulation.

In 2010, a total of six field trials were conducted to examine the concept of optical sensors as a way to arrive at a more optimum rate of N. Positive results were obtained with the optical sensor at five of the six sites while a negative performance was observed at one of the sites. Overall, for the first year of the trial, positive results were observed with the use of the optical sensor.

Malting and malt quality analysis are presently underway for all experiments.

Effect of harvesting methods and seed source on quality and yield of malting barley

Purpose:

To assess the quality yield and yield component responses of malting barley to a) straight cutting compared to swathing with or without a delay in harvest date, and b) certified compared to bin-run seed from several locations.

Reason for Project and Impact:

Barley growers have the option to use seed previously grown themselves (bin-run seed) or alternatively, to purchase pedigree seed. The quality of bin-run seed may be more variable depending on the conditions under which it was grown. Similarly, growers have the option to lay the barley in a swath to promote drying or straight cut the barley. Barley lying in a swath for an extended period of time may be more prone to weathering and diseases thus impairing quality. Little is known on the impact of these factors on malting barley end-quality.

Procedures:

Harvest method and date experiment

Locations: Lacombe, Beaverlodge, Scott, Indian Head

Variety: AC Metcalfe

Treatments:

Treatment combination	Harvest method	Harvest date
1	Straight cut	Normal date combining
2	Swath then combine	Normal date for combining swath
3	Straight cut	2 weeks after normal date
4	Swath	Swath and then combine 2 weeks after normal date

Seed source experiment

Locations: Lacombe, Beaverlodge, Fort Vermilion, Scott, Indian Head, Brandon

Variety: AC Metcalfe

Treatments:

Treatment combination	Seed source	Source location
1	Certified	Red Deer
2	Certified	Three Hills
3	Certified	Camrose
4	Bin-run	Red Deer
5	Bin-run	Three Hills
6	Bin-run	Camrose

Summary of results:

Barley growers have the option to use seed previously grown themselves (bin-run seed) or alternatively, to purchase pedigree seed. The quality of bin-run seed may be more variable depending on the conditions under which it was grown. Similarly, growers have the option to lay the barley in a swath to promote drying

or straight cut the barley. Barley lying in a swath for an extended period of time may be more prone to weathering and diseases thus impairing quality. Little is known on the impact of these factors on malting barley end-quality. Preliminary results suggest that straight cut harvesting, especially if done in a timely fashion may provide enhanced yield and higher TKW and test weight, while producers swathing their malt barley crop should harvest as soon as the crop is ready to avoid negative impacts on yield and kernel characteristics. Overall, the only agronomic parameter that appeared to be consistently affected by seed source (bin-run versus certified) was emergence, suggesting that malt barley producers can expect better stand establishment with certified seed. Improved stand establishment will help to ensure a competitive crop, while the use of certified seed will also ensure the level of varietal purity required by malt and brewing companies. Higher plant populations per unit area were observed with certified seed may help to improve malt quality based on improvements in quality observed with higher seeding rates in the first phase of our collaborative malt barley research.

Malting and malt quality analysis are presently underway for all experiments.

Net blotch: variability in relation to virulence, resistance and fungicide sensitivity

Purpose:

To conduct a prairie-wide assessment of the current status of the pathogens that cause netted and spotted net blotch of barley to determine:

1. their variability in pathogenicity, virulence, and molecular characteristics (e.g. form, asexual versus sexual reproduction, mating type, recombination);
2. their ability to overcome currently-used sources of resistance;
3. the occurrence of variation in the sensitivity of representative pathogen forms and isolates to the fungicides registered to manage net blotch.

Reason for Project and Impact:

Knowledge of the relative frequency and distribution of net form net blotch (NNB) and spot form net blotch (SNB) is limited; moreover we have limited up-to-date knowledge of the virulence and genetic structure present in these pathogen populations. The last comprehensive assessment of the *P. teres* population was done in the 1980's when Tekauz documented extensive variability in western Canada, including the presence of isolates virulent on several established sources of resistance (Tekauz 1990). The proposed work is innovative and unique as the virulence aspects of the work have not been done since the 1970's and 1980's, while dramatic changes in varieties have occurred over the last 25 years. In addition, the nature and diversity of the net blotch pathogen in western Canada has not been studied using modern molecular and population genetic techniques. Information related to the population genetic structure, the extent of asexual versus sexual reproduction, and the occurrence of mating types and forms in western Canada would be unique.

Knowledge regarding population genetic structure, the extent of asexual versus sexual reproduction, the occurrence of mating types and forms will be critical to predict the evolutionary potential of the net blotch pathogen and thus the longevity of resistance in existing and future cultivars. Moreover, this research ensures that plant pathologists and collaborating breeders are screening germplasm and breeding lines against the most prevalent and/or virulent pathogen races present in western Canada. An understanding of the extent of pathogen race variation will also lead to the more effective identification, utilization and management of future and current sources of resistance.

Concerns regarding fungicide resistance in western Canada have been increasing with the discovery of reduced sensitivity in *Sclerotinia sclerotiorum*, the causal agent of stem rot of canola, and in *Ascochyta rabiei*, the causal agent of ascochyta blight in chickpeas (Gossen et al. 2001; Chang et al. 2007). Within the last few years the cost of one of the main foliar fungicides Tilt® (a.i. propiconazole) and a range of generic alternatives used for net blotch in barley has dropped substantially. Reduced fungicide cost coupled with product promotion has led to increased interest in using fungicides to limit net blotch. As such, routine use of fungicides could increase the risk of pesticide resistance developing in *P. teres*, especially where producers routinely use fungicides. Baseline knowledge on variability in fungicide sensitivity of the net blotch pathogen population can be coupled with a better understanding of population genetic structure and the extent of asexual versus sexual reproduction in the net blotch pathogen. As a consequence the barley industry in western Canada will have a better understanding of baseline fungicide sensitivities and the potential for the net blotch pathogen to adapt to routine fungicide use and thus the need for a proactive approach to maintain the effectiveness of current and future fungicides for net blotch.

Procedure:

Barley fields across western Canada will be monitored for net blotch, and representative infected leaf samples collected and used to isolate single-spore cultures of *P. teres*. The relative pathogenicity/virulence of approximately 200-400 isolates obtained from AB, SK and MB, will be evaluated and compared using a differential set of resistant and susceptible barley cultivars/lines. Host reactions will be classified according to Tekauz (1985) and isolates grouped into pathotypes (Tekauz 1990). Isolates will be classified as *P. teres* f. *teres* (causal agent of NNB) and *P. teres* f. *maculata* (causal agent of SNB) based on host reactions and/or PCR-testing to determine the virulence in these two forms of the pathogen, and their relative regional frequency.

Genetic variation in the pathogen will be analyzed using amplified fragment length polymorphisms (AFLPs), which are useful in distinguishing between closely related isolates and can also be used to determine if disease spread from field to field is due to asexual or sexual propagules. Evaluation of fungicide sensitivities will be conducted to examine any differences between pathogen isolates derived from a wide geographic area, and those isolated from resistant or susceptible barley cultivars. Fungicide sensitivities will be assessed using a microtitre plate procedure or by growing fungal strains in Petri dishes on fungicide-amended agar. Furthermore, known and other potential sources of genetic resistance to net blotch will be identified from national and international germplasm collections and evaluated against the representative pathotypes identified. Standard experimental designs (CRD, RCBD, etc.) will be used for replicated laboratory, greenhouse and growth chamber experiments.

Summary of Results:

Barley leaf samples were collected from a total of 72 fields over all three prairie provinces. Samples were processed by AAFC Lacombe to ensure single-spore isolates will be ready for the Ph.D. student to conduct further virulence and molecular testing. Technicians at AAFC Lacombe are in the process of isolating from single leaves from each of these 72 sites to produce approximately 72 single-spored isolates where five cryovials are produced for each of the 72 isolates. Within each cryovial are a total of 15 agar plugs colonized with a single-spore isolate and these are frozen at -80C or under liquid N for storage. In addition, stratified sampling of leaves is underway for approximately 10 fields chosen at random. From single leaves and lesions single spore-isolates are being derived from five spores taken randomly from the same lesion on the same leaf. Single-spore isolates are also being derived from individual spores from five separate and distinct lesions on the same leaf. Finally, if enough leaves from individual sites are available, individual spores will be derived from single lesions on five separate leaves from the same field. In total, we anticipate having approximately 150-200 single spore isolates from 2010 with five cryovials for each isolate with 15 agar/culture plugs within each vial. For the summer of 2011 we intend on doing more intensive stratified leaf sampling within individual fields, in addition to our normal sampling plans. A Ph.D. student started on the project at the University of Alberta in January 2011.

VARIETY DESCRIPTIONS

The varieties described here were registered for sale as seed in western Canada as of the spring of 2009 and, except for new varieties, were grown commercially in Alberta up to this date. Varietal descriptions are not complete, but strengths and weaknesses are outlined, and an attempt is made to indicate why each variety may be useful in Alberta.

Additional varietal information is available on the Alberta Agriculture and Rural Development website *Ropin' the Web':* www.agric.gov.ab.ca (Select the tab "Decision Making Tools"; under General, select "Variety Yield and Performance Data"; then select "Cereals"; and then select barley type.)

For information on seed distributors refer to the *Alberta Seed Guide* on the website *'seed.ab.ca'*

Barley Varieties

Six-row General Purpose Varieties

AC Harper was developed by Agriculture and Agri-Food Canada, Lethbridge, and registered in 1996. It yields similar to AC Lacombe with better lodging resistance. AC Harper is shorter than AC Lacombe with similar test weight and kernel weight. It has intermediate resistance to scald, spot form of net blotch, common root rot and surface smuts. However, it matures two days later than AC Lacombe and is susceptible to septoria and loose smut.

AC Lacombe was developed by Agriculture Canada, Lacombe and registered in 1991. It is adapted to the black and grey wooded soils of Alberta with its good lodging resistance, good test weight and kernel weight. Good resistance to the surface-borne smuts, intermediate resistance to scald and net blotch. It is susceptible to common root rot, speckled leaf blotch, and loose smut. AC Lacombe is acknowledged as a leading silage variety.

AC Rosser was developed by Agriculture and Agri-Food Canada, Brandon, registered in 1996 and distributed by SeCan. It yields slightly higher and has slightly poorer lodging resistance than AC Lacombe. It matures two days later than AC Lacombe. AC Rosser has resistance to the surface-borne smuts and intermediate resistance to common root rot and net blotch. It is susceptible to scald, septoria and loose smut.

Chigwell (tested as BT577) was developed by the Field Crop Development Centre and supported for registration in 2008. This six-row, smooth-awned, hulled barley has good yield potential for grain and silage, similar to Vivar. It has good lodging resistance. It has excellent percent plump, with higher digestible energy (swine) and starch content than Vivar and AC Lacombe. It is resistant to the surface-borne smuts. It is moderately resistant to scald, spot blotch and net blotch (spot and net forms). It is susceptible to common root rot.

Manny was developed by Field Crop Development Centre, Lacombe and registered in 2003. It is a rough-awned feed barley with 4 to 9% higher yield than AC Lacombe. It is a strong strawed variety with 7% higher silage yields than AC Lacombe in central Alberta. Its seed size is smaller than AC Lacombe and it may not yield as well under low yielding conditions. However, in droughted conditions Manny has consistently shown superior ability to maintain yield. It has resistance to scald (field), and the surface-borne smuts. It has intermediate (fair) resistance to loose smut, and net blotch (spot form); susceptible to common root rot.

Stander was developed by the University of Minnesota/Agricore and registered in 1996 for malt but is now only grown for feed, primarily as a forage barley. It out-yields the malting checks by 8% and has good straw strength. It has intermediate resistance to common root rot. Susceptible to loose smut, surface-borne smuts, scald, net blotch and septoria.

Sundre was developed by the Field Crop Development Centre, Lacombe and registered in 2005. Sundre is distributed by Mastin Seeds Ltd. It is a 6-row, smooth-awned feed barley with high grain and silage yields in central Alberta, and with good kernel weight and seed plumpness. In FCDC silage trials, Sundre outyielded the high yielding six-rowed varieties Vivar and AC Lacombe. These characteristics make it a desirable multi-purpose variety for the livestock industry. Sundre has multiple gene resistance to scald, as shown in multi-station, multi-year trials. It has resistance to covered smut and false loose smut.

Trochu was developed by the Field Crop Development Centre, Lacombe and registered in 2000. This smooth-awned feed barley has high

percent plump, test weight and kernel weight. It is higher yielding than AC Lacombe. The high percent plump kernels facilitate even processing for cattle feed resulting in increased feed efficiency. Lodging resistance is similar to AC Lacombe. It is resistant to the surface-borne smuts and common root rot. It is susceptible to loose smut.

Six-row General Purpose Semi-Dwarf Varieties

BT584 (name pending) is a six-row, smooth-awned, hulled, general purpose barley developed by Alberta Agriculture at the Field Crop Development Centre, Lacombe, and registered in 2011. It's a semi-dwarf barley with strong straw, smut resistance and intermediate maturity traits equal to or better than Vivar. BT584 has stable grain yield and is well-adapted to western Canada. It has better than average combination of disease resistance package of spot blotch, scald and stem rust. It has good lodging resistance and quality traits similar to Vivar.

Kasota is an early maturing, high yielding semi-dwarf feed barley developed by Alberta Agriculture at Lacombe and registered in 1994. Its average yields are on par with the top mid-season to late-maturing feed barleys, while it matures 2 to 6 days earlier. It has very good straw strength, and is resistant to scald and the surface-borne smuts. Its test weight is high for a six-row.

Mahigan was developed by Alberta Agriculture in Lacombe and registered in 1998. It has 2% to 5% higher yield and a higher test weight than Kasota. It is equal to Kasota in scald resistance. It has a semi-smooth awn and is taller than Kasota. Mahigan has intermediate resistance to net blotch. It is one day later in maturity than Kasota.

Vivar was developed by Alberta Agriculture, Lacombe and registered in 2000. It is higher yielding than all check varieties (AC Lacombe, CDC Earl) with high test weight, percent plump and kernel weight. Its maturity is equal to AC Lacombe (medium). It has good lodging resistance. Vivar has rough awns. It has intermediate reaction in the field to scald, net blotch and loose smut. It is resistant to the surface-borne smuts and common root rot. Vivar has excellent ability to respond positively under high yielding conditions.

Two-row General Purpose Varieties

Busby (tested as TR06673) was developed by the Field Crop Development Centre and supported for registration in 2008. This two-row hulled barley has similar silage yields to Seebe, with 10% higher grain yields, 4 days earlier maturity, similar height and higher test weights and percent plumps. In comparison to Xena, its test weight, kernel weight, and percent plump are similar to Xena, while its digestible energy content (swine) and starch content are higher. This line has similar disease reactions as Seebe with the same excellent resistance to scald, the surface-borne smuts, and stripe rust, and susceptibility to common root rot and loose smut. It has better resistance to the spot form of net blotch than Seebe.

CDC Austenson (tested as TR06389) was developed at the Crop Development Centre, Saskatoon and registered in 2008. It has excellent straw strength and lodging resistance. Excellent yield potential and high test weight. It is resistant to the surface-borne smuts, Rpg1 stem rust, and spot form of net blotch. It is moderately resistant to spot blotch and FHB with moderately low DON levels. It is moderately susceptible to the net from of net blotch. It is susceptible to scald and loose smut.

CDC Coalition (tested as TR 03373) was developed at the Crop Development Centre, Saskatoon and registered in 2006. It has excellent straw strength and lodging resistance. Good yield potential, and high test weight. It is resistant to loose and false loose smut and Rpg1 stem rust, moderate resistance to covered smut. Moderately susceptible to net blotch and spot blotch, susceptible to septoria and scald.

CDC Helgason was developed at the Crop Development Centre, Saskatoon and registered in 2000. It has high yield (1% to 7% over CDC Dolly), strong straw, large plump grain, and high test weight. Maturity is equal to slightly earlier than CDC Dolly. Resistant to loose smut and the surface-borne smuts. Intermediate resistance to common root rot and net blotch. It has improved spot blotch rating. It is susceptible to scald.

CDC Mindon (tested as TR04378) was developed by the Crop Development Centre, Saskatoon and registered in 2007. CDC Mindon has superior FHB resistance and reduced DON levels when infected. Resistant to the smuts, stem rust and net blotch but susceptible to scald.

Champion (tested as TR04719) was developed by Westbred LLC, Bozeman, Montana and registered in 2007. It has excellent grain yields with high percent plump and test weight. It is resistant to the surface-borne smuts and spot form of spot blotch. It is moderately resistant to FHB with moderately low DON levels. It is moderately susceptible to stem rust and susceptible to scald, loose smut and net form of net blotch.

Conlon (tested as TR982) was developed by North Dakota State University as a malting type and registered in 2005 in Canada as a feed type. It is an early maturing variety with good lodging resistance and high test weight, kernel weight and percent plump. It has resistance to common root rot, FHB and stem rust but is susceptible to scald, spot blotch and covered and false loose smut.

Gadsby (TR08684) was supported for registration in 2010 and comes from the FCDC's two–row breeding program of Dr. Pat Juskiw. While taller than Xena, it has similar straw strength. It has a rough awn and is well-adapted to the Brown and Black and Grey Soil zones of western Canada. Its grain yield is 113% of Seebe and biomass yields 110% of Seebe. It heads and matures 2 days later than Xena but 2 days earlier than Seebe. This line has plumper, heavier kernels than Xena, with lower fibre and higher digestible energy content. It has resistance to the covered and loose smuts and scald, and moderate resistance to the spot form of net blotch. It has a moderately resistant / moderately susceptible reaction to common root rot, fusarium head blight and stem rust. It is susceptible to the net form of net blotch and spot blotch.

McLeod was developed by Western Plant Breeders in Bozeman, Montana and Agricore United, Calgary and registered in 2003. This 2-row feed combines high yield with good straw strength and test weight. Yields were 9% higher than the checks in Coop testing. Maturity is about one day later than checks. It is resistant to the surface-borne smuts. Intermediate resistance to common root rot and the spot form of net blotch. It is susceptible to scald, septoria, and net form of net blotch.

Niobe was developed by Field Crop Development Centre, Lacombe and registered in 2002. It has resistance to the surface-borne smuts. Intermediate resistance to loose smut, common root rot, net blotch, and scald. Niobe has improved lodging resistance and is higher yielding than CDC Dolly when grown in high yield areas. It is slightly earlier maturing than CDC Dolly. Like CDC Dolly, it has low resistance to septoria and spot blotch. It has lower percent plump kernels than CDC Dolly.

Ponoka was developed at the Field Crop Development Centre, Lacombe and registered in 2003. It has resistance to loose smut, covered smut and false loose smut. Intermediate resistance to scald (field), net blotch (spot form) and common root rot. Field resistance to net (net form) and spot blotch similar to or better than the checks. Silage yields are higher than AC Lacombe (the most common silage variety in Alberta) and higher grain yields than CDC Dolly. Yield of Ponoka is approximately 8% higher yielding overall, with yield 10% higher in the black and 12% higher in black/grey soil zones than CDC Dolly. Maturity 3 days later than CDC Dolly and lodging is similar to CDC Dolly and Harrington. Kernel weight lighter than CDC Dolly but heavier than Harrington. High plump. FHB reaction is fair, with DON levels similar to the checks.

Seebe was developed by the Field Crop Development Centre, Lacombe and registered in 1992. It is adapted to the high scald areas of Alberta. Its scald resistance is superior to all registered two-row varieties and equal to the best six-row varieties. In high scald areas it is higher yielding than Bridge. Maturity is 3 - 4 days later than Bridge in areas of high scald where the scald has hastened the maturity of more susceptible lines. Outstanding forage yields.

Xena was developed by Western Plant Breeders in Montana and registered for Canada by Agricore in 1999. It is high yielding (5% to 10% over CDC Dolly), has good lodging resistance, and high percent plump grain. It is one day later maturing and has slightly lower test weight than CDC Dolly. It has resistance to common root rot. Intermediate resistance to the surface-borne smuts. Susceptible to loose smut, scald, and net blotch.

Two-row General Purpose Semi-Dwarf Varieties

CDC Bold was developed by the Crop Development Centre, Saskatoon and registered in 1999. It has high yield potential, short strong straw, large plump grain with high test weight. It is resistant to the surface-borne smuts. It has moderate resistance to scald, the spot-form of net blotch and common root rot. It is susceptible to loose smut, and the net-form of net blotch.

CDC Thompson was developed by the Crop Development Centre, Saskatoon and given interim registration in 1994 and full registration as a feed (initially a malt) in 1999. This strong straw semi-dwarf has good yield only in high productivity

conditions; it has moderate scald resistance. Low yielding in stress environments.

Six-row Varieties Eligible for Malting Grades

Status according to the list of 'Recommended Malting Barley Varieties 2010-2011 published by the Canadian Malting Barley Technical Centre (CMBTC) is indicated.

CDC Clyde was developed at the University of Saskatchewan and recommended for registration in 2004. Yield is 2% higher overall compared to CDC Sisler, and 5% higher in Brown and 7% in Grey soil zones of western Canada. Strong, short-strawed variety. Maturity is similar to Excel. Good malting quality with low protein content. Moderately resistant to stem rust, spot form of net blotch, spot blotch and common root rot. Moderately susceptible to scald and barley yellow dwarf. Moderately resistant/moderately susceptible to net form of net blotch. Under market development.

CDC Kamsack was developed by the University of Saskatchewan and registered in 2008. This variety has good barley plumpness, kernel weight and protein levels. It also has high malt extract and friability levels, along with low wort beta-glucan. It is resistant to the surface-borne smuts and moderately resistant to the spot-form of net blotch. It is susceptible to scald and loose smut. It is undergoing market development.

CDC Laurence (tested as BT493) was developed by the University of Saskatchewan, Saskatoon and registered in 2006. It has good grain weight and plumpness with low malt protein and beta-glucan. It is susceptible to scald and FHB. It has moderated resistance to net blotch, stem rust, and the smuts. It is undergoing market development.

CDC Mayfair was developed by the University of Saskatchewan, Saskatoon and registered in 2008. It has exhibited good barley plumpness, barley protein, and good malt friability. It has good straw strength, grain plumpness and kernel weights. It yields about 6% lower than the feed checks, but 4 % higher than the malting checks. It is resistant to the surface-borne smuts. It is susceptible to the net-form of net blotch and FHB. It is undergoing market development.

Celebration was developed by Busch Agricultural Resources and registered in 2010. It is a six-rowed white aleurone malting barley. It has similar yields to Legacy. It is shorter and has better lodging resistance than Legacy. Plumpness levels were significantly higher than the checks in coop testing, but only similar to the checks in collaborative testing. Protein levels tended to be lower than the checks. Malt extract were on average higher than the checks, while soluble protein levels were similar. Beta-glucan and viscosity levels were lower than the checks. Diastatic power and alpha amylase were overall similar to the checks levels. This variety is resistant to covered, false loose and loose smuts and has moderate resistance to the spot form of net blotch and spot blotch. It is susceptible to the net form of net blotch and scald. Celebration is undergoing market development.

Legacy was developed by Agricore/Busch Agricultural Resources and registered in 2001. It has better yield, percent plump, and lower protein than B1602 and CDC Sisler. Good malt quality. It has resistance to stem rust, surface-borne smuts, and common root rot. Intermediate resistance to loose smut and net blotch (spot form). It is susceptible to scald, septoria, and net form of net blotch. CMBTC recommended malting variety, with declining demand.

Stellar-ND was developed by Busch Agricultural Resources and North Dakota State University and registered in 2010. It is a six-rowed white aleurone malting barley. It has similar yields to Legacy. Its plumpness levels were higher than the checks in first year Coops, but similar to checks in all other testing. Protein levels were similar to the checks, malt extract levels were higher than the checks, and soluble protein levels tended lower than the checks in Coop testing , but higher in Collaborative tests. Beta-glucan levels were lower as well as alpha amylase. Diastatic power levels were similar to Legacy but lower than Tradition. It is resistant to covered and false loose smut and moderately resistant to loose smut and spot blotch. Stellar-ND is susceptible to net blotch (net form) and scald, and moderately susceptible to common root rot. Stellar-ND is a recommended malting barley with limited but growing market share.

Tradition was developed by Agricore United and Busch Agricultural Resources and is distributed by Agricore United. Tradition received interim registration in 2002. It is a 6-row white aleurone malt barley with good yield, good percent plump, high quality, improved lodging resistance, and test weight comparable to CDC Sisler. It has resistance to stem rust, spot form of net blotch, surface-borne smuts, and common root rot. It is susceptible to scald, septoria, loose smut, and the net form of net blotch. CMBTC recommended malting variety, with declining demand.

Two-row Varieties Eligible for Malting Grades

Status according to the list of 'Recommended Malting Barley Varieties 2010-11 published by the Canadian Malting Barley Technical Centre (CMBTC) is indicated.

AC Metcalfe was developed by Agriculture and Agri-Food Canada, Brandon, given interim registration in 1994, and full registration in 1999. It yields 7% more than Harrington and is 1 day later than Harrington. It is resistant to loose smut, moderately resistant to the spot form of net blotch, the surface-borne smuts and common root rot. It is susceptible to scald and septoria. It has plump kernels, high test weight and excellent malt quality. CMBTC recommended malting variety.

Bentley (tested as TR05669) was developed by Field Crop Development Centre and supported for registration in 2008. This two-row hulled barley combines malting quality with excellent yield potential across western Canada for grain and silage. Its silage yields in the Coop trials were 108% of Virden. This line has good barley plumpness, kernel weight, and barley protein. It has reasonable extract, protein modification, and friability. It has good lodging resistance and similar maturity to AC Metcalfe. This line has excellent resistance to the spot form of net blotch, and moderate resistance to spot blotch and the surface-borne smuts. It has a moderately susceptible to resistant reaction to common root rot. It is moderately susceptible to loose smut and the net form of net blotch. It is susceptible to scald. This line is under market development.

CDC Copeland was developed by the University of Saskatchewan, Saskatoon, and registered in 1999. It is better yielding than Harrington. CDC Copeland has good kernel plumpness and weight. It is 2 days later in maturity than Harrington. It has intermediate resistance to the surface-borne smuts, net blotch and common root rot. It is susceptible to loose smut, septoria and scald. CMBTC recommended malting variety.

CDC Kendall was developed by the University of Saskatchewan, Saskatoon, and given interim registration in 1995 and full registration in 1999. Its maturity is equal to Harrington. It has 6% higher yield than Harrington. CDC Kendall has high test weight. It has intermediate resistance to common root rot and net blotch. It is susceptible to scald, septoria and the smuts. CDC Kendall is a CMBTC recommended malting variety.

CDC Landis was developed by the University of Saskatchewan, Saskatoon, and registered in 2008. It is a two-rowed hulled malting barley with good adaptability across western Canada, demonstrating good agronomic performance combined with greater yield potential than all malting checks, approximately 5% higher than AC Metcalfe, and good straw strength. It is resistant to non-QCC races of stem rust and the spot form of net blotch. It is moderately resistant to the surface-borne smuts and FHB. It is susceptible to scald. This variety is undergoing market development.

CDC Meredith was developed by the University of Saskatchewan, Saskatoon, and registered in 2008. It is a two-rowed hulled malting barley. It has superior grain yields (13% over AC Metcalfe, similar to the feed check Xena). It has high kernel weight and low protein. It is resistant to loose smut and has moderate resistance to the surface-borne smuts and FHB. It is susceptible to scald, spot blotch and the net form of net blotch. This variety is undergoing market development.

CDC Polarstar was developed by the University of Saskatchewan, Saskatoon, and Sapporo Breweries, Japan and was granted interim registration in 2008. It has a malting profile similar to CDC Kendall. It has good levels of plumpness, friability, and high levels of diastatic power and alpha amylase. It yields similar to AC Metcalfe. It is resistant to the surface-borne smuts, and has moderate resistance to FHB and spot-form of net blotch. It is susceptible to the net-form of net blotch, stem rust, scald, and loose smut. It is undergoing market development.

CDC Reserve was developed by the University of Saskatchewan, Saskatoon, and Sapporo Breweries, Japan. This variety combines good malting quality and a good level of pre-harvest sprouting resistance. It yields about 7% higher than AC Metcalfe. It is resistant to the spot form of net blotch. It is susceptible to the net form of net blotch, scald, and stem rust. This variety is undergoing market development.

Cerveza was supported for registration in 2009 and comes from the AAFC Brandon Research Centre's two–row breeding program of Dr. Bill Legge. While shorter than AC Metcalfe, it has similar straw strength. It heads and matures one day later than AC Metcalfe. It is about 9% higher yielding than AC Metcalfe. This line has good kernel weight, lower protein levels and higher extract than AC Metcalfe. It has resistance to the covered and loose smuts and moderate

resistance to the spot form of net blotch, fusarium head blight and spot blotch. It has a moderately resistant / moderately susceptible reaction to common root rot and stem rust. It is susceptible to the net form of net blotch and scald. This variety is undergoing market development by the Canadian Brewing and Malting Barley Centre.

Major (TR06297) was developed by Agriculture and Agric-Food Canada, Brandon Research Centre, and registered in 2009. It is a two-rowed malting barley with 9% higher yielding than AC Metcalfe over 2 years of coop testing. It has shorter, stronger straw and heavier, plumper kernels than AC Metcalfe combined with similar days to heading and maturity. Its plumpness and barley protein levels were similar to slightly higher than the checks. Malt extract levels were similar to the checks in coop testing, but were slightly lower than the checks in collaborative testing. Soluble protein and beta-glucan levels were on average slightly higher than the checks. Levels of diastatic power and alpha amylase were similar to AC Metcalfe and higher than CDC Copeland. Peeling levels were only slightly higher than CDC Copeland. It is resistant to the spot form of net blotch and loose smut, and moderately resistant to the surface-born smuts and spot blotch. It is susceptible to scald. Major is under market development.

Merit 57 was developed by Busch Agri-Resources-LLC and registered in 2008. It has exhibited higher levels of extract and alpha amylase, with good levels of diastatic power, friability, and protein modification. Barley protein levels averaged lower than the checks. It has 10% higher grain yields than AC Metcalfe. It has resistance to the spot form of net blotch and moderate resistance to common root rot. It is susceptible to loose smut. Merit 57 has an intermediate level of resistance to scald, the surface-borne smuts and stem rust. Merit 57 is undergoing market development.

Newdale was developed by Agriculture & Agri-Food Canada, Brandon and registered in 2001. It has higher yield (24% over Harrington), higher test weight, kernel weight, plumpness and stronger straw than Harrington. Good malt quality. Intermediate resistance to spot blotch and net blotch. It has resistance to stem rust (old races), common root rot, and surface-borne smuts. However, it is susceptible to loose smut, scald, septoria and stem rust race QCCJ. Newdale is a CMBTC recommended malting variety, with limited market demand.

Norman was developed by Agriculture and Agri-Food Canada and the University of Saskatchewan and registered in 2008. It has slightly improved (Higher) alpha amylase and lower beta-glucans of the wort. Its grain yields are similar to CDC Kendall and AC Metcalfe. Norman has moderate resistance to the spot-form of net blotch and FHB. However, its DON levels were 25 to 30% lower than CDC Kendall. It is susceptible to the surface-borne smuts, loose smut, stem rust, spot blotch and scald. Norman is undergoing market development.

TR05671 was developed by Field Crop Development Centre and supported for Interim registration in 2008. This two-row hulled barley has extra-low diastatic power combined with other acceptable malting traits that make is a desirable malting package for the craft brewing market. This line has higher kernel weight and good barley protein, with extract and protein modification levels similar to check values. It has good lodging resistance and matures about one day later than AC Metcalfe. This line has excellent resistance to the surface-borne smuts, and moderate resistance to the spot-form of net blotch. It has a moderately susceptible to resistant reaction to common root rot and scald. It is susceptible to the net-form of net blotch, spot blotch and loose smut. This line is no longer under market development.

Six-row Hulless Barley Varieties

AC Bacon was developed at Agriculture and Agri-Food Canada, Brandon, and registered in 1998. It yields 10% higher in the western black soils, 18% higher in the eastern black soils, 17% higher in the grey-wooded soils than Falcon. It has intermediate resistance to scald, surface-borne smuts and common root rot. It is resistant to septoria. However, it is susceptible to net blotch, loose smut, and has medium hull retention.

Falcon was developed by Alberta Agriculture at Lacombe and registered in 1992. It is a six-row hulless semi-dwarf. Its area of adaptation is the high scald and lodging areas of central Alberta. Falcon has excellent lodging resistance. It has intermediate resistance to scald, net blotch and common root rot. It has good resistance to surface-borne smuts. Susceptible to loose smut. Feed tests indicate high digestible energy and digestible protein for hogs. Falcon has good feed value as a silage.

Tyto was developed by Field Crop Development Centre, Lacombe and registered in 2002. It is a semi-dwarf with strong straw. Tyto has

intermediate resistance to scald, net blotch, and common root rot. It has resistance to surface-borne smuts, stem rust and septoria. Tyto has higher grain yield, and higher silage yield than Falcon, with good seed weight and test weight.

Two-row Hulless Barley Varieties

CDC Lophy-I (HB379) was developed by Crop Development Centre, Saskatoon and registered in 2007. This line has 75% lower phytate than regular barley. Lophy-I has resistance to loose smut, FHB (DON), and covered smut. It is susceptible to scald. Its test weight is similar to six-row hulless types.

CDC Carter was developed by the Crop Development Centre, Saskatoon and registered in 2008. It has exhibited grain yield similar to CDC McGwire, good dirty and clean test weights, similar kernel weight, plumpness, protein, beta-glucan, and acid extract viscosity. It is resistant to the surface-borne smuts and loose smut and has moderate resistance to the spot form of net blotch. It has an intermediate reaction to the net-form of net blotch, stem rust, spot blotch and FHB. It is susceptible to common root rot and scald.

CDC McGwire was developed by the Crop Development Centre, Saskatoon and registered in 1999. It has high yield potential, very good threshability, resistance to net blotch and stem rust race MCC, moderate resistance to scald, spot blotch, false loose and covered smut. It is susceptible to loose smut and stem rust race QCC.

Forage Barley Varieties

AC Ranger was developed by Agriculture & Agri-Food Canada, Brandon and registered in 2000. This smooth awned, six-row, hulled barley has a high forage yield and quality, good lodging resistance and grain yield, moderate resistance to net blotch, and resistance to non-QCC stem rust. Its maturity is later than AC Lacombe. It is susceptible to scald, septoria, and QCC races of stem rust.

Binscarth (FB006) was developed by AAFC, Brandon and registered in 2006. It is a six-rowed hulled barley. Binscarth has 3% higher forage yields than Virden, and better forage quality. It has slightly lower DON levels than the other FHB susceptible six-row check cultivars. It is resistant to covered smut. It is moderately susceptible to net blotch and spot blotch, and susceptible to scald and loose smut.

CDC Cowboy (tested as FB 201) was developed by the Crop Development Centre, Saskatoon and recommended for registration in 2004. It is a two-rowed, hulled variety. It has high forage dry matter yield potential in non-scald areas, plump grain with high test weight and kernel weight. Fair lodging resistance. It is resistant to stem rust, covered and false loose smuts. Moderately resistant to net blotch. Susceptible to spot blotch, barley yellow dwarf, and loose smut.

Desperado was developed by AAFC, Brandon, and registered in 2007. It is a six-rowed, smooth-awned, hulled variety. It has high biomass yields and grain yield similar to AC Ranger. It has better test weight than AC Ranger. It has resistance to the surface-borne smuts and the non-QCC races of stem rust. It has moderate resistance to common root rot and the spot form of net blotch. It is susceptible to the net form of net blotch and scald.

Dillon was developed by Westbred Plant Breeders, Bozeman, Montana and registered in 2000. This six-rowed, hooded barley (no awns) has a high forage yield for silage or green feed, good lodging resistance, and relatively good feed value. It is moderately susceptible to net blotch and spot blotch with a grain yield lower than AC Lacombe.

Stockford was developed by Westbred Plant Breeders, Montana and Agricore United and was registered in 2004. It is a two-rowed, hooded forage barley that has improved forage quality and dry matter yield in comparison to the hooded check Westford. It has resistance to true loose smut, surface borne sumts and moderate resistance to common root rot and spot blotch.

Westford was developed by Westbred Plant Breeders, Bozeman, Montana and registered in 2000. This hooded barley (no awns) has good straw strength (equal to AC Lacombe), high forage yield for silage and green feed. It is moderately susceptible to net blotch and spot blotch. The relative feed value is lower than AC Lacombe or Duke, but higher than Virden, and has a low grain yield.

Specialty Use Hulless Barley Varieties

This category includes specialty hulless barley varieties that have a high waxy starch content and are intended for the human food market and therefore should not be grown for the feed market. It also includes high beta-glucan, high fibre varieties, intended for the human food market.

CDC Alamo was developed by the Crop Development Centre, Saskatoon and registered in 1999. This is a specialty type barley and should only be grown after a market has been secured. It is a waxy hulless with 100% amylopectin starch, good threshability and straw strength, large plump grain, and with moderate scald resistance. It is susceptible to all smuts, stem rust, net and spot blotch. Yield is only equal to Condor.

CDC Fibar was developed by Crop Development Centre in Saskatoon and registered in 2003. It is a waxy two-row hulless with 100 % amylopectin starch and high beta-glucan levels with high acid extract viscosity designed specifically for specialty starch barley food markets. Its agronomic performance is not outstanding as this variety was registered with only one year of data. It is susceptible to common root rot, stem rust, net and spot forms of net blotch and loose smut.

CDC Rattan was developed by the Crop Development Centre, Saskatoon and registered in 2003. It is a waxy two-row hulless with 95 % amylopectin starch. This variety has improved agronomic performance with an 11% yield increase over the check CDC Candle. Straw strength is due to shorter plant height, with better plumpness and test weight. It is susceptible to scald, smuts and spot form of net blotch and common root rot.

Enduro (HB813) was developed by Westbred LLC, Bozeman, Montana, and registered in 2007. It is a two-row waxy barley that combines high yield and superior straw strength with high percent plump seed, moderate resistance to surface-borne smuts and net blotch (spot form). Susceptible to stem rust, loose smut and spot blotch.

Millhouse (tested as HB 109) was developed by Agriculture & Agri-Food Canada, Brandon and Winnipeg and recommended for registration in 2004. It is a standard 2-row non-waxy hulless with high milling extract for flour at 87 %. The flour is a source of dietary fibre and anti-oxidants. Yield is 7% higher than CDC Candle, the 2-row hulless check. Maturity is 2 days later than check. Lodging ratings are fair. It is resistant to stem rust but susceptible to most other diseases - common root rot, loose smut, spot blotch, scald and septoria.

Wheat Varieties

Red Spring Wheat

5400 IP was developed by Agricore United and Proven Seeds and registered for interim contract registration in 2006. This variety is grown under contract for Wharburtons in Manitoba and Saskatchewan. Yield is 97% of the checks in 2001 and 2002, with protein similar to AC Barrie. Straw strength is better than AC Barrie but is 1.5 days later in maturity. Resistant to stem rust and loose smut, moderately resistant to leaf rust, bunt and Fusarium head blight. Leaf spot is similar to checks.

5500 HR was developed by AgriPro/Agricore United and registered in 2000. It has high yield (10% over checks - equal to McKenzie), very high test weight and 1000 kernel weight, slightly better lodging resistance than McKenzie. Maturity is similar to the check AC Barrie. It is resistant to leaf rust, moderately resistant to bunt and loose smuts. It is moderately resistant to moderately susceptible to stem rust.

5600 HR was developed by Agricore United and registered in 1999. It has stronger straw than Neepawa and McKenzie, higher test weight than Neepawa and Roblin, good resistance to leaf rust, loose smut, common bunt, and with higher yields than the checks (except McKenzie). It does particularly well in Manitoba. 5600 HR matures 2 days later than the check.

5601 HR was developed by AgriPro / Agricore United and was registered in 2001. It has shown improved yield potential in the brown soil zone compared to all the checks except McKenzie. 5601 HR has good rust resistance and the highest fusarium head blight resistance currently available. It is moderately resistant to bunt, loose smut, and common root rot. Lower yield potential outside the brown soil zone with similar maturity to AC Barrie. It is best adapted to Manitoba and southern Saskatchewan.

5602 HR was developed by Agricore United and Proven Seed and recommended for registration in 2004. It has high yield, 9% higher than AC Barrie and equal to McKenzie. High protein; good straw strength; higher test weight than checks. Kernel weight is similar to AC Barrie. 5602 HR is medium-late in maturity, similar to AC Barrie. Improved Fusarium head blight resistance. It is resistant to leaf rust, stem rust and loose smut.

AC Abbey was developed by Agriculture Canada, Swift Current and registered in 1998. It is a sawfly resistant, strong strawed semi-dwarf with high yield (6-10% over AC Eatonia), and earlier maturity (2 days) over AC Eatonia. It has poorer field response to leaf spotting diseases than AC Eatonia in the Brown and Dark Brown soil zone tests. It has moderate resistance to leaf and stem rust, loose smut, bunt and common root rot.

AC Barrie was developed by Agriculture and Agri-Food Canada Research Station at Swift Current and registered in 1994. It has high yield potential, strong straw, large seed size, and high protein. Maturity for this check variety is 100 days for a provincial average. It has resistance to leaf and stem rusts, loose smut and bunt.

AC Cadillac was developed by Agriculture & Agri-Food Canada, Lethbridge and registered in 1996. Similar protein to check, heavy test weight, and large seed size. It has resistance to bunt, loose smut, leaf spot, leaf and stem rusts. Maturity is equal to AC Barrie, with fair lodging rating.

AC Cora was developed by Agriculture and Agri-Food Canada Research station at Winnipeg and registered in 1994. AC Cora is approximately 3% higher yielding than the check cultivar Katepwa. It carries good levels of resistance to leaf and stem rust, common bunt, and is moderately resistant to loose smut. AC Cora is similar in maturity to AC Barrie.

AC Eatonia was developed by Agriculture Canada Research Station, Swift Current, and registered in 1993. It has improved sawfly resistance, resistance to bunt, and moderate resistance to common root rot. It has larger kernel size and slightly higher yield than Leader, but has variable loose smut reaction. It was developed for the sawfly susceptible areas of Western Canada.

AC Elsa was developed by Agriculture & Agri-Food Canada, Swift Current, registered in 1996 and is distributed by SeCan. It has high yield potential (4% plus over AC Barrie), high protein, and short straw. It has resistance to leaf spot, leaf and stem rust and loose smut. It has moderate resistance to bunt and common root rot. It is susceptible to fusarium head blight of southern Manitoba, one day later maturing than AC Barrie, with straw strength only equal to AC Barrie.

AC Intrepid was developed by Agriculture and Agri-Food Canada, Swift Current, and registered in 1997. Grain yields are 1% to 2% higher than checks, with early maturity equal to Roblin, short strong straw, and moderate resistance to disease. However, it does have moderate susceptibility to loose smut and slightly lighter test weight.

AC Majestic was developed by Agriculture & Agri-Food Canada at Winnipeg and applied for registration in 1995. It is a short, strong-strawed variety with slightly lower yields than the check, and similar maturity to the check. It has resistance to loose smut and moderate resistance to bunt. Fair lodging rating.

AC Splendor was developed by Agriculture & Agri-Food Canada, Winnipeg, registered in 1996 and distributed by Cargill. It is early maturing (2 days earlier than AC Barrie) with good yield, similar protein levels compared to the check. Its lodging rating and pre-harvest sprouting are both fair.

Kane was developed by Cereal Research Centre, AAFC Winnipeg, and recommended for registration in 2006. It has similar maturity and yields to AC Barrie. Resistant to leaf and stem rust, as well as intermediate resistance to bunt and leaf spot. Moderately susceptible to loose smut and Fusarium head blight. It was only tested in Central Wheat Cooperative trials in Manitoba and Saskatchewan. Awned variety.

CDC Abound was developed by the Crop Development Centre, Saskatoon and recommended for registration in 2006. It is a semi-dwarf that yields 9% higher than AC Barrie with very good straw strength as well high test and kernel weights. It is 1 to 2 days later than checks. It has resistance to stem rust and intermediate resistance to bunt and loose smut. Moderately susceptible to leaf rust and leaf spot and susceptible to fusarium head blight.

CDC Alsask was developed by the University of Saskatchewan and recommended for registration in 2004. It has high yield, early maturity, and large kernel weight. It has resistance to leaf rust and bunt. Leaf spotting ratings were limited by drought conditions. It is moderately susceptible to susceptible to Fusarium head blight. Intermediate resistance to stem rust. Resistant to intermedate resistance to loose smut.

CDC Bounty was developed by the Crop Development Centre, Saskatoon and registered in 1999. It has high yield, ranging from 103% to 106 % of checks, heavier kernels, and high test weight. It is resistant to loose smut with intermediate resistance to bunt and common root rot. It has moderate reaction to leaf rust. Fair lodging resistance and poor tolerance to leaf spot and fusarium.

CDC Go was developed by the Crop Development Centre, Saskatoon and registered in 2003. It is a strong strawed semi-dwarf, hollow stemmed variety that yields 3% higher than AC Barrie. Test weight is similar to checks but it has a higher kernel weight. It is moderate in reaction to leaf rust. It is resistant to moderately resistant to stem rust. Moderately susceptible to moderately resistant to loose smut. Susceptible to leaf spots. It has resistance to bunt. Good lodging ratings.

CDC Imagine was developed by the Crop Development Centre, Saskatoon and registered in 2002. It is distributed by AgriPro/Saskatchewan Wheat Pool. This is the first wheat registered for the 'Clearfield'™ weed control system – Adrenalin (imidazolinone-tolerant). It is strong-strawed, has maturity equal to AC Barrie, with leaf disease reaction similar to the checks. It is lower yielding than AC Barrie in Saskatchewan, but higher yielding in Alberta.

CDC Osler (tested as PT 555) was developed by the Crop Development Centre, Saskatoon and registered in 2003. Yield is 1 % lower than AC Barrie, and it is adapted to the shorter season wheat growing areas of Alberta and Saskatchewan. It is awnless, standard height, and with maturity between AC Barrie and AC Splendor. Lodging is equal to checks with heavier kernel weight than checks. It is R to MR to stem rust and MR to MS for leaf rust. Fusarium index is I to S.

CDC Teal was developed at the Crop Development Centre, Saskatoon and registered in 1991. It is a Roblin replacement with good stem and leaf rust resistance, earlier maturity, shorter stronger straw, and larger kernels than Neepawa and Katepwa. CDC Teal has lower resistance to loose smut and root rot than AC Barrie and poor resistance to leaf spotting.

Goodeye was developed by Agriculture and Agri-Food Canada Swift Current. Goodeye carries resistance to orange wheat midge, and has high grain yield (8% over AC Barrie). It has resistance to stem rust, loose smut, and moderately resistant to leaf rust. Goodeye is susceptible to common bunt and moderately susceptible to FHB. It is early maturing and has good lodging resistance**.**

Harvest was developed by Agriculture & Agri-Food Canada, Winnipeg and registered in 2001. It has excellent straw strength, high test weight, and excellent resistance to sprouting. Good resistance to rust and loose smut. It yields better in Manitoba than Saskatchewan, and slightly better than the checks in Alberta. It is more susceptible to fusarium head blight than Katepwa, AC Majestic, and AC Barrie. Susceptible to bunt and common root rot. Its area of adaptation is the central and eastern prairies where leaf rust and weathering reduce yield and grade; but where fusarium head blight is not acute.

Helios was developed at the Semiarid Prairie Agricultural Research Centre of Agriculture and Agri-Food Canada, Swift Current and registered in 2005. Distributed by La Cooperative Federee de Quebec. It is 3% higher yielding than AC Barrie, and 1 day earlier. Resistant to stem rust and loose smut with intermediate resistance to bunt and Fusarium head blight. Moderately susceptible to leaf rust and leaf spotting as well is awnless. Adapted to Western Canada where rust is not a problem.

Infinity was developed by Agriculture & Agri-Food Canada, Swift Current and recommended for registration in 2004. It is higher yielding than AC Barrie by 5%, but lower than Superb. Matures earlier than Superb and similar to AC Barrie. Similar protein levels to AC Barrie. Fair lodging resistance, similar to Katepwa. Moderately resistant to leaf rust and bunt. Resistant to stem rust and loose smut. Susceptible to Fusarium head blight.

Journey was developed by the Saskatchewan Wheat Pool and registered in 2001. It has high grain yield, test weight, and protein. Strong straw and reduced height. It is one day later maturing than AC Barrie. It has resistance to rust and bunt. Moderate-to-intermediate resistance to fusarium head blight, with improved pre-harvest sprouting resistance. Yield advantage best in rust areas of western Canada with yields better in southern Alberta and similar to the checks in central and northern Alberta.

Katepwa was developed by Agriculture Canada, Winnipeg and registered in 1981. This cultivar is similar to Neepawa in yield, quality and agronomic traits but is easier to thresh. Katepwa is resistant to stem rust, bunt and common root rot; moderately resistant to leaf rust and loose smut; and moderately susceptible to septoria leaf spot. Katepwa is primarily adapted to the traditional hard red spring production areas.

Laura was developed by Agriculture Canada at Swift Current and registered in 1986. Laura is similar in quality to Neepawa, but is higher yielding as well as 1 - 2 days later maturing. Laura is adapted to the brown and southern dark brown soil zones. This is an awned cultivar. Laura is resistant to rust, moderately resistant to common root rot and susceptible to loose smut as well as bunt.

Lillian was developed by Semiarid Prairie Agricultural Research Centre, Swift Current and Cereal Research Centre, Winnipeg and registered in 2003. It is a sawfly resistant variety with higher yields of 4 to 8 % over AC Abbey. Lillian has improved resistance to leaf rust and leaf spotting diseases, however it is slightly taller and weaker strawed and one day later maturing relative to AC Abbey. It is susceptible to fusarium head blight.

Lovitt was developed by Agriculture Canada, Swift Current and registered in 2002. It is earlier maturing (1-2 days) and higher yielding (2-3%) than AC Barrie. It has resistance to loose smut. Intermediate resistance to bunt and common root rot.

McKenzie was developed by Saskatchewan Wheat Pool and registered in 1997. It is high yielding (2% to 5% over AC Barrie) and similar maturity to AC Barrie. Shorter straw (5cm) and straw strength equal to check, sprouting resistance. Resistant to leaf rust, stem rust and bunt. It is however, susceptible to loose smut, leaf spotting and Fusarium head blight.

Park was developed by Agriculture Canada at Lacombe, and registered in 1963. Park is medium to tall in height, but has good resistance to lodging and shattering. It is resistant to loose smut, some of the races of stem rust, but susceptible to leaf rust, bunt and head melanosis. It is a very early wheat variety, therefore it can be grown in shorter season areas than most other wheat varieties.

Peace was developed by Agriculture Canada, Winnipeg and registered in 2002. It is slightly (1 day) earlier and higher yielding compared to AC Barrie. It has excellent common bunt resistance, and good leaf rust resistance compared to AC Barrie. Its lodging resistance and fusarium head blight reaction are no better than AC Splendor. Peace is adapted for the Parkland and Peace River areas of western Canada.

Prodigy was developed by Saskatchewan Wheat Pool and registered in 1998. It has yields that are 3-4% higher than check, high protein (0.4% over AC Barrie), high test weight, strong straw and resistance to the prevalent races of leaf and stem rust and bunt. Similar maturity to AC Barrie and moderately resistant to loose smut and common root rot.

Alvena was developed at the Semiarid Prairie Agricultural Research Centre (AAFC), Swift Current and recommended for registration in 2006. Yield is 5 % more than AC Barrie and 1 to 2 days earlier. Moderately resistant to stem rust and loose smut with intermediate resistance to leaf rust and bunt. Good straw strength with wheat and flour protein similar to checks. Moderately susceptible to Fusarium head blight.

Roblin was developed by Agriculture Canada, Winnipeg and registered in 1986. This variety is similar to Neepawa in quality with excellent protein content, shorter stature, and about 2 days earlier maturity. Roblin may be suited to production in the Parkland and Peace River areas of Alberta. Roblin has resistance to rust, moderate resistance to loose smut and common root rot. It is susceptible to bunt and leaf spotting.

Somerset (tested as BW 307) was developed by Agriculture & Agri-Food Canada, Cereal Research Centre, Winnipeg, and recommended for registration in 2004. Yield is 4 % higher than AC Barrie but 9% lower than Superb. Maturity is 1 day earlier than AC Barrie. Fair straw strength and lower test weight than checks. This variety is awnless, tall, and has adequate sprouting resistance. It has resistance to leaf rust, stem rust and loose smut. It is susceptible to Fusarium head blight and leaf spot.

Superb was developed by Agriculture & Agri-Food Canada, Winnipeg and registered in 2000. It has high kernel weight, high test weight, high grain yield (7% to 11% over AC Barrie in different yield classes), shorter straw with better lodging resistance. It is resistant to leaf and stem rust, moderately resistant to bunt, loose smut and root rot. However, it is 2 days later maturing than the checks.

Waskada was developed by Agriculture and Agri-Food Canada, Winnipeg and was registered in 2007. It has a high kernel weight, high test weight, and high grain yield (2% over Superb and 11% over AC Barrie). It has good stem rust resistance, intermediate leaf rust resistance (MR-MS), bunt resistance, loose smut resistance, and FHB resistance higher than AC Barrie. Waskada is one day earlier in maturity than Superb.

Hard White Spring Wheat

Kanata was developed by Agriculture & Agri-Food Canada, Winnipeg. It was given interim registration in 2000, 2-year interim in 2004, and full registration in 2006. Market testing has been completed on this hard white seeded wheat. It has good lodging resistance. Intermediate resistance to stem rust and Fusarium head blight, moderately susceptible to leaf rust and loose smut. Maturity is 2 days earlier than AC Barrie. However, it was lower yielding (4% lower in 2003-2004, and 6% lower in 2005 than AC Barrie). Small kernel size. It is susceptible to bunt and leaf spot.

Snowbird was developed by Agriculture & Agri-Food Canada, Winnipeg, given interim registration in 2000 and full registration in 2004. Market testing will be done on this hard white seeded wheat for 3 years. It has good yield (2% to 3% over AC Barrie), better lodging resistance than McKenzie, resistance to leaf rust, with moderate resistance to stem rust, loose smut and root rot. However, it has late maturity (2 days later than AC Barrie), small kernel size and medium test weight.

Prairie Spring Wheat

5700 PR was developed by AgriPro/Agricore United and was registered in 2000. It has similar yields to check AC Taber, high test weight, very good lodging resistance and matures one day earlier than AC Taber. It has moderate resistance to stem rust, intermediate resistance to leaf rust and very good resistance to common bunt. Fusarium head blight resistance is only equal to the CPS checks - AC Crystal and AC Vista.

5701 PR was developed by AgriPro/Agricore United and registered in 2001. It has yield potential similar to AC Taber, combined with good test and kernel weight. Maturity is 1 day later than AC Taber. Good straw strength. Improved

resistance to leaf rust, fusarium head blight and lose smut compared to the check cultivars. It is moderately susceptible to common bunt. The area of adaptation is the Canadian prairies except where fusarium head blight is a problem.

5702 PR was developed by AgriPro/Agricore United and registered in 2007. 5702 PR is high yielding (15% over AC Crystal), with a high test and kernel weight with good lodging resistance. It is moderately resistant to leaf rust, moderately resistant to leaf spots, and intermediate in resistance to common bunt. It is moderately susceptible to stem rust, loose smut and FHB

AC 2000 was developed by Agriculture & Agri-Food Canada, Swift Current and given interim registration in 2000. It is a white-seeded variety that has improved milling properties, noodle making characteristics, and leaf spot resistance over AC Vista. It is resistant to common bunt and loose smut, with better lodging resistance than AC Karma and AC Vista. It has no yield advantage and is 3 days later maturing than AC Vista. It has insufficient leaf rust resistance for the rust areas of Western Canada.

AC Crystal was developed by Agriculture & Agri-Food Canada, Swift Current, registered in 1996 and is distributed by SeCan. It is red seeded and has similar yield, similar test weight and better leaf spot resistance than AC Taber. Maturity between AC Foremost and AC Taber (1 day later than AC Foremost). Good straw strength, and better fusarium head blight tolerance than all of the checks. Suitable for irrigation production. It is susceptible to the new loose smut race T9.

AC Foremost was developed by the Agriculture and Agri-Food Canada Research Stations at Swift Current and Lethbridge and registered in 1994. AC Foremost is a red-seeded CPS cultivar with a maturity advantage of 1 day compared to AC Taber and improved tolerance to conditions which promote premature sprouting when compared to other CPS wheats. This cultivar is resistant to stem rust, common bunt and loose smut but is susceptible to common root rot and leaf spotting.

AC Karma was developed by Agriculture and Agri-Food Canada Research Station at Swift Current and registered in 1994. AC Karma is white-seeded CPS wheat with stronger straw than the white-seeded check cultivar Genesis. Although this cultivar is superior to the check for leaf and stem rust, common bunt, and loose smut, it is similar in yield potential on the brown and dark brown soils of the western prairies. AC Karma is about 1 day earlier maturity than AC Taber.

AC Taber is a red seeded semi-dwarf developed by Agriculture Canada, Swift Current and registered in 1991. It is resistant to bunt, leaf and stem rust with good quality. It is similar in maturity to hard red spring wheat checks. It is susceptible to loose smut.

AC Vista was developed by Agriculture & Agri-Food Canada, Swift Current, registered in 1996 and distributed by Value Added Seeds. It is white seeded with quality increase (gluten and kernel strength), pre-harvest sprouting resistance improved and one day earlier than AC Karma. Loose smut and rust resistant. It is susceptible to fusarium head blight, has weaker straw and lighter test weight than AC Karma.

HY 639 (test number, no name yet) was developed by Agriculture and Agri-Food Canada, Swift Current and registered in 2000. It has about 1.5% higher protein content than current CPS wheats (AC Vista and AC Crystal). HY 639 yields well in Manitoba and S.E. Saskatchewan, but less than AC Crystal in other areas. It is resistant to leaf and stem rust, bunt and loose smut. It matures 1 to 2 days earlier than AC Crystal. It is lower yielding than AC Crystal outside of Manitoba and S.E. Saskatchewan.

Snowhite 475 (tested as HY 475) was developed by Agriculture & Agri-Food Canada, Swift Current and received interim registration in 2004; renewed in 2006 and is distributed by Farm Pure Seeds. It has early maturity, high protein content, and good test weight. Good lodging resistance. It is lower yielding than CPS white check varieties, but yielded more than the CPS red checks. Susceptible to Fusarium head blight.

Snowhite 476 (tested as HY 476) was developed by Agriculture & Agri-Food Canada, Swift Current and received interim registration in 2004; was renewed in 2006 and is distributed by Farm Pure Seeds. It has high protein and resistance to common bunt. Yields are similar to AC Crystal but lower than checks for CPS white. Better resistance to stem rust than the checks. It is susceptible to Fusarium head blight, similar to other CPS varieties. Maturity is 2 days later than AC Vista and it has taller plant height than the checks.

Snowstar was developed by Agriculture and Agri-Food Canada Winnipeg and registered in 2007. It has high yield (3% over Snowbird), high test and has good resistance to leaf and stem rust. It has improved FHB resistance over the checks. Snowstar is susceptible loose smut and common bunt.

Soft White Spring Wheat

AC Andrew was developed by Agriculture & Agri-Food Canada, Lethbridge, given 3-year interim registration in 2000 and full registration in 2004. This high protein soft white spring wheat will be grown to test the market for export. A lower quality high protein wheat, which is much higher yielding (15 to 19% over checks) than regular low protein SWS wheat. Resistant to stripe rust, stem rust, powdery mildew. Moderate resistance to leaf rust and black point. Good lodging and shattering ratings. Like check varieties, it is susceptible to loose smut. Intermediate resistance to bunt.

AC Meena was developed by Agriculture & Agri-Food Canada, Lethbridge and registered in 2000. It out-yielded AC Reed by 5%, AC Phil by 2% and AC Nanda by 6%. AC Meena has improved end use quality. It is resistant to stripe rust, moderately resistant to powdery mildew and black point. It is susceptible to bunt, leaf rust and highly susceptible to loose smut.

AC Nanda was developed by Agriculture and Agri-Food Canada, Lethbridge and registered in 1997. It has improved end-use quality. AC Nanda has adult plant resistance to stripe rust, moderate resistance to powdery mildew, and better black point resistance. However, the maturity is three days later than AC Reed. Intermediate resistance to bunt. Like the check varieties, it is susceptible to loose smut.

AC Phil was developed by Agriculture & Agri-Food Canada Research Station at Lethbridge and applied for registration in 1994. AC Phil is higher yielding by up to 12% (in some areas) than the standard cultivar AC Reed and carries excellent resistance to stripe rust. Same as other soft white wheat varieties, AC Phil is only suitable for production under irrigation.

AC Reed was developed at Agriculture Canada, Lethbridge and registered in 1991. It has higher yield potential than Fielder with stripe rust resistance, moderate sprouting resistance, powdery mildew and common root rot resistance. The line is shorter than Fielder with good lodging resistance and superior cookie quality to Fielder. AC Reed is susceptible to black point, bunt, and loose smut similar to Fielder and Owens.

Bhishaj was developed by Agriculture & Agri-Food Canada, Lethbridge and registered in 2002. It is high yielding (9% over AC Reed and 7% over AC Phil) and has high quality for the domestic market. It has adult-plant resistance to the new stripe rust race SLR-Y2K. It is susceptible to bunt. Bhishaj is adapted for the irrigation regions of southern Alberta and Saskatchewan.

Sadash was developed by Agriculture & Agri-Food Canada, Lethbridge and recommended for registration in 2006. It is a semi-dwarf with awns; it has improved disease resistance. Maturity is similar to AC Andrew with good straw strength and shattering resistance. It is moderately resistant to stem rust with intermediate resistance to leaf rust and loose smut. Resistant to Fusarium head blight. Moderately susceptible to bunt and black point.

Amber Durum Wheat

AC Avonlea was developed by Agriculture and Agri-Food Canada, Swift Current, and registered in 1997. It is 1% to 2% higher yielding than Kyle, maturity similar to Kyle, high grain protein and shorter, stronger straw. Good resistance to leaf and stem rust, common bunt and common root rot. It is however, highly susceptible to loose smut.

AC Melita was developed by Agriculture & Agri-Food Canada Research Station at Winnipeg and registered in 1994. AC Melita yields lower than Kyle. This cultivar has good lodging resistance, excellent levels of leaf and stem rust resistance, resistance to common bunt, but is highly susceptible to loose smut. AC Melita is suitable only for production in the traditional durum wheat growing areas of the prairies.

AC Morse was developed by Agriculture & Agri-Food Canada, Winnipeg, registered in 1996 and distributed by SeCan. It has excellent lodging resistance with medium height straw, high grain protein and very good yield. It is susceptible to loose smut and has slightly lower test weight than Kyle. Maturity is 1 day earlier than the checks in Alberta.

AC Navigator was developed by Agriculture & Agri-Food Canada, Swift Current, and given interim registration in 1998, and full registration in 2002. It has stronger gluten than all current varieties and will be test marketed for this quality feature. This semi-dwarf has shorter, stronger straw than Kyle and Plenty, good adaptation to durum growing area, 3-5% higher yield than Kyle, AC Avonlea and AC Morse on dryland and 11% higher on irrigation. It has resistance to leaf and stem rust and common bunt. It is susceptible to loose smut. Currently it is grown under contract with the CWB.

Commander (tested as DT 722) was developed by Agriculture and Agri-Food Canada, Swift Current (SPARC) and registered in 2004. It is higher yielding by 2 to 5 % over check varieties. Semi-dwarf with 1 day later maturity than the checks. Resistant to leaf and stem rust. Gluten strength meets new target for strong gluten subclass. Plans are to grow this variety under identity preserved class, as it is indistinguishable from other amber durums. Leaf spot reaction is similar to AC Navigator but slightly worse than checks.

Kyle was developed at Agriculture Canada, Swift Current and registered in 1984. In its day, Kyle was considered high yielding. For people interested in ornamental arrangements, Kyle is black awned (bearded) at maturity. It has weak straw, late maturity, and is long-strawed. This cultivar is resistant to rust (leaf and stem) and bunt. Intermediate resistance to common root rot. Susceptible to loose smut.

Napoleon was developed by Agriculture & Agri-Food Canada, Winnipeg, registered in 1999, and distributed by Canterra Seeds Ltd. It has high yield (up to 8% higher) in Area 3, black soil zone, combined with low cadmium uptake. It is highly resistant to the prevalent races of leaf and stem rust and bunt. It has similar test weight to the check. It is moderately resistant to common root rot and susceptible to loose smut.

Plenty was developed by the University of Saskatchewan and registered in 1990. It has high yield, fairly strong straw, with maturity slightly earlier than Kyle. Resistant to rust and bunt. Intermediate resistance to common root rot.

Sceptre was registered in 1985 by the Department of Crop Science, University of Saskatchewan. It is a lower yielding early durum variety with the lowest incidence of kernel smudge. Good straw strength with short straw. This variety is adapted to the dark brown soil zone of Alberta and Saskatchewan. .Sceptre is resistant to rust and bunt. Intermediate resistance to common root rot. Susceptible to loose smut.

Strongfield (tested as DT 712) was developed by Agriculture & Agri-Food Canada, Swift Current (SPARC) and registered in 2003. High grain yield (7% higher) in combination with good quality grain protein similar to AC Avonlea and improvements in gluten strength. Maturity is 1 day earlier than AC Avonlea. Resistant to leaf and stem rust with intermediate resistance to bunt. Some field resistance to leaf spot. Fusarium head blight susceptible - similar to checks. Susceptible to loose smut.

Extra Strong Spring Wheat

AC Corinne was developed by Agriculture & Agri-Food Canada, Winnipeg and registered in 1998. It has improved pre-harvest sprouting resistance and leaf rust resistance over Glenlea, with Glenlea extra strong wheat quality plus higher protein, and remaining disease resistance. Its maturity averages 1 day later than the check Amazon and is 1% to 2% higher yielding.

Amazon was developed by the University of Manitoba, Winnipeg and registered in 1998. It is Glenlea with tan spot resistance and slightly (6 cm.) shorter. The yield is 3-4% lower than Wildcat and Glenlea in Zone 3, and 1% lower overall than Glenlea. Moderate resistance to bunt and common root rot.

Bluesky was developed by Agriculture Canada, Beaverlodge and registered in 1987. Bluesky is similar in quality to Amazon but is shorter in stature and earlier maturing by 2 - 3 days. This cultivar provides a suitable extra strong type for the Parkland and Peace River areas of Alberta. Bluesky is resistant to stem rust, loose smut, and common root rot. It has only intermediate resistance to leaf rust and bunt.

Burnside (tested as ES 54) was developed by Agriculture & Agri-Food Canada, Winnipeg and registered in 2003. It is a red seeded extra strong with 3 to 7 % higher yields and 0.9 % higher protein with 2 days earlier maturity as compared to Amazon. It has intermediate preharvest sprouting resistance, moderate resistance to leaf and stem rust, resistance to loose smut and intermediate resistance to common bunt. It is similar to the checks for tan spot and septoria. It is susceptible to fusarium head blight.

CDC Rama (tested as ES 21) was developed by the Crop Development Centre, Saskatoon and was registered in 2001. It has higher yield than the check cultivars (Glenlea and AC Corinne) in the brown and dark brown soil zones, with higher grain protein levels. It has lower yield than the check in the Red River Valley. It is susceptible to leaf spotting disease like the check cultivars.

CDC Walrus (tested as ES 41) was developed by the Crop Development Centre, Saskatoon and registered in 2003. It has 3 to 7 % higher yield than checks with earlier maturity and similar straw strength. It is resistant to stem rust and loose smut, with MR to MR-MS to leaf rust. It is MR to I for common bunt. Fusarium index is similar to checks.

Glenavon was developed by Agriculture & Agri-Food Canada, Winnipeg and registered in 1999. Compared to Amazon, AC Glenavon is higher yielding, has better test weight, improved pre-harvest sprouting resistance and is slightly earlier maturing. AC Glenavon is somewhat more susceptible to Fusarium head blight than Amazon and is only equal to Amazon in straw strength.

Laser was developed by the University of Alberta, registered in 1996 and distributed by Canterra Seeds Ltd. It is 2% higher yielding and has better quality than Wild Cat. Seed size, resistance to loose smut, stem rust, root rot, straw strength and height are all similar to Wild Cat. It is susceptible to bunt like Wild Cat, and similar susceptibility to leaf rust as Wild Cat and Park.

Winter Wheat – Select Varieties

AC Bellatrix was developed by Agriculture Canada, Lethbridge and registered in 1998. It is bunt resistant compared to all the check varieties, which are susceptible. Winter survival yield, straw strength, test weight, protein and the incidence of vitreous kernels all compare favourably with the checks. Like the check cultivars, it lacks resistance to leaf diseases, stem rust, and contains more blackpoint.

AC Readymade was developed by Agriculture Canada, Lethbridge, with 10% higher yield, better lodging resistance, protein, bunt resistance and good quality. However, it has lower winter hardiness than current cultivars.

AC Tempest was developed by Agriculture & Agri-Food Canada, Lethbridge, registered in 1997 and distributed by SeCan. It is similar to AC Readymade with stronger straw, high protein, higher grain yield (4%) and flour yield. It has moderate bunt resistance, is susceptible to leaf diseases and only moderate (like Readymade) winter hardiness.

CDC Buteo was developed by the Crop Development Centre, Saskatoon and registered in 2001. It is similar to CDC Osprey with improved quality and rust resistance. However, the average grain yield has been marginally lower than the check cultivar CDC Osprey.

CDC Osprey was developed by the Crop Development Centre, Saskatoon and applied for registration in 1995. It is a high yielding semi-dwarf with strong, short straw. It is two days earlier for its adaptation area which is the non-rust

areas of western Canada. Very good winter hardiness. Susceptible to bunt and leaf rust.

McClintock was developed by the University of Manitoba and registered in 2001. It has high yield potential, good winter survival and straw strength. Superior test weight and excellent rust resistance. It does not appear to suffer from physiological leaf spot. The protein concentration is similar to CDC Osprey. It is susceptible to bunt.

Norstar was developed by Agriculture Canada Research Station, Lethbridge and registered in 1977. Norstar has high levels of winter hardiness and good milling quality. Due to its tall height, it may be subject to lodging and subsequent yield reduction when grown in the higher rainfall areas of Alberta. Rated good for piebald kernels.

Radiant was developed by Agriculture & Agri-Food Canada, Lethbridge and recommended for

registration in 2001. Currently this variety is held up as a plant with a novel trait. It is resistant to wheat curl mite, the vector of wheat streak mosaic. It has high yield potential, good winter hardiness, moderate height, strong straw, high test and kernel weight, and protein equal to CDC Osprey. It is susceptible to stem and leaf rust, common bunt and has higher kernel blackpoint percentage than the check. The area of adaptation is the winter wheat area of the non-rust western Canadian prairies.

Canada Western Red Winter Wheat

CDC Clair was developed by the Crop Development Centre in Saskatoon and applied for registration in 1995. It is a semi-dwarf with strong, short straw, yielding 2% higher than CDC Kestrel. It is rust resistant and has maturity equal to CDC Kestrel with significantly higher protein than CDC Kestrel. It is adapted to the winter wheat production area of western Canada, particularly Saskatchewan. Rated fair for piebald kernels.

CDC Falcon was developed by the Crop Development Centre, Saskatoon and registered in 1998. It has superior stem and leaf rust resistance over all current winter wheat varieties in western Canada. It also has high yield, fair to good winter hardiness, semi-dwarf short strong straw, especially good for direct seeding and straight cut harvest. Good protein being 0.9% above CDC Kestrel. However, it does have lower flour yield than CDC Osprey.

CDC Harrier was developed by the Crop Development Centre, Saskatoon and registered in 1997. It is a winter hardy semi-dwarf with leaf and stem rust resistance better than all other currently registered winter wheat varieties. However, the grain quality is only equal to CDC Kestrel.

CDC Kestrel was developed at the Crop Development Centre in Saskatoon and registered in 1990. It has 13% higher yield and shorter, stronger straw than Norstar. Its winter hardiness is very good, equal to Norstar, and has superior rust resistance. It can have a lower protein content under high yield conditions. It is susceptible to bunt. Rated poor for piebald kernels.

CDC Raptor was developed by the Crop Development Centre, Saskatoon and registered in 1999. It is a high yielding, winter-hardy, strong straw, short stature semi-dwarf with superior stem and leaf rust resistance. Protein content is 0.25% lower than CDC Osprey (but 5% higher than CDC Kestrel) and it has poor gluten strength. It is susceptible to bunt. Rated fair for piebald kernels.

Triticale Varieties

Spring Triticale

AC Alta was developed by Agriculture and Agri-Food Canada, Swift Current and registered in 1994. AC Alta yields 12-14% higher than the test means. It has disease resistance similar to Pronghorn. For seed production this cultivar is best suited to the brown soils, but like other spring triticale cultivars, it has excellent forage potential as silage in both the black and brown soil zones.

AC Certa was developed by Agriculture and Agri-Food Canada at Swift Current and applied for registration in 1995. AC Certa has excellent disease resistance, improved test weight, sprouting resistance, and is one day earlier than the test means, but is lower yielding than test means.

AC Copia was released in 1993 by Agriculture Canada, Swift Current. Its yield is similar or slightly higher than test means, ranging from 3-16% higher yield. Superior yield to Wapiti under Alberta conditions. It has a high test weight with good disease resistance.

AC Ultima was developed by Agriculture & Agri-Food Canada, Swift Current and registered in 1999. It has improved quality for food end use (Hagberg falling number), good disease resistance and is 1 day earlier than other spring triticales. It has a lower test weight than AC Copia and AC Certa.

Bunker was developed by the Field Crop Development Centre, Lacombe and was registered in 2005. Bunker will be marketed by FarmPure Seeds Ltd. It is a reduced-awn triticale with resistance to FHB similar to the most resistant check variety (Pronghorn). Bunker is early maturing similar to the check cultivars AC Ultima and Pronghorn, and has good leaf and stem rust resistance and improved test weight (bushel weight). Bunker also has higher silage yields (non-Coop data) than either AC Ultima or Pronghorn.

Pronghorn was developed by Alberta Agriculture, Field Crop Development Centre, Lacombe and registered in 1995. Pronghorn is two days earlier and has yields equal or superior to the check cultivars. It has resistance to loose smut and bunt and moderately resistant to common root rot. Good lodging and shattering resistance. It is adaptable in the long growing areas of western Canada and is moderately susceptible to certain races of stem rust.

Taza was developed by Field Crop Development Centre, Lacombe in 1994 and registered in 2010. It is an awnletted (reduced awn expression) standard height spring triticale line intended for use as a feed grain conserved forage, swath grazing crop and potentially for industrial use. Taza is adapted to the Canadian Prairie Provinces. It yields similar to Pronghorn but is equal to or higher than AC Ultima and AC Certa. This line has good lodging resistance, good test weight, and high kernel weight. Taza is MS to MR for FHB resistance; it is resistant to leaf rust and stem rust.

Tyndal was developed by the Field Crop Development Centre, Lacombe and supported for registration in February 2005. Tyndal is distributed by SeCan. It is a reduced-awn triticale which has grain yields similar to the highest yielding triticale check cultivar AC Ultima combined with good, leaf and stem rust resistance, test weight, early maturity, good lodging resistance and high forage yields. Tyndal has acceptable levels of disease resistance including FHB minimum requirements.

Wapiti was developed by Alberta Agriculture at Lacombe and registered in 1987. Wapiti is a spring triticale with maturity, height, test weight, lodging resistance and sprouting susceptibility similar to Carman but with improved yield and test weight. Wapiti also has resistance to leaf rust, stem rust, loose smut, and bunt. It has resistance to common root rot. Its potential for silage production is comparable to the best barley varieties in the high rainfall areas of Alberta and superior in the dry areas.

Winter Triticale

Bobcat was developed by Alberta Agriculture, Lacombe and registered in 1999. It is about 20 cm. shorter, 10% higher yielding, and has similar winter survival to Pika in the parkland areas. It is easy threshing and has short awnlettes, which may improve greenfeed production. However, it is lower yielding than Pika in the brown soils.

Luoma was developed by Alberta Agriculture and Rural Development and registered in 2008. Luoma is an awnletted winter triticale with high yield (10%), high kernel weight (3mg), high test weight (1kg), and good winter survival (15%) compared to the awnletted check Bobcat. It has resistance to leaf and stem rust resistance.

Metzger was developed by Alberta Agriculture and Rural Development and will complete registration in 2009. Metzger is an awnletted winter triticale with high yield (10%), high kernel weight (3mg), high test weight (1kg), and good winter survival compared to the awnletted check Bobcat. It has resistance to leaf and stem rust.

Pika was developed by Alberta Agriculture, Field Crop Development Centre, Lacombe and released in 1990. Pika is similar to Norstar winter wheat in hardiness and higher yielding than Wintri winter triticale. Due to early maturity, Pika may be more suited to seed production in the higher rainfall areas of Alberta than currently available spring triticales. When spring seeded with barley and oat mixtures or seeded on its own Pika provides a high yielding long duration pasture in the high rainfall areas of Alberta. Mixtures with oats and barley also provide a high quality silage and in addition, fall pasture from the Pika regrowth.

Rye Varieties

Fall Rye

AC Remington was developed by Agriculture Canada, Swift Current and was registered in 1998. This semi-dwarf winter rye has improved grain yield (7%), test weight, kernel weight and Hagberg Falling Number over the first semi-dwarf cultivar AC Rifle. Plant height, maturity, and ergot infection is similar to AC Rifle. However, the kernel size is smaller than conventional height varieties but still larger than AC Rifle. This variety has a low frequency of tall plants, but they are not as obvious as AC Rifle.

AC Rifle was developed by Agriculture and Agri-Food Canada Research Station at Swift Current and registered in 1994. AC Rifle is a semi-dwarf rye with excellent levels of winter hardiness and yield potential similar to currently available conventional height winter rye cultivars. This cultivar is suitable for production in the traditional winter rye production areas of the prairies.

Dakota was developed by Agricore United, received interim registration in 1996 and full registration in 2004. It has high yields across the prairies, good winter survival and high falling number. It has slightly low bushel weight. Later maturity than the check varieties. Susceptible to ergot, similar to other fall rye varieties.

Danko was developed by the Polish Plant Breeders, Poznan, Poland and is distributed by Agricore United/Proven Seeds. It is high yielding with very good test weight and 1000 kernel weight and high winter hardiness. Danko is a strong strawed fall rye with intermediate resistance to stem smut.

Hazlet (tested as RT 193) was developed by Agriculture & Agri-Food Canada, Swift Current and recommended for registration in 2004. Yield performance is very good over the check varieties and equal to Dakota. Its test weight is higher than the checks and it has blue colored grain. Lodging ratings are very good with short plant height. Hazlet is susceptible to ergot, similar to other fall rye varieties.

Musketeer was developed by Agriculture and Agri-Food Canada Research station at Swift Current and registered in 1980. Musketeer is a standard height winter rye with excellent levels of winter hardiness similar to check cultivars Frontier and Puma but superior to Kodiak. This cultivar has excellent levels of resistance to disease with the exception of ergot. This cultivar is suitable for production in the traditional rye areas of the western prairies.

Prima was developed by Agriculture and Agri-Food Canada Research station at Swift Current and registered in 1985. Prima has out-yielded the standard check cultivar Musketeer by approximately 9% in the traditional rye production areas of the western prairies. This cultivar has similar disease resistance to other currently grown rye cultivars and is susceptible to stem smut. Prima in intended as a replacement for the cultivar Musketeer in the traditional rye production areas.

RT 178 (name pending) was developed by Agricore/Russian Academy of Agricultural Science and registered in 1999. It is the best yielding fall rye over the last 3 years of Co-op tests. It has good winter hardiness, better lodging resistance than Kodiak or Prima, high falling number and has the dark blue color desired by millers. However, the percent ergot was higher than in most check varieties.

Historical Barley Collection

Barley Variety	Test Number	Year Released In Canada	Where Developed	Characteristics
Charlottetown 80		before 1900	Agriculture Canada, P.E.I.	Two-row, feed
Hannchen		1908	Sweden (Univ. of Saskatchewan)	Two-row, malting
OAC 21		1910	Ontario Agric. College, Guelph	Six-row, malting
Olli		1930	Agriculture Canada, Ottawa	Six-row, malting
Plush		1939	Agriculture Canada, Brandon	Six-row, feed
Sanalta		1940	University of Alberta	Two-row, feed
Warrior		1941	University of Saskatchewan	Six-row, hooded barley
Titan		1943	University of Alberta	Six-row, feed
Montcalm		1945	Macdonald College, Quebec	Six-row, malting
Vantage		1947	Agriculture Canada, Brandon	Six-row, feed
Husky		1953	University of Saskatchewan	Six-row, feed
Vantmore		1954	Agriculture Canada, Brandon	Six-row, feed
Wolfe		1954	Agric. Canada - Lacombe & Ottawa	Six-row, feed
Herta		1956	Sweden	Two-row, feed
Parkland		1956	Agriculture Canada, Brandon	Six-row, malting
Jubilee		1960	University of Saskatchewan	Six-row, feed
Palliser		1960	Agriculture Canada, Lethbridge	Two-row, feed
Betzes		1960	Poland via USA	Two-row, malting
Champlain		1962	Macdonald College, Quebec	Six-row, feed
Gateway 63		1963	University of Alberta	Six-row, malting
Conquest		1965	Agriculture Canada, Brandon	Six-row, malting
Galt		1966	Agriculture Canada, Lethbridge	Six-row, feed
Centennial		1967	University of Alberta	Two-row, feed
Paragon		1968	Agriculture Canada, Brandon	Six-row, malting
Bonanza	BT 308	1970	Agriculture Canada, Brandon	Six-row, malting
Volla		1970	Germany	Two-row, feed
Trent		1972	University of Guelph	Six-row, feed
Hector	TR 502	1973	Agriculture Canada, Lethbridge	Two-row, malting
Windsor		1973	University of Alberta	Six-row, feed
Fairfield		1976	Agriculture Canada, Lethbridge	Two-row, malting
Klondike		1976	Agriculture Canada, Brandon	Six-row, feed
Klages		1977	U.S.A., USDA-ARS, Idaho	Two-row, Malting
Melvin		1977	University of Saskatchewan	Six-row, Feed
Summit		1978	Rothwell/North Amer. Plant Breeders	Two-row, Feed
Elrose		1979	University of Saskatchewan	Two-row, malting
Bedford	BT 330	1979	Agriculture Canada, Brandon	Six-row, feed
Johnston	BT 334	1980	Agriculture Canada, Brandon	Six-row, feed
Norbert	TR 206	1980	Agriculture Canada, Winnipeg	Two-row, feed
Argyle	BT 120	1981	University of Manitoba	Six-row, malting
Harrington	TR 441	1981	University of Saskatchewan	Two-row, malting
Otal	BT 655	1981	USDA-ARS, Alaska	Six-row, feed
Empress	BT 507	1982	Alta. Agric. Crop Research, Lacombe	Six-row, feed
Abee	TR 604	1982	Alta. Agric. Crop Research, Lacombe	Two-row, feed

Barley Variety	Test Number	Year Released In Canada	Where Developed	Characteristics
Diamond	BT 618	1982	Agriculture Canada, Lacombe	Six-row, feed
Leduc	BT 337	1983	Agriculture Canada, Brandon	Six-row, feed
Scout	TR 453	1982	Crop Dev. Centre, Saskatoon	Two-row, hulless
Tupper	BT 445	1984	Crop Dev. Centre, Saskatoon	Six-row, hulless
Heartland	BT 346	1984	Agriculture Canada, Brandon	Six-row, feed
Jackson	BT 657	1984	Agriculture Canada, Beaverlodge	Six-row, feed
Samson	SD 501	1985	Alta. Agric. Crop Research, Lacombe	Semi-dwarf, six-row, feed
Duke	BT 469	1986	Crop Dev. Centre, Saskatoon	Semi-dwarf, six-row, feed
Duece	TR 484	1986	Crop Dev. Centre, Saskatoon	Two-row, feed
Ellice	TR 212	1986	Agriculture Canada, Winnipeg	Two-row, malting
Winchester	BT 914	1986	Alta. Wheat Pool/West. Plt. Breeders	Semi-dwarf, six-row, feed
Noble	BT 518	1987	Alta. Agric. Crop Research, Lacombe	Six-row, feed
Stein	TR 479	1987	Univ. of Saskatchewan, Saskatoon	Two-row, malting
Virden	BT 363	1987	Agriculture Canada, Brandon	Six-row, feed
Condor	TR 607	1988	Alta. Agric., Crop Research, Lacombe	Two-row, hulless
Brier	BT 483	1988	Crop Dev Centre, Saskatoon	Six-row, feed
AC Stacey	BT 663	1988	Agriculture Canada, Beaverlodge	Six-row, feed
B1602	BT 922	1989	Busch Ag. Res./Alberta Wheat Pool	Six-row, malting
Winthrop		1989	W.G. Thompson & Son Ltd.	Two-row, feed
Bridge	TR 544	1990	Agriculture Canada, Lethbridge	Two-row, feed
CDC Richard	TR 307	1990	Crop Dev Centre, Saskatoon	Two-row, hulless
CDC Buck	BT 492	1990	Crop Dev Centre, Saskatoon	Six-row, hulless
Crème	BT 477W	1990	University of Saskatchewan	Six-row, malting
Manley	TR 490	1990	University of Saskatchewan	Two-row, malting
Duel	BT 917	1990	Busch Ag. Res./Alberta Wheat Pool	Six-row, feed
Tankard	BT 477	1990	University of Saskatchewan	Six-row, malting
AC Oxbow	TR 226	1990	Agriculture Canada, Winnipeg	Two-row, malting
B1215	TR 930	1990	Busch Ag. Res./Alberta Wheat Pool	Two-row, malting
CDC Guardian	TR 117	1991	Crop Dev Centre, Saskatoon	Two-row, feed
AC Lacombe	BT 634	1991	Agriculture Canada, Lacombe	Six-row, feed
Seebe	TR 621	1992	Alberta Agriculture, Lacombe	Two-row, feed
Tukwa	SD 503	1992	Alberta Agriculture, Lacombe	Six-row, feed, semi-dwarf
Falcon	HB 501	1992	Alberta Agriculture, Lacombe	6-row, hulless feed, semi-dwarf
AC Albright	BT 670	1992	Agriculture Canada, Beaverlodge	Six-row, feed
Phoenix	HB 602	1993	Alberta Agriculture, Lacombe	Two-row, feed, hulless
CDC Earl	SD 402	1993	Crop Develop't Centre, Saskatoon	Six-row, feed, semi-dwarf
Stetson	SD 903	1994	Western Plant Breeders, Montana	Six-row, feed, semi-dwarf
Kasota	SD 506	1994	Alberta Agriculture, Lacombe	Six-row, feed, semi-dwarf
AC Buffalo	BT 374	1994	Agric. & Agri-Food Canada, Brandon	Six-row, malting
AC Metcalfe	TR 232	1994	Agric.& Agri-Food Canada, Brandon	Two-row, malting
BT 926		1994	Busch Ag. Res./Alberta Wheat Pool	Six-row, malting
Bronco	BT 934	1994	W.G. Thompson & Sons, Ltd.	Six-row, feed
Excel	BT 201	1994	University of Minnesota	Six-row, malting
Robust	BT 200	1994	University of Minnesota	Six-row, malting
CDC Stratus	TR 128	1994	University of Saskatchewan	Two-row, malting
CDC Thompson	TR 129	1994	University of Saskatchewan	Two-row, semi-dwarf, feed
CDC Dolly	TR 318	1994	Crop Dev Centre, Saskatoon	Two-row, feed
CDC Silky	HB 314	1994	Crop Dev Centre, Saskatoon	Six-row, hulless

Barley Variety	Test Number	Year Released In Canada	Where Developed	Characteristics
CDC Candle	HB 313	1994	Crop Dev Centre, Saskatoon	Two-row, hulless, waxy
CDC Dawn	HB 316	1995	Crop Dev Centre, Saskatoon	Two-row, hulless
CDC Kendall	TR 133	1995	University of Saskatchewan	Two-row, malting
HB 803		1995	Alberta Wheat Pool	Two-row, hulless
Merlin	HB 801	1995	Alberta Wheat Pool	Two-row, hulless
AC Harper	BT 704	1996	AAFC, Lethbridge	Six-row, feed
AC Hawkeye	HB 103	1996	Agric.& Agri-Food Canada, Brandon	Six-row, hulless
AC Rosser	BT 377	1996	Agric.& Agri-Food Canada, Brandon	Six-row, feed
CDC Fleet	TR 328	1996	Crop Dev Centre, Saskatoon	Two-row, feed
CDC Sisler	BT 433	1996	University of Saskatchewan	Six-row, malting
Stander	BT 202	1996	University of Minnesota, USA	Six-row, feed
CDC Unity	TR 139	1996	University of Saskatchewan	Two-row, malting
CDC Gainer	HB 326	1997	Crop Dev Centre, Saskatoon	Two-row, hulless
Tercel	HB 605	1997	Alberta Agriculture, Lacombe	Two-row, hulless
AC Bountiful	TR 243	1997	AAFC Winnipeg	Two-row, malting
Foster	BT 204	1997	North Dakota State Univ./UGG	Six-row, malting
Merit	TR 970	1998	Busch Ag Resources/Alberta Pool	Two-row, malting
AC Bacon	HB 105	1998	Agric. & Agri-Food Canada, Brandon	Six-row, hulless
Mahigan	SD 511	1998	Alberta Agriculture, Lacombe	Six-row, semi-dwarf, feed
Jaeger	HB 608	1998	Alberta Agriculture, Lacombe	Six-row, hulless
CDC Freedom	HB 329	1998	Crop Develop't Centre, Saskatoon	Two-row, hulless
CDC Yorkton	BT 459	1999	Univ. of Saskatchewan, Saskatoon	Six-row, malting
CDC Copeland	TR 150	1999	Univ. of Saskatchewan, Saskatoon	Two-row, malting
Peregrine	HB 504	1999	Alberta Agriculture, Lacombe	Six-row, hulless
Niska	SD 513	1999	Alberta Agriculture, Lacombe	Six-row, semi-dwarf, feed
Xena	TR 975	1999	Western Plant Breeders, /Agricore	Two-row, feed
HB 805		1999	Western Plant Breeders, /Agricore	Two-row, hulless
CDC Alamo	HB 340	1999	Crop Dev Centre, Saskatoon	Two-row, hulless, waxy
CDC McGwire	HB 335	1999	Crop Dev Centre, Saskatoon	Two-row, hulless
CDC Speedy	HB 343	1999	Crop Dev Centre, Saskatoon	Two-row, hulless
CDC Bold	SD 422	1999	Crop Dev Centre, Saskatoon	Two-row, semi-dwarf, feed
CDC Helgason	TR 346	2000	Crop Dev Centre, Saskatoon	Two-row, feed
B1202	TR 934	2000	Busch Ag. Resources / Agricore	Two-row, malting
CDC Select	TR 153	2000	University of Saskatchewan	Two-row, malting
Trochu	BT 558	2000	Alberta Agriculture, Lacombe	Six-row, feed
Westford	- - -	2000	Agricore/Western Plant Breeders	Six-row, forage
AC Ranger	EX 467-5	2000	Agric. & Agri-Food Canada, Brandon	Six-row, forage
Dillon	BZ593-159	2000	Agricore/Western Plant Breeders	Six-row, forage
Prowashonupana	HB 903	2000	Western Plant Breeders/ConAgra	Two-row, hulless, food use
Vivar	SD 516	2000	Alberta Agriculture, Lacombe	Six-row, semi-dwarf, feed
CDC Battleford	BT 456	2001	University of Saskatchewan	Six-row, malting
CDC Tisdale	BT 462	2001	University of Saskatchewan	Six-row, malting
Legacy	BT 950	2001	Agricore/Busch Ag. Resources	Six-row, malting
Rivers	TR 256	2001	Agric. & Agri-Food Canada, Brandon	Two-row, feed
Newdale	TR 258	2001	Agric. & Agri-Food Canada, Brandon	Two-row, malting
Conlon	TR 982	2001	N. Dakota State Univ./Cargill	Two-row, malting
Lacey	BT965	2002	Univ. of Minnesota/AAFC, Brandon	Six-row, malting
Tradition	BT 954	2002	Agricore / Busch Agric. Resources	Six-row, malting

Barley Variety	Test Number	Year Released In Canada	Where Developed	Characteristics
CDC Springside	BT 478	2002	Crop Dev Centre, Saskatoon	Six-row, malting
Calder	TR 262	2002	AAFC, Brandon	Two-row, malting
CDC Goodale	TR 166	2002	Crop Develop't Centre, Saskatoon	Two-row, malting
CDC Trey	TR 359	2002	Crop Develop't Centre, Saskatoon	Two-row, feed
Niobe	TR 651	2002	Alberta Agriculture, Lacombe	Two-row, feed
Tyto	HB 513	2002	Alberta Agriculture, Lacombe	Six-row, hulless
Manny	BT 562	2003	Alberta Agriculture, Lacombe	Six-row, feed
Ponoka	TR 01656	2003	Alberta Agriculture, Lacombe	Two-row, feed
McLeod	TR 710	2003	Western Plant Breeders/Agricore	Two-row, feed
CDC Rattan	HB 364	2003	Crop Dev Centre, Saskatoon	Two-row, hulless, waxy
CDC Fibar	HB 373	2003	Crop Dev Centre, Saskatoon	Two-row, hulless, waxy
CDC Clyde	BT 490	2004	University of Saskatchewan	Six-row, malting
Millhouse	HB 109	2004	AAFC, Brandon & Winnipeg	Two-row, hulless, food use
HB 811	HB 811	(2004)	Westbred Plant Breeders, Montana	Two-row, hulless, waxy
Binscarth	FB 006	2004	AAFC, Brandon	Six-row, forage
Stockford	FB 302	2004	Agricore / WestBred, Montana	Two-row, hooded, forage
CDC Cowboy	FB 201	2004	Crop Dev Centre, Saskatoon	Two-row, forage
Sundre	BT 566	2005	Alberta Agriculture, Lacombe	Six-row, feed
CDC Coalition	TR 03373	2005	Crop Development Centre, Saskatoon	Two-row, feed
CDC Aurora Nijo	TR 03903	2005	Sapporo Breweries/ Univ. of Sask.	Two-row, malt (interim reg.)
CDC Laurence	BT 493	2005	University of Saskatchewan	Six-row, malt
Selkirk	BT 970	2005	Proven Seeds	Six-row, malt
Alston	BT 974	2006	Proven Seeds	Six-row, malt
CDC Lophy-I	HB 379	2006	Univ. of Sask./Crop Develop't Centre	Two-row, hulless, low phytate
Enduro	HB 813	2006	Westbred / Proven Seeds	Two-row, hulless, waxy
CDC Mindon	TR 04378	2006	Crop Dev Centre / Univ. of Sask.	Two-row, FHB resistant
Champion	TR 04719	2007	Westbred / Proven Seeds	Two-row, feed
---	HB388	(2007)	CDC / University of Sask	Two-row, hulless
Desperado	FB012	2007	AAFC, Brandon	Six-row, forage
CDC Landis	TR05102	2008	CDC / University of Sask	Two-row, malt
CDC Meredith	TR05104	2008	CDC / University of Sask	Two-row, malt
Bentley	TR05669	2008	FCDC	Two-row, malt
TR05671	TR05671	2008	FCDC	Two-row, malt (interim reg.)
Merit 16	TR05910	2008	Busch Ag Resources	Two-row, malt
Merit 57	TR05911	2008	Busch Ag Resources	Two-row, malt
CDC Reserve	TR05912	2008	Sapporo Breweries / CDC / U of Sask	Two-row, malt
Norman	TR05915	2008	AAFC, Brandon / CDC / U of Sask	Two-row, malt
Chigwell	BT577	2008	FCDC	Six-row, feed
CDC Kamsack	SR410	2008	CDC / University of Sask	Six-row, malt
CDC Mayfair	SR412	2008	CDC / University of Sask	Six-row, malt
CDC Carter	HB390	2008	CDC / University of Sask	Two-row, hulless
CDC Austenson	TR06389	2008	CDC / University of Sask	Two-row, feed
Busby	TR06673	2008	FCDC	Two-row, feed
CDC PolarStar	TR06918	2008	Sapporo / CDC / University of Sask	Two-row, malt (interim reg.)
---	FB313	(2009)	WestBred, LLC/Viterra	Two-row, hooded, forage
---	TR07728	(2009)	WestBred,LLC/Viterra	Two-row, feed
Cerveza	TR06294	(2009)	Agric and Agri-Food Canada, Brandon	Two-row, malt

Historical Barley Collection

Barley Variety	Test Number	Year Released In Canada	Where Developed	Characteristics
Major	TR06297	2009	Agric and Agri-Food Canada, Brandon	Two-row, malt
---	SR420	(2009)	University of Saskatchewan	Six-row, malt
Celebration	BT980	2009	Busch Agric. Resources LLC	Six-row, malt
Stellar-ND	BT984	2009	NDSU Research Found/BAR LLC	Six-row, malt
CDC ExPlus	HB402	2009	CDC/University of Sask.	Two-row, hulless
Taylor	HB705	2009	Agric and Agri-Food Canada, Brandon	Two-row, hulless
---	SR424	2009	University of Saskatchewan	Six-row, malt
CDC Anderson	SR425	2009	University of Saskatchewan	Six-row, malt
CDC Kindersley	TR07114	2010	University of Saskatchewan	Two-row, malt
Gadsby	TR08684	2010	FCDC	Two-row, general purpose
---	HB122	2010	AAFC – Brandon	Two-row, hulless
---	HB08305	2010	CDC / University of Saskatchewan	Two-row, hulless
---	FB817	2010	Westbred / Viterra	Forage barley

( ) Where brackets indicate recommended for registration by the PRCOB, but have not been registered by CFIA.

Historical Wheat Collection

Wheat Variety	Test Number	Released in Canada	Where Developed	Characteristics
Red Fife		about 1885	Peterborough From Danzig, Poland	HRSW
Ladoga		1888	Russia	HRSW
Hard Red		1890	India	HRSW
Stanley		1895	Agriculture Canada, Ottawa	HRSW
Preston		1895	Agriculture Canada, Ottawa	HRSW
Marquis		1910	Agriculture Canada, Ottawa	HRSW
Kitchener		1911	Rosthern, Saskatchewan	HRSW
Karkov 22mc		1912	Macdonald College	HRWW
Prelude		1913	Agriculture Canada, Ottawa	HRSW
Ruby		1920	Agriculture Canada, Ottawa	HRSW
Garnet		1925	Agriculture Canada, Ottawa	HRSW
Red Bobs 222		1926	University of Alberta	HRSW
Reward		1928	Agriculture Canada, Ottawa	HRSW
Early Red Fife		1932	Agriculture Canada, Ottawa	HRSW
Canus		1935	University of Alberta	HRSW
Thatcher		1935	University of Minnesota	HRSW
Rescue		1946	Agric. Canada - Ottawa & Swift Current	HRSW
Saunders		1947	Agriculture Canada, Ottawa	HRSW
Chinook		1952	Agriculture Canada, Ottawa	HRSW
Selkirk		1953	Agriculture Canada, Winnipeg	HRSW
Canthatch		1959	Agriculture Canada, Winnipeg	HRSW
Winalta		1961	Agriculture Canada, Lethbridge	HRWW
Cypress		1962	Agriculture Canada, Lethbridge	HRSW
Park		1963	Agriculture Canada, Lacombe	HRSW
Manitou		1965	Agriculture Canada, Winnipeg	HRSW
Lemhi 62		1968	USDA-ARS Idaho	SWS Wheat
Neepawa		1969	Agriculture Canada, Winnipeg	HRSW
Hercules		1969	Agriculture Canada, Winnipeg	Durum Wheat
Pitic 62		1969	CIMMYT, Mexico	Utility Wheat
Wascana		1971	Agric. Canada - Regina & Swift Current	Durum Wheat
Sundance		1971	Agriculture Canada, Lethbridge	HRWW
Glenlea		1972	University of Manitoba	Extra Strong
Napayo		1972	Agriculture Canada, Winnipeg	HRSW
Springfield		1972	USDA-ARS, Idaho	SWS Wheat
Wakooma		1973	Agric.Canada - Regina & Swift Current	Durum Wheat
Canuck		1974	Agriculture Canada, Swift Current	HRSW
Macoun		1974	Agriculture Canada - Regina & Swift Current	Durum Wheat
Sinton		1975	Agriculture Canada - Regina & Swift Current	HRSW
Chester		1976	Agriculture Canada, Lethbridge	HRSW
Fielder		1976	USDA-ARS, Idaho	SWS Wheat
Coulter		1977	Agriculture Canada, Winnipeg	Durum Wheat
Norstar		1977	Agriculture Canada, Lethbridge	HRWW
Benito		1979	Agriculture Canada, Winnipeg	HRSW
Columbus		1980	Agriculture Canada, Winnipeg	HRSW
Leader		1981	Agriculture Canada, Swift Current	HRSW
Katepwa		1981	Agriculture Canada, Winnipeg	HRSW
Medora		1982	Agriculture Canada, Winnipeg	Durum Wheat
Arcola		1983	University of Saskatchewan	Durum Wheat

Wheat Variety	Test Number	Released in Canada	Where Developed	Characteristics
Kyle	DT375	1984	Agriculture Canada, Swift Current	Durum Wheat
Owens		1984	USDA-ARS, Idaho	SWS Wheat
HY320		1985	Agriculture Canada, Swift Current	CPRS Wheat
Kenyon	BW571	1985	University of Saskatchewan	HRSW
Lancer		1985	Agriculture Canada, Swift Current	HRSW
Sceptre		1985	University of Saskatchewan	Durum Wheat
Blue Sky		1986	Agriculture Canada, Beaverlodge	Utility Wheat
Conway		1986	University of Saskatchewan	HRSW
Laura		1986	Agriculture Canada, Swift Current	HRSW
Leader		1986	Agriculture Canada, Swift Current	HRSW
Roblin		1986	Agriculture Canada, Winnipeg	HRSW
Wild Cat		1986	Agriculture Canada, Beaverlodge	Utility Wheat
Norwin		1986	Montana State University	HRWW
Arcola		1987	Agriculture Canada, Winnipeg	Durum Wheat
Oslo		1987	Saskatchewan Wheat Pool	CPS Wheat (red)
Genesis		1989	Agriculture Canada, Swift Current	CPS Wheat (white)
Biggar		1989	Agriculture Canada, Swift Current	CPS Wheat (red)
Minto		1990	Agriculture Canada, Winnipeg	HRSW
CDC Makwa		1990	Crop Development Centre, Saskatoon	HRSW
Pasqua		1990	Agriculture Canada, Winnipeg	HRSW
Cutler		1990	University of Alberta	CPRS Wheat
Plenty		1990	University of Saskatchewan	Durum Wheat
CDC Kestrel		1990	Crop Development Centre, Saskatoon	HRWW
AC Reed		1991	Agriculture Canada, Lethbridge	SWS Wheat
CDC Teal		1991	Crop Development Centre, Saskatoon	HRSW
AC Taber		1991	Agriculture Canada, Swift Current	CPS Wheat (red)
AC Readymade		1991	Agriculture Canada, Lethbridge	HRWW
CDC Merlin		1992	Crop Development Centre, Saskatoon	HRSW
AC Domain		1992	Agriculture Canada, Winnipeg	HRSW
Invader		1993	AgriPro Biosciences	HRSW
AC Eatonia		1993	Agriculture Canada, Swift Current	HRSW
AC Michael		1993	Agriculture Canada, Lacombe	HRSW
AC Barrie		1994	Agriculture Canada, Swift Current	HRSW
AC Cora		1994	Agriculture & Agri-Food Canada, Winnipeg	HRSW
AC Foremost		1994	AAFC, Swift Current/Lethbridge	CPS Wheat (red)
AC Karma		1994	Agriculture Canada, Swift Current	CPS Wheat (white)
AC Phil		1994	Agriculture & Agri-Food Canada, Lethbridge	SWS Wheat
AC Melita		1994	Agriculture & Agri-Food Canada, Winnipeg	Durum Wheat
AC Majestic		1995	Agriculture & Agri-Food Canada, Winnipeg	HRSW
CDC Bavaria		1995	Crop Development Centre, Saskatoon	Spring Spelt
CDC Osprey		1995	Crop Development Centre, Saskatoon	HRWW
CDC Clair		1995	Crop Development Centre, Saskatoon	HRWW
AC Cadillac		1996	Agriculture & Agri-Food Canada, Lethbridge	HRSW
AC Crystal		1996	Agriculture Canada, Swift Current	CPS Wheat (red)
AC Elsa		1996	Agriculture Canada, Swift Current	HRSW
AC Morse		1996	Agriculture & Agri-Food Canada, Winnipeg	Durum Wheat
AC Splendor		1996	Agriculture & Agri-Food Canada, Winnipeg	HRSW
AC Tempest		1996	Agriculture & Agri-Food Canada, Lethbridge	HRWW
AC Vista		1996	Agriculture Canada, Swift Current	CPS Wheat (white)
Laser		1996	University of Alberta	Extra Strong
AC Avonlea		1997	Agriculture Canada, Swift Current	Durum
AC Intrepid		1997	Agriculture Swift Current	HRSW

Wheat Variety	Test Number	Released in Canada	Where Developed	Characteristics
AC Nanda		1997	Agriculture & Agri-Food Canada, Lethbridge	SWSW
CDC Harrier		1997	Crop Development Centre, Saskatoon	HRWW
McKenzie		1997	Saskatchewan Wheat Pool	HRSW
Prodigy		1998	Saskatchewan Wheat Pool	HRSW
AC Abbey		1998	Agriculture Canada, Swift Current	HRSW
AC Bellatrix		1998	Agriculture & Agri-Food Canada, Lethbridge	HRWW
CDC Falcon		1998	Crop Development Centre, Saskatoon	HRWW
Alikat		1998	University of Alberta	HRSW
AC Pathfinder		1998	Agric. & Agri-Food Canada, Swift Current	Durum (high gluten)
AC Navigator		1998	Agric. & Agri-Food Canada, Swift Current	Durum (high gluten)
Amazon		1998	University of Manitoba	Extra Strong
AC Corinne		1998	Agric. & Agri-Food Canada, Winnipeg	Extra Strong
CDC Bounty	BW 720	1999	Crop Development Centre, Saskatoon	HRSW
5600 HR	BW 238	1999	UGG Research Farm	HRSW
AC Glenavon	ES 13	1999	Agric. & Agri-Food Canada, Winnipeg	Extra Strong
AC Napoleon	DT 494	1999	Agric. & Agri-Food Canada, Winnipeg	Durum
CDC Raptor	S95-4	1999	Crop Development Centre, Saskatoon	HRWW
CDC Ptarmigan	S86-375	1999	Crop Development Centre, Saskatoon	SWWW
5500 HR	BW 245	2000	AgriPro/UGG	HRSW
Superb	BW 252	2000	Agric. & Agri-Food Canada, Winnipeg	HRSW
Kanata	BW 263	2000	Agric. & Agri-Food Canada, Winnipeg	HWSW
Snowbird	BW 264	2000/2006	Agric. & Agri-Food Canada, Winnipeg	HWSW
AC 2000	HY 446	2000	Agric. & Agri-Food Canada, Swift Current	CPS Wheat (white)
HY 639		2000	Agric. & Agri-Food Canada, Swift Current	CPS Wheat (red)
5700 PR	HY 961	2000	AgriPro/UGG	CPS Wheat (red)
AC Meena	SWS 234	2000	Agric. & Agri-Food Canada, Lethbridge	SWSW
AC Andrew	SWS 241	2000	Agric. & Agri-Food Canada, Lethbridge	SWSW (high protein)
CDC Trilogy	BW755	2000	University of Saskatchewan, Saskatoon	
AC Napoleon	DT494	2000	Agriculture & Agri-Food Canada, Winnipeg	
	HY644	2000	Agriculture & Agri-Food Canada, Winipeg	
Journey	BW 243	2001	AgPro / Saskatchewan Wheat Pool	HRSW
5601 HR	BW 256	2001	AgriPro / UGG	HRSW
Harvest	BW 259	2001	Agriculture & Agri-Food Canada, Winnipeg	HRSW
5701 PR	HY 962	2001	AgriPro / UGG	CPSW (Red)
CDC Rama	ES 21	2001	Crop Development Centre, Saskatoon	Extra Strong
Radiant	W 337	2001	Agriculture & Agri-Food Canada, Lethbridge	HRWW
CDC Buteo	S96-33	2001	Crop Development Centre, Saskatoon	HRWW
McClintock	UM 5089	2001	University of Manitoba, Winnipeg	HRWW
CDC Imagine	BW 758	2002	Crop Development Centre, Saskatoon	HRSW
Lovitt	PT 205	2002	Agric. & Agri-Food Canada, Swift Current	HRSW
Peace	PT416	2002	Agric. & Agri-Food Canada, Winnipeg	HRSW
Bhishaj	SWS 285	2002	Agric. & Agri-Food Canada, Lethbridge	SWSW
Lillian	BW 776	2003	AAFC Swift Current & AAFC Winnipeg	HRSW
CDC Go	BW 781	2003	Crop Development Centre, Saskatoon	HRSW
Not registered	PT 559	2003	Crop Development Centre, Saskatoon	HRSW
CDC Osler	PT 555	2003	Crop Development Centre, Saskatoon	HRSW
Strongfield	DT 712	2003	Agriculture & Agri-Food Canada, Swift	Durum
CDC Walrus	ES 41	2003	Crop Development Centre, Saskatoon	Extra Strong
Burnside	ES 54	2003	Agriculture & Agri-Food Canada, Winnipeg	Extra Strong
Commander	DT 722	2004	Agriculture Canada, Swift Current	CWAD
Snowhite 475	HY 475	2004	Agriculture Canada, Swift Current	CPSW
Snowhite 476	HY 476	2004	Agriculture Canada, Swift Current	CPSW

Wheat Variety	Test Number	Released in Canada	Where Developed	Characteristics
5602 HR	BW 297	2004	Agricore United / Proven Seed	CWRS
CDC Alsask	BW 301	2004	University of Saskatchewan	CWRS
Somerset	BW 307	2004	Agriculture & Agri-Food Canada, Winnipeg	CWRS
Infinity	BW 799	2004	AAFC, Swift Current	CWRS
Snowbird	BW 264	2005	AAFC, Winnipeg	HWSW
Helios	PT 211	2005	AAFC, Swift Current	CWRS
	PT425	2005	Agriculture & Agri-Food Canada, Winnipeg	HRSW
	BW 295	2006	Agricore United/Proven Seeds	HRSW
Kane	BW342	2006	Agriculture & Agri-Food Canada, Winnipeg	HRSW
CDC Abound	BW824	2006	Agriculture & Agri-Food Canada, Winnipeg	HRSW
Alvena	PT213	2006	Agric. & Agri-Food Canada, Swift Current	HRSW
Sadash	SWS349	2006	Agriculture & Agri-Food Canada, Lethbridge	SWSW
Snowstar	BW315a	2006	Agriculture & Agri-Food Canada, Winnipeg	
CDC Abound	BW824	2007	University of Saskatchewan, Saskatoon	
CDC Verona	DT540	2008	University of Saskatchewan, Saskatoon	
Peregrine	DH99-37-	2008	University of Saskatchewan, Saskatoon	
Stettler	BW867	2008	Agric. & Agri-Food Canada, Swift Current	
Broadview	W425	2009	Agriculture & Agri-Food Canada, Lethbridge	
Shaw	BW394	2009	Agriculture & Agri-Food Canada, Winnipeg	
	HY682	2009	Agriculture & Agri-Food Canada, Winnipeg	
CDC Thrive	PT575	2009	Agriculture & Agri-Food Canada, Winnipeg	
	W460	2011	Alberta Agriculture Crop Research, Lacombe	

Historical Triticale Collection

Triticale Variety	Test Number	Year released in Canada	Where Developed	Characteristics
Rosner		1972	University of Manitoba, Winnipeg	Spring
Welsh		1977	University of Manitoba, Winnipeg	Spring
OAC Wintri		1980	Ontario Agric. College, Guelph	Winter
Carman		1980	University of Manitoba, Winnipeg	Spring
OAC Triwell		1980	Ontario Agric. College, Guelph	Spring
OAC Decade		1984	Ontario Agric. College, Guelph	Winter
Beagueleta		1986	Agriculture Canada, Charlottetown & CIMMYT	Spring
Wapiti	T44	1987	Alberta Agric., Field Crops, Lacombe, AB	Spring
OAC Trillium		1988	Ontario Agric. College, Guelph	Winter
Frank	T59	1988	Agriculture Canada, Swift Current, SK	Spring
Bura		1989	CIMMYT, Mexico	Spring
Pika	81DE01015	1990	Alberta Agriculture, Field Crops, Lacombe, AB	Winter
Banjo	T72	1991	University of Manitoba, Winnipeg	Spring
AC Copia	T111	1993	Agriculture Canada, Swift Current	Spring
AC Alta	T122	1994	Agriculture & Agri-Food Canada, Swift Current	Spring
AC Certa	T128	1995	Agriculture & Agri-Food Canada, Swift Current	Spring
Pronghorn	T124	1995	Alberta Agric. Crop Research, Lacombe	Spring
Sandro		1998	RAC Swiss Federal Research Station	Spring
Bobcat	88DL01076	1999	Alberta Agriculture Crop Research, Lacombe	Winter
AC Ultima	T150	1999	Agriculture & Agri-Food Canada, Swift Current	Spring
Bunker	T181	2006	Alberta Agriculture Crop Research, Lacombe	Spring
Tyndal	T182	2006	Alberta Agriculture Crop Research, Lacombe	Spring
Luoma	WT004	2008	Alberta Agriculture Crop Research, Lacombe	Winter
Metzger	WT005	2009	Alberta Agriculture Crop Research, Lacombe	Winter
Taza	T198	2010	Alberta Agriculture Crop Research, Lacombe	Spring
	T200	2010	Agriculture & Agri-Food Canada, Swift Current	Spring
	T204	2010	Agriculture & Agri-Food Canada, Lethbridge	Spring