Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Canada

BIODIVERSITY *News*

Key to an innovative future for Canada

We eat, we breathe, we live biodiversity

Everyday, the sun rises over fields, lakes and forests casting a warm glow on the vast expanses of potential resources and habitats that contribute to biodiversity. The delicate and irreplaceable network of plants, animals and insects that has evolved over billions of years, has gained the attention of the United Nations who have declared 2010 the International Year of Biodiversity.

"The food we eat, the air we breathe, the houses we live in, the fuel we use and the medicines we can't live without are all dependent on biodiversity," emphasized Agriculture and Agri-Food Canada Science Director Dr. Barry Grace. "The fine intermingling of species that exists to provide us with the basic functional services we require is absolutely incredible."

"Biological diversity" or "biodiversity" is the variety of life on Earth at all levels of biological organization - genetic, species and ecosystems. It includes the differences *between* species and the even smaller differences *within* species at a chromosomal level.

The International Year of Biodiversity offers the opportunity to increase global awareness of the importance of biodiversity.

"The International Year of Biodiversity is a wonderful chance to bring emergent leaders to the table to talk about where our planet has come from, and where things are headed," says Kathryn White, Executive Director of United Nations Canada. "It's about so much more than establishing our carbon footprint so far – it's about coming together as a nation to engage Canadians in all aspects of this important topic."

Scientists believe that there are over 13 million species on the earth, and biodiversity includes even the tiniest genetic variations within these species. It is a colossal concept to grasp, but researchers across the globe are working together to understand biodiversity, and the implications human activities have on its future.

"About forty percent of the global economy is based on biological processes," White explains. "We unfortunately never realize how heavily we rely on biodiversity until natural environments are de-rooted and we're left at a significant loss. We need to learn how to maximize the investment biodiversity has given us, before it's too late."

With this acknowledgment in mind, researchers are taking interest in all aspects of biodiversity. Genebanks around the world are collecting and protecting species, programs are being implemented that maintain species and their habitats, innovative research is being done to create more resilient and useful strains and studies are aiming to prevent countries' native species from extinction through human impacts and invasive species.

"Many people don't realize how quickly human activity is impacting biodiversity," Dr. Grace says. "Species are becoming extinct much more quickly than they used to, and it needs to be understood that every species we lose is the equivalent to the loss of another prospective resource."

Indeed there is no end in sight for the potential of natural resources. Today wheat is being transformed into car interiors, cows are being used to fight back against invasive plant species, and trees are being utilized as water filtration systems.

Thankfully Agriculture and Agri-Food Canada has programs implemented across the country that integrate people from a variety of specialties, to promote collaborations in science and innovation that can contribute to the positive change.

"The preservation of biodiversity requires a multidisciplinary and intergenerational approach," White says.

"There are very few, if any species that live solitarily," agrees Dr. Grace, "and this isn't a topic that can be tackled on individual fronts. International partnerships are irreplaceable, and they will be the answer to maintaining the beauty and the bounty of our Earth's biodiversity."

www.agr.gc.ca/biodiversity

Recognizing the importance of biodiversity, Canada became the first industrialized country to ratify the United Nations Convention on Biological Diversity in 1992. This international treaty provides an action plan for Canada in conservation, sustainability, and fair and equitable sharing of the benefits that result from the genetic components of biological diversity, such as the use of raw materials for scientific research and commercial products like pharmaceutical drugs.

In this Issue…

Canada's National Collections

Preserving Canada's treasured collections

Located on the Central Experimental Farm in Ottawa, as part of the Eastern Cereal and Oilseed Research Centre, the KW Neatby and William Saunders buildings look like most government buildings of their day – traditonal brick buildings with rows and rows of windows. Most visitors probably walk by without ever really giving these buildings a second thought.

Yet, within those brick walls is an assemblage of invaluable national treasures - the largest bioresource reference collections of fungi, insects and vascular plants in Canada.

Put quite simply, as Dr. Owen Lonsdale, Collections Manager for the Canadian National Collection of Insects (CNC) remarked, "There are numerous collections throughout the country that are either government or university associated, the CNC just happens to be one of the biggest in the world and the most frequently used in Canada. This is where we, as a country, gather and preserve much of our biodiversity."

The Eastern Cereal and Oilseed Research Centre (ECORC) not only houses some of the country's most valuable natural treasures; it is also home to a team of over 75 scientists, researchers, biologists and technicians who, through their collective intellectual power, and scientific and technological capabilities, work with the various specimens in the collections to ensure the protection and preservation of Canadian biodiversity.

Through examination, analysis and synthesis of the treasured collections, the team of scientific superheroes:

- identify unknown species and specimens, sometimes for the first time;
- develop control measures to stem the advance of invasive alien species into Canada;
- forecast the spread of invasive species;
- discover the scientific, medical, environmental and social importance of the specimens; and, with increasing importance,
- provide support for research aimed at reducing the billions of dollars lost annually to invasive species in agriculture, forestry, northern wilderness areas and other native habitants.

And so much more!

As one of Agriculture and Agri-Food Canada's 19 national research centres, ECORC is an active centre of exploration and discovery, incorporating:

- The Canadian National Collection of Insects, Arachnids and Nematodes (CNC), containing over 16 million specimens and one of the five largest collections of its kind in the world;
- The Glomeromycota in vitro Collection (GINCO) holding 150 mycorrhiza isolates on plant hosts;
- National Mycological Herbarium (DAOM) contains 350 thousand specimens as well as the Canadian Collection of Fungal Cultures (CCFC) – a living fungal collection with over 16 thousand cultures; and the
- National Vascular Plant Herbarium (DAO) with 1.5 million specimens.

Canada's National Collections (cont'd.)

The potato wart outbreak in 2000 illustrates the importance of both the collections and scientists in not only protecting and preserving Canadian biodiversity but also addressing economically-important problems for the agri-food sector.

Native to Europe, the quarantinable fungus responsible for potato wart disease attacks the growing points on the potato tuber. The most obvious symptoms of the disease are soft cauliflower-like proliferations of tissue surrounding the infected cells. White at first, when exposed to light the wart-like proliferations become green in colour and then darken. Eventually, the wart tissue rots to release thick-walled, persistent spores that can live for up to 40 years in the soil. Infested land must be taken out of production.

Potato wart was discovered back in 1909 to have contaminated soil in Newfoundland (prior to Newfoundland becoming a Canadian province), and the disease was quarantined accordingly. The government even forbade the movement and transportation of soil and potatoes out of the province. This remains true to today.

However, in 2000 a serious problem arose: a sudden outbreak of potato wart disease was being reported in Prince Edward Island – the potato capital of Canada. Immediately, the potato industry ceased exports and the federal government knew the infected fields must be located and contained quickly before there was to be any chance of opening the market back up. The Canadian Food Inspection Agency turned to the Eastern Cereal and Oilseed Research Centre mycology unit headed by Dr. André Lévesque in Ottawa!

"The mycology molecular labs, together with the herbarium and culture collection staff worked overtime – day and night. Extracting and comparing DNA from the new and historic samples of the disease from the mycology herbarium, and from related fungi from both the herbarium and the living fungal culture collection; they were able, in less than a week, to develop a preliminary unique genetic profile of the disease agent affecting the potatoes," recounts Dr. Scott Redhead, Research Scientist and Curator at the National Mycology Herbarium.

Without having a collection that included samples of the disease, it would have been much more difficult for scientists to profile the disease's DNA sequence – a necessity in developing an effective assay. The ability to sequence the DNA saved an enormous amount of time, allowing many samples to be tested quickly without the need to evaluate each one individually under a microscope.

"Being a quarantined organism, it was not the sort of thing that could be brought over the border for quick study by our researchers. The resources had to already be in Canada. The herbarium and culture collection had everything necessary to make comparable DNA extractions of the causal agent and of related fungi. This was only achievable because of the collections."

It's no wonder that scientific champions from around the world come to ECORC, a Canadian "superhero hub," to visit the collections. With its world-renowned reputation, an international network of scientists, researchers, biologists and technicians come from far and wide to utilize and learn from the collections in order to support and advance their own investigations and pursuits.

"We are in constant interaction with major collections around the world. Not only do we allow them to borrow from our collections but we are able to utilize their collections via loans as well. We are constantly collaborating with international scientific organizations. There is a great deal of mutual respect within the collections community," notes Dr. Redhead.

And while, Dr. Lonsdale admits, "To know you are the first person to identify a species that nobody has ever seen before NEVER gets old. It is a true honour to bring it into the world and explain its relevance."

In true superhero fashion, he adds, "This is something we all (collections community) take quite seriously. Our work is a lot of fun but with it also comes a lot of social responsibility. It is imperative that we are able to relay, both domestically and internationally, the importance of our work and the relevance it has for humans, society and, in particular, global biodiversity."

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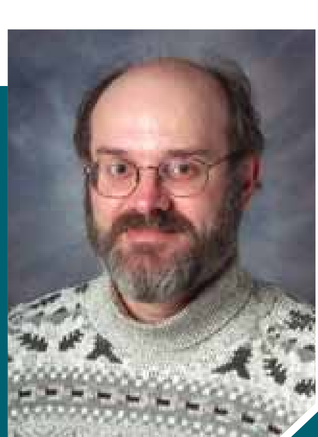

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Canada's National Collections (cont'd.)

Taxonomy in action – discovering new invasive species

The highly invasive plant species known as European common reed was originally found in Canada in 1910 but was confused with a similar native plant until 2001 when it entered a phase of rapid expansion. The rapidly increasing populations led researchers to discover that the plant was in fact an invasive alien from Europe, disguised as a native species.

Dr. Paul Catling, Research Scientist at the National Plant Herbarium, explains how this discovery was made:

"AAFC botanists have a very special tool for discovering plants in disguise. It is a collection of over 1.5 million plant specimens collected throughout Canada over the last two centuries. To find out if the plant that was recently spreading along the road was different, it was only necessary to go to the collection and carefully compare the spreading roadside plants with plants collected earlier in remote wetlands.

AAFC botanists analyzed traits with respect to time and habitat and discovered that the plants lacking red colour, having small flowers, and occupying nutrient-rich habitats were invaders. Without the collection of priceless specimens including a time sequence, this discovery would not have been possible."

Following the discovery, AAFC scientists not only studied the new species and plotted its movement but furthered their research to predict future spread of the invader. They predicted that it would enter the prairie provinces and it did within a week! They also warned of impacts on ducks in prairie potholes and interference with water flow in western irrigation districts. These impacts could cost many millions of dollars. Being alerted to the risks now provides a little time to be prepared.

European common reed has become one of the top invasive alien plant species in Canada. Tall, thick reeds reaching to 3 meters, leaves with razor sharp edges, and deeply embedded rhizomes assist this large perennial grass in effectively crowding out native plants and aggressively taking over the natural environment.

"It is an aggressive plant that thoroughly dominates many places where it grows and it has a devastating effect on native flora and fauna," explains Dr. Catling. "In some regions it has become a serious competitor of cereal crops. Detecting it early so that it can be controlled prior to much more extensive damage can save a lot of money."

However, a correct prediction does not denote the end of their involvement on this issue. AAFC scientists are currently working to support the development of monitoring and innovative management strategies.

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>
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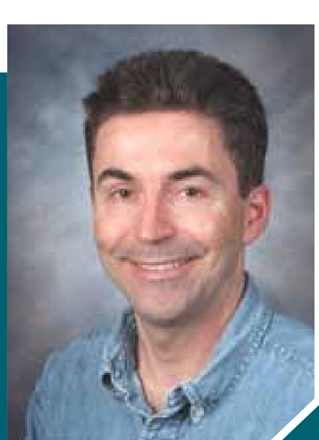
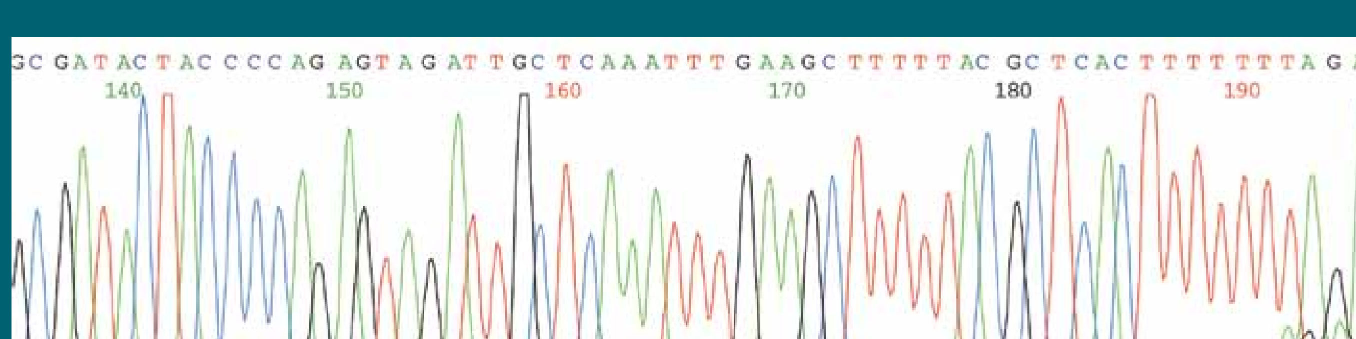
> *National Plant Herbarium*



Canadian biodiversity expertise presented to the United Nations

During International Year of Biodiversity (2010) Dr. André Lévesque, was invited to share his expertise through a feature presentation at the International Year of Biodiversity Science Policy Conference at the United Nations Educational, Scientific and Cultural Organization (UNESCO) Headquarters in Paris, France.

The January 2010 conference gathered together 250 participants from all continents to present new scientific findings on biodiversity relating to several key themes and issues, and to assess implications for government policy-making.



Canada's National Collections (cont'd.)

Contributing to the "Catalogue of Life"

There are a lot of species in the world - perhaps as many as 13 million!

Classifying them all is quite complex and only a fraction of these have been properly recognized, described and named. So far there is no complete list of all of the named species making classification even more difficult - but this issue is finally being addressed. Agriculture and Agri-Food Canada is part of an international partnership called the Integrated Taxonomic Information System (ITIS) which aspires to do just that – help catalogue every known living organism in the world.

"ITIS is a North American initiative that is working with the global indexing project called Species 2000," Biologist Dr. Guy Baillargeon explains. "Together, we're building a 'Catalogue of Life' that's aiming to index every identified living species in the entire world – from tiny microbes to giant whales."

The ITIS catalogue will contain scientific names, synonyms, common names and hierarchical classification for land, water, and airborne organisms mainly found in North America from all biological kingdoms - animals, plants, fungi, and microbes.

"ITIS is like a dictionary of names," Dr. Baillargeon describes. "Not particularly attractive, but an indispensable underlying infrastructure for other value-added projects that offer the more attractive information such as pictures, identification aids, or references for a species."

"ITIS presently has about 600,000 names in its database," Dr. Baillargeon says. "By April 2010 the collaboration with Species 2000 will have over 1.2 million species recorded from around the world, and we believe this number will be about 1.8 million when the list is complete."

AAFC is primarily responsible for providing multilingual interfaces for all of the information being put together. Through this, we are facilitating the sharing of biological information among researchers and cooperating agencies globally for a worldwide network.

This project - by giving a baseline for species at this point in time - is a significant contribution to the world's ability to describe, conserve, and manage biodiversity.

"We have 250 years of work by taxonomists, and still no complete list of what is known to exist on our planet," Dr. Baillargeon reflects. "We need to start adequately managing our resources, and to do that, we need to really know what's out there right now."

"Together, we're building a 'Catalogue of Life' that's aiming to index every identified living species in the entire world – from tiny microbes to giant whales."

- Dr. Guy Baillargeon

As a taxonomist with the National Biological Collections in Ottawa, Dr. Lévesque's research supports biodiversity efforts as he works with leading edge technology to analyze and identify fungi and fungal cultures. Using DNA technology initially pioneered by the medical field, Dr. Lévesque set up a DNA lab at the Eastern Cereal and Oilseed Research Centre in Ottawa which has become critical for rapid, routine and accurate identification of fungal organisms.

The lab supports research by other scientists with the National Collections and is allowing major advances in a number of agricultural areas such as plant pathology. Many of these scientists also work on the DNA Barcode of Life, an international initiative to develop further the routine use of DNA sequencing for identification that originated from the University of Guelph.

Dr. Lévesque's presentation at the United Nations Conference explored how the sequencing of DNA, the blueprint of life, has created a revolution in taxonomy. Research into biodiversity and taxonomy helps in early detection of invasive species, and supports accurate diagnostics of pests and pathogens. Important information is provided to authorities responsible for the security of international trade and commerce.

Canada's Genebanks

Preserving our genetic resources

It's like finding a needle in a haystack. It takes years of patience and research to develop a new plant resistant to a particular crop pest and still have consumer appeal. It's important for scientists to have a large selection of genetic materials as you never know which variety contains the genetic resistance to a future crop pest.

Today's agriculture is intensive and benefits from the genetic uniformity of crops. There is not a huge selection or variation in today's crop plants. This is a concern for plant breeders and scientists worldwide who are looking for genetic materials. On a global scale, the United Nations Food and Agriculture Organization has recognized the importance of protecting and preserving genetic resources for food and agriculture. They work in concert with the Consultative Group on International Agricultural Research (CGIAR), a worldwide network of plant genetic resources centres and the Global Crop Diversity Trust based in Rome, Italy.

In Canada, Agriculture and Agri-Food Canada identifies, collects, preserves and encourages utilization of crops grown in Canada through Plant Gene Resources of Canada (PGRC). The headquarters for this national operation rests at the Saskatoon Research Centre in Saskatchewan where Dr. Ken Richards oversees the Canadian Genetic Resources Program.

The site in Saskatoon is responsible for more than 1,000 species of plants and preserves over 113,000 seed samples in its seed genebank including native Canadian plants of economic importance or those at risk of loss to our biodiversity. On Canada's behalf, it has also accepted formal responsibility for principal world collections of barley and oat and backup world collection of pearl millet.

The main backup facility for Canada's seed collection is the United States Department of Agriculture facility in Fort Collins, Colorado.

Also located in Saskatoon is the newly-formed Canadian Animal Genetic Resources Program, a joint initiative between AAFC and the University of Saskatchewan. Created in 2005, this program ensures the long-term conservation of genetic diversity of Canadian animal and poultry breeds by cryopreserving the germplasm.

The Canadian Genetic Resources Program also includes a collection of over 3,500 tree-fruit and small-fruit crops in the Canadian Clonal Genebank at AAFC's Greenhouse and Processing Crops Research Centre in Harrow, Ontario.

"Very few people realize Canada conserves 1,500 different strawberries or over 850 unique apples," says Margie Luffman, curator of the genebank. "Although we might not commercially grow all the varieties, each one is distinct and the genetic information inside may become a valuable resource in the future as scientists look to the past as they develop new varieties."

Scientists in Fredericton, New Brunswick, also maintain a collection of over 140 heirloom and modern Canadian bred potato varieties at AAFC's Potato Research Centre. "The diversity in the potato is vastly greater than what we see on the produce counters in our stores," emphasized retired potato breeder, Dr. Richard Tarn. "Take the humble potato… this crop originated in South America and spread throughout the world. Today there are over 7,500 different potato varieties from around the world in the collection at the International Potato Centre in Peru."

"Canadian agriculture is based on crops that originated from areas outside of Canada," states Dr. Richards. "No country can pretend to preserve on its own all of the genetic diversity needed for all of its crop plants for all time. It's vitally important to coordinate and share the work of conservation among countries for the benefit of citizens everywhere."

FAST FACTS

Stats on samples stored at Canadian Genebanks

oat	28,000
barley	39,000
wheat	14,000
flax	3,500
brassicas – mustard, canola	3,500
forages – alfalfa, grasses	4,500
tomato	2,800
apple	850
strawberry	1,500
potato	140
peach	63
pear	130

Canada has the world's largest collections of barley and oat and significant collections of flax and bird's-foot trefoil, an important forage legume for cattle production.

Banking on a future for seeds – Global Seedbank in Norway

The Government of Norway, along with help from the Global Crop Diversity Trust, has developed the Svalbard Global Seed Vault, sometimes referred to as the "Doomsday Vault," to conserve plant materials for future generations. It will be the most secure conservation facility in the world, existing to store backup copies of the world's seeds in case the primary repository holding them is compromised. In the winter of 2008, Dr. Ken Richards delivered on behalf of Plant Gene Resources of Canada about 6,000 distinct samples from the Canadian genebank collection representing about 90 species of plants to this global seed storage facility in Norway. Over the last three years more seeds have been sent for a total of 15,000 from Canada.

Canada's Genebanks (cont'd.)

Connecting conservation with innovation: *Maximizing the genetic diversity of flax*

As the largest producer and exporter of oilseed flax in the world, genetic diversity is crucial to improving Canadian flax and enhancing future market opportunities. The nutritional qualities of this crop, which is rich in omega-3 fatty acids, dietary fibre, lignans and other antioxidants, has also sparked a renewed interest in using it to enhance foods and in developing new flax varieties for specific end-uses.

For the three independent flax breeding programs in Western Canada, having access to a diverse gene pool is key. The Plant Gene Resources of Canada offers just that - allowing for the development of new lines of flax to meet the needs of the latest farm practices, for new crop uses as well as new varieties that are adapted to climate change and resistant to disease.

The Plant Gene Resources of Canada (PGRC) is located at the Saskatoon Research Centre of Agriculture and Agri-Food Canada. The collection has been assembled over the last 40 years and is Canada's national bank of plant germplasm for food and agriculture.

Through exchange with genebanks and flax breeders in the United States, Russia, Germany, Czech Republic, Poland, Turkey, Chile, and many other countries, this irreplaceable resource has been made possible.

"This genebank includes more than 3,500 samples of flax lines from 76 countries," explains Dr. Axel Diederichsen, PGRC curator. "The germplasm represents an extremely diverse array of flax types selected for over the course of many years – it's really an incredible resource!"

Historic cultivars and lines developed by AAFC, Canadian universities and private breeders are all a part of this collection. Seeds from the flax collection are also available to breeders and researchers nationally and internationally. The web site (see www.agr.gc.ca/pgrc-rpc) provides access to information about the germplasm and can be used for ordering seed samples.

Besides having the resources to create new flax lines, and to keep them secure in the future, the collection also offers the opportunity for detailed flax characterization and evaluation. In 1998, PGRC pursued this opportunity by beginning a number of projects with financial support from the Saskatchewan Flax Development Commission. These research projects led to many publications assessing the diversity of characteristics such as molecular structure, drought tolerance, seed yield, plant height, disease resistance as well as the quality of seed oil, and fibre content.

"The genetic diversity of flax is in fact striking," says Dr. Diederichsen. "Plants may be as short as 17 cm or as tall as 130 cm; the flowers can be blue, purple, white or pink; seeds can be brown, yellow, olive or speckled- we have a lot to work with!"

Since the base collection of flax is so large and some samples are genetically very similar, PGRC researchers decided to select 380 accessions that concentrate the diversity found in the entire collection. This concentration became the first core collection for flax to be created worldwide and is now being studied in a cooperative project between flax breeders at AAFC's Morden Research Station in Manitoba and the University of Saskatchewan in Saskatoon.

Ongoing collaboration with Flax Canada 2015 and Genome Prairie will enable further innovative research into the core collection and help ensure the sustainability of the Canadian flax industry and maintain Canada's continued role as a world leader in flax production and exportation!

AAFC negotiated the International Treaty on Plant Genetic Resources for Food and Agriculture. In 2002, Canada ratified this Treaty adopted by the United Nations FAO.

Virus depository in Summerland and fungal collection in Ottawa

Virologist Mike Bernardy maintains the collection of over 250 viruses (mainly tree fruit viruses) at the Pacific Agricultural Research Centre in Summerland, British Columbia. This collection has helped scientists develop diagnostic kits to identify viruses such as blueberry scorch virus. Carolyn Babcock at the Eastern Cereal and Oilseed Research Centre in Ottawa maintains Canada's fungal collection of over 16,000 living strains.

Animal genetics on-line

This year, AAFC will launch its new website for animal genetic resources – making the holdings of the genetic collection available on-line. The collaborative project was undertaken with scientists from the United States Federal Department of Agriculture and Brazil. This important tool has already attracted interest from other countries in Central and South America.

Molecular techniques measure biodiversity over time

A new tool is helping scientists examine the past 100-plus years of genetic diversity in crops. Molecular techniques allow scientists to study varieties of specific crops to see how their diversity has developed and changed through the years and help us to better understand the risks of genetic vulnerability and erosion. The research team is currently examining samples of oat, flax, hard red spring wheat and potato – their oat samples go back 115 years!

FLAX FACTS

Flaxseed contains about 35-45% oil and is one of nature's richest oilseed sources of omega-3 fatty acids. It is also rich in dietary fibre and is an excellent source of lignans and other antioxidants.

Crop Innovation

Canadian-grown success have had a global impact on agriculture

Spartan apple

A child is born: the father, Newtown Pippin, the mother, McIntosh, But upon later genetic evaluation, it is found the offspring shares no genetic relationship to the putative father. A case of mistaken parenthood begins. Thankfully, however, this is just the story of the Spartan apple – whose true origin still remains a mystery.

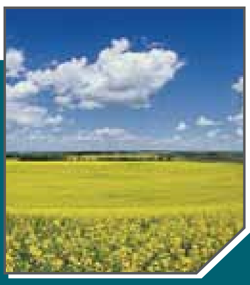
Created in the 1920s by Dr. R.C. Palmer of AAFC's Pacific Agriculture Research Centre in Summerland, British Columbia, the Spartan was one of the first apples in Canada to be created using a formal scientific breeding system. Strangely, however, according to forensic evidence now available, a mix-up occurred making this crisp, long-lasting fruit an enjoyable plant-breeding accident.

This underscores the joy of biodiversity. There is a cornucopia of benefits farmers and consumers can gain through a marriage of nature's natural selection and science's advances. Often the consumer doesn't understand what goes into the breeding process; they only see what's on the grocery shelf.

Researchers in crop development try to look into the future to create a long term, commercially successful crop. The apple breeding process for example can take as long as 20 years, so researchers need to try to predict what will be valued that far ahead.

The ability to cross-breed different strains of crops together is essential. It allows growers to produce crops under external pressures such as climate change and environmental factors that may normally prevent any growing at all.

Genetic diversity is indeed nature's insurance policy as it equips plants with what may be needed for pest and climate resilience. It is also great for people as it has resulted in new food, pharmaceutical and bio-energy products that will contribute to meeting present and future demands.



Canola

Sometimes plants contain far more genetic potential than is naturally selected for. This is another benefit of using biodiversity to develop new crops, as was the case with canola, Canada's Cinderella crop.

Canadian scientists Dr. Keith Downey of AAFC's Saskatoon Research Centre in Saskachewan and Dr. Baldur Stefansson, a plant breeder at the University of Manitoba, developed the oilseed in 1974. It is a genetic variation of rapeseed and was developed to reduce levels of glucosinolates (which contribute to the sharp taste in mustard) and remove two fatty acids that aren't essential for human growth.

This resulted in a plant high in good fats like monounsaturates and omega-3s and low in bad fats such as saturates and trans fats. It's also a good source of Vitamin E.

Soybean

Another plant developed in Canada to create better value is the Harovinton soybean. Food-grade soybeans in general have gained significant attention lately for their assortment of health benefits. They are the base for tofu, high in protein, a good source of omega-3 fatty acids, calcium, folates and iron. The oil of the plant is also used in a variety of industrial lubricants, cosmetics, candles and even vehicle fuel.

AAFC scientist Dr. Richard Buzzell developed a variety that has become world-renowned and significantly contributed to Canada's becoming a world leader in soybean production.

The Harovinton soybean - also known as the "Asian Pearl"- was developed fifteen years ago at the Greenhouse and Processing Crops Research Centre in Harrow, Ontario. The large-seeded, high-protein variety is resistant to root-rot and is tolerant of herbicides, meaning it has consistently produced high yields.

These features have contributed to the variety becoming highly marketable, and particularly successful in the Japanese tofu market. In 2006 it won the Seed of the Year competition which recognizes new Canadian developed field crops, forage, fruits, vegetables or herb varieties.

Clearly biodiversity and scientist's ability to understand and make use of it has lead to significant improvements in crops available today. Biodiversity needs to be maintained as it is unpredictable what problems will arise in the future, and by keeping biodiversity in the gene pool, the likelihood of being able to respond to future issues is increased.

Marquis wheat

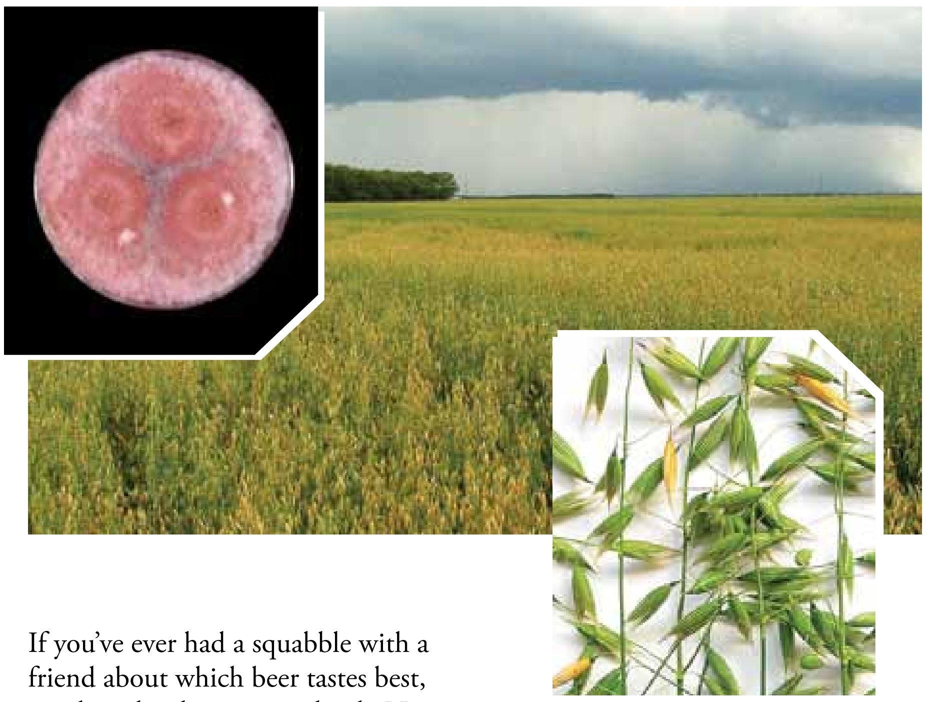
Marquis wheat is another biodiversity success story that helped earn Canada its title as "the breadbasket of the world" early in the twentieth century.

The story begins with Dr. Charles Saunders - an 'experimentalist' in Ottawa – and with just twelve grains of wheat. In the early 1900s, existing strains of high-quality wheat were unsuccessful in Canada because they matured too late and fell victim to early frosts. So Saunders collected wheat samples from around the world and cross-bred them.

The result was the development of Marquis wheat which ripened early, was resistant to heavy winds, and had the ability to produce high quality flour and bread. This quickly became the primary strain of wheat in Canada and the United States. One hundred years later, new spring wheat varieties continue to be developed with improved yields and disease resistance, yet many still trace some genes to the original Marquis wheat of the early 1900s.

Crop Innovation (cont'd.)

Securing cereal



If you've ever had a squabble with a friend about which beer tastes best, you have biodiversity to thank. Not only does biodiversity provide foods with differing tastes, it also offers opportunity for the cross-breeding of plants for industry to obtain disease resistance - ensuring your favourite beer won't soon disappear.

Dr. Andy Tekauz, an Agriculture and Agri-Food Canada researcher in cereal diseases, is one scientist helping to make certain this doesn't happen.

Fusarium head blight (FHB) is a cereal crop disease that decreases yield, and produces a toxin that is harmful to some livestock and could be toxic to humans at high enough levels. It has been known to affect wheat and barley for years, and has recently been found to affect oats as well.

"It was both surprising and interesting when FHB started showing up in our region in the mid-1980s," says Tekauz. "For me it began as a curiosity, but after it caused a severe outbreak of blight in 1993 it became a real concern. The scientific search for genetic resistance to mitigate the problem soon kicked into high gear."

The fungal disease thrives in moist, temperate climates, and over the past 15 years has become one of the most important cereal diseases in many parts of North America. With the use of genebank databases – catalogues of preserved genetic information – scientists have been working towards finding lines of wheat, barley and most recently oats that are more resistant to FHB.

"It is a long process towards successfully making a crop more disease-resistant," Tekauz reflects. "You may find a line of oat that has good resistance, but if it results in low yields or poor quality grain, it's of little use."

The research team started by selecting a few hundred lines of oats from around the world to test for resistance. Those that showed resistance were then cross-bred with locally adapted lines to see if a promising plant could be grown. Dr. André Comeau, an AAFC scientist at Ste.-Foy, Quebec, who had visited Brazil, suggested that particular attention be paid to South American material. Since there is a very heavy infection pressure in many South American countries due to their humid conditions, it was believed that natural selection for fusarium resistance had already occurred there.

"Fortunately, amongst the hundreds tested, we've been able to identify about nine or ten oat lines that have shown noteworthy promise," Tekauz says. "When grown in the FHB disease nursery they have had significantly lower levels of toxins than would normally be seen."

The effects of FHB on cereal crops are detrimental to both yield and quality so the benefits of crossing local varieties with those that show resistance are substantial to farmers and consumers alike. If a disease like this were allowed to run its course, entire strains of wheat, oats and barley could be lost. So the innovative research that leads to developing adapted, resistant strains will prevent this from happening, meaning no threat to locally produced bread, breakfast cereal or beer.

Plant origins and diversity

Canadian agriculture is mostly based on crops that originated from areas outside of Canada. For example, wheat originated in the Near East (in such countries as Iran), corn in Mexico and Guatemala, alfalfa in Turkey, soybean in China, and potatoes in South America. In order to improve these crops we need access to biodiversity resources in other countries. Crops of economic importance that are native to Canada are limited and include sunflower, strawberry, raspberry, saskatoon berry, blueberry, currant, cranberry and a large number of native forage and grass species.

"It is a long process towards successfully making a crop more disease-resistant, you may find a line of oat that has good resistance, but if it results in low yields or poor quality grain, it's of little use."

- Dr. Andy Tekauz

Invasive Species

Invasives are growing to be a problem

"Invasive species are part of a vicious cycle. A foreign weed will arrive, strangle out native plants which are the food supply for small creatures like rabbits, rabbits decrease in number which means wolves run out of food and the chain reaction continues."

- Ron Moss

Invasive species

These aliens aren't the large-eyed, spindly, green creatures seen in movies, but instead are plants, mammals, birds, reptiles, insects, amphibians, invertebrates, and micro-organisms that are foreign to Canada's naturally occurring environment.

Canada is known for its natural beauty. Whether you're a hunter, birdwatcher, hiker, or simply a nature lover, there's plenty to see in Canada. The country contains tundra, grasslands, deserts and forests resulting in unique ecological communities of plants and animals living together in each particular climate. As distinct as these areas are from each other, however, they are all presently fighting the same battle against aliens.

These aliens aren't the large-eyed, spindly, green creatures seen in movies, but instead are plants, mammals, birds, reptiles, insects, amphibians, invertebrates, and micro-organisms that are foreign to Canada's naturally occurring environment. They are called "invasives" and whether they have spread from one part of Canada to another, or have been brought in from outside the country, they are considered a threat both to Canada's native species and biodiversity.

Invasives are successful because they have an advantage over the native species. They compete for resources, prey on local species, alter natural habitats, change valued local species through hybridization and harm local species that have no foreign disease resistance. Ultimately, they are taking over.

Ever since people began traveling around the world invasives have existed. Unfortunately, as the ability to travel has increased, so has the spread of invasives. Some are favourable, such as corn, originally from Mexico, or the domestic cat from Africa. Others, however, have been proven costly, such as the West Nile virus, the Asian long-horned beetle which is devastating Canadian forests, and the Zebra mussel which starves local water life of its food.

"It is estimated that invasives cost Canada $4.2 billion per year," Ron Moss, technical trade manager at Agriculture and Agri-Food Canada reports. "Whether it is foreign species affecting crop production, decreasing the existence of wild game for hunting, or wiping out species that are used to promote tourism, invasives are hurting Canada and are potentially the biggest threat to our biodiversity."

"Invasives come from places where they have their own threats that keep them under control," Moss explains. "Native Canadian life forms are already experiencing the stress of climate change and invasives arrive with nothing holding them back. Only the strongest survive, which unfortunately means the fragile balance that allowed for Canadian biodiversity to exist is being lost."

Moss stresses that the most important strategy for dealing with invasive species is setting up programs for early detection and rapid response. By the time an entire field is filled with an invasive species, the reversal is a lot harder to accomplish than if a small patch was detected early on.

"Invasive species are part of a vicious cycle," Moss says. "A foreign weed will arrive, strangle out native plants which are the food supply for small creatures like rabbits, rabbits decrease in number which means wolves run out of food and the chain reaction continues."

AAFC is working with other organizations such as the Canadian Food Inspection Agency (CFIA) to better understand the issue and put together prevention programs that every Canadian can participate in.

Invasive Species (cont'd.)

Keeping in what we may want out

Most people try to keep creepy crawlies out of the buildings they live and work in, but Agriculture and Agri-Food Canada specialists are trying to keep them in! The Insect-Microbial Containment Facility at the Lethbridge Research Centre in Alberta was recently constructed to provide a secure environment for researchers to study the biology, efficacy, and specificity of exotic pests, without allowing them to be released into the environment.

"Pests" include arthropods (especially insects), pathogens and weeds - most of which are invasive species from outside of Canada – and are destructive to agriculture. The new Insect-Microbial Containment Facility, which was carefully constructed to ensure none of the test subjects could escape, is enabling researchers to find new ways to naturally control such pests.

"We are now capable of doing some very exciting research we couldn't before," research scientist Dr. Rosemarie De Clerck-Floate says. "There are lots of guidelines that need to be met in a facility such as this to ensure we can study potential pests without actually introducing them into the environment."

The organisms being examined are of no risk to human health, but could potentially pose a risk to Canadian agriculture. They are being carefully examined in the containment centre until deemed safe or even beneficial for release as biocontrol agents.

"We're learning of some incredible methods of progress towards restoring the ecological balance that has been disrupted by invasives," Dr. De Clerck-Floate says. "For example, there are some invasive weeds that we are beginning to control with foreign insects."

Although helping control invasive species is only one aspect of what the centre does, it's a significant one. The ability to do this innovative research is so important because it helps to maintain Canada's biodiversity that is being threatened by exotic species.

"Invasive weeds are very destructive. They displace native vegetation, local critters that feed on those plants, and the pollinators. It's great to know that we will be able to reclaim huge expanses of land that have unfortunately been taken over and prevent it from happening in the future."

"We're learning of some incredible methods of progress towards restoring the ecological balance that has been disrupted by invasives,"

- Dr. Rosemarie De Clerck-Floate

Invasive Species web portal

In May 2009 the Government of Canada launched an invasive species Web portal as a partnership between various federal departments (see www.invasivespecies.gc.ca). This portal serves as a gateway to information on Canada's efforts to reduce the risks invasive species pose for the environment, economy and society. It also provides links to other credible sources on invasive species.

"Invasive weeds are very destructive," Dr. De Clerck-Floate reflects. "They displace native vegetation, local critters that feed on those plants, and the pollinators. It's great to know that we will be able to reclaim huge expanses of land that have unfortunately been taken over and prevent it from happening in the future."

"We are now capable of doing some very exciting research we couldn't before. There are lots of guidelines that need to be met in a facility such as this to ensure we can study potential pests without actually introducing them into the environment."

- Dr. Rosemarie De Clerck-Floate

On-farm Biodiversity

Hand-in-hand to save the land

"We use a multi-focus approach for these programs (Prairie Shelterbelt Program and the Community Pasture Program). They integrate and promote collaboration between many international networks which lead to building awareness of current issues, and help farmers adopt Beneficial Management Practices (BMPs)."
- Jamie Hewitt

The maintenance of Canadian and worldwide biodiversity is not a small task. Without the integration of a variety of unique and specialized initiatives the job would be impossible. Agriculture and Agri-Food Canada is an important link to a number of programs that add up to a significant benefit to biodiversity.

Programs such as the Prairie Shelterbelt Program and the Community Pasture Program benefit farms and the environment. The Shelterbelt Program carefully plots a variety of trees to protect farm crops and livestock from wind, snow, dust and the hot sun year-round.

The Community Pasture Program is AAFC's largest and longest-running contribution to landscape conservation on the Prairies. Created in the 1930s to reclaim badly degraded lands, the program currently manages 929,000 hectares (2.2 million acres) of land for environmental and economic sustainability. These lands comprise 85 community pastures in Saskatchewan, Manitoba and Alberta.

Both initiatives increase water retention in the area, act as a natural filter for run off, prevent erosion, and reduce greenhouse gases while at the same time offer a habitat for birds, animals and pollinators. By planting species native to Canada in these areas, biodiversity is being maintained and facilitated.

"We use a multi-focus approach for these programs," Environmental Analyst Jamie Hewitt explains. "They integrate and promote collaboration between many international networks which lead to building awareness of current issues, and help farmers adopt Beneficial Management Practices (BMPs)."

As stewards of the land, many farmers have already been adopting BMPs - ways of conserving soil, air, water and biodiversity resources in agricultural landscapes without sacrificing farm productivity. BMPs use a holistic approach to management so that they offer some benefit to the farmer while also significantly minimizing the impacts and risks to the environment created by farming.

AAFC works with conservation organizations such as Ducks Unlimited and the North American Waterfowl Management Plan which focus on BMPs that help conserve and increase aquatic land, habitats and wildlife in Canada.

Ducks Unlimited also provides farmers with the opportunity to restore wetlands on their farms to their original size and configuration, often at no cost. Restored wetlands offer a natural filtration system for runoff, they retain water which reduces soil erosion in the area, and they support a wide range of plants and animals that live only in wetlands.

Ducks Unlimited contributes to The North American Waterfowl Management Plan which is a project supported by organizations in the United States, Canada and Mexico. The plan works to conserve migratory birds and their habitats in wetlands across North America, and has been considered one of the most successful conservation initiatives in the world.

"A lot of these projects have made clear the inter-relationship of agro-industry systems and biodiversity," Hewitt says. "Our research at demonstration sites is showing how significantly biotic populations can be enhanced or destroyed by simple changes in agricultural practices."

It is clear that everything in nature is intertwined, and so then our efforts need to be as well. Through collaborative programs and inititaives such as these, farmers, the environment and biodiversity all benefit.

AAFC works with conservation organizations such as Ducks Unlimited and the North American Waterfowl Management Plan which focus on BMPs that help conserve and increase aquatic land, habitats and wildlife in Canada.

On-farm Biodiversity (cont'd.)

Biodiversity extension specialists

Native rangelands

Native rangelands are areas of natural vegetation dominated by grasses and shrubs. Many have been drastically altered and decreased in size as a result of agricultural and urban development, but their maintenance is beneficial in more ways than one. Short- and moderate-height vegetation provides preferred habitats for birds, small mammals such as gophers and squirrels, and larger game species such as deer and grouse. Rangelands also conserve the biodiversity of native plants, regulate water conditions and protect soil from erosion. Rangelands are integral in the cattle industry as they provide livestock with larger grazing areas. Cattle can be trained to eat certain plants, which can in turn reduce the threat of certain invasive plant species in the area. Agriculture and Agri-Food Canada programs are working to sustain and expand these areas so Canadians can continue to reap their benefits.

Agriculture and biodiversity can co-exist in harmony. Just ask Heather Wiebe, who is constantly amazed by the connections she sees between natural ecosystems and agricultural management in her work as a biodiversity extension specialist in the Range and Biodiversity Unit in Regina.

Or ask biodiversity analyst Erl Svendsen of Saskatoon, who is well aware of the challenge of conducting research and protecting species at risk (SAR) that exist on Agriculture and Agri-Food Canada research sites.

"It is a huge responsibility we have," Wiebe says. "How can agriculture be profitable yet leave the land resilient and accessible to wildlife?"

It's a question the Community Pasture Program (CPP), created in the 1930s to reclaim badly degraded Prairie lands, aims to answer. This AAFC-led program manages 929,000 hectares of land, comprising 85 vast community pastures in Saskatchewan, Manitoba and Alberta. It is one of several programs dedicated to ensuring biodiversity is protected and enhanced through effective management practices.

CPP encompasses - and here's where the harmonious co-existence part comes in – the grazing of 210,000 cows, calves, bulls and horses on lands containing fragile grassland ecosystems and many SAR. The grazing of cattle is symbiotically tied to the survival of many SAR. For example, the Burrowing Owl chooses habitat that is grazed low enough to spot predators and depends on the dung of large herbivores such as cattle to line its nest.

Tools developed for the CPP include a calendar that lists the periods of the year when SAR are most sensitive to disturbance, factsheets on various species, interactive maps, and recommendations for setbacks for infrastructure. The unit (part of the Agriculture and Agri-Food Canada Agri-Environment Services Branch) also works with provincial conservation data centres and other specialists to ensure they are using the best information available.

SAR can also influence the research that the department conducts in a very real and direct way. To date, 33 SAR have been documented on seven AAFC research properties in British Columbia, Alberta, Ontario and Quebec. These discoveries have generated a need for greater awareness among AAFC staff working on these sites, and have implications for research, habitat management and maintenance on a larger level, says Svendsen.

These research sites are part of a larger landscape and it is the wild and uncultivated areas of the sites that contain sometimes quite rare SAR. For example, a research site in Alberta is the only place in Canada containing self-sustaining populations of four SAR which are interdependent with one another for either parasitical or reproductive purposes.

"We look to the species experts, national SAR recovery strategies and status reports for information about threats to a federally protected species in agricultural landscapes. These are reviewed in the context of how operations on the AAFC research properties may need to be adjusted to accommodate SAR as well as how the agriculture sector as a whole may be impacted," Svendsen notes. "We provide advice and information so those with the authority to make decisions have the right information."

A four-step evaluation process has been implemented on AAFC research farms to provide land-use decision makers with the information they need to protect SAR. These steps include screening for wildlife habitat, developing habitat maps with multiple Geographic Information System (GIS) layers, ground surveying, and management planning.

Yet another part of extension work is tied more closely to research that will help the producer improve profitability while preserving biodiversity.

For example, ecologist Mark Wonneck of Calgary is looking at ways that biodiversity can provide benefits to production systems. Mark is conducting research into the value of wild pollinators in canola production systems in central Alberta that builds on prior studies that suggest that providing habitat for bees (i.e. flowering plants, nesting sites and materials) can boost pollination services to both crops and yields. He is also involved in research investigating the role of wild pollinators in native grassland systems in the foothills of the Rockies. In the future, he hopes to investigate the role of biodiversity in pest and disease control, as well as soil fertility, to see if there are ways that producers can take even better advantage of the effect pollinators can have on the ecosystem.

So far, he has shared his findings with producers in Alberta, British Columbia and the Atlantic provinces.

"There is still a great deal we don't know about the role biodiversity plays in ecosystems," Wonneck says. "As we understand more, I think we'll be in a much better position to help producers simultaneously reduce their environmental impact and improve their bottom line."

On-farm Biodiversity (cont'd.)

Canada's popular poplar

Anticipating the changes in climate, you would dress differently if you were headed to northern Canada than if you were headed south. In the spring you may sport a toque in the Yukon, or a pair of shorts in southern British Columbia. We react to our environment – and so do plants! A tree in northern Canada looks very different than the same type of tree in the south, which has driven Agriculture and Agri-Food Canada agroforestry researchers to investigate the adaptability of trees to climate change.

In one of the world's most extensive undertakings of plant collection, researchers are collecting balsam poplar tree samples from almost fifty different locations across Canada. Bill Schroeder, head of research at AAFC's Agroforestry Centre in Indian Head, Saskatchewan, formulated the AgCanBap project to see how altering a tree's natural climatic growing environment would affect its growth.

"Most of the collections that have followed this approach have been done with the precise purpose of providing genetics for breeding," Schroeder explains. "This was our purpose too, but perhaps more important, we're sampling to find the natural diversity of a single tree species and how it adapts uniquely to different environments."

The trees are collected from the farthest stretches of Canada and will contribute to a gene conservation of the poplar, one of the most widely distributed plants across Canada. The collection also clearly demonstrates the natural adaptations of plants over an evolutionary period.

"It's quite interesting how varied these trees are in their growing behaviour," Schroeder reflects. "I'm somewhat surprised this hasn't been done earlier, but it really does take dedication and commitment over time."

In sample locations such as northern Quebec, Labrador, the Northwest Territories and the Yukon; the trees have been found to be very short, but have an incredible ability to photosynthesize quickly since they don't have many long days of sun exposure.

"If you move trees from the north to the south," Schroeder explains, "they have a hard time adapting to the longer growing season. They are used to growing very rapidly for only a short period of time so even in warmer climates they still end up really short."

The research team is currently investigating what might happen if a tree with high photosynthetic rates is crossed with those that are used to long growing seasons.

"Poplar trees are often used as a natural filter beside waterways," Schroeder explains. "They absorb a lot of things we don't want in our water, so we could potentially use the high uptake rates of northern species to create even more effective nutrient interception."

The program will give researchers a good look at what climate change will do to different species in the future and will help them prepare for these effects.

"It is very important to do these kinds of collections to monitor the changes in native species over time," Schroeder says. "It provides a baseline for comparison in the future, and what we learn about adaptability to climate change with poplars can be applied to other tree species."

"We're sampling to find the natural diversity of a single tree species and how it adapts uniquely to different environments."

- Dr. Bill Schroeder

Circling the Globe with Trees

Imagine planting enough trees to circle the globe 27 times! That is exactly what farmers in western Canada have done by planting 600 million trees during the past hundred years. In a time when countries are deforesting their lands, Canada, a land with a prosperous lumbering industry, recognizes the importance of trees to industry, agriculture and the environment and continues to plant trees for future generations.

These trees were supplied through the Prairie Shelterbelt Program, one of the longest running Government of Canada programs. Since 1901 the Shelterbelt Centre has been developing and distributing genetically superior trees and shrubs to farmers for planting on agricultural land in western Canada. The Centre has been performing tree improvement breeding for over 60 years and is the longest running tree research program in North America.

Today the trees are being bred to adapt to climate change, to accommodate a growing interest in biodiversity and the environment, to help meet industry demand for bioproducts and biofuels, and to help fulfill an increased demand in tree-related products such as nutraceuticals, wood materials and fibre. Some tree species distributed to farmers through the program include Scots pine, Colorado spruce, white spruce, caragana, willow, hybrid poplar, green ash, bur oak, villosa lilac, choke cherry, silver buffaloberry and sea buckthorn.

On-farm Biodiversity (cont'd.)

The latest buzz: Bee biodiversity taking a sting

If you've ever complained about there being too many bees around, consider yourself lucky. Pollinators – such as bees, butterflies and bats – are responsible for the continued existence of more than seventy percent of the world's flowering plant population.

By carrying pollen from the male to female parts of flowers, pollinators assist in plant reproduction and thus biodiversity. Unfortunately, as a result of habitat destruction and alteration, pesticide use, and the introduction of diseases, the abundance and diversity of pollinators are drastically decreasing.

Steve Javorek - a research biologist for Agriculture and Agri-Food Canada is looking specifically at developing conservation and restoration guidelines for landscapes to nurture the preservation of native bee populations in Canada.

"Most fruit, vegetables and seed crops depend on bees for pollination," Javorek reflects. "No less than 90 commercially grown food crops in Canada rely on pollinators. As we become more disconnected from where our food comes from, such things as the role of bees and the implications of their decline fail to resonate in our everyday lives."

As keystone species - those which other species depend on - the over 700 types of native bees in Canada have a unique role in the maintenance of the country's biodiversity. They are essential to the reproductive cycles of most flowering plants and thus to the ecosystem itself, by supporting plant populations that other animals and birds rely on for food and shelter. If the proper environments don't exist for these bees, they cannot survive to continue pollinating the plants they are uniquely responsible for.

"When a person is looking for a new house, they consider how easy it will be for them to access the things they will need such as the groceries," Javorek explains. "In one sense, bees are very much the same as us; their "neighbourhood" must include a suitable place to live from which they can access food and other requirements over the course of their life span. The loss of this "real estate" limits areas where diverse bee communities can survive. The loss or reduction of bees and their pollination services sends ripples throughout the entire ecosystem that impact the very sustainability and resilience of the landscape."

Thankfully, researchers are formulating realistic management programs for the landscapes that bees and other pollinators live in.

"Bees are very misunderstood by most people," Javorek says. "When we think of bees the picture of a hive with the queen supported by her workers generally comes to mind. The vast majority of native bees, however, are solitary - each female constructs her own nest which she provisions with pollen and nectar for her young. Our only native bees that form a colony are bumble bees!"

Native bees nest in a wide variety of habitats including soil, wood and cavities and, depending on the species, can pollinate a wide variety of flowers or, in some cases, form an intricate relationship with a single plant species. Unlike honey bees, whose hives can be moved closer to food supplies, native bees must must make a living on the resources offered by their local environment. If the land is altered, their food supply and home are disturbed, and they'll either leave or cease to exist.

In collaboration with farmers, landscapers and the general public, pollinator and plant diversity can be maintained.

"Simple changes can make a big difference," Javorek says. "Incorporating native flowers and plants into a family garden not only looks nice, but can offer nesting opportunities and a source of nectar and pollen for these critters."

City planners can integrate green spaces into their layouts, and farmers can enhance or maintain "bee friendly" habitat on their land to promote diverse native bee communities.

"There were some blueberry farmers in eastern Canada that took notice of the declining bees," Javorek said. "They need their blueberries, and the blueberries need the bees, so they were really interested in what they could do to help."

So next time you're admiring a garden full of flowers, or the abundance of fresh local produce in the store, remember you have pollinators to thank and do your part in saving these irreplaceable little critters.

"Most fruit, vegetables and seed crops depend on bees for pollination. No less than ninety commercially grown food crops in Canada rely on pollinators. "

- Steve Javorek

Canadian Agricultural Biodiversity

Biodiversity - the variety of life on Earth! Scientists at Agriculture and Agri-Food Canada play a role in protecting and preserving the diversity of our crops

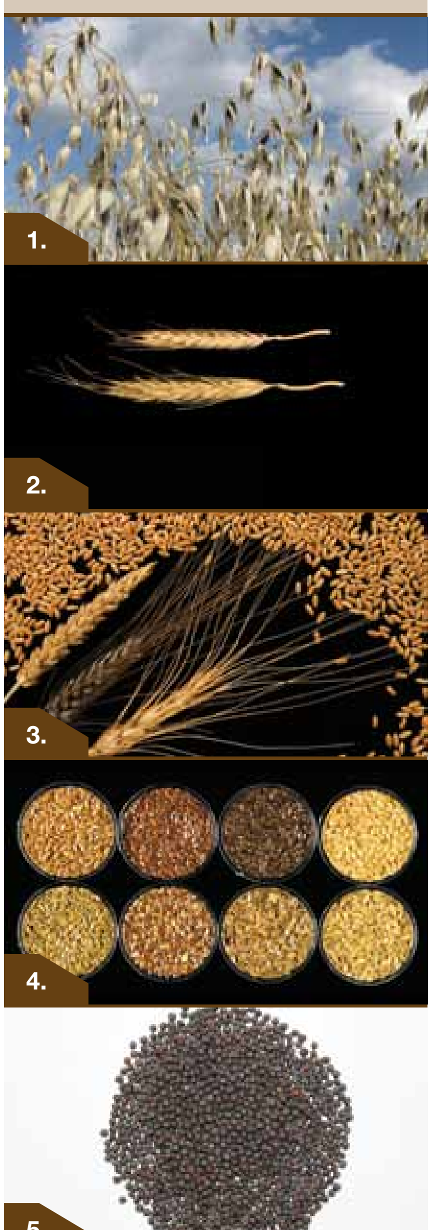
GENEBANKS:

- Agriculture and Agri-Food Canada identifies, collects, preserves and encourages the use of crops grown in Canada through the Genebanks of Plant Gene Resources of Canada.
- The role of the Genebanks is to provide scientists with a wide diversity of genetic materials to help them develop new crops for Canadian farmers with increased yield, better taste, or resistance to crop pests.

NATIONAL COLLECTIONS:

- Agriculture and Agri-Food Canada maintains the largest bioresource reference collections in Canada.
- The Collections of insects, fungi and vascular plants play an essential role in the development of new crops, bioproducts and biotechnologies capable of sustaining the long-term quality, yields and profitability of Canadian agriculture.
- The Collections support national efforts to protect Canada's borders from invasive pests.

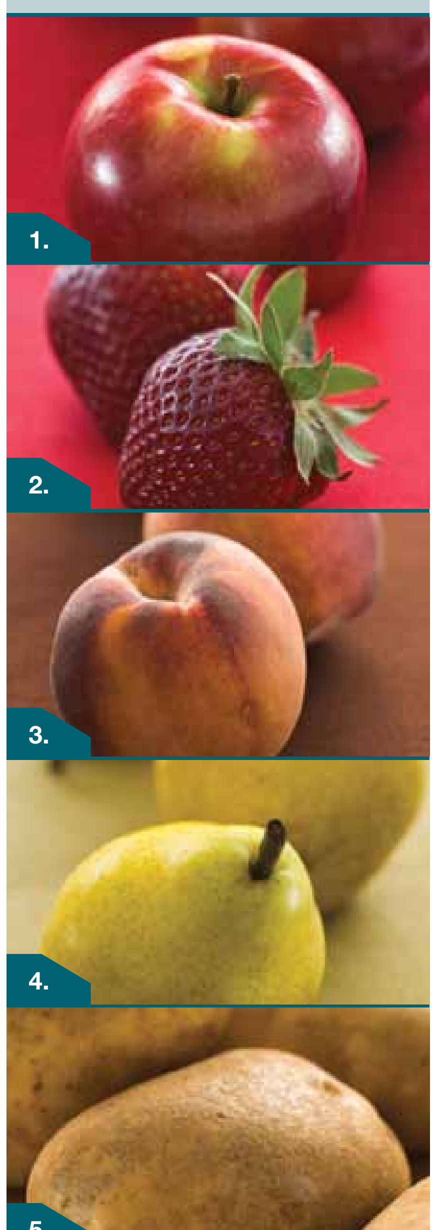
SEEDS
Seed Genebank, Saskatoon, SK.



1. **Oat:** 28,000 samples
2. **Barley:** 38,000 samples
3. **Wheat:** 14,000 samples
4. **Flax:** 3,500 samples
5. **Brassicas:** 3,500 samples (mustard, canola)

Total collection: over 1,000 plant species and 113,000 samples

FRUITS AND POTATOES
Canadian Clonal Genebank, Harrow, ON, and Potato Genebank, Fredericton, NB.



1. **Apple:** 850 samples
2. **Strawberry:** 1,500 samples
3. **Peach:** 63 samples
4. **Pear:** 130 samples
5. **Potato:** 140 samples

Total collection: 3,500 samples

ANIMAL GERMPLASM
Canadian Animal Genetic Resources Program, Saskatoon, SK.

1. **Cattle:** 16 breeds, 249,000 semen doses
2. **Poultry:** 3 breeds of chicken 1 of turkey, 480 semen doses
3. **Goat:** 36 semen doses
4. **Bison:** 600 semen doses
5. **Elk, deer:** 630 semen doses

NATIONAL COLLECTIONS
Ottawa, ON.

1. **Insects, Arachnids and Nematodes:** 16 million specimens
2. **National Mycological Herbarium:** 350,000 specimens
3. **Canadian Collection of Fungal Cultures:** 16,000 living strains
4. **Vascular Plant Herbarium:** 1.5 million specimens
5. **Glomeromycota *in vitro* Collection:** 94 living strains of mycorrhiza

For more information visit www.agr.gc.ca