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Indian Head Research Farm

1886 - 2011

Inside:

Canada

History of Indian Head Research Farm

As one of the original five experimental farms established in 1886 by the Federal Government, the Indian Head Research Farm continues to play a vital role in supporting Canada's agriculture industry in matters of seed production, variety development and evaluation, and soil and crop management research. As well as meeting producer needs, the Indian Head Research Farm has broadened its scope to include studies on the sustainability of our soil resource, which is becoming increasingly important to the general public. Good soil management is imperative if we are to meet the world's future needs for food.

The early history of this facility at Indian Head, Saskatchewan, focused on providing immediate support to the settlers moving west, many of whom had little farming experience but were attracted to the region by the new opportunities offered to them. Scientists adapted crops and species (cereal grains, oilseeds, vegetables, fruit trees and perennial forage species) to make them better suited to the area and developed their knowledge of soil management and crop production. The research farm also gave settlers information about animal care and nutrition and access to the best available genetics for horses, beef and dairy cattle, hogs and chickens. During the Depression, Indian Head became the key research farm to combat blowing soil from the dust bowl on the Canadian Prairies.

In 1972, the Indian Head Research Farm was linked to the Regina Research Centre. In 1983, the new director in Regina saw the excellent research opportunities at Indian Head with its buildings, a large, productive land base and a willing and capable staff and set about building the science programs there.

These efforts coincided with the release of Soils at Risk, Canada's Eroding Future in 1984 by the Senate Standing Committee on Agriculture, Fisheries and Forestry, which heightened Canadians' awareness of the serious issue of soil degradation. This led to federal-provincial initiatives that brought additional resources and public support to Indian Head.

It was well-recognized that the key to protecting soils from wind and water erosion was standing stubble and surface residue, practices that resulted in better soil moisture conservation and long-term improvements in soil quality. There was an urgent need to develop crop production practices to capitalize on this newfound knowledge. Other programs, such as the National Soil Conservation Program in 1989, provided funding not only to scientists to conduct research activities but also to producer groups to allow first-hand opportunities to try these new production practices.

In 1984, the Seed Increase Unit was transferred from Regina to Indian Head and in 1992, it became one of the first seed establishments in Canada to employ a digitized seed inventory system when a commercial programmer was engaged to develop such an application. The closure of the Regina Research Centre in 1992 resulted in the transfer of two field research programs to Indian Head. That same year, the research farm was linked to the Semiarid Prairie Agricultural Research Centre in Swift Current, Saskatchewan.

Because soils and crops research will always be critical to food production, the Indian Head Research Farm continues to evaluate technologies and solve soil and crop management problems. It owns and operates 1,200 acres of arable land serving three programs: the Seed Increase Unit, the Arid Prairie Wheat Breeding Program and the Agronomy Research Program. The Indian Head Research Farm continues to support the agricultural industry and its producers by actively participating in the network of departmental sites in western Canada. In 2010, the Agronomy Research Program ran 100 field trials and included 15 different crops.

The Indian Head Research Farm remains an important site for agronomy research, variety development and seed production. The current structure allows for the evaluation and development of technologies at the small-plot, large-plot and field-scale level, making Indian Head unique among Agriculture and Agri-Food Canada's research facilities. As a result of its large land base and easy access to additional land in close proximity, the Indian Head Research Farm is also well-positioned to provide leadership in the development and testing of future applications in robotics, remote sensing, harvest management, grain storage technology, cropping systems and cultivar development and testing at different scales of production.

Seed Increase Unit

What happens once researchers discover a new seed variety? How do a few seeds in the lab turn into fields of growing crops?

The Seed Increase Unit (SIU) at the Indian Head Research Farm is key, with a national mandate to produce, maintain and distribute breeder seed of crop varieties developed by AAFC plant breeders and to co-ordinate winter nursery activities for the Research Branch.

Successful varieties of durum, wheat, oats, barley, flax, pulses and other crops developed by AAFC researchers are sent to Indian Head for propagation. The SIU rapidly propagates breeder seed of these newly introduced cultivars and then distributes it to pedigreed seed growers, who in turn grow the varieties and sell them to farmers as certified seed.

The SIU propagates these varieties on breeder plots at the Indian Head Research Farm and in off-season locations in New Zealand and California.

"We use winter increases for several reasons," says Dave Gehl, who is responsible for the SIU. "To increase seed for planting trials the following year, to enable segregation so that the seeds are genetically more uniform, to make field selections based on agronomic characteristics and disease resistance, and for us in Canada, to develop valuable breeder seed and recover from catastrophic failure as caused by adverse weather."

Because of the amount of seed they handle, in 1992, the SIU began using a digitized seed inventory becoming one of the first seed establishments in Canada to employ such a system.

And because there is a chance of introducing local seed-borne pathogens into the breeder seed, which could then be spread, the SIU has to ensure that their seed is disease-free.

So for three years, starting in 2000, the SIU employed dry heat treatment to eradicate seed-borne fusaria on infested cereal lots using a large sample drier at Indian Head. A dedicated walk-in oven was installed three years later, making the SIU the first seed operation in Canada to use this method routinely.

Today, the SIU is an officially certified "registered seed establishment," meaning that it complies with rigorous quality control standards. It has also served as a model for the Canadian seed industry in the development of quality assurance systems.

"The SIU is the largest single source of breeder seed in the Canadian pedigreed seed system," notes Mr. Gehl.

The SIU's current inventory includes more than 300 registered varieties of 42 crop kinds reflecting AAFC's pre-eminent role in plant breeding of field crops. These crops include cereals, oilseeds, pulses, forage legumes, grasses and special crops. The unit has produced more than 900 breeder seed lots since 1990, which have formed the basis of pedigreed seed production of these varieties and subsequent commercial production on millions of acres across Canada.

When Less Means More: No-till Helps Make Modern Agriculture Sustainable

As a relatively recent innovation, no-till farming has revolutionized the way Prairie farmers manage their soils and grow their crops. Although its widespread adoption in western Canada did not take hold until the late 1980s and early 1990s, the seeds of change were sown in the 1930s. It was during this period – the so-called Dirty 30s – that Canadians became aware of just how vulnerable the soil resource is.

No-till farming is a system where the soil is not mechanically tilled and seeding and fertilizing are done with as little soil disturbance as possible. It is a technology that has proven itself as both environmentally responsible and economically beneficial.

Ongoing efforts at the Indian Head Research Farm have been instrumental in documenting and promoting the positive effects of no-till. The scientists have conducted a number of long-term studies to compare different tillage methods, crop rotations and crop types for their effects on crop production, as well as soil fertility and health. They looked at no-till and minimum-till systems versus conventional tillage and crop rotations with spring wheat, winter wheat, field peas, flax and fallow (unseeded).

What they found was that changes in tillage methods and crop rotations had no adverse effects on crop establishment. Grain yields were higher for all crops with no-till, except for winter wheat which was always seeded with no-till. This yield advantage was attributed to the extra soil water conserved under no-till, especially in the top 30 centimetres of the soil.

The research team also observed that under no-till flax used water more efficiently. It would appear that the lack of soil disturbance with no-till has a positive effect on certain soil fungi which form a mutually beneficial relationship with flax roots, aiding in water and nutrient uptake.

“These are comprehensive studies,” says Dr. Guy Lafond, Lead Scientist and Production Systems Agronomist at Indian Head. “We collected a lot of data for more than a decade and discovered no significant interaction between tillage system and year and no interaction at all between tillage system and crop rotation.”

He adds, “Our findings offer solid evidence that the benefits of no-till occur over a wide range of growing conditions and that knowledge developed under conventional tillage management also applies to no-till management.”

Some of the research looked further into the effects of many years of continuous cropping under no-till management. The objective was to compare changes in soil quality characteristics and also crop responses to applications of nitrogen fertilizer.

For this study, the Indian Head Research Farm had two adjacent fields being managed under no-till -- one for 31 years and the other for nine years. A piece of native prairie was included to provide a benchmark reflecting the changes which have occurred in soil quality with cultivation.

The researchers found that overall yields of spring wheat and canola were 14 and 16 per cent higher, respectively, in the field under long-term no-till rather than short-term no-till. They related this difference to the long-term no-till field having higher levels of soil organic carbon and nitrogen which can change into plant-available forms.

“The Indian Head Research Farm is the first science organization to actually measure the long-term benefits of no-till,” says Dr. Lafond. “The results support the view that no-till production systems, combined with continuous cropping and proper fertility management, are essential to sustaining the soil resource and meeting the long-term demand for food, feed, fibre and fuel around the world.”

Dr. Lafond and his team suggest that, under favourable climatic conditions, long-term no-till will make more nitrogen available for crop growth and support higher grain yields and grain protein levels. Farmers will be able to achieve these higher grain yields without necessarily having to add more crop inputs like fertilizer. Over time, further increases in soil productivity are still possible with no-till. ▶

No-till is being practised on roughly 45 million hectares worldwide, with most occurring in North and South America. The rate of adoption is expected to continue growing as farmers seek ways to minimize their environmental footprint without compromising farm profitability. The Food and Agriculture Organization of the United Nations is now actively involved in promoting minimal soil disturbance along with permanent soil cover and crop rotations as "the three principles of Conservation Agriculture" to achieve sustainable and profitable agriculture and to meet global food needs.

Innovative Approaches to Nitrogen Fertilizer Management

Providing an adequate supply of essential plant nutrients has a major impact on crop yields. Nitrogen is the most limiting nutrient to crop production on the Canadian Prairies. Improper management of nitrogen fertilizers can have detrimental effects on the environment, such as leaching of nitrates into ground water, contamination of surface waters with organic and inorganic forms of nitrogen and the unnecessary production of nitrous oxide – a greenhouse gas that is 300 times more potent than carbon dioxide.

There are four key components to nitrogen fertilizer management which include form, placement, timing and rate. Research on the Prairies has provided answers to most crop production questions pertaining to nitrogen form, placement and timing. Arriving at the correct nitrogen rate still remains a big challenge for producers and the research community.

Since 2004, the Agronomy Research Program at Indian Head has been leading an initiative to help determine a more optimal nitrogen rate that takes into account the crops grown, the fertility of a field based on its previous management, soil texture and geographical location.

For example, soils at the Indian Head Research Farm hold about 3,382 to 3,560 pounds of nitrogen per acre to a depth of six inches. If the soil temperature and soil moisture conditions are optimal for nutrient cycling, research may show that one to two per cent of the organic nitrogen present could be changed into plant-available forms.

The new approach being tested by Dr. Guy Lafond and his team involves estimating crop biomass at about halfway through the growing season (the five to six-leaf stage in cereals or the mid-bolting stage in canola) and predicting grain yield potential from these measurements. The estimations are done using an active optical sensor mounted on a sprayer that emits light in a narrow band and determines the Non-Difference Vegetative Index (NDVI). If one can estimate grain yield potential early in the growing season, one can decide if enough nitrogen is available to the crop to reach that potential.

The efforts at Indian Head have investigated the relationships to predict yield potential from NDVI readings in canola, spring wheat, barley, oats, durum and winter wheat. The relationships have been determined for canola and spring wheat and are now commercially available. More research is under way to develop the relationships for the other crops.

"The advantage of this approach," says Dr. Lafond, "is that it allows for real-time measurements of yield potential and the simultaneous application of additional nitrogen, if required, while taking into consideration soil temperatures, moisture conditions and natural variations across the field."

"Plants are very good at integrating what they have experienced in terms of climatic conditions and nutrient availability."

The new technology is being adopted by producers as a way to apply nitrogen fertilizer more efficiently across their fields.

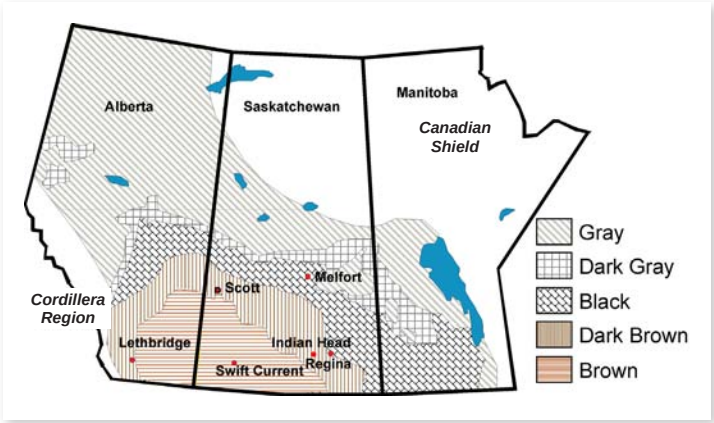
Indian Head Research Farm's Role in SPARC's Wheat Program

Durum and Canada Western Hard Red Spring Wheat are the highest valued wheats in the world, and Canada is a major world wheat trader. A major portion of these crops are based on cultivars developed through Agriculture and Agri-Food Canada's Semiarid Prairie Agricultural Research Centre (SPARC) Wheat Program, headquartered in Swift Current.

The SPARC Wheat Program – formally the Arid Prairie Wheat Breeding Program – exists to breed improved varieties of wheat and durum.

The program's research area encompasses the arid and semi-arid regions of the Brown and Dark Brown and thin Black soil zones, which represent about 40% of the cultivated area of Canada.

Because there is a progression in aridity from Indian Head to Regina to Swift Current, all three locations are very important for variety development.



The Indian Head Research Farm is the principal off-station location for testing early-generation common wheat lines, and the Regina Research Farm is the principal second location for durum lines.

Both Indian Head and Regina play an important role in adaptation testing of eight other crops, serving up to nine AAFC research studies as well as other projects. The two groups each efficiently grow and process more than 17,000 plots per year with five-person crews.

"In order to develop wheat and durum varieties that would thrive on different types of soil, the Research Centre in Swift Current utilizes test sites in multiple locations," notes Dr. Ron De Pauw, wheat breeder at SPARC. "Their importance cannot be overstated."

The benefit of western Canadian wheat varieties compared to their development costs has been estimated to be greater than 4 to 1.

Over the years, testing cultivars in different soils allowed researchers to advance Canada's most prolific durum varieties, Wascana, Wakooma, Kyle, Avonlea and Strongfield.

AC Barrie and Lillian, developed by the SPARC wheat program, were the most widely grown Canada Western Hard Red Spring wheat varieties in Canada for most of the last 13 years. Yet despite these varieties' breakthroughs in yield of high quality grain and broad adaptation, they likely would not have been selected from one-location-only tests!

Thank Indian Head and Regina Research Farms for the role they played.

Canaryseed Research

The Northern Great Plains of western Canada have been well known for the production and export of hard red spring wheat, durum wheat and barley for most of the 20th century. These crops continue to be important; however, it is now common for growers to include special crops in their cropping systems and rotations.

Special crops are a catch-all category for those crops not included in major grains, oilseeds or horticultural groups. Canaryseed, the primary birdseed crop on the Canadian Great Plains, is one of those specialty crops that have been produced in western Canada since the late 1970s.

Canadian farmers grow about 75 per cent of the world's canaryseed, with the bulk of that coming from Saskatchewan. Changes in demographics, increasing disposable income and environmental awareness have led to an international bird food market that is growing at rate of 4 per cent per year. This presents Canadian farmers with another viable cash crop option - birds are popular pets for apartment dwellers in countries with high urban populations, such as Mexico, the United States, Belgium, Spain, Italy and Brazil.

Interestingly, canaryseed was first tested at Indian Head 115 years ago, by Angus MacKay, the first superintendent of the Indian Head Experimental Farm. He first tested it as a hay crop in 1896 and as a grain crop in 1906.

Then in the 1980s, research on canaryseed production was conducted at the Indian Head Research Farm by Dr. Holt using conventional tillage.

With the change from conventional tillage to no-till and the increased importance of canaryseed, Bill May, Crop Management Agronomist at the Indian Head Research Farm, is taking a deeper look at the agronomic aspects of the crop.

"Farmers have reported that the grain yield of canaryseed has been dramatically lower than expected in some fields in some years," he notes. Mr. May's research is focused on solving this problem and improving the economic returns to farmers growing canaryseed.

"The research I've been involved in concluded that seeding date, chloride - a nutrient found in potash, and control of a leaf disease called Septoria leaf mottle impact canaryseed yields," says Mr. May.

Mr. May's research indicates that canaryseed is more sensitive to chloride than most other crops grown in Canada. Research on chloride and canaryseed strives to identify the optimal chloride application rate and to determine why canaryseed is so sensitive to this nutrient.

"We hope that by understanding how chloride affects canaryseed, we'll gain a better insight into chloride's function in all plants," he says. "We may even be able to use chloride sensitivity as a tool to help select new cultivars of canaryseed."

Mr. May continues his research projects on canaryseed in partnership with organizations like the Indian Head Agricultural Research Foundation, the University of Saskatchewan, the Canaryseed Development Commission of Saskatchewan and the Saskatchewan Ministry of Agriculture.

Currently canaryseed is limited to being used to feed birds; however, the Canaryseed Development Commission of Saskatchewan is pursuing the registration of hairless canaryseed as a novel food for human consumption which could include it being used as a gluten-free flour, sesame seed replacement, speciality starch and in vermicelli noodles. Potential new markets for canaryseed could also exist in food for other pets and livestock feed.

If novel food approval is granted, the potential market for canaryseed could increase dramatically.

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