Harrow Research and Development Centre

Building on the Past.
Growing into the Future.

Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada

Canada

Harrow Research and Development Centre - Building on the Past, Growing into the Future.

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Over a Century of Success!

It all started with some plants, a plot of land, a desire for knowledge, and the need to improve an agricultural commodity.

Established in 1909, Agriculture and Agri-Food Canada's (AAFC) experimental farm in Harrow, Ontario has grown from humble beginnings to a world-class research centre that boasts the largest greenhouse research facility in North America.

Little did this department know that the site selected and established over 100 years ago would become a jewel in the crown of Canadian agricultural research. Their work laid the groundwork for leading-edge research in the production of dry beans, food-grade soybeans, field and greenhouse vegetables, soil and weed management, and germplasm conservation.

The site was selected to complement and reflect the diverse and intensive agriculture of southwestern Ontario. The soil, climate, disease and weed pressures of the area provided scientists with a living laboratory for their research.

Today, the Harrow site is part of a national network of twenty AAFC research and development centres located across Canada.

FROM THE DIRECTOR...

The business of agriculture has undergone significant change in Canada since the first research site at Harrow was established in 1909. Agricultural research has grown from an industry based largely on hard work and resourcefulness to one based on science and technology. For over a century, the Harrow Research and Development Centre (RDC) has served the agricultural sector and carried out research to provide science-based solutions to issues and challenges faced by the farming community. The mission of Harrow RDC is to develop and transfer new technologies for the production and protection of greenhouse vegetables and field crops. Harrow RDC leads research on the quality and sustainable use of Ontario soils and reduction in greenhouse gas emission and nutrient losses from agricultural soils to enhance the environmental health of farmlands in the Great Lakes basin. We have grown from humble beginnings to a world class research facility and we look forward to the next century of serving Canadians and continuing to bring excellence in agricultural research to the global stage.

Dr. Della Johnston, Director, Research, Development and Technology

Original Harrow RDC Office

100 YEARS OF RESEARCH HISTORY

The station was first established in 1909 and by 1923 it was known as the Dominion Experimental Station at Harrow. It was renamed the Harrow Research Station in 1959, the Greenhouse and Processing Crops Research Centre (GPCRC) in 1995 and finally the Harrow Research and Development Centre in 2015. While the name may have changed, the research continued and significant accomplishments in breeding of soybean, dry bean, corn, field vegetables and tree fruits, plant protection and soil management were achieved.

GROWTH IN RESEARCH AND FACILITIES

The "boom" era, following the Second World War, led to a call for better quality fresh market produce and processed foods. Harrow's fresh market and processing vegetable trials were enhanced and research expanded to include a greater diversity of crops. The number of scientists working at the Centre increased and additional land was acquired to support the expansion of Harrow's research activities.

There was a growing need for plant protection specialists such as plant pathologists, entomologists, nematologists and weed control experts. New research led to the construction of specialized facilities. In 1948, the study of plant diseases (pathology) began in the Centre's greenhouses. The research greenhouses have a scientific mandate to help the industry produce the highest quality and highest yielding greenhouse vegetable crops. Research results contribute significantly to the local economy as the areas around Harrow have the largest concentration of greenhouse production in North America.

The Woodslee substation was acquired in 1946 (renamed as the Honourable Eugene F. Whelan Experimental Farm in 1984). The Affleck Farm across from the main site was acquired in 1957. Altogether, the Centre now comprises 216 hectares. A new main laboratory and administrative facility was added in 1967 and forms the core of the buildings that still exist on the site.

RESEARCH'S CHANGING MANDATES

Ongoing discoveries and new knowledge brought shifts in research priorities, which continue to evolve.

Harrow currently conducts research in five main areas. These are Horticulture, Oilseeds, Agro-Ecosystem Resiliency, Clean Technology and Biodiversity & Bio-resources. Research results are focused on increasing agricultural productivity, improving environmental performance, improving attributes for food and non-food uses and addressing threats to the agriculture and agri-food value chain.

Harrow Research and Development Centre aerial picture

Multiple strands of beans

It's 'Bean' a Long Time

If you fancy beans in your chili, burritos, soup, or enjoy baked beans, you can probably thank Agriculture and Agri-Food Canada (AAFC) scientists. In the past 60 years, scientists at Harrow have tested and bred an astounding 35 dry bean varieties.

The dry bean program evolved from evaluating beans suitable to the local area to developing new varieties with increased disease resistance and superior agronomic and nutritional qualities.

When the Centre's dry bean breeding program began in 1956, there was extensive white (or navy) bean production in the Harrow area. Early on, American cultivars grown in nearby Michigan were studied for their ability to grow in Ontario. Research at the Centre later resulted in new Canadian white bean varieties with improved characteristics and resistance to common diseases such as root rot and anthracnose.

As Ontario's bean-growing acreage increased in the late 1960s, the breeding program expanded to include expertise from crop physiologists, pathologists and entomologists. These scientists work together to address complicated diseases and production problems. From 1966 to 1983, eight new white bean varieties were introduced to southwestern Ontario.

Although most of the Centre's bean breeding plots are in southern Ontario, scientists have worked extensively with researchers in western Canada and with universities and public institutions in the United States and Europe. Beans developed at the Centre are grown in the Maritimes, Prairies and the United States and many are exported to Europe.

White beans

Clean and Sustainable Water

Dr. Tiequan Zhang and Dr. Chin Tan at water cleaning station

Clean water is another environmental concern. It is necessary to ensure that fertilizer and herbicides from agriculture are prevented from entering surrounding lakes. Soil fertility is studied at length by staff researchers to ensure the amount of fertilizer applied to crops does not exceed what is required. Nearby ditch water is regularly sampled and analyzed for chemical impacts from research plots.

One cannot speak of conservation efforts at the Centre without mentioning the irrigation recycling system, a revolutionary product developed by AAFC scientists. During the rainy spring season, run-off containing nutrients that were applied to the crop prior to planting, is collected in large cisterns that are buried below tile drain level in a field. In southern Ontario, the period from late June through mid-August, a crucial period in crop-growing, can experience minimal rainfall. When the soil becomes dry, sensors in the soil detect the loss of moisture and trigger a computer to start the cistern pumps and move water back up into the soil. This sends the stored water, nutrients and all, back into the crop via the same tile drains that originally brought the water to the cistern.

Study on mitigating water quality impacts of manures and fertilizers.

Dr. Chin Tan's research on drainage capture and water recycling has increased crop production and improved water quality. The controlled drainage/sub-irrigation "closed loop" water recycling system has improved soybean yields by 50 per cent and grain corn yields by nearly 90 per cent. It also contributed up to 40 per cent reduction in phosphorus and nitrate losses. Commercial large-scale drip irrigation water recycling has increased horticultural crop yields while reducing adverse water quality impacts: the drip fertigation/irrigation system increased processing tomatoes yields by an average 36 per cent relative to the non-irrigated system. This system also increased water and nutrient use efficiency by 25 per cent and 35 per cent, respectively, relative to a non-irrigated system.

Cover Crops: A Good Tool for Soil Health

Red clover, a cover crop, planted in a harvested winter wheat plot as part of an AAFC crop rotation study.

According to research conducted at the Harrow RDC, cover crops can help resolve a host of soil health and environmental concerns, especially nutrient retention.

"Cover crops are an amazing tool that producers have available to them," says Dr. Craig Drury, a soil management and biochemistry researcher at Harrow. "The cover crop increases soil organic carbon, improves soil structure and overall soil quality, and can also improve the drainage of soil."

> *Cover crops are an amazing tool that producers have available to them."*

Cover crops are planted in the late summer or early fall following the harvest of a cereal crop, or inter-seeded into an annual row crop, such as corn. They can capture the residual nitrogen that remains in the soil at the end of the growing season and effectively tie it up over winter. The nitrogen is then released into the soil when the cover crop decomposes in the following spring. This is important because, as Drury says, farmers "want to hold a nutrient like nitrogen in the soil as long as they can and make more of it available for future crops".

A five-year field study determined that cover crops improved soil health not only by absorbing nutrients from the soil but also by reducing the amounts of fertilizer nutrients leaching through the soil and out of the root zone. "The cover crops act very much like a sponge," says Drury, adding they are "very beneficial from a water quality standpoint" because they help reduce surface runoff while absorbing nutrients from the soil.

Water loss, through runoff or leaching, varies according to the whims of the weather, but "this is where cover crops fit into the picture really well," he says. As a result, this practice can help farmers minimize runoff during periods of excess moisture – or drought.

Planting cover crops is cost-effective and the benefits increase when used with other soil management practices, such as tile drainage and sub-irrigation. Ultimately, producers are more likely to enjoy higher crop yields, increased long-term savings and reduced environmental impact.

Soft white winter wheat on a hazy day.

Food Soybean Database for Industry

Canadian soybean production has been steadily climbing since the 1980's. Canada offers world-class expertise on soybean composition and product quality and AAFC researchers are playing a role in helping industry create a soybean database. The Canadian Food-Grade Soybean Database was initiated in 2005 to address requests for information about Canadian soybean varieties grown for soy food manufacturing. The database has recently been upgraded onto an interactive platform by the Ontario Soybean and Canola Committee (OSACC) and includes varieties grown in Manitoba, Ontario, Quebec and other emerging production areas.

At the Harrow RDC, samples are analysed for composition using near infrared spectroscopy. Properties of interest to the international soy food industry are evaluated, including sucrose, oligosaccharides, total fermentable carbohydrates and total isoflavones. The searchable database enables users to compare sub-sets of varieties, search by composition, and compare historical data to identify varieties that meet their needs.

Varieties that are included in the database are on a voluntary basis and must be currently available or soon to be released. The soybean samples are collected from the Ontario Soybean Variety Trials conducted by the OSACC.

Harvesting single rows of soybeans

Measuring soybean oil and protein content.

Wind Tunnel

Wind Tunnel Study

Addresses the “Lost” Nitrogen of Corn Production and Provides Farmers with Innovative Nitrogen Management Options

Corn is one of the most common field crops in eastern Canada, but it requires large inputs of costly nitrogen fertilizer to generate maximum economic yields. Our scientists are researching ways to reduce fertilizer nitrogen loss. They are studying the “4-R” principle of fertilizer management: Right amount applied; Right application time; Right placement location; and Right fertilizer source.

The team at Harrow is using in-field wind tunnels to collect and measure the amount of nitrogen from several common fertilizer formulations and different methods of application. The wind tunnel study is part of a cross-Canada AAFC research network examining the nitrogen use efficiencies of the most important crops in each of Canada’s primary agricultural regions.

Lead scientist, Dr. Craig Drury, is looking at two of the most common sources of applied nitrogen (urea granules and urea-ammonium nitrate), in combination with and without nitrogen inhibitors, and various methods of application (broadcasting, streaming and injection) to determine the best way to make nitrogen available and accessible to the crop. Dr. Drury studies the distribution and fate of applied nitrogen in the crops, soil and air under the nine combinations of source and method applications.

Soil "Fingerprinting": Opening Doors to Improved Soil Monitoring

Different sizes of soil aggregate are recorded.

A key question for agricultural producers is "How do I know if what I'm doing is enhancing the quality of my soil?" Soil quality directly affects crop yields and sustainable agricultural production; however, monitoring and tracking changes in soil quality is a complicated process.

Because there are many soil attributes, land use decisions, and environmental issues to consider, a team led Dr. Catherine Fox has developed the "A-Horizon Framework" with an electronic field form to record detailed characteristics of the surface layer of the soil to create a "soil fingerprint". This new Framework offers an innovative and systematic approach to record soil properties that affect soil quality and are subject to change, such as soil structure, bulk density (extent of compaction), amount of organic matter, pH, and salinity.

Soil with good structure and organic matter content.

As soil properties are recorded electronically in the field form, a soil fingerprint is automatically generated. This soil fingerprint is applied to field and landscape soil assessments in order to monitor changes both during the growing season and over several years. A database of many soil fingerprints can also be used by researchers to develop models to evaluate soil quality, assist in soil remediation efforts, and assess overall environmental impacts.

Natalie Feisthauer, a member of the Ontario Knowledge and Technology Transfer (KTT) group, has introduced the "soil fingerprint" to provincial soil management specialists and university researchers for testing in the field. Media coverage and staff networking have raised the interest of potential users, ranging from innovative farmers to soil ecotoxicologists.

Soy Ahoy!

Field selection of soybean varieties by Dr. Kangfu Yu

Although the soybean was a latecomer to the Canadian agricultural scene, it has achieved a phenomenal rise in popularity.

It was not grown in Canada until early in the twentieth century but after the Second World War, soybeans became an important economic crop, and one of the principal crops in south western Ontario's Essex County.

- In 1923, a soybean breeding program was started at the Centre which proved to be one of the most outstanding in North America, producing many new varieties. The Centre's first variety *Harman* was released in 1943 and was followed by *Harosoy* in 1951, which became the predominant variety in Canada and the Midwest U.S.A.
- By 1965, Harosoy 63 grew to become 80 per cent of the Canadian soy crop and 26 per cent of total US crop (Over 40 per cent grown in each state of Illinois, Indiana and 58 per cent in Michigan).
- One variety, *Harovinton*, won the "Seed of the Year" award in 2006 and is still valued by Japanese tofu producers who call it "Asian Pearl" and have made it the nation's soybean industry standard. These 'food-grade' varieties are very high in protein and are used to make miso, tofu and soy-milk.

AAFC researchers strive to develop soybean varieties that are new and improved, not only from a health and nutrition perspective, but are also higher-yielding and more disease resistant. Some beans are even being bred to have a less 'beany' flavour. These varieties are more suitable for use in innovative foods such as ice cream sandwiches, soy shakes and veggie burgers, which are ideal for people with food allergies, preferences or intolerances.

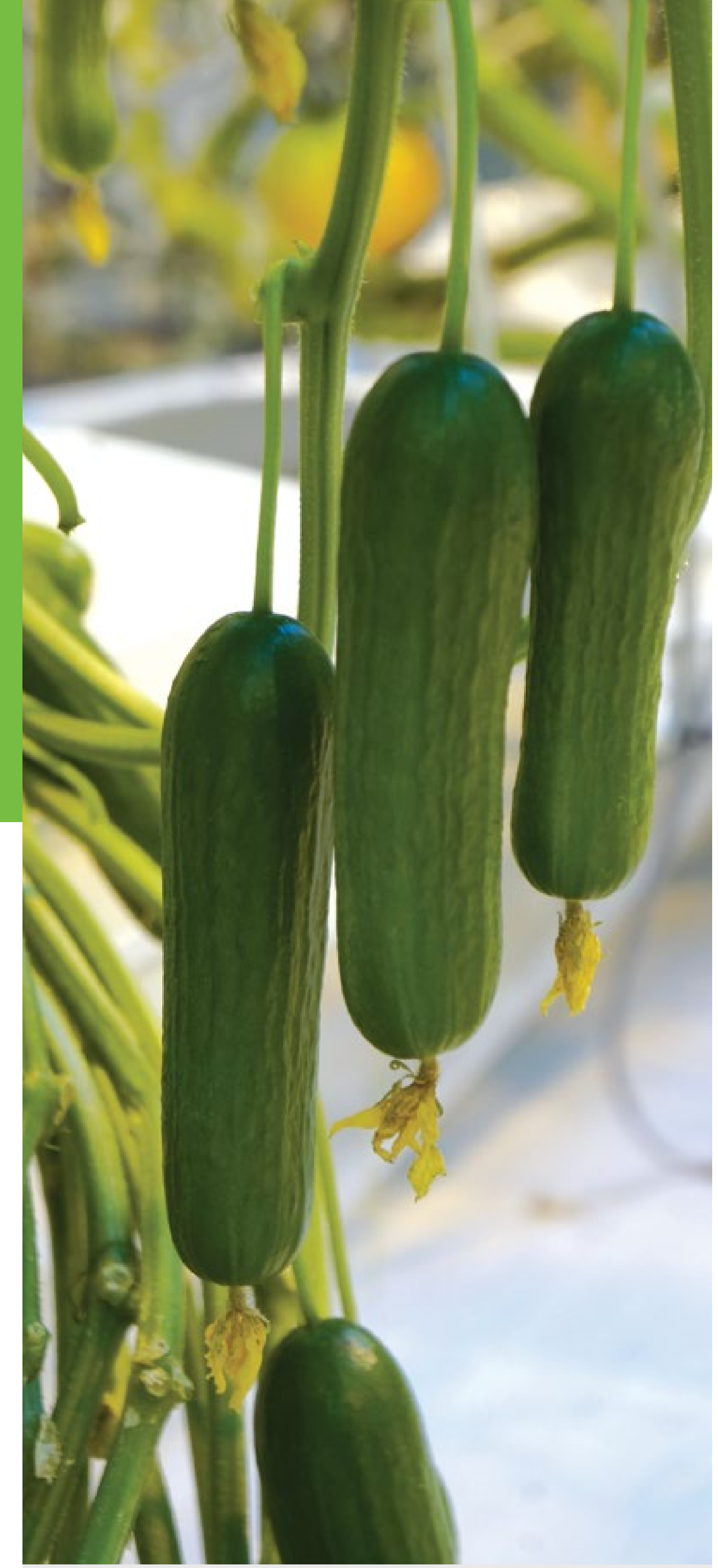
Tofu and soybeans

Soybean Breeding

Since 1989 the food grade soybean breeding program has made significant contributions to Canada's reputation of food grade soybean production in the world exporting markets, especially in Asia, Europe and United States. The program has developed high yield, high quality, and pest resistant food grade soybean varieties for Canadian soybean growers. Since the release of the Canadian food grade soybean standard variety, Harovinton, 17 high yield, high quality and/or pest resistant food grade soybean varieties have been released including the AAC Stern variety published in 2014 and the AAC26-15 variety published in 2015.

Field of soybeans

Ripe soybeans



Greenhouse cucumber

Veggie Tales

Southwestern Ontario's agricultural history could not be told without mentioning field and greenhouse vegetables! Forty per cent of Ontario's vegetables are grown in this part of the province where an early growing season, coupled with soil and climatic conditions, result in ideal growing conditions.

Field vegetable research began at the Centre in the 1920s with tomatoes and sweet corn. Researchers set out to develop a tomato that could resist disease, tolerate frost and have an improved flavour and quality. Their mission was accomplished when Harrow's first tomato variety, fittingly named '*Harrow*' was introduced in 1951. Over the years, research results have also contributed to improvements in the production of cucumbers, cabbage, cauliflower, broccoli, eggplant, Brussel sprouts, and peas.

AAFC scientists have always taken a collaborative, multi-disciplinary approach to vegetable research. Crop breeders, plant pathologists, entomologists and weed specialists join forces to share concepts from different perspectives which leads to comprehensive solutions and innovative ideas to address industry and sector challenges.

Harrow Research and Development Centre Timeline

1909

Research site is established on rented land from Ferris Farm.

Six oat varieties are tested and one field is seeded to winter wheat in cooperation with the Canadian Seed Growers Association.

1915

The Centre's land increases to 50 acres (20.4 hectares) and the option to purchase the entire Ferris farm 200 acres (81.6 hectares) is obtained.

1923

The option to purchase Ferris farm was exercised and the Dominion Experimental Station was formally established. The Centre begins breeding and testing of corn hybrids to be more resistant to pests and disease after European Corn Borer was first discovered in Ontario.

Soybean breeding program begins.

1930

Horticultural program is expanded to include fertilizer experiments on crops such as early tomatoes, asparagus, early potatoes, sweet corn, canning peas and apples.

1938

The earliest insect studies begin when yields of corn, soybean, tree fruit and vegetable are diminished due to disease.

1943

Harman, the Centre's first soybean variety, is released.

1946

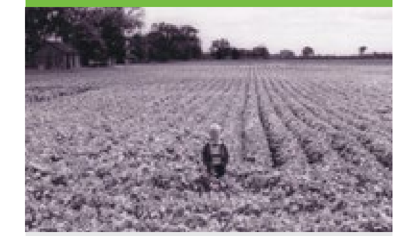
The Experimental Substation at Woodslee is established as an area for specialized research on Brookston Clay soils, which is a common soil type for field crop production in Southwestern Ontario.

The first double-cross corn hybrid made entirely of inbred lines of Canadian origin is developed and named HARVIC 300. King Grain produced this seed until 1963.

1948

The study of plant diseases (pathology) begins in the newly constructed greenhouses.

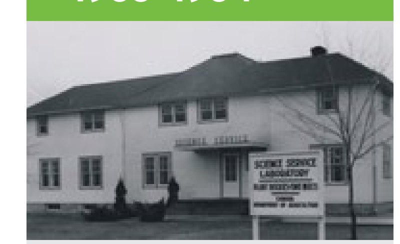
1951



Soybean cultivar Harosoy is released. It is one of the most successful soybean varieties ever developed in North America.

Harrow, the Centre's first tomato variety is introduced.

1953-1954



Harosoy wins the World Championship Seed Sample award in Chicago.

1956

Dry bean breeding program begins.

1962

Weed research program is launched to help growers avoid losses created by weeds.

1963

Harosoy 63 soybean developed for greater phytophthera root rot resistance is released.

1968

Centre is named as the main weed research centre for AAFC Eastern Canada.

1974

Harliton, one of the first seedless greenhouse cucumbers is released.

1977

Harcor soybean is developed to resist new races of the phytophthera root rot disease.

1983

Development of the first critical period for weed control in transplanted tomatoes is established. This period defines when weeds need to be controlled to avoid unacceptable economic losses.

1984

Woodslee Substation renamed in honour of the 22nd Minister of Agriculture and Agri-Food, the Honourable Eugene Whalen who was also the Member of Parliament for Essex.

1985

Harus wheat seed is bred and licensed.

1986

Tillage trials to reduce erosion and reduce water quality impacts from agriculture were implemented with provincial partners and farm co-operators under the Soil and Water Environmental Enhancement Program.

1989

Harrow Fertigation Manager®, used in greenhouse technology and field culture is launched. It adjusts water and nutrient supply to a crop according to computer analysis of inputs from sensors.

1990

ENA, a soft white winter pastry wheat variety, becomes commercially available because of its tolerance to fusarium.

1996

Clonal Gene Bank moves to Harrow from AAFC Smithfield Experimental Farm in Trenton, Ontario.

1998

Opening of north greenhouse complex consisting of 16 D-poly- and 8 glass-greenhouses which made the Centre the largest greenhouse research facility in North America.

2003

Establishment of the first herbicide registration program in seed corn.

2005

Canadian Food-Grade Soybean Database initiated.

2006

Harovinton named "Seed of the Year" and Japanese seed-buyers label it "Asian Pearl," a significant factor in opening up the lucrative Japanese market to Canadian soybeans.

2008

Over 11,000 participated in an AAFC poll to name a new pear variety and the Harovin Sundown Pear is introduced. It has recently been renamed the Cold Snap Pear™.

Using HPS (high pressure sodium) lights in the greenhouse increased annual cucumber yields by 100 to 150 per cent in comparison to unlit conventional systems.

2009

September 12, AAFC-Harrow celebrates 100 years of agricultural research excellence.

2010

An innovative closed loop water management technology is developed and installed at the Honourable Eugene F. Whalen Experimental Farm. This system ensures optimum water availability for crop growth.

2013

Bee "vectoring" is developed as an alternative to pesticide use. This process uses bees to deliver a biopesticide for control of insect pests.

The first hazelnut orchard for pesticide research was established.

2014

Soil "fingerprinting" is developed to measure soil health in soil's upper horizon.

Scientists are able to reduce ammonia volatilization losses by up to 99 per cent by varying both fertilizer application methods and nitrogen formulations.

2015

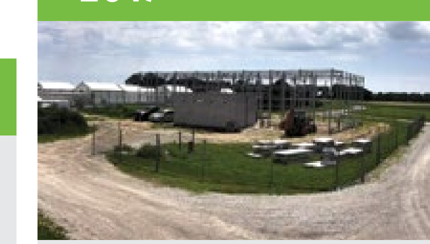
Developed sustainable, environment-friendly, energy-efficient, high-quality, and pesticide-free greenhouse crop production systems.

2016

Developed soil testing indicators for risk assessment of soil phosphorus loss and quantitative measures for availability of phosphorus in manures.

Establishment of a herbicide resistance screening program for Southwestern Ontario.

2017



Transplant greenhouse constructed bringing greenhouse footprint to 1.07 hectares or 2.64 acres. The Centre continues to be the largest greenhouse research facility in North America.

It's all in the Genes

Since 1990, the Canadian Clonal Gene Bank at the Centre has been collecting, conserving, virus indexing, characterizing and distributing a wide variety of tree fruits and berries. In fact, the Gene Bank collection today includes over 3,500 tree fruit and small fruit crop plants!

Approximately two-thirds of the collection consists of indigenous wild relatives of Canadian fruit crops, and the remaining one-third are breeding selections of Canadian origin or cultivars of interest to Canadian scientists.

The Gene Bank is part of AAFC's efforts to identify, collect, preserve and encourage utilization of crops grown in Canada through the Canadian Genetic Resource Program. AAFC also maintains a Seed Gene Bank and Canadian Animal Genetic Resources Program in Saskatoon, Saskatchewan, and a collection of Canadian potatoes at the Potato Research Centre in Fredericton, New Brunswick.

Rose Accessions of the Canadian Clonal Genebank.

Did you know?

The Centre still has some older fruit trees with many desirable characteristics such as cold hardiness and disease resistance. Pollen and budwood from these trees are shared with other fruit tree breeders worldwide.

Soil Sample Tractor

Minimizing Our Footprint

Since the Centre's inception, environmental sustainability and natural resource stewardship have played an integral role in all research programs and operations onsite.

To prevent soil erosion, minimum and zero till practices have been integrated into field research activities. This process conserves moisture in the soil and gives crops a better chance of growing well. It also greatly reduces costly inputs such as fertilizer and tractor fuel.

Crop rotation is also used to prevent soil erosion and maintain soil moisture and fertility. In this process, different crops are planted in sequence in different years.

Joann Gignac with a typical soil core being processed in a soil physics laboratory.

Managing Soils to Benefit Crops

Producers can increase field crop yields and reduce soil and environmental damage with management practices, says Dr. Dan Reynolds, research scientist at Harrow RDC.

"Long multi-crop rotations, which include perennials, seem to improve soil attributes," he says. The combination of rotating crops, adding amendments and planting cover crops in the fall can improve the physical quality and resilience of soil.

Although soil 'texture' is the primary determinant of physical quality and resilience, good management practices can improve and maintain the capacities of virtually any soil, says Dr. Reynolds. On the other hand, over-cultivation and long-term use of the same crop or two-crop rotations will eventually degrade any soil.

Collection of soil core samples for determination of plant-available air and water capacities.

Core sample of clay loam soil showing signs of periodic water logging.

Winning the War on Pests, Insects, Diseases, Weeds…

Managing pests has always been an important component of research at the Centre. The earliest insect studies began in 1938 when yields of corn, soybean, tree fruit and vegetable were diminished due to disease. Over the next 30 years, many notable contributions and scientific breakthroughs in the fields of nematology and bacteriology emerged, as did a multi-facetted approach to the solution of pathological problems – what we now call integrated pest management.

Just as insects and disease impede the growth of healthy, quality crops, so do weeds. They love to compete with the slower-growing cultivated crops, for water, sun and nutrients. Weed control was once done by cultivation, hand weeding and crop rotation. In the mid-1940s, herbicides were introduced and were first used at the Centre in 1946 to successfully control annual broadleaf weeds in oats, flax and sweet corn.

In 1962, a weed science research program was launched at Harrow, designed to control weeds in horticultural and field crops through the development of reliable chemical control methods.

Dr. Robert Nurse, standing amongst velvet leaf weed

Colorado potato beetle (*Leptinotarsa decemlineata*)

The Centre has also found ways to minimize chemical pest control methods. Studying the life cycles of pests and targeting them when most vulnerable minimizes the amount of spraying required. When application cannot be avoided, measures are taken to prevent sprays from being airborne and reaching non-target areas.

Centre scientists have tackled some of the most destructive insect pests, weed infestations and fungal invasions with great success. Over the years, management techniques have evolved to protect the crops, the environment and to ensure a quality, safe and nutritious product for consumers.

Controlling Giant Ragweed in Soybeans and Corn

Giant ragweed when it emerges at the same time as soybean.

Giant ragweed is one of the most problematic weeds in southern Ontario and is one of four weeds in the region that are resistant to glyphosate (a broad-spectrum herbicide).

The Harrow research team, led by Drs. Robert Nurse and Eric Page, believes that shifts in acreage from corn to soybeans, coupled with changes in cropping systems

High density corn suppressing giant ragweed.

practices, allowed giant ragweed to make the jump from being a roadside weed to one of the top five most frequent and hard to control row crops weeds. Advances in corn breeding, including increased stress tolerance, have allowed for a tripling in planting density since the 1950s, which has made controlling giant ragweed in corn a bit easier. They suggest that increasing the corn seeding rate can act as an effective weed control tool, suppressing giant ragweed growth and reproduction, and helping to offset the higher cost of non-glyphosate herbicides by protecting crop yield.

Controlling giant ragweed in soybeans, however, is more difficult. The crop's lower canopy offers little potential for weed suppression and the options for in-crop herbicide control are limited. The best prevention is to practice a three-year crop rotation that incorporates pre-emergent herbicides with high density weed suppressing cereals.

MINOR USE PESTICIDE PROGRAM

The Centre is one of seven Canadian locations collaborating on the Minor Use Pesticide Program. It was launched in June 2002 as a joint initiative between AAFC and Health Canada's Pest Management Regulatory Agency (PMRA). A minor use pesticide refers to the crop-protection treatments (fungicides, insecticides and herbicides) usually used on low acreage, high-value crops, or where pest control is only needed on a small portion of the overall crop acreage. These pesticides are usually used in such small quantities that manufacturers find the sales potential is not sufficient for them to seek registration in Canada. Under the program, scientists are conducting field trials and laboratory analysis to obtain the required data for the registration of new minor uses of pesticides. These efforts are assisting environmental stewardship by Canadian producers, promoting safe food for Canadians and helping Canada's producers to remain competitive in global markets.

Ginseng trials minor use pesticide.

Let Them Eat Cake … and Tacos and Pasta

Bakers and cake-lovers alike were delighted when, in 1985, a new flour made from Harus wheat was introduced. Harus, was the first of many new varieties of Canadian soft white winter wheat to be released by the Research Centre at Harrow. Several more recent varieties such as Ashley and FT Acton have been jointly released with local seed companies.

Tractor transferring grain

The winter wheat program operated under three main goals: fusarium resistance (disease), winter hardiness and sprouting tolerance. The program's aims were to develop high yielding, disease resistant winter wheat cultivars that provided superior processing quality for commercialization and end-product utilization as well as develop crossbreeds to incorporate resistance to various rusts and powdery mildew.

Have you ever wondered where the corn that makes a taco shell so crunchy comes from? A number of corn varieties used for food processing, and also for livestock feed, have been developed at the Centre. Over the years, several large companies such as Northrup King Seeds Ltd, Pioneer® and Pickseed® have purchased the rights to the Centre's corn varieties. Hybrids from some of these lines are still being produced by companies today.

Did you know?

Soft white winter wheat, found mostly in Eastern Canada, is so-called because it is planted in the fall, lies dormant through the winter freeze and is harvested the next July. Spring wheat, found mostly in Western Canada, is planted in the spring and harvested in late summer of the same year.

Flowering greenhouse cucumber plants.

In the Greenhouse… Where it's Summer Year 'Round

According to Statistics Canada and the Census of Agriculture, 2016, the greenhouse vegetable industry occupies over 1525 hectares. The value of vegetable and fruit sales from the greenhouse industry is approximately 1.3 billion dollars.

Early greenhouses at the Centre were used for plant propagation. By 1948, the study of plant diseases was being conducted inside the glass walls of the Centre's greenhouses. Today the Centre houses the largest greenhouse research facility in all of North America, with 10700m² (1.07ha) of state-of-the-art greenhouses. That's about the size of a football field!

Greenhouse horticulture has definitely evolved in the 2,000 years since it was first developed by the ancient Romans. A greenhouse is designed to control the interior environment and optimize environmental variables to enhance productivity, flavour and quality of the produce being grown.

Outside view of greenhouse.

Nowadays, all environmental variables such as temperature, moisture level, atmosphere and crop nutrients are computer-controlled. In fact, one of the first environmental computers was developed under contract at the Centre. This led to the development of a computerized fertilizer injector in 1988, called the Harrow Fertigation Manager™ (HFM™). More than 100 HFM™ units are now in commercial use in North America, Europe and Asia.

Chemical control methods, once the answer to ridding greenhouses of destructive insects, have been replaced through AAFC research with biological controls such as predatory insects. In the 1970s, researchers at the Centre pioneered the using a small predatory wasp to rid the greenhouse produce of plant damaging white flies.

In the 1980s, energy costs for greenhouse production became a major concern. The Centre appointed an energy engineer and examined alternatives to glass covers. Lexan™ channel plastic, which had been used in the Aerospace Program, was adopted. This was a more cost-effective, durable alternative, had a longer lifespan, transmitted sunlight wavelengths that plants required and conserved more energy.

Today, peering through the Centre's greenhouse walls would reveal AAFC scientists conducting research to improve production, optimize greenhouse environmental strategies, and develop reduced risk, alternative pest controls. Researchers continue to enhance production for larger export markets through diversification of greenhouse vegetable crops. In response to consumer demand, the gamut of greenhouse vegetable development has grown to include new varieties for single-servings and tasty alternatives to traditional veggies. Cocktail tomatoes, mini cucumbers, and snack-size sweet peppers are a few of the new arrivals to the AAFC research and development roster.

Greenhouse interior

Greenhouse Lighting: Bright Lights, Big Produce

Green peppers under purple light

When it comes to greenhouses, not all light is equal, according to Dr. Xiuming Hao, who is researching how light quality can impact plant growth and nutritional value at the Harrow RDC.

Greenhouses equipped with energy-efficient lighting systems allow producers to grow high quality produce year round. However, Canada has low year-round natural light that impedes greenhouse production, especially during the winter months. The solution comes in the form of artificial lighting; however crops develop and grow differently when they are supplied with alternative light sources. And not all artificial light is equal.

"Light quality refers to actual spectrum composition of the light, which largely influences plant growth, fruit yield and quality, and the production of health promoting compounds," explains Dr. Hao. "Light spectrum compositions have not been explored much for how they improve plant growth and fruit yield and quality."

Dr. Xiuming Hao

Research in this area is largely unexplored because in the past, there was no alternative to high pressure sodium lamps (HPS) in greenhouses. HPS lighting emits broad spectrum light. However, with the development of light emitting diodes, or LEDs, this is now possible.

Plant growth, fruit yield, and fruit quality are affected by light quality which can influence the production of anti-oxidants. Dr. Hao and his team have been analyzing how different light spectrum compositions impact plant growth, fruit yield, and anti-oxidants in cooperation with Dr. Rong Cao at the Guelph Research and Development Centre. They have identified the optimal light composition to promote anti-oxidant production in mini cucumbers.

LEDs' low surface temperature allows them to be placed directly inside a crop canopy without injuring the plants. This increases the light reaching the plants while ensuring that energy use is as efficient as possible. LEDs are about 30 to 80 per cent more efficient than HPS lighting.

Greenhouse lights

Did you know?

The Centre operates the largest greenhouse research complex facility in North America

The ornamental peach tree, Harrow Candifloss is named for its full, fluffy pink blossoms that resemble a cone of candy floss. The laneways to the Centre's experimental plots were once lined with Harrow Candifloss, Rubirose and Frostipink ornamental peach trees.

When the glaciers of the last ice age receded, various soil types and land contours were left behind in southern Essex County. For this reason, the Centre has three distinct soil types on-site: black muck, fox sandy loam and yellow (gumbo) clay soil. The glaciers deposited a terminal moraine that runs through the middle of the Centre's property. Visitors are often surprised to learn that this moraine divides a massive, pristine, fresh-water aquifer located underground at the Centre.

To study the long-term effects of agricultural production and the changes that have occurred over time, Agriculture and Agri-Food Canada has a collection of agricultural data, historical soils and heritage field plot experiments preserved at research centres across Canada. The Centre's heritage plots located at the Honourable Eugene F. Whalen Experimental Farm, were designated a Food and Agriculture Organization-UNESCO Global Terrestrial Observing System (GTOS) site in 1996.

Some of the people that make it all happen at the Centre.