Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada

Brandon Research Centre

1886 – 2011

CELEBRATING 125 YEARS

Canada

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For more information, visit: **www.agr.gc.ca**

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Historic Beginning, Promising Future

The Brandon Research Centre is one of five original agricultural research facilities established by the Government of Canada in 1886. For the first 80 years, this facility was known as the Brandon Experimental Farm. Technologies developed elsewhere were tested for suitability in the prairie environment. Seed of superior crop varieties and stock of superior animal breeds were made available to farmers.

In the early years, 40 varieties of spring wheat were evaluated for improved rust resistance and early maturity. During the period of drought beginning in 1920, experiments were carried out to evaluate new soil conservation methods to minimize soil and moisture loss. With orientation of activities redirected at solving more complex production problems, a need arose for more specialized talent, better laboratories and concentration on a smaller number of agricultural issues.

This change in direction led to the reorganization of the Experimental Farm as the Brandon Research Station in 1966. A long-term beef program was begun in 1969 to evaluate foreign cattle breeds newly imported from Europe. Before 1986, more than 50 per cent of all barley varieties grown in western Canada and over 80 per cent grown on the eastern prairies were developed at Brandon. At the 100-year mark in its history, research at Brandon changed focus to investigate the effects of geographical location, fertilizer form and fertilizer placement on nutrient use efficiency and crop yield for traditional crops and new introductions, such as soybean and flax.

In 1994, the Brandon Research Station was renamed the Brandon Research Centre and it began directing more efforts to studying the effects of farming practices on the environment and developing innovative techniques that could improve soil, meat, feed and seed quality. New projects looked at creating profitable and environmentally sustainable forage-based beef production systems to support the cattle industry.

Other work at Brandon has provided information on the impact of nutrient and waste (manure) management practices and tillage systems on greenhouse gas emission, as well as loss of nitrogen (a gaseous form like ammonia) into the air and accumulation of nitrate, phosphorus and other nutrients in the soil profile. The economic cost of recommended practices has been assessed against the benefit to the environment. Breeding and plant pathology targeting the control of crop pests and emerging crop diseases remain important areas of study.

With its current research land base of 890 hectares plus 445 hectares of leased pasture, the Brandon Research Centre is recognized as a science and innovation leader in the development of integrated agricultural systems to address the production and environmental issues of farmers in the fertile Aspen Parkland Ecoregion of western Canada.

Today, the Brandon Research Centre is an integral part of Agriculture and Agri-Food Canada's network of 19 research centres across the country, united in their goal to provide innovative solutions to the challenges facing Canada's agri-food sector.

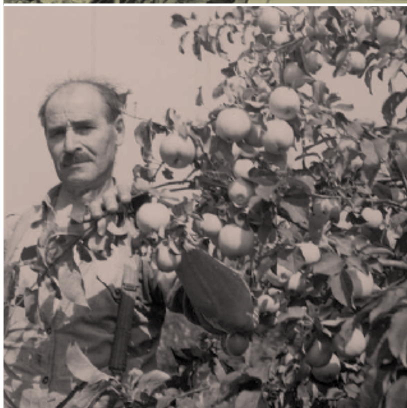
1886 2011

Superintendents, Directors and Research Managers

Brandon Experimental Farm	1886–1965
S.A. Bedford	1888–1905
N. Wolverton	1906–1907
J. Murray	1907–1911
W.C. McKillican	1911–1925
M.J. Tinline	1925–1946
R.M. Hopper	1946–1960
J.E. Andrews	1960–1965
Brandon Research Station	1966–1993
W.N. MacNaughton	1966–1980
B.H. Sonntag	1980–1986
E.E. Swierstra	1986–1991
J.A. Roberston	1991–1993
Brandon Research Centre	1994–present
J.A. Roberston	1994–1996
R.M.N. Kucey	1996–2003
K.M. Volkmar	*Acting* April 1–17, 2004
W.P. McCaughey	*Acting* April 18–July 15, 2004
K.M. Volkmar	*Acting* July 16, 2004–April 1, 2006
F. Selles	2006–2010
R.B. Irvine	*Acting* October 28, 2010–January 31, 2011
A.P. Moulin	*Acting* February 1–April 30, 2011
K.E. Buckley	*Acting* May 1–June 30, 2011
R.B. Irvine	July 2, 2011–present







How Weather and Water Cycles Affect Agriculture

The year 2011 marks the start of research programs in agro-micrometeorology and agro-hydrology at the Brandon Research Centre. New scientists will study both lateral and vertical fluxes of important elements like carbon, nitrogen, phosphorus and micronutrients, as well as air- and water-borne synthetic contaminants.

"Our research will identify how land-use practices influence both the size and chemical form of these fluxes," says Dr. Aaron Glenn, agro-micrometeorology scientist at Brandon. Lateral fluxes refer to the movement of material with water through the soil, groundwater and downstream aquatic systems, while vertical fluxes refer to mass and energy exchange between the soil and atmosphere.

Dr. Glenn explains, "Spatial studies will be used to examine whether different parts of the landscape, such as wetlands, riparian areas, hill slopes and shelterbelts, act as "hotspots" of elemental cycling – adding to, transforming or removing nutrients and contaminants in the air and water."

Additional studies will determine the influence of climate and hydrology on crop physiology and biomass production and look at the interactions between canopy microclimates and plant water/nutrient-use efficiency. This work will help farmers manage extremes in weather and water levels to minimize the impact and risk associated with crop and animal production on the eastern Prairies.

Dr. Henry Wilson, agro-hydrology scientist at Brandon, adds, "Other new research will identify how the water cycle and fluxes in liquid water, water vapour and snow are influenced by land-use change and beneficial management practices on scales ranging from individual plants and local soils to agro-ecosystems to entire watersheds and airsheds."

Dr. Wilson plans to examine potential changes in surface energy balance and biogeochemical transformations that are associated with the addition of perennial crops in rotational systems. He will look at the effects of varying tillage intensity and timing, as well as incorporating cover crops and fall/winter crops. He will also evaluate the use of low head dams for water storage and flood mitigation and the maintenance of wetlands in the landscape as beneficial management practices.

There will be detailed analyses of wetland type, wetland landscape position, drainage and water level management on greenhouse gas emissions, water, energy and nutrient fluxes from the Parkland agricultural landscape. Retrospective studies may make use of historical land-use, meteorological and hydrological datasets that have been collected over the last century to identify the extent to which land-use and climate change may interact to influence water levels and overland flooding.

Beef Gets Omega-3 Boost by Adding Flax to Cattle Diets

As the popularity of omega-3 fatty acids in our diet continues to grow, Agriculture and Agri-Food Canada beef scientists are working to emulate the way pork, poultry and eggs can be enriched by feeding flax to cattle.

Omega-3 polyunsaturated fatty acids are known to be associated with heart health in humans and are being studied for other possible benefits, such as enhancing the immune system and reducing the risk of developing some cancers. A proven way of boosting the omega-3 content of food products is supplementing animal diets with flax, one of the richest sources of plant-based omega-3.

"Previous studies on flax-fed beef found that if you add flax to cattle diets, you can get significant increases in omega-3 fatty acids," says Dr. Hushton Block, beef scientist at the Brandon Research Centre. "However, the challenge is getting the omega-3 levels high enough consistently to label the meat as a source of fat that is good for you." To make this claim, Health Canada specifies that the meat must contain 300 milligrams or more of omega-3 polyunsaturated fatty acids per 100-gram serving.

Feeding diets containing flaxseed is not a straightforward process. There are limits to the amount of flax that can be fed before it starts to have a negative impact on animal growth and feed utilization. Diets with more than six to eight per cent flax meal can actually disrupt the process of fermentation in the rumen, or stomach.

A potential solution to falling short of label requirements is to extend the feeding period over which cattle receive omega-3 supplementation and thereby increase the total amount of omega-3 fatty acids consumed and available for incorporation into beef tissue. Earlier research, which did not result in a high enough omega-3 level, included flax at the maximum recommended rates (six to eight per cent added fat) for 60 to 100 days in a conventional feedlot production system.

At Brandon, Dr. Block has evaluated the effect of extending the flax supplementation period to 250 days. He looked at the impact on cattle growth, carcass characteristics, fatty acid profile and meat sensory traits like aroma, tenderness, juiciness and flavour. To slow the normal rate of fattening in cattle and allow the added flax to have a proportionately greater effect on the fatty acid profile of beef, the animals on test received a high-forage diet.

Dr. Block found that long-term supplementation of cattle with flax did increase the omega-3 fatty acid profile of beef with little impact on cattle growth, carcass characteristics or meat sensory traits. Unfortunately, the increases in omega-3 content of beef were not as high as he hoped and the health claim could only have been made for cuts having a fat content similar to regular ground beef. However, there was a surprise with results from the fatty acid analyses.

"The exciting part," notes Dr. Block, "was the elevated level of vaccenic acid. We got somewhere in the range of eight to nine times of what was present in the control."

Vaccenic acid is a product resulting from 'biohydrogenation' of alpha-linolenic fatty acid, the main omega-3 fatty acid in flax. Biohydrogenation occurs when microbes in the rumen of cattle try to saturate the alpha-linolenic fatty acid with hydrogen molecules before the fatty acids are available for uptake by the animal.

The human health benefits of vaccenic acid are just beginning to be explored. As reported in a number of scientific journals, recent medical research indicates that it may reduce triglycerides, LDL (low-density lipoprotein) cholesterol and total cholesterol in the bloodstream.

Dr. Block will continue his research efforts aimed at enriching the omega-3 content of beef. The increase he found in vaccenic acid content also explains why long-term supplementation with flax was not as successful as expected at raising the levels of omega-3. The omega-3 fatty acids consumed by cattle were being diverted to vaccenic acid.

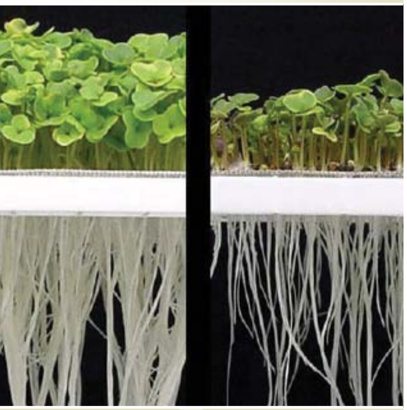
He is working with scientists at AAFC's Lacombe Research Centre in Alberta to evaluate other strategies in addition to long-term flax feeding, including further diet modifications. The implications for consumers could be the health benefits afforded by enriched beef products; for producers, new and potentially lucrative niche markets.

Canola Seed Vigor – Quick Tests Take its Measure

Scientists at the Brandon Research Centre have developed quick tests that can reliably measure vigor loss in canola seed within 24 hours. The new canola assays are useful when making decisions about seed selection at any stage of harvest, storage, processing and marketing. They are important risk reduction tools for farmers when used to check the quality of seed before planting.

Loss of vigor can reduce seedling emergence, crop establishment and possibly crop yield. Vigor loss is caused by aging, which may be accelerated by poor seed quality, poor storage conditions and pesticide seed treatments. The new tests identify seed that is not likely to perform as well as high-quality seed of the same variety.

The assays work by detecting gaseous ethanol (ethyl alcohol) given off by deteriorated seed. There are two assays: an on-farm colour test and an instrumental laboratory test. The colour version identifies two seed quality categories – good and deteriorated. The instrumental version utilizes modified breathalysers and yields quantitative values that place seed within a four-category vigor scale – good, fair, poor and very poor. The assays are easy to use and can be run with all types of canola seed, including bare and pesticide-treated seed.

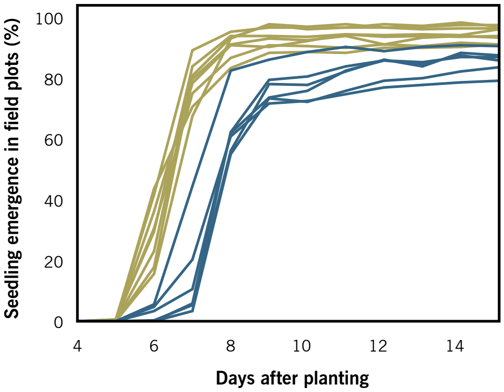


"We have found good correlations between color assay results, instrumental assay results and the growth of seedlings in the laboratory and the emergence and growth of seedlings in the field," says Dr. Wayne Buckley, biochemist at Brandon.

The colour assay gives very few false positives, which means that it is very accurate in identifying high-quality seed. Failure to pass the colour test, though, indicates a risk of poor seedling establishment and a 79 per cent chance that the seed has less than 90 per cent official germination.

In a recent survey, 11 per cent of canola seed planted by growers failed the colour test, while seven per cent fell into the fair vigor category and 5 per cent fell into the poor or very poor categories when analyzed with the instrumental test.

Emergence of high- and low-vigor canola seed in field plots (line colour shows colour assay result)



Feeding Your Potatoes with Just the Right Amount of Nitrogen at the Right Time

Nitrogen is frequently a limiting nutrient in crop production. Irrigated potato systems require adequate levels of nitrogen to optimize crop yield and quality and economic returns to growers.

Nitrogen is supplied to the plant by a combination of three sources: as commercial or organic fertilizer and from the soil as inorganic nitrogen or through nitrogen mineralization; that is, the breakdown of organic residues to form nitrogen compounds that can be used by plants.

While growers can control the amount of fertilizer nitrogen applied, and soil inorganic nitrogen can be estimated through soil testing, soil nitrogen mineralization remains difficult to predict.

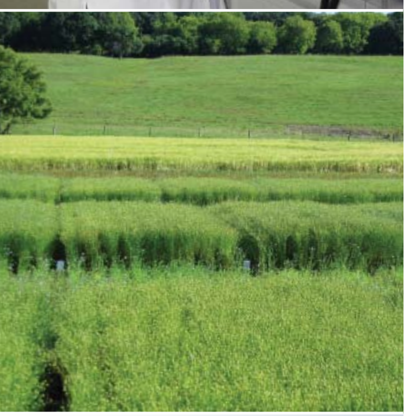
Dr. Ramona Mohr, agronomist at the Brandon Research Centre, has initiated a three-year study to gain a better understanding of nitrogen dynamics in irrigated potato systems and the factors affecting crop nitrogen demand and soil nitrogen supply. This study is being supported by Agriculture and Agri-Food Canada's Sustainable Agriculture Environmental Systems (SAGES) initiative and the Agri-Environment Services Branch. SAGES aims to improve the scientific knowledge of agriculture's interaction with the environment.

"Better matching nitrogen supply with crop nitrogen demand, both in terms of quantity and timing," says Dr. Mohr, "has the potential to reduce nitrogen losses into the environment and to improve nitrogen use efficiency by the crop."

Dr. Mohr and her collaborators are now into their second year of investigations at a field site near Carberry, Manitoba. The team includes scientists from the Brandon Research Centre, AAFC's Potato Research Centre in Fredericton, New Brunswick, and from the Canada-Manitoba Crop Diversification Centre and Manitoba Agriculture, Food and Rural Initiatives Office – both in Carberry.

By measuring a prescribed set of crop, soil and weather variables, the researchers hope to answer such questions as: How do nitrogen rate, timing and source affect potato yield and quality? Which tools and/or tests can best be used to determine the nitrogen status of the potato crop during the growing season? How do weather conditions, soil characteristics and farming practices impact nitrogen utilization by crops and soil nitrogen status?

Producers will benefit through the development of economically and environmentally sustainable nitrogen management strategies suited to Manitoba's unique soil and climatic conditions. Use of these new and improved practices will contribute to the long-term viability of the processing potato industry in Manitoba.



Managing Cadmium in Western Canadian Soils

Canada is recognized worldwide for providing a leadership role in identifying the environmental and health hazards of metal-containing substances like cadmium, zinc and other trace elements. Our scientific breakthroughs contribute to ongoing improvements in risk assessment and mitigation.

Since the 1990s, Dr. Cynthia Grant, soil scientist at the Brandon Research Centre, has served as principal investigator for a host of projects evaluating the long-term fate of cadmium in fertilizers on different agricultural soils and the effects of farm management practices on cadmium accumulation in crops and soils.

Cadmium is a potentially harmful, trace element that can be transferred from soils to humans through the food chain. It occurs naturally in extremely small amounts in all soils and is also present as a contaminant in phosphorus fertilizers. Existing regulations control allowable trace element levels in fertilizers.

Previous research has shown that repeated applications of cadmium in phosphorus fertilizers may increase the cadmium levels in soils and possibly raise the cadmium content of crops. However, the bioavailability of cadmium added to soils in this way will vary with soil characteristics, such as texture, pH, salinity and the presence of other elements like zinc, iron and chlorine.

In one of her latest studies, Dr. Grant looked at the effect of eight annual (from 2002 to 2009) applications of phosphorus fertilizer at seven field sites across the Canadian Prairies. She tested three different commercial sources of monoammonium phosphate, varying in their cadmium concentration, and three different rates of application on crop rotations of durum wheat and flax.

She found that cadmium levels increased in the surface 7.5 cm of soil with annual applications of phosphorus fertilizer containing moderate or high concentrations of cadmium. Increases deeper in the soil profile (7.5 to 15 cm from the surface) occurred only if the phosphorus fertilizer contained a high concentration of cadmium. She also found that the cadmium content of durum wheat and flax increased with cadmium accumulation through phosphorus fertilization. However, the results varied across soils and environments, based on the nature of the soil.

"Cadmium accumulation in both the soil and crop was affected by soil characteristics," says Dr. Grant, "so it is important to consider these characteristics when assessing risks from adding cadmium into soils."

Dr. Grant and her collaborators are pursuing this study for another two years. The team includes scientists from AAFC's Brandon Research Centre, Melfort Research Farm and Lethbridge Research Centre, the University of Manitoba and Alberta Agriculture, Food and Rural Development.

No more fertilizer will be applied to the field sites being cropped, and the researchers will continue monitoring cadmium levels to determine the residual impact of cadmium added from phosphorus fertilizers. The findings will provide more information about the persistence of cadmium and phosphorus, and their availability to plants, in the long term. The scientists will also investigate the effectiveness of various soil tests for predicting the bioavailability of cadmium and phosphorus and the risk of their movement into surface water.

"We believe our results will lead to new agronomic practices and environmental indicators," adds Dr. Grant, "that may prevent soil and water degradation and potential loss of crop quality over time."

This study has been supported by a range of agencies in the years since it began, including the International Plant Nutrition Institute, Westco Fertilizers Ltd., Agrium Inc. and the Metals in the Human Environment Research Network (a collaboration of academia, government and industry in Canada that conducts research in support of science-based environmental and human health risk assessments for metals in water, soil and food). It is currently being funded by the Alberta Crop Industry Development Fund and the Agri-Food Research and Development Initiative.

Variable Rate Application Can Help Producers Farm More Efficiently

As a relatively recent innovation, variable rate application of fertilizers and pesticides is revolutionizing the way Prairie farmers manage their soils and grow their crops. The technology was introduced in the 1990s and is becoming more common in crop production.

Farmers are evaluating the costs and benefits of adopting variable rate application for their operations, especially in light of recent increases in the cost of fertilizers and other crop inputs. On one side of the ledger is their investment in remote-sensing data, yield maps and electronic controllers to automatically change the amounts of crop input applied according to pre-defined rates.

But, on the other hand, there are real opportunities to maximize crop yield. And there are potential benefits in terms of improvements in health of the crop and soil and quality of the surface and ground water. Crop inputs would be applied according to the plant needs across the entire field rather than the average of the field.

Dr. Alan Moulin, soil scientist at the Brandon Research Centre, recently completed a study northwest of Carberry, Manitoba, to look at irrigated potato production under variable nitrogen management. This study involved scientists at AAFC's Horticultural Research and Development Centre in Saint-Jean-sur-Richelieu, Quebec, and Southern Crop Protection and Food Research Centre in London, Ontario, plus the Agricultural Research Organization in Israel.

The objectives were three-fold. The first was to develop a method of applying nitrogen fertilizer at variable rates that was based on remote-sensing data associated with crop production in different parts of the field (including hill slopes and wet areas) and on light-reflectance data from ground-based sensors. The second was to assess the potential value of splitting nitrogen application over the growing season. The third was to establish the relationship between nitrogen status of the potato crop, reflectance of light by plant leaves as measured by ground-based sensors and yield data collected from the research plots.

Dr. Moulin and his collaborators found that there was no clear trend regarding the effect of landform on potato yield. Nitrogen fertilizer increased both the total and marketable yield of potatoes at rates from 75 to 225 kilograms per hectare. Split application of nitrogen at seeding and midway through the growing season did not provide a significant advantage over single application at seeding, likely due to the short growing season in western Canada. The researchers observed no significant interactions between landform and fertilizer rate or timing of application.

The concentration of nitrogen in potato leaf tissue (specifically, the petiole leaflet) proved to be a good predictor of yield potential. All sensor readings were significantly related to leaf nitrogen content and were affected by fertilizer application. However, a research tool called a spectroradiometer was better at predicting leaf nitrogen content than both the commercially-available contact and non-contact sensors which Dr. Moulin tested. The spectroradiometer is a type of non-contact sensor that can measure light reflectance over a wide range of wavelengths – from 350 to 1,050 nanometres.

"We believe technology providing non-contact estimates of petiole nitrogen, and with that indications of possible yield, could be used to determine nitrogen-deficient areas in individual fields, says Dr. Moulin. "When this information is collected over time, producers could map out fertilizer management zones with higher potential yield."

Working Together to Build a Better Barley

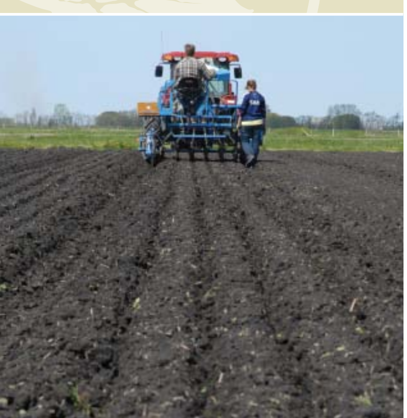
The Brandon Research Centre has established an international reputation for its barley-breeding efforts and its line-up of top-performing barley varieties. Together with farmers' investment through the Western Grains Research Foundation, scientists here have helped to make Canadian farms some of the most productive in the world.

Since 1939, the centre's barley breeders have developed and released 34 varieties for the malting, feed and hulless markets with improvements in disease resistance, agronomic performance and malting quality or nutritive value. Collectively, these superior traits have given Canadian barleys a competitive edge at home and abroad.

The ongoing challenge for breeders in developing new varieties is to make a needed improvement without affecting the desirable traits that already exist. For example, consider the problem farmers may have with pre-harvest sprouting in malting barley.

Some malting barley varieties have a greater propensity to germinate than others under wet conditions during crop maturation through harvest. This compromises the likelihood of the crop being selected for malting purposes by the beer industry.

Although the barley is still alive, once pre-harvest germination has occurred, the barley will never perform optimally in the malt house, compromising malt quality. While long-term dormancy is not desirable, it is recognized that some resistance to pre-harvest sprouting is required to ensure barley quality under a wide range of harvest conditions.



Dr. Bill Legge, barley breeder at Brandon, has been looking into the genetic control of pre-harvest sprouting or the rate of dormancy release. A recent study was undertaken with colleagues from the Grain Research Laboratory at the Canadian Grain Commission and the Crop Development Centre at the University of Saskatchewan.

Using a known genetic marker and agronomic data, the researchers were able develop a number of barley lines which combine the 'Baudin' source of resistance to pre-harvest sprouting (found in the Australian varieties Chebec and Stirling) with the levels of malting quality that approach TR253 and AC Metcalfe (currently the dominant two-row malting barley in North America).

"Through further breeding and testing," says Dr. Legge, "it should be feasible to produce high-quality malting barley varieties similar to current Canadian standards but that do not sprout in the swath when the weather turns wet before harvest."

Barley Varieties Developed at Brandon Research Centre

2011	Roseland	two-row hulless food
2010	Cerveza	two-row malting
2009	Taylor	two-row hulless malting
2009	Major	two-row malting
2009	Norman	two-row malting
2008	Desperado	six-row forage or feed
2006	Binscarth	six-row forage
2006	Millhouse	two-row hulless milling
2002	Rivers	two-row feed
2002	Calder	two-row malting
2001	Newdale	two-row malting
2001	AC Ranger	six-row forage or feed
1999	AC Bountiful	two-row malting
1999	Black Bart	six-row black-hooded sheep fodder (in New Zealand)
1998	AC Bacon	six-row hulless feed
1997	AC Metcalfe	two-row malting
1996	AC Rosser	six-row feed
1996	AC Hawkeye	six-row hulless feed
1994	AC Buffalo	six-row white-aleurone malting
1993	TR229	two-row malting
1986	Virden	six-row forage
1984	Heartland	six-row feed
1981	Leduc	six-row feed
1980	Johnston	six-row feed
1979	Bedford	six-row feed
1976	Klondike	six-row feed
1970	Bonanza	six-row blue-aleurone malting
1967	Paragon	six-row blue-aleurone malting
1965	Conquest	six-row blue-aleurone malting
1961	Keystone	six-row feed
1956	Parkland	six-row blue-aleurone malting
1954	Vantmore	six-row feed
1947	Vantage	six-row feed
1939	Plush	six-row feed