Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada

Innovation *EXPRESS*

Science News from Agriculture and Agri-Food Canada

Volume 3, Number 2

The year 2011 marks the 125th anniversary of public agricultural research in Canada. In 1886, Parliament passed legislation to create Canada's first five research farms – the beginnings of today's network of 19 research centres across Canada.

Much has changed since the early days when research was about helping European settlers learn how to survive in a new world and giving them the tools to be able to feed and sustain themselves off the land through the harsh Canadian winters. Today agriculture is a sophisticated, high-tech industry, and Canada has become a world leader in innovative agriculture.

By any measure, this is a productive, progressive sector made so by the dedication of hard-working producers, food processors – and scientists. This anniversary is an excellent opportunity to recognize the contributions of Agriculture and Agri-Food Canada's (AAFC) dedicated staff and partners, past and present, who have guided federal science to ensure that our research reflects the needs of the industry we serve and helped make today's industry modern and innovative.

Science has brought us a long way in the past 125 years and will continue to play an important role in addressing the challenges on the horizon. Thanks to the talent and expertise of Research Branch scientists and staff, and our growing networks of partners in every sector, we can all look forward to more exciting advancements that will contribute to the success of the sector, to the Canadian economy, and to the health and well-being of Canadians.

Jody Aylard
Acting Assistant Deputy Minister,
Research Branch, Agriculture and Agri-Food Canada

Inside:

Canada

Pushing the Frontiers with New Crop Varieties

A visit to any farmer's market or grocery store shows what a wide variety of choices contemporary farmers have when it comes to what they can grow, but when the first settlers came to Canada, their options wouldn't have filled one shelf.

For 125 years, federal scientists have worked very hard to give Canadian farmers the means to feed a growing nation and give Canada a competitive edge in world markets.

It began with crop development scientists collecting and testing plant material from around the world to develop candidates suitable for Canadian growing conditions. They would then recommend where and how to grow the crops to farmers.

Today, plant breeders work closely with fellow researchers in plant pathology, microbiology, entomology and agronomy to develop new varieties with better yield and quality and agronomic traits such as drought tolerance, resistance to disease, insects and weeds or appeal to special markets.

Over 92 per cent of the durum wheat grown in western Canada traces its origins to varieties developed in Swift Current, Saskatchewan. Nearly, 75 per cent of the spring wheat originates from Swift Current and Winnipeg, Manitoba, and most Canadian strawberries trace their roots back to varieties from Kentville, Nova Scotia. New high-yielding mustard varieties developed in Saskatoon, Saskatchewan, continue to keep Canada on top of the world's condiment mustard production.

The development of new varieties has diversified not only what is grown in Canada but also where it can be grown. New varieties from Harrow, Ontario, and Morden, Manitoba, have helped diversify dry bean production in Ontario and Manitoba, while early-maturing varieties from Lethbridge, Alberta, helped establish dry beans as a viable rotational crop on irrigated land and now account for 80 per cent of beans grown in southern Alberta.

Plant breeding efforts have established Canada as the world leader in discovering, developing and commercializing canola. Some call canola the "Cinderella crop" because of its humble roots and its transformation – canola now rivals wheat as Canada's top cash crop. The story continues as AAFC scientists in Saskatoon have developed new varieties to expand canola production into dry, hot regions of Saskatchewan and southern Alberta.

Scientists in Ottawa, Ontario, have also helped expand the farming frontier in Ontario by creating new varieties of wheat, corn, soy and oats that withstand cooler temperatures. In Charlottetown, Prince Edward Island, scientists have developed new lines of barley, winter wheat and spring wheat, and created testing protocols to assess silage corn hybrids, grain corn hybrids, food-grade soybeans and oilseed soybean lines for short-season production in the Atlantic region.

While the tools and methods for developing new crop varieties may have changed during the past 125 years, the goal has remained the same – creating varieties to meet the needs of farmers, consumers and specific markets. Scientists will be on the front line in developing the new crop varieties that will feed a growing population, fight new pests and diseases and grow in a changing climate.

Crop development research locations - 2011

Agassiz, British Columbia (strawberry, raspberry, blueberry) Summerland, British Columbia (cherry, apple), Lethbridge, Alberta (perennial biomass crops, triticale, wheat, forages, potatoes, dry bean), Lacombe, Alberta (oat, field peas), Swift Current, Saskatchewan. (wheat), Saskatoon, Saskatchewan (canola, mustard, forage), Brandon, Manitoba (barley), Morden, Manitoba (dry bean, flax), Winnipeg, Manitoba (wheat, oat, barley), Harrow, Ontario (soybean, dry bean), Vineland, Ontario (apple), Ottawa, Ontario (wheat, oat, corn, soybean, barley), Saint-Jean-sur-Richelieu, Quebec (lettuce, strawberry, raspberry), Fredericton, New Brunswick (potato), Kentville, Nova Scotia (strawberry, raspberry, blackberry, white wine grapes).

Milestones in Canadian crop development:

- 1980 – Shepody potato is released and becomes one of the top french fry varieties in the world (Fredericton, New Brunswick)
- 1984-present – New late-ripening, high-quality sweet cherry varieties are released, improve financial returns to growers, enhance Canadian presence on world markets (Summerland, British Columbia)
- 1989 – Harovinton soybean is released and establishes Canada as preferred source of premium quality soy for tofu in Japan (Harrow, Ontario)
- 1997 – AC Metcalfe barley is released and dominates market and is prized by growers, maltsters and brewers throughout the world (Brandon, Manitoba)
- 2003 – Chemanius raspberry is released and increases grower productivity and quickly dominates the field in British Columbia, Washington State and Oregon (Agassiz, British Columbia)
- 2007 – Award-winning variety of lettuce is released that is more tolerant to the diseases associated with heat stress and is better adapted to the growing transformation and export markets (St-Jean-sur-Richelieu, Quebec)
- 2008 – AC Gehl, a hulless oat, is released and attracts new markets as rice replacement and high-end animal feed (Ottawa, Ontario)
- Potato cultivars resistant to potato wart disease and golden nematode contribute to 70 per cent of potatoes grown in Newfoundland (St. John's, Newfoundland and Labrador)
- Micropropagation technologies for small fruits and medicinal plants help respond to increased demands for production of cranberry, lingonberry, dwarf raspberry, strawberry, lowbush blueberry, cloudberry and roseroot in Newfoundland (St. John's, Newfoundland and Labrador)

Growing Crop Production through Research

Farming is more than just a simple process of planting seeds and harvesting crops. It is a complex modern production system that requires knowledge of the land and agronomic practices – when, what and where to plant, and how to cultivate and harvest crops to ensure high yields and excellent quality. From coast to coast and crop to crop, Agriculture and Agri-Food Canada (AAFC) scientists have helped farmers develop new strategies to stay competitive and improve production.

Originally, federal agricultural researchers focused on helping new settlers to Canada learn how to work this new land in a new climate – creating production guides for various crops and holding field days to demonstrate the latest farming techniques. As Canadian agriculture shifted from mixed farming for personal use to commercial farming, researchers began to develop suitable crop rotations, plant populations and row spacing for various crops. Today, agricultural researchers continue to refine farming practices, introduce new crops, increase yield and quality, expand production into new regions and create new technologies.

Many innovations from AAFC labs have created large-scale changes to the industry. In the Canadian prairies, for example, AAFC research has influenced the broad movement away from frequent summer fallowing and monoculture cereal cropping using conventional mechanical tillage, to more continuous cropping systems that use mixed cereal-oilseed-legume rotations together with conservation tillage.

Some innovations have influenced farming practices beyond our own fields. A carrot foliage trimmer recently developed by scientists in Charlottetown, Prince Edward Island, for example, is now used in North American and European carrot fields to reduce losses from rot.

Scientists in Swift Current, Saskatchewan, are known for their contributions to conservation tillage – designing and evaluating the equipment to developing production practices for cereal, oilseed and pulse crops. These methods and equipment have been used by farmers across the Canadian prairies and elsewhere to minimize soil disturbance, increase crop yield, reduce greenhouse gas emissions and protect soil and water resources.

Swift Current scientists also developed production practices which allowed new and alternative oilseed and pulse crops to be grown in this dry region. Scientists in Lacombe, Lethbridge, and Beaverlodge, Alberta, worked with university and provincial researchers to develop canola production technologies to improve the stability of yield, crop quality, productivity and sustainability.

Similarly, scientists in Lacombe, Alberta, Indian Head, Saskatchewan, and Brandon and Scott, Manitoba, along with colleagues at the Canadian Grain Commission and Alberta's Ministry of Agriculture and Rural Development studied farming systems and developed best management practices to improve the quality of malting barley. This 2005-2008 study was the first in North America to directly link the effects of agronomic practices in the field to the quality of malted barley.

Advances in winter wheat agronomic practices and seeding equipment developed by scientists in Lethbridge, Alberta and Brandon, Manitoba, in the 1980s also helped winter wheat production expand from southern Alberta eastward into Saskatchewan and Manitoba and northward into the parkland agricultural areas. A similar crop expansion took place in north-western Quebec and north-eastern Ontario where new techniques to produce and preserve forages developed by scientists in Kapuskasing, Ontario, helped establish a beef industry in the region.

Research in Newfoundland has delivered some new options to farmers. Scientists in St. John's developed production protocols for Newfoundland roseroot, European lingonberry and Russian cultivars of sea buckthorn and honeysuckle. They also introduced a production system for planting seed corn into beds covered with photodegradable plastic mulch. This helped farmers save money by growing their own seed corn instead of importing costly feed grain from the mainland and opened the door for a substantial expansion of the dairy industry in Newfoundland over the past ten years.

The greenhouse vegetable industry has also evolved through the collaborations of AAFC scientists. Crop management research in Harrow, Ontario, helped the industry switch to soilless – or hydroponic – growing systems in the mid-1980s and replaced their weekly feeding schedule with a seasonal fertigation program where nutrients are adjusted according to crop growth and environmental conditions. The subsequent release of a patented and commercialized computer-controlled fertigation system, the Harrow Fertigation Manager™, reduced labour costs and improved crop yield and quality for the greenhouse industry.

Over the years, the contribution of federal crop production specialists has had a significant impact on agricultural practices and has changed the agricultural landscape across Canada and sometimes beyond. These changes have given farmers new tools, techniques and crop options, increasing their profitability and competitiveness in today's international markets.

Genetic Research – Studying the Small for Big Results

Genetic research may seem like a modern field but farmers and scientists have been influencing the genetics of crops for centuries, selecting for characteristics like high yields, hardiness, adaptability and taste.

Today scientists have the tools to do more in-depth and thorough genetic examination of our agricultural resources. AAFC's involvement in mapping the genetic structure of various Canadian crops has helped pinpoint important agronomic traits such as disease resistance, yield and quality for use in plant breeding.

Originally established as the Dominion Rust Research Laboratory in 1926, the Winnipeg lab has been the site of many landmark discoveries in disease epidemiology. Here scientists developed a rapid DNA technology to identify wheat varieties with natural pest resistance and also created a method for rapid identification of *fusarium graminearum*, a fungus that causes wheat head blight, one of the most devastating cereal diseases in the world. They have also contributed to the discovery of rust-resistant genes in wheat and oats, establishing Canada as a world leader in the frontline battle against cereal rust diseases like Ug99, a threat to wheat crops world-wide.

AAFC's Plant Gene Resources of Canada (PGRC), headquartered in Saskatoon, Saskatchewan, also contributes to international efforts to protect and preserve the world's agricultural resources. This program promotes the exchange of plant genetic material with scientists around the world to help develop new crops. The PGRC collection contains over 113,000 seed samples including the world collection of oat and barley.

Also part of the PGRC, a clonal genebank in Harrow, Ontario, contains over 3,400 samples of small fruits and tree fruits, while the research centre in Fredericton, New Brunswick, contains over 130 samples of potatoes.

The Animal Genetic Resources Program, a joint initiative with the University of Saskatoon, plays a similar role, cryopreserving the germplasm of Canadian animal and poultry breeds to support research in livestock biodiversity. Similarly, scientists in Lethbridge, Alberta, recently combined forces with the University of Alberta to create a large-scale genomic research centre to study cattle genetics.

AAFC scientists have recently contributed to major discoveries in the field of animal genetics that are going a long way toward controlling disease. In Guelph, Ontario, scientists discovered a gene cluster responsible for necrotic enteritis, a deadly poultry disease. In Beaverlodge, Alberta, scientists working in partnership with the University of British Columbia recently identified molecular markers in honeybees with enhanced disease and mite resistance. This discovery will be used in bee breeding to keep colonies healthy and safeguard against wintering losses.

Farmers, breeders and scientists of the past could select for the traits they could count, see and taste. Now, AAFC scientists are using tools to look deep inside at the smallest components of plants and livestock to select for the traits that will preserve them on a large scale.

Ken Richards, Manager, Plant Gene Resources showing seed samples to John Knubley, Deputy Minister of AAFC, and Belinda White, Corporate Secretary.

Animal Science Keeps Canada on Cutting Edge

From its beginning, Agriculture and Agri-Food Canada (AAFC) science has contributed to the development of the animal production industry.

Starting in 1889, scientists established national herds of beef, dairy, swine, sheep and poultry from the best available breeds. Research focused on improving the national herd by making these purebred registered animals available to local breeders and developing strategies to improve quality and decrease feed costs.

Over the years, nutritional and management experiments became more sophisticated, and research evolved to include animal breeding and genetics, animal health and welfare, enhanced production systems, and meat quality and safety. AAFC's scientific contributions have helped animal production in Canada remain competitive and stay on the leading edge of technology to provide consumers with safe, high-quality food.

Scientists in Sherbrooke, Quebec, for example, discovered that adding Vitamin B12 and folic acid to daily rations improved dairy cows' metabolism and the quantity and nutritional quality of their milk. When added to daily rations for pigs, it increased the fertility of breeding sows and produced piglets with more vigor and strength. This feeding strategy has been widely adopted by farmers since 1998.

Collaboration between scientists in Sainte-Foy, Quebec, and Laval University in Quebec City, Quebec, resulted in the world's first feeding guide to help dairy farmers reduce the risk of milk fever, a common disorder that occurs after calving. At La Pocatiere, Quebec, scientists developed new breeds of sheep and used light to adapt their reproduction to marketplace demand – ensuring lambs were available at specific times of the year.

Scientists at Lacombe, Alberta, Brandon, Manitoba, and Nappan, Nova Scotia, and the Western Beef Development Centre in Saskatoon, Saskatchewan, developed winter grazing methods to reduce the cost of feeding cattle in winter. Implemented during the past ten years, the use of swath grazing, bale grazing and stockpiling forages has reduced costs related to fuel, fertilizer and labour, manure management and animal health.

Scientists in Lethbridge, Alberta, continue to develop ways to reduce the amount of methane produced by both beef and dairy cattle by feeding them different diets, and changing the way cattle are managed. One of their discoveries was that lowering dietary crude protein provided a practical and cost effective way of reducing ammonia emissions from feedlots.

Other AAFC scientists in Western Canada are examining various ways to efficiently and economically produce pork and beef products enriched with omega-3 and make the system of producing these animals available to all farmers. And across Canada scientists are studying ways to reduce the use of antibiotics in livestock production through diet including the possible use of probiotics, essential oils and bacteriophages. The team is now comparing the effects on animals fed antibiotics with those fed combinations of probiotics, antioxydants, and bacteriophages in terms of growth and general health.

Close collaboration with the Canadian Honey Council, the Canadian Association of Professional Apiculturists and their international counterparts is addressing emerging bee health issues and helping honey producers cope with challenges. Scientists at Beaverlodge, Alberta, are examining and developing treatment strategies for *Nosema ceranae*, a parasite implicated in the recent losses of colonies world-wide.

Another partnership, this one between scientists in Agassiz, British Columbia, and the University of British Columbia, led to the creation of a Dairy Education and Research Centre to help dairy farmers build facilities and develop management practices that reduce stress and improve the animals' health and welfare. A new dairy research complex in Sherbrooke, Quebec, built with a $12-million investment under the Modernizing Federal Laboratories program in the Economic Action Plan, is helping AAFC step up its research excellence in nutrition, physiology, immunology and molecular biology.

Hot water pasteurization of beef and pork carcasses developed by scientists at Lacombe, Alberta, has improved microbiological safety while also cutting costs. Scientists at Lacombe study meat processing, including production, packaging and distribution, and how they influence product safety, shelf life and consumer acceptance.

AAFC science continues to support the animal sector by developing techniques that improve farmers' economic and environmental performance and enhance the quality and safety of the food system.

New Technologies Deliver More, Safer Food Choices

In 1886, fruits and vegetables were stored in root cellars – dark, damp, partially buried storage rooms built into the side of a hill or sunk into the ground. Homes were not equipped with fridges, freezers, or processed instant meals.

Fast forward 125 years and many of the changes in the way food is preserved, processed, packaged and stored can be traced to the work of federal agricultural scientists. Agriculture and Agri-Food Canada (AAFC) scientists work closely with industry to produce better food, develop and market novel products and enhance the safety of the food system.

The AAFC Research Centre in Kentville, Nova Scotia, has specialized facilities, including a pilot plant for fruit and vegetable processing and food storage chambers with individual control and monitoring of modified atmosphere food storage conditions. New controlled atmosphere storage technologies developed there for blueberries have extended their shelf life three-fold and helped growers capture a larger market share. Another of their technologies, known as HarvestWatch™, is now used internationally to improve storage conditions and extend the shelf life of apples.

In Saint-Hyacinthe, Quebec, the Industrial Program is helping food companies develop new products, new formulations and new processes for greater commercial success. Innovations from scientists in Saint-Hyacinthe include a technology for producing natural food colouring that has since been transferred to industry, and a unique fruit dehydration system which helped Canada break into the US market for dried cranberry products.

Other innovations from across Canada include Smart Crate™, a new reusable container developed by scientists in Saint-Jean-sur-Richelieu, Quebec, in collaboration with Laval University and industry. This system not only reduced packaging costs, it also decreased fresh fruit and vegetables waste during transportation. In Guelph, Ontario, scientists developed a flax dehulling technology to remove the hull from the tiny flax seeds. The technology is now used commercially to create new health and beauty products for global markets. Scientists in Summerland, British Columbia, also conducted sensory research to help the wine industry design and implement a wine quality assurance program in the province.

AAFC scientists are also developing diagnostic tools for better identifying and understanding food borne hazards including toxins, residues, contaminants, pathogens and allergens along with control mechanisms to reduce them. AAFC recently opened a pilot plant in Guelph, Ontario, where government scientists work with the food industry to validate emerging food-safety technologies in Canada.

Modern food research includes building an understanding of the link between food, nutrition, health and wellness. AAFC contributes to increasing opportunities for farmers and other producers by studying possible health benefits of crops that could provide high-value options for farmers. Recently scientists in Guelph provided some of the research supporting the functional properties and physiological effects of oat beta-glucan to substantiate the Canadian health claim statement, “Oat fibre helps reduce cholesterol, which is a risk factor for heart disease.” AAFC research in Summerland, British Columbia, also contributed to the body of evidence supporting the health benefits of berries, cherries and flax - boosting marketing options for these crops.

AAFC science does not end when the crops leave the farm. By working with the food industry, the department helps deliver new opportunities to farmers and healthy, safe and abundant food for Canadians.

Keeping Pests at Bay – From the Lab

Since the early days of agriculture, there has always been a need to keep crops free from pests to maximize food production. For over 125 years, Agriculture and Agri-Food Canada (AAFC) scientists have played a vital role in Canadian agriculture by studying Canada's agricultural pests and helping farmers use control strategies to protect their crops.

Even before the first research farms were established in 1886, entomologists with the Department of Agriculture were reporting on insects that were damaging crops and describing ways they could be controlled. Today, AAFC scientists across the country are taking a multidisciplinary approach to develop and deliver a complementary array of pest control strategies for Canadian crops and livestock. The goal is to attain maximum pest control with minimum pesticide use – to lower production costs and the impact on the environment and beneficial insects.

AAFC researchers from Lacombe and Lethbridge, Alberta, Saskatoon and Scott, Saskatchewan, and Brandon, Manitoba, have played a leadership role in examining and promoting integrated weed management on western Canadian farms. Their research emphasized combining optimal agronomic factors such as diverse crop rotations, higher than normal seeding rates, and competitive crop cultivars to reduce weed populations. This has helped growers decrease their herbicide use and subsequently delay the development of glyphosate-resistant weeds that are becoming a severe problem in other parts of the world.

Scientists across Canada also continue to study the diseases affecting Canadian agriculture and develop ways to minimize their impact. Often this involves finding and examining the causal agent, establishing proper crop management practices to minimize disease presence and developing new plant varieties with improved resistance to the disease.

For instance, the discovery by scientists in Fredericton, New Brunswick, of phytotoxins linked to potato common scab disease was the key to finding and growing resistant varieties. In Brandon, Manitoba, scientists identified soil-borne diseases as the chief constraint to the long-term productivity and economic sustainability of shorter-term irrigated potato rotations in the region. This has helped demonstrate the importance of using management strategies that prevent disease build-up.

A national mycotoxin testing facility in Ottawa, Ontario, identifies, purifies and detects mycotoxin levels in food and animal feeds, allowing scientists to monitor and study plant diseases caused by the fungus *Fusarium graminarum* and guide breeding research in resistant cereal and oilseed cultivars.

Fusarium graminarum is the pathogen that causes wheat and barley head blight and corn ear rot - some of Canada's most devastating plant diseases over the past 30 years in terms of its impact on the health and safety of consumers and animals, and on farm income. Research on this fungus has led to the development of best management practices to help farmers and industry minimize its impact and has helped establish standards for mycotoxin levels in foods and animal feeds.

Across Canada, scientists are also developing novel techniques to help control insect pests. Scientists in Winnipeg, Manitoba, working closely with colleagues at the University of Manitoba and the Canadian Grain Commission, shared information on insects and diseases affecting stored products and ways to prevent the loss of grains and oilseeds during storage. On-site testing by AAFC scientists has also helped flour mills control pests without annual fumigation that use an ozone-depleting substance.

In British Columbia, scientists from Summerland helped develop and implement a Sterile Insect and Area Wide Control to limit populations of the codling moth in regional apple and pear orchards. The introduction of sterile male codling moths not only reduced pesticide use, it also opened up new insect biological control options.

Biological control – the use of live organisms such as viruses, bacteria, fungi, insect parasitoids and predators to control insects, diseases and weeds – has a long history of success in Canada. Biological control is often used to combat invasive species, helping to stop pests from reaching thresholds where farmers can experience economic loss.

Recently, research in Saint-Jean-sur-Richelieu, Quebec, has supported the introduction of four new biological control agents to help control pests on horticultural crops. Research in London, Ontario, supported the release of a parasitic wasp to control the Tarnished Plant Bug (*Lygus lineolaris*), a major insect pest of vegetables, fruits and other crops in Ontario.

Through the years, AAFC research has developed many novel techniques and strategies to help farmers control pests. Close collaboration with farmers, industry and research colleagues across Canada will continue to strengthen Canada's ability to control crop pests with techniques that minimize environmental impact while producing safe, healthy and abundant food.

Quick Response Tackles Pest Outbreaks

History shows us that when pest populations are not kept in check, the consequences can be devastating. For 125 years, Canadian farmers have relied on the expertise of scientists at Agriculture and Agri-Food Canada (AAFC) to identify the culprits responsible for outbreaks, study the specimens in detail and offer strategies to combat them.

This service dates back to 1886 when a personal collection of insects and plants was donated to the federal government. Throughout the years scientists in Ottawa, Ontario, have maintained and expanded what is now a national collection which includes samples of fungi, insects and vascular plants. The collection is housed in high-tech storage facilities with access to DNA technology for rapid, routine and accurate identification of specimens. A collection of freeze-dried cultures and live viruses is also maintained in Ottawa, Ontario, and in Summerland, British Columbia, to help detect and respond to viral outbreaks.

These collections are called into service to help resolve urgent pest-related issues such as when potato wart disease was discovered in Prince Edward Island in 2000, immediately restricting potato trade with the United States and when sudden oak death disease was discovered in a British Columbia nursery in 2003, threatening the survival of local trees. In both cases, AAFC scientists relied on the national collections to develop new tests to quickly detect the presence of these diseases, setting the groundwork for a solution.

During the outbreak of potato wart in 2000, AAFC also provided the Canadian Food Inspection Agency (CFIA) with lab space in Charlottetown, Prince Edward Island, and the services of a local molecular biologist. AAFC scientists were consulted on high-level trade negotiations to reopen the border. The molecular assay developed by AAFC for potato wart is now used by the CFIA and foreign specialists to detect disease spores directly from soil.

In 2003, scientists again used the national collections to demonstrate that the strain of sudden oak death disease had a European origin which helped to trace it to an Oregon nursery. AAFC worked closed with Natural Resources Canada and CFIA on an extensive research program to support CFIA surveys which has successfully kept Canada free of this pathogen. The assay developed by AAFC scientists to detect this disease is now used in Canada and the United States, facilitating trade between the countries.

The national plant collection has helped identify invasive weeds such as Kudzu vine and European common reed, recently discovered in Canada. Early detection of these invasive plants helped scientists respond quickly to recommend control measures to prevent the weeds from spreading and interfering with crop production.

Following a major outbreak of wheat midge in 1983, scientists in Saskatoon, Saskatchewan, discovered a natural enemy of the wheat midge and developed a tool-box of management strategies to improve the timing, placement and efficacy and insecticides for maximum pest control and minimal impact on the beneficial insect. Combined, these strategies saved farmers millions of dollars through reduced pesticide use.

In 1989-91, scientists in Fredericton, New Brunswick, also helped Canada respond to an outbreak of Potato Virus Y. They quickly developed new classification models to identify this virus and later created new molecular tests to simultaneously detect multiple potato viruses to help the industry avoid new outbreaks. Their work helped to lift the quarantine on this disease and resolve important trade issues.

The discovery of the devastating Plum Pox Virus (PPV) in the Niagara stone fruit industry in 2000 was tackled by scientists in Summerland, British Columbia, and London, Vineland, and Ottawa, Ontario. The research team developed a sensitive diagnostic test that is used throughout North America to detect PPV infected trees in the orchard. In addition, the team used molecular technologies to produce a PPV resistant plum variety.

Another strategy to combat outbreaks has been to track key pests and prevent them from reaching peak levels. Several monitoring systems, developed and implemented by AAFC scientists and their partners, are helping farmers pinpoint which pests will present a problem, and when and where to apply appropriate control measures.

In British Columbia, scientists at Agassiz developed and implemented insect and disease monitoring programs for key vegetables in the lower mainland. In the Prairies, scientists from Saskatoon, Saskatchewan, Lethbridge and Beaverlodge, Alberta, are collaborating with provincial counterparts in Alberta, Saskatchewan and Manitoba, the Canola Council of Canada, Dow AgroSciences, the Western Grains Research Foundation and Environment Canada. They are monitoring insect populations at approximately 6,000 field sites to develop pest forecast maps and risk warnings for potenital crop damage. In Quebec, a software program also uses climate conditions and temperature to predict the risk of disease and insect populations in fresh market fruits and vegetables.

The combined result of these monitoring and forecast systems has been an increase in the presence and impact of natural biological controls, a dramatic reduction in environmental problems, lower costs with improved control, and a major reduction in insecticide use.

An early response to pest outbreaks is key to keeping the pests from spreading and interfering with crop production, thus reducing the economic impacts on the farming community. AAFC's national network of pest management specialists linked to Canada's national collections of fungi, insects, vascular plants and virus has been an invaluable resource to the agricultural industry and scientific community by playing a vital role in keeping Canada's agricultural pests in check, contributing tools and knowledge to resolve trade issues, and helping the industry respond quickly to unexpected pest outbreaks.

Resource Science: a Plus for the Environment

The study of the natural resources so vital to farming began with soil and water research early in Agriculture and Agri-Food Canada's (AAFC) century and a quarter of agricultural research — the first soil survey took place in 1914, followed by a study of irrigation and land management practices in 1916.

Even before this, researchers were finding ways to reduce the ecological footprint of agriculture and create sustainable farming practices. A series of long-term crop plots across Canada, including one established in Lethbridge, Alberta, in 1911, have helped illustrate the environmental impacts of crop and livestock systems. This valuable information has been used by scientists to suggest more sustainable production practices.

Today, AAFC scientists across Canada continue to examine the impact of various soil amendments and fertilizers on crop productivity as well as on soil and water quality. They are analyzing the use of nitrates, phosphorus and other fertilizers to recommend nutrient management and farming practices for various crops across Canada.

These are some of the ways that AAFC science is playing a role in developing diagnostic tools for the industry and new technologies for farmers to help maintain soil and water quality and ensure that key nutrients are available to crops.

- Research in Agassiz, British Columbia, has given growers new ways to test soil to balance the nutritional requirements of crops and minimize the potential for environmental pollution in intensively cultivated crops in south coastal British Columbia.
- Scientists in Sainte-Foy, Quebec, also developed new diagnostic tools to improve nitrogen and phosphorus management and reduce the risk of environmental pollution for these elements.
- Scientists in Brandon, Manitoba, played a key role in developing more efficient fertilizers for soil and environmental conditions in western Canada which also improve nitrogen and nutrient use and crop performance while minimizing environmental impacts.
- Researchers in Sainte-Foy discovered that residue from the paper industry is an excellent source of nutritional elements and proved its use as an organic amendment to improve soil quality.
- Researchers in London and Ottawa, Ontario, were involved in determining the impact of materials found in animal and human waste on agricultural land and recently reviewed manure and biosolid application practices. This research helped create new regulatory guidelines across Ontario and introduce new microbial source tracking methods to refine water quality standards nationally.
- New methods to measure soil water content developed by scientists in Ottawa, have been adopted world-wide and revolutionized soil physics, environmental science and water management.
- Scientists in Harrow, Ontario, developed a sub-irrigation water recycling system that uses the existing tile drainage system to capture excess water, store it in an adjacent reservoir and return it to crops during dry periods. Use of this water management system has become an official guideline for good farming practices and is being used by a mix of Canadian and American producers to increase crop yields and reduce water pollution and water consumption.
- In Sherbrooke, Quebec, scientists created a bioreactor that transforms pig manure into electric power. Farmers who install the system benefit in several ways. They have a potential new income source if they can produce enough energy to sell the excess to the power grid and they have access to the natural fertilizer produced in the process which is better balanced for agricultural soils. Canadian society benefits from the reduction in on-farm methane emissions. The system was recently installed on several farms in Quebec, Ontario and Manitoba and is being eyed by farmers and industry in the United States, Mexico, Spain, Poland and China.

Science has helped to refine farming techniques to optimize crop production while respecting the earth's natural resources. And science will be key to delivering even more sustainable farming practices to ensure that these farming resources are available for future generations.

Tell Us What You Think

Innovation *Express* is the Research Branch of Agriculture and Agri-Food Canada's quarterly newsletter to promote research partnerships and technology transfer to organizations interested in agri-food research and development.

We welcome your comments and suggestions.

Contact Us:

Innovation *Express*

c/o Research Branch, AAFC

1341 Baseline Road

Ottawa, Ontario

K1A 0C5

Innovation.Express@agr.gc.ca

www.agr.gc.ca/innovationexpressmagazine

NEW – Electronic Distribution

We are creating an electronic distribution system to notify subscribers when a new issue of **Innovation *Express*** and other pertinent Research Branch news are available.

If you would like to "subscribe", please visit our website:
www.agr.gc.ca/innovationexpressmagazine

Debbie Lockrey-Wessel
Managing Editor

AAFC No. 11657B
ISSN 1920-0471 (Print)
ISSN 1920-048X (Online)
ISSN 1920-0498 (En ligne)