KENTVILLE'S CENTURY OF SCIENCE

Atlantic Food and Horticulture Research Centre

100 years of innovation

In agriculture's new fields, Kentville's research is still bearing fruit

In 1911, most horsepower was on four legs, electricity was in the dark ages, half of Canadians lived in farm communities and the Kentville Experimental Station was the country's newest agricultural research facility.

A lot has changed since then. Canadian agriculture has become a high-tech multi-billion dollar industry that not only feeds the world but continues to find new uses for agricultural production in health, the environment and industry.

And the Kentville Experimental Station is now called the Atlantic Food and Horticulture Research Centre, a research facility at the forefront of science that is making these links.

In a year when Agriculture and Agri-Food Canada's Research Branch is marking its 125th anniversary, the research centre is celebrating its centennial with a productive past and a promising future.

Kentville research is currently behind medical studies looking at the value of probiotics in the gut and whether blueberries can ease the impact of Alzheimer's disease and failing eyesight in an aging population.

The centre is a world authority on the storage and shelf-life of food, an increasingly valuable role in a marketplace that craves fresh produce but still ends up throwing more than a quarter of it away.

This is where vitamin-enhanced canned apple juice was born and where the Honey Crisp apple was fine-tuned for the Maritime climate to become a premium-priced, jumbo superstar.

It's where processors like Oxford Frozen Foods, Sarsfield Pies and Van Dyk's Health Juice Products found research that helped them perfect their products.

This is where 60 per cent of the strawberry varieties grown in Canada were developed.

Over its first 100 years, the centre has had a hand in the development of almost every agricultural commodity in Nova Scotia and the Atlantic region.

"It's hard to imagine where agriculture would be in this province without the research centre," says Beth Densmore, president of the Nova Scotia Federation of Agriculture. "As farmers, we depend on it."

"It's a two-way street," says research centre manager and scientist Dr. Mark Hodges. "I can't imagine how we could do our research, then or now, without the help and input of farmers."

The 100-hectare Kentville Experimental Station was established by the federal government in 1911 at the request of the Nova Scotia Fruit Growers Association to help expand commercial apple production.

At the time, the Annapolis Valley's nearly 2.5 million trees supplied England with most of its apples.

But if apples were the core of its research, the centre also quickly established itself as a site for improving all of agriculture.

By 1912, scientists were breeding new fruit and vegetable varieties, studying new methods of planting and harvesting, looking at insect and disease resistance and making plans to expand into livestock research.

The site has since grown to 188 hectares with satellite research farms in Sheffield and in Nappan.

Today, the centre's 36 researchers and staff of 120 continue much of the work begun in 1911 but with added emphasis on food quality and safety, processing and food storage.

The 125-year-old Nappan Research Farm, one of the five original research farms created by the federal government in 1886, is now home to Atlantic beef research and soil and water studies.

The Kentville centre is part of an Agriculture and Agri-Food Canada research network that now includes 19 research centres and 20 satellite research farms. The network is linked to universities and research institutes across Canada and around the world.

The Kentville centre has scientists at the University of Moncton and the Nova Scotia Agricultural College. Most of the scientists also teach graduate students.

Hodges says partnerships with researchers outside the department only make sense given the complexity of modern agriculture.

"You can't look at agriculture in isolation any more," he says. "Agriculture deserves the attention of the best minds in science and

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New varieties have created opportunities for agriculture

On a fall afternoon in September, apple growers walked through an orchard on the grounds of the Atlantic Food and Horticulture Research Centre, in Kentville, to get a taste of the future.

Or at least a possible future.

Surrounding them were more than 150 varieties of apples from around the world, the result of the first half of a four-year collaborative project with the Nova Scotia Fruit Growers' Association to identify promising new varieties for the Maritimes.

Like automobiles in a car lot, the apples came with new and improved features – better disease and insect resistance, bigger yields and enhanced health properties.

As the group sampled apples, Dr. Charlie Embree, a researcher in the centre's tree fruit program, shared results his team had gathered on the fruits' flavour and performance in the orchard and in storage. The varieties were selected by Marina Myra, a biologist working with the Nova Scotia Fruit Growers Association.

"Growers are always looking for new varieties," says Doug Nichols, a Morristown apple grower and a Nova Scotia Tree Fruit Growers' Association director who was part of the group that day.

"There are a lot of reasons for that – productivity, the changing Maritime climate, market quality and giving consumers what they are looking for. In some cases, apple varieties have become popular in other parts of the world and we want to see how they adapt to our climate."

Finding varieties that meet the needs of Maritime agriculture has long been a part of the work of the research centre.

In fact, if variety is the spice of life, the research centre has been on a hot streak during its 100-year history.

Plant breeders at the centre have developed more than 85 new varieties of fruits and vegetables with local names like Nova Spy, Scotia and Minas.

Researchers have conducted trials on thousands of more varieties from around the world to find those that could be grown in the Maritime climate.

Variety trial work was already underway in 1912 even as buildings were still going up on the new research site.

The trials have included apples, pears, peaches, plums, strawberries, raspberries, blueberries, blackberries, melons, carrots, tomatoes, squash, spinach, peas, beans, beats, corn, potatoes, rutabagas, cereals, flax and hemp.

At times, new varieties have allowed some struggling sectors to regain their footing and allowed new ones to emerge.

In the 1930s and 1940s, vegetable trials and new processing research helped farmers and processors take advantage of consumer demand for canned produce.

During the 1970s and 1980s, Grand Pre Winery worked with Kentville researchers on a decade of field trials with an unnamed grape variety from Ontario. The collaboration resulted in L'Acadie Blanc, now the signature home-grown grape of Nova Scotia's multi-million dollar wine industry.

Research manager Mark Hodges says the research centre's goal has always been to keep farmers ahead of the competition and in step with the consumer's taste for unique, healthy and environmentally friendly foods.

But advances in the centre's technology, including an electron microscope and a $500,000 piece of equipment called a Liquid Chromatograph Mass Spectrometer are taking advantage of the mapping of the molecular world to blaze new trails in agriculture.

"It's re-defining how we look at varieties," Hodges says. "We are not just looking at how a plant grows, but what it can mean to our health, to our environment and to our economy.

"One hundred years ago, our researchers must have seen all kinds of opportunities to advance agriculture.

"Today, we feel there are more possibilities than ever before."

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those minds are found in a lot of different laboratories, looking at issues from a lot of different angles.

"What brings us together is our commitment to making things better."

Dr. Francois Tremblay, a clinical scientist in the Department of Opthalmology and Visual Sciences at Dalhousie University's IWK Health Centre in Halifax, agrees.

He is about to launch a human clinical trial to determine if drinking fortified blueberry juice daily can improve the eyesight of the elderly who are losing their vision to macular degeneration.

But he admits it probably wouldn't have happened if he had not been approached by Kentville's Dr. Wilhelmina Kalt about promising research linking blueberries to improvements in vision.

The initial meeting led an initially skeptical Tremblay to begin human and animal trials to test the theory. The results were encouraging.

"All of the research I've done in this area over the last two years is the fruit of that initial collaboration," he says. "It's been a great collaboration. I've learned a lot from Dr. Kalt."

Kalt says it's these kinds of collaborations that have her excited as the Atlantic Food and Horticulture Research Centre enters into its second century.

"When you look back and see what has been accomplished in agricultural research, and then look ahead to what we might accomplish, you can't help but feel proud to be part of it."

Combining an early corn trial

To create a great apple takes patience ... and more than a few double-crosses

“Try this,” Dr. Charlie Embree says, slicing out a wedge from an apple that’s almost as big as a grapefruit.

The apple is crisp and bursting with juice. But it’s the taste that grabs your attention.

Is that citrus?

The Atlantic Food and Horticulture Research Centre’s veteran tree fruit breeder laughs. “It’s an acidy apple and it really cleanses the mouth. People either love this one or they don’t like it all.”

It’s a unique taste for a marketplace that increasingly rewards unique food experiences.

But for now, this late-season apple doesn’t even have an official name, let alone space at the produce section. It’s just one of the latest selections from the research centre’s apple breeding program, which began almost as soon as the station opened in 1911.

“It’s rare to find a new variety that is quickly accepted by the apple growers of the world,” admits Embree, who joined the program in 1982 after 15 years as a provincial tree fruit specialist. “Breeding tree fruits is a very long process and at the end of the day, even with a great apple, it’s a matter of consumer acceptance.”

These days, the focus of the centre’s apple research is also on evaluating varieties in orchard trials rather than breeding new apples from scratch.

That includes a current four-year collaborative project with the Nova Scotia Fruit Growers’ Association and AgraPoint International to search for the next superstar apple for the Maritimes from among up to 200 varieties from breeding programs around the world.

The stakes are high. In 2010, Nova Scotia producers sold more than $12 million in apples and apple products, or 10 per cent of the Canadian total.

In the 1930s, Nova Scotia produced over half the apples grown in Canada. With the right varieties in growers’ orchards, Embree believes it could regain that status and more.

“We’re just now benefiting from all the work that went into our apple breeding programs in the 1950s, 60s and 70s,” says Embree, who has developed seven new varieties of apples and three varieties of pears.

“What we are looking for are potential new varieties with better disease and insect resistance and high quality and productivity.”

In fact, apple breeding is one of the longest and most painstaking productions in horticultural breeding, often involving decades of work and tens of thousands of seedlings.

It begins with controlled cross-pollination. Researchers select two varieties with traits they want in a new apple or pear. To do that, they take pollen from the blossoms of the variety with the best traits, known as the father.

The collected pollen is then painstakingly brushed onto the blossoms of the mother tree at just the right time with a small paint brush. Parts of the blossom are pulled off to ensure that it can’t be pollinated by a bee, which could introduce traits from another variety.

“Basically, we are doing what bees do except that they are very random,” says David Baldwin, a tree fruit technician at the Centre since 1984. “We are being very deliberate in our pollination.”

The apples that grow from this pollination on the mother tree are harvested when mature and the seeds removed. Like human children, these seeds carry some of the genetics of both parents.

Each year, researchers do several different crosses, filling the greenhouse with small pots of seeds that will become seedlings over the winter, and are planted in the orchard the following year.

Dr. Charlie Embree

Then the waiting begins. It can take between five and eight years for the first apples to appear on these seedling trees.

At that point, the testing begins. Trees with apples that show promise are evaluated for several more years in the orchard for their horticultural characteristics and resistance to disease and insects.

Tree fruit technician David Baldwin

Often, the new seedlings have a mixture of some, but not all, of the traits the breeders were looking for. It’s a decades-long process that depends on the breeder’s skill at identifying those varieties with winning traits.

A number of generations are often needed to build in disease and insect resistance. It requires exhaustive knowledge of the traits of many of the world’s 7,500 varieties of apples.

“The science is in selecting the best parents, which in turn pass on the best traits,” says Embree.

He says recent mapping of the apple’s genetic make-up will help to speed up apple breeding in the future by making it easier to identify genes responsible for particular traits.

And it should open the door to new research into the health benefits of the fruit as well.

Embree says more than four decades of tasting and testing hasn’t spoiled his appetite for the fruit.

“I had a Honeycrisp last night with a slice of camembert cheese,” says Embree. “It was delightful.”

Kentville apple harvest 1911

Strawberry fields forever

The framed puzzle in the office of Dr. Andrew Jamieson looks impossibly hard. Printed on the nearly identical pieces are hundreds of red strawberries.

“My family was trying to put it together but it was too difficult so I gave it a try,” says Jamieson. “I just broke it down into six smaller sections and worked it out from there.”

It may be as good a description as any of Jamieson’s success in puzzling out solutions to the challenges of growing one of Canada’s best-loved native crops, the strawberry.

In a 28-year career, he has developed eight new varieties of strawberries that have added more than a week to the fruit’s heart-breakingly short season and given strawberry lovers more to sink their teeth into.

For strawberry growers, the extra days have meant extra dollars.

In a season that typically lasts three or four weeks, Jamieson’s early and late season strawberry varieties have helped the industry generate $10 million in sales in Atlantic Canada and nearly $70 million across the country.

Today, an estimated 60 per cent of the strawberries grown in Canada are varieties developed at the research centre during the last 50 years by breeding teams led by Jamieson and his predecessor Dr. Donald Craig.

It’s a slow process. It takes about eight years to produce a new strawberry variety and the work can be frustrating.

“It would be very easy if you were just to focus on one trait,” says Jamieson. “But it’s always about balancing a suite of traits such as disease and insect resistance and taste and firmness and a host of other things.

“And then you might have what looks like a success ruined by a trait you didn’t foresee, which in one case was that the strawberries were growing too close to the ground.”

Jamieson’s successes include the 20-year-old Cavendish, which still has sales of several million plants a year, and the best-selling Cabot.

His most recent release, a late-season strawberry the size of an egg called Valley Sunset, has given growers a large berry to fill baskets at a time of the season when the fruit is getting small.

“If you look at the varieties we have today, firmness and size have gone up and I think the flavour has improved,” he says.

This year, Horticulture Nova Scotia made the berry breeder an honourary life member.

“As a nursery man, I get excited when I hear Andrew is about to release another variety,” says Charles Keddy, a member of the organization and president of two Nova Scotia nurseries that sell Jamieson varieties.

Dr. Andrew Jamieson

“We sell strawberry plants in every province in Canada and across the north-eastern United States and Andrew’s varieties represent up to three-quarters of my sales.”

The honour also recognized Jamieson’s research in other berries, including new varieties of grapes, raspberries and blackberries and work on sea-buckthorn, edible honeysuckle and even a white blueberry developed by one of his predecessors, Ivan Hall.

Jamieson says growers have been a critical part of his research – with the emphasis sometimes on the critical.

“If you want a really honest opinion, you ask growers to look at your research plots when they are in the middle of their own growing season,” Jamieson says. “It’s a very busy time of year, they’re tired and they’re in a critical mood.

“It’s the kind of feedback that makes for better berries in the long run.”

Research in bloom

Every year, on the second Sunday in June, thousands of people flock to the Atlantic Food and Horticulture Centre in Kentville to admire Atlantic Canada’s largest collection of rhododendrons and azaleas.

Although the Centre is no longer involved in ornamental research, the collection is a colourful reminder of a nearly 40-year floral focus that has left its stamp in flower beds and greenhouses across the country – and inspired a stamp of its own from Canada Post.

“Our objective was to provide hardy, flowering shrubs that would enhance and beautify Canadian gardens,” says Dr. Peter Hicklenton, who worked in the ornamental section for 16 years. “Today, you don’t have to travel too far to find one of our rhododendrons gracing the landscape.”

The value has been more than aesthetic. Flowers and shrubs are now a $6 billion industry in Canada.

Flowering shrub research officially began at the research centre in 1958 under now retired plant breeder Donald L. Craig, but its roots go back to the 1920s. That’s when Dr. William Saxby Blair, the research centre’s first superintendent and a flower enthusiast, planted them on the grounds.

Today the collection includes more than a dozen varieties of rhododendrons and azaleas developed in Kentville that have flower colours ranging from brilliant oranges and reds to softer pinks and whites.

There are also varieties from around the world that were tested by the ornamental team for their suitability in a northern climate.

The Kentville varieties weren’t shrinking violets. They won 16 major awards and 200 ribbons at national and regional flower shows.

At the centre of it all was the hard-to-spell rhododendron.

With over 900 species, it ranges from tiny plants with flowers the size of a dime to towering trees with blooms larger than a person’s head. Only 25 species are native to North America.

In 2009, Canada Post paid tribute to the eye-catching blossoms with the release of two commemorative rhododendron stamps, including the Minas Maid variety developed by Craig.

The Minas Maid was the first red rhododendron variety developed in the Kentville program.

“I was pleasantly surprised when Canada Post called to ask me about this one,” Craig says. “It’s rewarding because the breeding of these varieties involved so much time and effort.

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Dr. Mark Hodges with centre's honourary life membership

Researchers step in to create a honey of an apple

The Honeycrisp is the apple of John Eisses' eye. The Annapolis Valley farmer grows nearly 10 hectares of them in his orchard in Centreville, north of Kentville.

"The Honeycrisp apple was one of a couple of things that turned the apple industry around here," says Eisses. "We were just scraping by in the late eighties and early nineties before it came on."

The Honeycrisp is now a consumer favourite that's popular with growers like Eisses who can fetch over $500 a bin compared to $150 for other apple varieties grown in Nova Scotia.

"It's a big, juicy and crisp apple," says Eisses. "My wife uses it for apple sauce and doesn't add any sugar at all."

In Nova Scotia, there are already nearly 110,000 Honeycrisp trees, and more are being planted each year.

The apple now makes up five per cent of the $14.5 million apple crop in the province.

But the apple, originally developed in Minnesota in the 1960s, might not have gone anywhere in the Maritimes without the help of apple specialists at the Atlantic Food and Horticulture Research Centre.

"We knew we had a product the marketplace wanted, but this is a fussy apple," says Dela Erith, executive director of the Nova Scotia Fruit Growers Association. "We needed to solve some production and storage issues."

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"Over the years, I germinated enough seed to produce 20,000 plants, and of all of those thousands, I only named about a dozen varieties."

Agriculture and Agri-Food Canada's ornamental research has since been transferred to the industry.

In 1994, the research centre released its final variety, the Holy Grail of the breeding program -- a rare yellow rhododendron hardy enough for the Maritime climate.

It was named the G.S. Swain in honour of the late George Swain, a pioneering horticulturalist at the research centre who helped Craig get the breeding program going.

"It was a fitting way to complete the program," says Hicklenton. "I think George Swain would be pleased to see his name attached to such a memorable variety."

"The apple was riddled with problems in the early days," agrees Kentville plant physiologist Dr. John DeLong. "If we didn't deal with these issues successfully, the farmer was left with a devastated apple crop that ended up being pressed for juice, so there were some high stakes at play."

One of those early problems was that the apple sometimes turned brown inside during storage.

"We had to work out an entirely new way to handle the Honeycrisp after it was harvested," said DeLong. "It is an odd apple that way."

Conventional wisdom called for apples coming in from the field to be quickly refrigerated because heat can damage the quality of the apple.

But researchers discovered the apple required delayed cooling.

"With Honeycrisp we found that if we delayed cooling for a week in a room that was about 20 degrees Celcius, it got rid of the browning problem." said Delong.

They also discovered that storing the apples at five degrees Celsius in a controlled atmosphere storage room with low oxygen and high carbon dioxide levels would keep the apple at peak quality for a longer period of time.

'When you take them out of storage after six or eight months, they taste nearly as good as the day you picked them off the tree," he says.

Another problem was in the orchard. The tree was notorious for hit and miss production, producing too many blossoms one year and not enough the next, a condition known as biennial bearing.

"There are other varieties with this tendency but Honeycrisp is the worst yet," says Kentville tree fruit physiologist Charlie Embree. "But it can be fixed with detailed attention to new growing techniques, including pruning, blossom thinning and the application of plant-based crop load regulators at the right times and rates."

Research-based guidelines for growing and storing techniques have now become standard practice for Honeycrisp growers.

"Without the research centre, we would not be able to do what we do," says Erith. "As far as I am concerned, they have made the Nova Scotia Honeycrisp the number one Honeycrisp in North America."

"It is very gratifying for us when we can be closely connected to the industry and provide a solution like that," says DeLong. "That's one of the reasons you become a scientist.

"Working on the Honeycrisp left me feeling a lot like a parent watching a child grow up."

Centre gets lifetime membership

The partnership has worked for a century. Let's make it a lifetime.

That was the thinking in January when the Nova Scotia Fruit Growers' Association presented an Honourary Life Membership to the Atlantic Food and Horticulture Research Centre.

It's the first time the association has honoured an entire institution.

"We felt that 100 years of successful collaboration between the Nova Scotia apple and the research centre is something that should be celebrated," said president Mike Walsh. "Successful research is what keeps our industry going."

The 146-year-old association was the original driving force behind the establishment of the research centre in 1911.

Over the years, the partnership has led to new apple varieties like the Nova Spy and transplanted success stories like the premium-priced Honeycrisp, new value-added opportunities like apple juice and processed products and new storage technologies that have made it possible to sell fresh apples year round.

Walsh says the industry also owes a debt of gratitude to Dr. A.D. Pickett, an environmental pioneer.

Working at the research centre in the 1940s, Pickett invented the integrated pest management system for orchards that is now used worldwide by many commodities.

The system uses knowledge about insects, regular monitoring of their populations and a variety of techniques to reduce the need for chemicals to control insect pests, minimizing the ecological impact.

Walsh says the next century will see new opportunities as science reveals the full health and economic potential of tree fruits, from their high antioxidant levels to components that can be extracted for food, health and industrial products.

"We're looking forward to working with the research centre and seeing what kind of future we can create."

Contented chickens will give Canadians more of their favourite meat

It looks like a scene from a science fiction movie. Dr. Bruce Rathgeber slides his hands into gloves fitted in the side of a sealed box and squeezes what looks like alien ooze. "I'm essentially working inside an artificial chicken belly," he says. "It's really quite neat."

Welcome to Nova Scotia Agricultural College's Haley Institute where novel ways of looking at chicken are part of the job for Rathgeber, a poultry researcher for the last five years.

It's the latest chapter in poultry research in Nova Scotia that began at the Atlantic Food and Horticulture Research Centre in 1911.

While early research focused on breeding types and egg production, the emphasis today is on healthy birds that can meet Canadians' demand for 12 million chickens per week as their number one meat source.

Rathgeber and his team are looking at eliminating the traditional fasting periods that chickens endure while being transported from the farm to the processing plants.

"Normally birds aren't fed prior to shipping so that their digestive tract is empty when they arrive at the processing plant," says Rathgeber. "But just because you stop feeding them doesn't mean they stop eating."

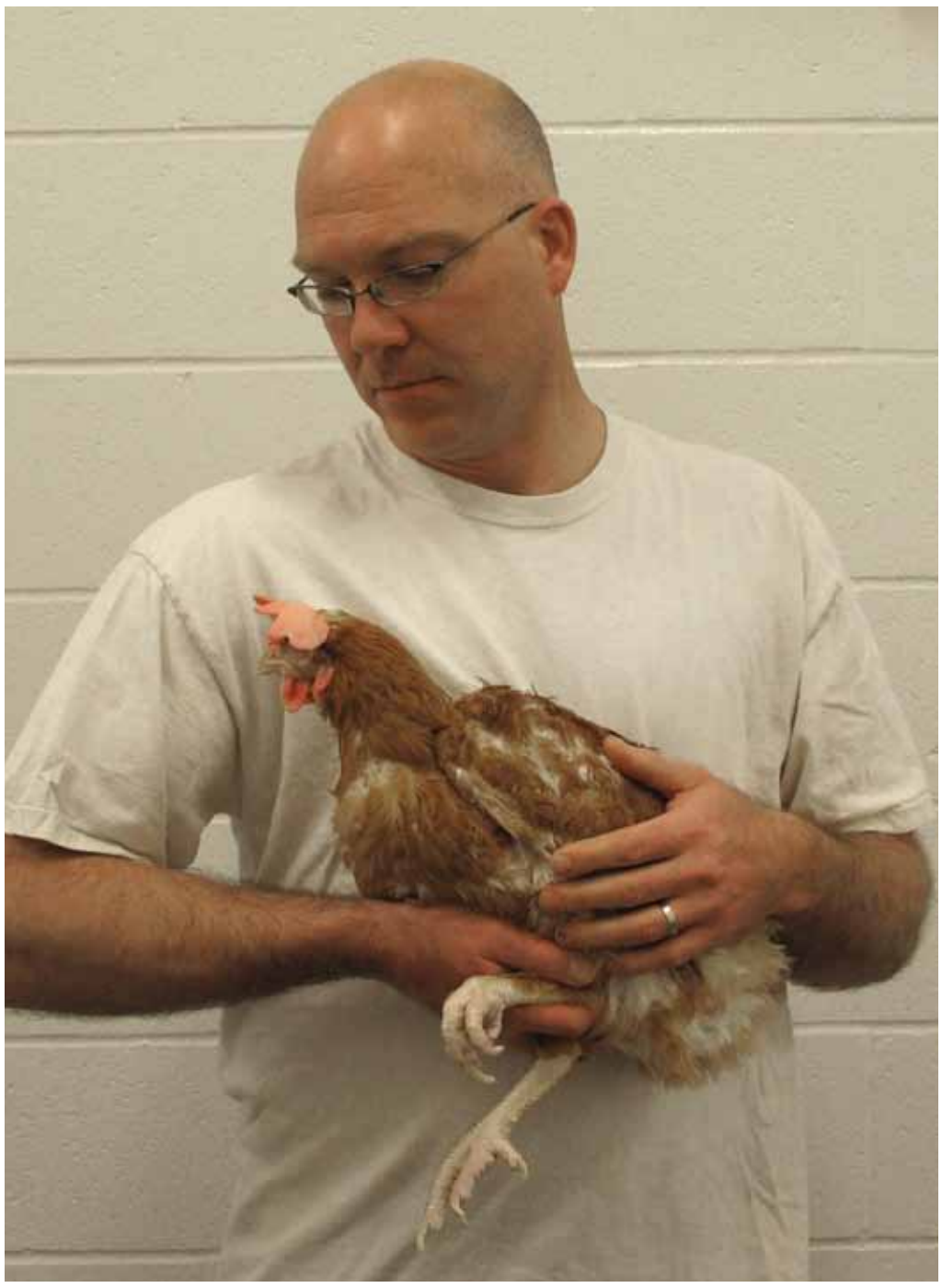
In the eight to 12-hour period that chickens are being prepared for transport, the chickens will continue to peck the ground at their feet. Before arriving at the plant, many birds will have consumed material which can lead to increased levels of problematic bacteria.

"These broiler chickens are like eating machines," he says. "So we're looking at using a specialized feed that will keep the birds satisfied while keeping their digestive systems clean."

Inside the Haley Institute, the artificial gut is allowing Rathgeber and his team to develop a specialized feed with naturally occurring plant enzymes that will reduce the potential for harmful bacteria in a chicken's digestive tract.

"We pump a controlled atmosphere into the box and it mimics the inside of a chicken's digestive tract," says Rathgeber. "Rather than working with a couple of thousand chickens to look at different combinations of feed, we can manage with about a dozen and this box."

The goal is to find a highly digestible feed that will keep chickens satisfied during their trip from the farm to the processor while ensuring they don't pose a food safety risk during processing.



Dr. Bruce Rathgeber

"The addition of naturally occurring antimicrobials in the feed will also give the birds a bit of a clean-out as they consume it. So far we've looked at garlic extract and lysozyme, an antimicrobial from eggs and we're going to be looking at red seaweed extract."

Rathgeber estimates that a normal bird loses about 4 ½ per cent of their body weight during the fasting. "By continuing to feed the birds, we can cut that weight loss in half," he says.

So while the new experimental feed may cost a little more to produce, the chickens will arrive at processing plants heavier, cleaner and less stressed.

In a country where the average Canadian eats 35 kilograms of chicken annually, the extra weight could be significant boost for the poultry industry.

The research centre's poultry barn in 1915

Livestock manager Brian Trueman with grazing cattle at the Nappan Experimental Farm

Creating healthier beef a cut above the competition

As cattle graze contentedly in a field of winter rye in a pasture at the Nappan Experimental Farm just south of Amherst, Nova Scotia, Brian Trueman points out swaths of stubble in the field that look like they've been mown.

"They love this stuff," the livestock manager says with a chuckle. "They really eat it up."

The grazing is a part of an experiment taking place in four provinces to find the best mix of pasture grasses that will keep cattle happily munching healthy, omega-rich grass for longer periods of time.

It may sound like a case of seeing if the grass is greener on the other side, but the result could be healthier cuts of beef for consumers and lower costs for beef producers.

"We know that putting cattle out to pasture is the best way to feed them," says John Duynisveld, a research biologist at the Nappan Experimental Farm. "The trick now is to keep that healthy diet going even longer."

Duynisveld says the merits of a grass-fed diet are backed by more than a century of beef research in Nova Scotia, first at the 125-year-old experimental farm and then at the Atlantic Food and Horticulture Research Centre.

For the last 15 years, the community of Nappan has been Atlantic Canada's principle venue for beef research for the Atlantic region. It's home to Agriculture and Agri-Food Canada's Nappan Experimental Farm and the Nova Scotia Cattle Producers' Maritime Beef Testing Society.

In this latest research, Duynisveld and Dr. Yousef Papadopoulos have joined forces with Agriculture and Agri-Food Canada researchers in Manitoba, Ontario and Quebec to evaluate pasture grasses.

Eight different pasture grass mixtures are being grown in checkerboard quadrants in the four provinces that will allow cattle to eat the different grasses separately. The varieties were chosen for their nutritional value, hardiness and growth rate.

Researchers will look at the nutritional impact of the grasses on the overall health of the cattle and how the grasses stand up to the weather and the wear and tear of grazing.

"We will be able to see how much the cattle enjoy eating the different grasses by weighing them weekly," says Duynisveld. "The better the cattle like the grasses, the more they'll eat."

To check the hardiness of the grasses, he admits researchers will be sitting back and literally watching the grass grow.

"We have to monitor the grass over several seasons to get an accurate analysis. We'll look at how fast it grows, how late in the season cattle can continue to graze and how well the selection of grass holds up."

John Tilley, Chairman of Nova Scotia Cattle Producers, likes what he sees.

"We're very excited about this research. The work being done today is going to be very, very important in the next few years."

Beef producers, he says, know the benefits of using more grass and forage in cattle feed.

"They may not grow as quickly as they would on barley but forage really is the best kind of food for a ruminant animal," he says. "There's a lot of research that shows us that the more cattle are fed grass or fed on forage, the better the balance of fatty acids."

Duynisveld says the naturally healthy diet should help local growers compete with bigger players by appealing to consumers looking for healthy cuts of red meat.

A longer grazing season also means fewer costs for growers.

"The most expensive element in the beef industry is feeding in the winter," says Tilley. "Once you get cattle out on the land, your costs really go down."

Both Duynisveld and Tilley believe the research could help re-define the cattle industry in different regions of the country, including Atlantic Canada.

"This research has the potential to lead to a more sustainable beef production model for use here in the Atlantic and other parts of Canada," says Duynisveld. "Ideally, we'll see Canadians choose beef because it represents a healthier product."

Beef cattle at the Kentville Research Station in 1914

Research does a gut check

Dr. Martin Kalmokoff is fascinated with the human gut. No, not the one that continues to expand over belts. The one that is 8.5 metres of intestine.

Inside that winding tube live an estimated 800 species of bacteria that number in the trillions. And increasingly it has the attention of agricultural and health researchers.

“Most people don’t find the gut tract interesting,” admits Kalmokoff, a microbiologist at the Atlantic Food and Horticulture Research Centre who has been studying the link between food and gut health.

“But in addition to digesting your food, it is your largest immunological organ, the foundation of your immune system. When it’s not working right, you start seeing a lot of problems.”

The guts of many Canadians are in turmoil these days. This country has one of the highest rates of Crohn’s and ulcerative colitis in the world with an estimated 200,000 sufferers. With these chronic bowel diseases, which often require surgery or long-term medication, the immune system begins attacking the healthy tissue of the intestines.

Hundreds of thousands more suffer with irritable bowel syndrome, one of the most common intestinal ailments.

Like many researchers, Kalmokoff thinks part of the problem lies in the Western diet.

“We’ve gone through a radical change in what we eat, how we eat and how we process our food,” he says.

For the last five years, he has been studying whether a diet rich in dietary fibre -- non-digestible carbohydrates known as prebiotics – can provide food for good bacteria in the gut and encourage their growth.

Examples of foods rich in dietary fibre include field peas and triticale. Probiotics, on the other hand, are living bacteria themselves.

The food industry wants to know about prebiotics, too. Food companies have been seeking permission from Health Canada to make health claims about the prebiotics in their products.

This year, Kalmokoff and Steve Brooks of Health Canada’s Bureau of Nutrition Health are running a human clinical feeding trial involving 30 people. The participants are consuming prebiotics in addition to their regular diet. What comes out the other end is examined.

“Health Canada wants to see any suggested claims substantiated before they will allow any health claims,” says Kalmokoff.

An earlier study with rats found that prebiotics can change the communities of bacteria in the gut. Kalmokoff says what’s less clear is whether those changes result in better health.

“It’s turned out to be a very complicated subject. The gut is really an ecosystem that’s very rich in species. But there is still so much that we don’t know about it.”

Dr. Martin Kalmokoff working in a sterile environment

Kalmokoff pursued the subject as a member of the Advanced Foods and Materials Network, a national network of researchers from universities, governments, national and international research institutes, industry and not-for-profit organizations.

Created in 2003, the network looks for new ideas and new technologies which will create new commercial opportunities while improving the lives of Canadians.

That includes leading-edge diet research.

Through the network that members have nicknamed GutNet, Kalmokoff is working with gastro-enterologists at McMaster University in Hamilton to better understand the connection between food and the gut’s performance.

“We are seeing a huge international effort in this area,” he says. “The gut is just like any other ecosystem. We have to take care of it.”

Antioxidants, eh

Canadian farmers and gardeners know that our growing conditions can be tough. But Dr. Mark Hodges of the Atlantic Food and Horticulture Research Centre says the northern climate may be giving us healthier food.

“Our Canadian climate is a little more stressful than other climates and that stress seems to contribute to high antioxidant levels,” says Hodges.

Antioxidants are nutrients in food which can slow down the breakdown of cells in the body caused by oxidation. Call it human rust proofing. Antioxidants have been linked to disease prevention and stronger immune systems.

They are created in plants in the first place when their own cells are threatened. Hodges says the plants respond to climate stress by triggering more antioxidant production.

He has begun a two-year study with the United States Department of Agriculture to compare the antioxidant levels in spinach grown in Nova Scotia and Texas. The crops will be grown in the same type of soil using the same production methods. The only thing different will be the climate.

Red clover and menopause

Red clover may be a source for a natural estrogen replacement for women who suffer from the symptoms of menopause, according to Atlantic Food and Horticulture Research Centre scientist Dr. Yousef Papadopoulos.

Used for hundreds of years as forage and animal feed, red clover contains significant concentrations of compounds called isoflavones that appear to have health benefits for humans.

In the plant, the isoflavones act as a self-defence mechanism against insects, bacteria and moulds. But research suggests isoflavones may also offer a hormone-regulating function that could reduce menopausal symptoms like hot flashes. They may also help reduce bone loss caused by a decrease in estrogen in post-menopausal women.

Papadopoulos and Dr. Rong Cao and Dr. Krista Powers from Agriculture and Agri-Food Canada’s research centre in Guelph, Ontario, are studying the role genetics and growing conditions have on isoflavone levels in red clover and its potential as a medicinal plant.

Isoflavone estrogen extracts from soybeans have been commercialized in recent years but the team has found that the levels of isoflavones in red clover are 30 times higher than soybeans.

As the list of health benefits grows, the blueberry comes in from the wild

Neri Vautour remembers the day the future of the wild blueberry industry changed.

“We were at a blueberry growers meeting 15 years ago and Dr. Wilhelmina Kalt from the Atlantic Food and Horticulture Research Centre was giving a presentation on antioxidant levels in blueberries,” recalls Vautour, executive director of the Wild Blueberry Association of North America (WBANA). “She said, ‘Your blueberries are so high in antioxidants, they may be number one.’”

“And one of our members said, “What’s an antioxidant?”

Before Kalt, a food chemist, could answer, another grower said, “Who cares? If we are number one and it’s good for you, we are going for it.”

By the end of the evening, the association had agreed to tie its future marketing to the antioxidant story line and looked to Kalt and her research collaborators to provide the scientific evidence.

Since then, antioxidants have become a catchword for the health conscious that has turned the little blue Canadian native berry into an internationally recognized superfood.

Fifteen years of research have shown that berry components work in a variety of ways to benefit health and wellness and that the antioxidant power of berries is only part of the growing body of evidence supporting their benefits.

Sales of wild blueberries have exploded with increasing scientific interest in the fruit’s links to everything from improved brain and heart health to lower cholesterol and better night vision.

Canadian wild blueberry production has increased by more than 50 per cent in the last 15 years, including $14 million in exports to health-conscious Japan last year. New markets include China, Korea and Scandinavia.

“Everyone knew the berries were good for you, but we needed scientific proof,” says Vautour. “WBANA was the first to use the antioxidant link and it all has to do with Willy. Our industry turned around because of that slogan, “Number one in antioxidants.”

For Kalt, now a leading authority on the health benefits of wild blueberries, the story continues to be one of the most interesting among many linking food and health.

“The whole renaissance in the importance of fruits and vegetables to health and wellness started about 15 years ago when researchers found that there were lower levels of chronic illness and degenerative disease in populations which ate more fruits and vegetables,” she says.

“Even taking fruit and vegetable vitamins and minerals into account, there were still some benefits to fruits and vegetables that were unaccounted for.”

That triggered interest in fruit and vegetable phytochemicals – plant chemicals - including those with antioxidant properties. Antioxidants have been linked to a slowing down of the breakdown of cells in the body caused by oxidation.

At the time, Kalt was intrigued by health claims made about the bilberry, a European cousin of the wild blueberry and a staple of European and Asian folk medicine.

With new information about phytochemicals, Kalt looked at wild blueberries again and discovered they were full of potent antioxidants called flavonoids, including the very abundant flavonoid called anthocyanin which is the pigment that confers the intense blue color to blueberry fruit.

“That really launched it,” she says. “The blueberry industry saw it as an opportunity to promote their intense blue color as a sign of the fruit’s healthful components.”

Since then, Kalt has participated in studies that have taken the wild blueberry into neuroscience, cardiovascular health, cancer prevention and studies on aging.

One study showed delayed aging in rats fed blueberry juice.

Dr. Wilhelmina Kalt and the wild blueberry

Another study involving blueberry-eating pigs suggested the berries may help lower cholesterol.

This year, she is working with Dr. Robert Krikorian in the Department of Psychiatry at the University of Cincinnati on a human clinical trial looking at the effect blueberry juice has on cognitive function in the elderly.

“The field is getting very exciting and it’s really ramping up in terms of the strength of evidence for human health benefits,” says Kalt.

Kalt’s role in all of the research has been to analyze and unravel the chemical complexity of the blueberry. Among their various analytical tools, she and her research team use a Liquid Chromatograph Mass Spectrometer to identify the diverse array of phytochemicals found in blueberry fruit.

“Blueberries are particularly complex because the anthocyanins are abundant and diverse. Lots of berries will have less than 10 specific types of anthocyanins. Blueberries can have 25 or more, making the specific profile of these pigments difficult to separate and track.”

The analysis is critical to helping medical researchers figure out the role blueberries can play in disease prevention and health improvement. This type of approach is also important in creating R&D opportunities related to the use of more purified therapeutic extracts.

As the research reveals new health benefits for consumers, Kalt says she’s delighted to see it translate into good news for the blueberry industry.

“I always say it’s the same old fruit, but this new knowledge and awareness of its potential value has helped the industry tremendously,” says Kalt.

Vautour agrees.

“To wild blueberry growers, Dr. Wilhelmina Kalt is a godsend,” he says. “She has taken the wild blueberry industry in a totally different direction.”

Fiddleheads: a new super food

Spinach made Popeye a powerhouse. But he might have done even better with fiddleheads.

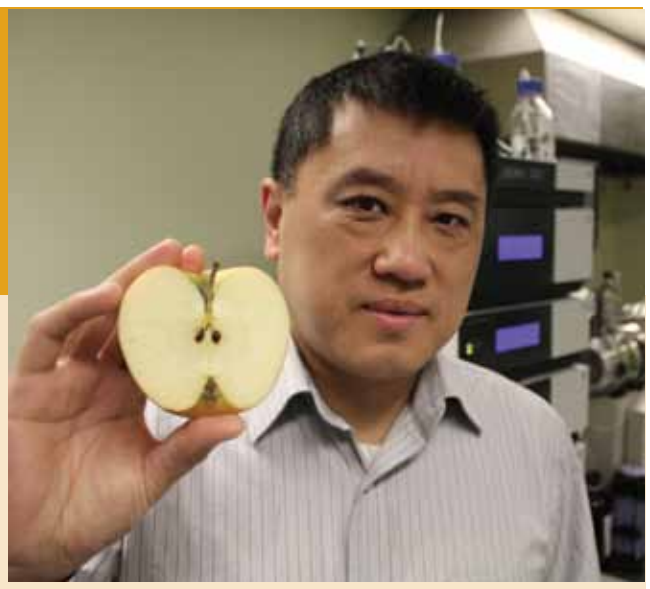
Like spinach, the wild Maritime spring treat is a source of Vitamins A and C, iron, magnesium, potassium, niacin, phosphorous and dietary fibre. But fiddleheads have the added bonus of omega-3 fatty acids. This is the good fat most often found in fish.

“Fiddleheads, it turns out, are very healthy,” says Dr. John DeLong, who has been studying the nutritional content of fiddleheads at the Atlantic Food and Horticulture Research Centre. “They are high in fatty acids and antioxidants.”

As part of the research, he and technician Conny Bishop also went to the kitchen to find the best way to prepare fiddleheads. They need to be cooked long enough to kill any bacteria that might be in the tightly coiled head but not so long that the nutritional value of the ferns is lost.

DeLong is publishing a peer-reviewed paper this year detailing his findings. He hopes it will encourage more people to try fiddleheads and generate interest in it as a cultivated or naturalized crop.

Unlocking the mysteries of flavour



Dr. Jun Song is unraveling what constitutes flavour

Imagine biting into the grainy flesh of a pear and tasting an apple. Or crunching into an apple and tasting a strawberry.

The fruit mash-ups could be a future niche market as research scientists like Dr. Jun Song, a post-harvest physiologist specializing in food quality at the Atlantic Food and Horticulture Research Centre, close in on the science of flavour.

It turns out flavour is not just a matter of taste.

“Flavour is generated though complex biosynthesis and metabolic pathways,” says Song. “Proteins are the regulators of flavour.

“Based on chemistry and physiology and our understanding of the flavour characteristics of fruits, we think we have new techniques to improve their natural flavours. And for some specialty markets looking for something different, we think we can even change taste.”

While researchers at the centre have been studying flavour for 30 years, it has been in relation to how breeding, growing and storage techniques can influence taste.

Last year’s successful mapping of the apple genome by international research teams opened the door wider on the genes and proteins responsible for particular traits.

That was coupled by the research centre’s purchase of a $500,000 instrument called a Liquid Chromatography Mass Spectrometer (LC/MS) that is allowing Song and his colleagues to detect thousands of proteins in a sample.

It’s called proteomics, the study of proteins that make up all living organisms, including fruit.

“The LC/MS is allowing us to look at the proteins in a way that we could not before,” says Song. “We are going to be able to discover the factors in the biological process that regulate flavour.”

He says the knowledge could lead not only to better techniques for storing fruit but also the creation of some exotic new food products that could mean more money for farmers and better tasting fruit for consumers.

“There is always a balance between flavour and the storage that is used to maintain shelf life of fruit,” says Song. “If we understand the pathways and proteins that regulate the flavour we experience, we can design some strategies and approaches for fruit storage that can reduce this loss of flavour.”

And reverse it.

“If we know which proteins produce this flavour, we should be able to re-activate them in storage,” Song says.

He says advances in science are now giving taste its full due, along with firmness, texture and colour.

“Flavour is a very powerful experience for the consumer,” Song says. “It really determines whether the consumer will come back to purchase the product again,” he says.

“Our long-term goal is to improve the flavour of fresh fruits and vegetables and increase consumption so that people are taking full advantage of their nutritional benefits.”

Research that makes scents

Dr. Charles Forney uses a gas chromatograph and a good nose to separate flavour smells in fruit samples

Dr. Charles Forney wants your fruit to smell so good you can taste it.

That’s why this specialist in fruit quality is sitting in his lab at the Atlantic Food and Horticulture Research Centre about to sniff through a small glass cup at the end of what looks like a vacuum cleaner hose.

Running through the middle of the hose is a thin heated tube carrying some of the 100 components that make up the taste and smell of an apple.

He breathes in and smiles.

“This is nice,” he says. “Very fruity.” In earlier sniffs of the sample, he had picked up some floral tones and what he called a green note, a faint smell of newly-mown grass.

If it sounds like a wine tasting, it’s because the taste of a good wine and the flavour of a good piece of fruit share the same starting point when it comes to flavour – your nose.

Tastebuds can only distinguish five qualities – sweet, sour, bitter, salt and a savory, meaty flavour known as umami. It’s the nose that fills in the rest.

Aroma and flavour are actually made up of hundreds of components known as volatiles and non-volatiles. Non-volatiles like salt and sugar are tasted on the tongue. Volatiles are sensed through the nose.

Fruit contain a dynamic mix of volatiles that can change based on how the fruit is grown and harvested, stored and packaged.

And it is a mix that can be boosted to bring out rich, intense flavours.

“We are trying to understand the chemistry behind good flavour,” says Forney. “We are also looking at how the things we do to food before and after harvest affect the flavour of fruits, particularly blueberries and apples.

“The challenge is to determine which volatiles contribute the most to the smell of the fruit.”

Forney works with a gas chromatograph to separate the different volatiles in his fruit samples.

Trained sensory volunteers are then brought in to rate the intensity of the aromas.

It can be a memorable experience.

“Some smells will induce past memories for some of the people sitting at the machine,” says Forney. “ People are always surprised by this effect.”

Once compounds are identified and rated, the information can be used to improve the taste of produce.

“Think of an apple as a flavour factory that turns its sugars and acids into flavour compounds,” says Forney. “We can enhance flavours by infusing it with some of these compounds.”

Some infused fruit have already made it to the fruit stands. Grapples, for example, are apples infused with grape flavour.

But Forney says his focus is to boost the natural flavour and aromas of fresh fruit, not to introduce artificial flavours.

“We’re trying to get more flavour into a big red strawberry so that it really does taste as good as it looks,” said Forney.

Currently, Forney is studying the volatiles in blueberry juice to see how the natural rich taste can be returned after being muted during processing.

Information from the project is being used to improve the storage of fruits and vegetables to maintain pleasing volatiles. It is also being used to evaluate the effectiveness of packaging to prevent fruit from picking up unpleasant volatiles from the air, known as taints.

“Ten years ago consumers focused on the appearance and firmness of fruits and vegetables,” Forney says. “Today the emphasis is on the flavour.”

Shelf Life

High-tech storage, electronic tags and atmosphere packaging helping to stem food waste

We've all experienced it. You go to the fridge and discover the broccoli has turned yellow and the bean sprouts are a bag of mush. Meanwhile, the tomatoes have deflated on the counter.

You toss the food and think -- what a waste.

According to the George Morris Centre, a Canadian agricultural think tank, an estimated 40 per cent of food ends up being thrown away between the farm and the plate, much of it due to spoilage and a deterioration in food quality.

The losses pile up in storage on farms and in grocery stores, processing plants, restaurants and the home, as well as during transportation throughout the food chain.

For nearly 80 years, the Atlantic Food and Horticulture Research Centre has been working to reduce waste with better storage, innovative packaging and transportation technologies that have extended the shelf life of fruits and vegetables by days, weeks and even months.

The research centre is now internationally recognized as a leader in post-harvest technology, the science of keeping produce fresh, tasty and healthy as long as possible.

"Food waste is a loss for everyone," says research centre manager Dr. Mark Hodges. "Farmers and the food industry lose income and consumers throw away part of their food dollar and the nutritional benefits of that produce."

Dr. Charles Eaves launched the post-harvest research program at the centre in 1933. In the late 1930s, he introduced one of the first controlled atmosphere storage facility for fruits and vegetables in the western hemisphere. The unit extends shelf life by lowering the amount of oxygen and carbon dioxide that normally triggers the breakdown of produce.

In 2001, Dr. Robert Prange and Dr. John DeLong updated the technology with a much more sophisticated sensor and software system called HarvestWatch™. Developed with Nova Scotia electronics company Satlantic Inc., HarvestWatch™ allows apples to be stored at the lowest possible oxygen level to best preserve the taste and appearance of the fruit. Sensors pick up signals directly from the apples. So if the oxygen level in the room is too low, the apples let the sensors know and the storage operator can make the appropriate adjustments.

The ability of HarvestWatch™ to extend the shelf life of apples eight to twelve months from the traditional two or three months has resulted in the sale of more than 3,000 units around the world.

"What happens in the field up to harvest and what happens to produce after harvest are really two different worlds," says DeLong, who has been working in post-harvest research at the centre since 1996. "If you are eating an apple out of season, and you like it, that's post-harvest physiology in your hand."

Prange recently retired after working on post-harvest research at the centre since 1987. He says global competition has changed the way people think about fresh produce.

"The idea of seasonality in the consumer's mind is a thing of the past," he says. "It's created a longer marketing season for farmers and raised consumer expectations about the quality of produce."

The expectation of quality is at the heart of a study conducted by Denyse LeBlanc, a food engineer at the centre who is currently working from the University of Moncton.

Working with an Agriculture and Agri-Food Canada research team in Nova Scotia and Quebec, LeBlanc is developing shelf life calculation models. The work is based on a two-year study that looked at the effect fluctuations in temperature and relative humidity had on the quality of fresh produce as it is moved through the food distribution system.

The models could eventually lead to an electronic tag on cases of fruits and vegetables that would automatically calculate how much shelf life they have left in them. That would help wholesalers and retailers accurately gauge quality and rapidly move produce with less shelf life remaining.

"This would ensure that high quality produce is always available to consumers while minimizing losses," says LeBlanc.

Another area where losses can be high is the growing market for fresh-cut vegetables. While the convenience is great, their shelf life in the home is often less than a week.

Microbiologist Dr. Lihua Fan has been experimenting with edible coatings and natural anti-microbials on fresh-cut vegetables that ensure safety and don't affect the taste.

"Our treated squash has a shelf-life of 15 days, compared to nine days for untreated squash," says Fan. "Different fresh-cut produce would require different treatments but the goals would be the same – better quality and safe produce for longer periods of time."

Postharvest physiologist Dr. Charles Forney has approached the shelf life question from the packaging angle, looking at compostable plastic to create a mini atmosphere-controlled storage environment for produce in the store.

"Fresh produce is still living and respiring so something like a whole onion or a diced onion needs to breathe," says Forney. "When you seal it up in a package, you change the air around the product.

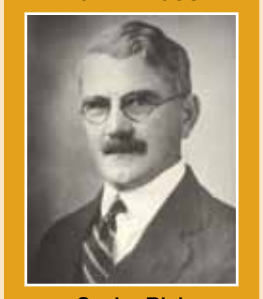
"We found that sealing the package with low levels of oxygen and high levels of carbon dioxide was beneficial in maintaining the quality of the onion and slowing down its microbial breakdown."

Hodges says the research centre will continue to identify new ways to improve the shelf life of produce.

"It's an area of research that is going to continue to grow as demand for food increases," he says. "Nobody wants to see food go to waste."

1911

1912 - 1938



Saxby Blair

1912

William Saxby Blair appointed first Superintendent.

1911

Land cleared for Kentville Research Centre.

1920

Research illustration stations established at local farms.

1921

1924

W.K McCulloch publishes method to index seed potatoes.

1929

Cecil Eidt develops forced air dehydrator, revolutionizing dehydrated fruit and vegetable production.

1928

At peak of pollination studies, research centre is home to 184 bee colonies.

1931

1935

Canning food processing research begins.

1939

Dr. Charles Eaves establishes the first controlled atmosphere storage in the Western Hemisphere, extending the shelf life of stored produce.

1938 - 1952

Dr. Arthur Kelsall

1941

1943

Royal Russet apple juice, the first vitaminized apple juice in Canada, based on research by Herbert Aitkin.

1946

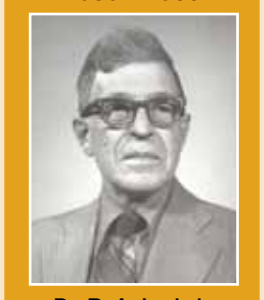
Dr. A.D. Pickett publishes first paper on integrated pest management which becomes the foundation of more environmentally friendly farming.

1951

1952

Ornamental bush research begins, leading to new varieties of rhodendrons and azaleas.

1959 - 1960



Dr. R. A. Ludwig

1960

Research begins on broiler chickens, which eventually cuts in half the time it takes to raise a two kilogram chicken.

1952 - 1959

Dr. Charles Bishop

1957

Scotia released, the first of six new tomato varieties developed by vegetable specialist Eugene Chipman.

1961

1961

1961 - 1979

Dr. J. R. Wright

1961

First Kentville-bred apple variety, Scotia released.

1962

The research centre marks 50 years of continuous weather monitoring, which continues today.

1967

First Rhododendron Sunday showcases flowering shrub research.

1971

1979

A highly efficient steam blancher was developed and commercialized for food processing.

1980

Kentville Agriculture Centre opens.

1979 - 1990

Dr. G. M. Weaver

1981

1981

L'Acadie white wine grape becomes grape of choice for Nova Scotia's emerging wine industry.

1985

Upgraded pilot plant becomes one of the country's leading food processing research facilities.

1986

Recommended herbicide use guidelines established to control grass, broadleaf and woody perennial weeds in wild blueberry fields.

1986

'Honeycrip' apple identified as a high quality cultivar with unique fruit characteristics that is well adapted to the Nova Scotia climate.

1991 - 2003

Dr. Wade Johnson

1991

1995

Kentville Research Centre renamed the Atlantic Food and Horticulture Research Centre.

1995

Scab resistant apple cultivar released.

1993

New methods created for the production of wild blueberry juice, creating new market opportunities for growers.

1997

Controlled atmosphere storage technologies developed that extend the market life of highbush blueberries by up to nine weeks.

2005 - 2008

Dr. Roy Bush

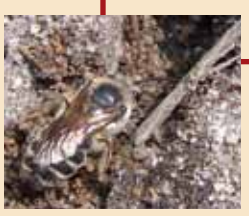
2001

2001

HarvestWatch™ developed. The storage sensor and software prolongs the quality of apples in storage by months.

2007

Three-year survey identifies 180 varieties of wild bees in Nova Scotia.



2008

A mild-heat treatment technology developed that kills bacteria while preserving the quality and nutrition of fresh-cut fruits and vegetables.

2010 - Present

Dr. Mark Hodges

2009

Valley Sunset, the research centre's 16th strawberry variety, released.

2011

Entrance to the Nappan Experimental Farm, early 1900s

Nappan celebrates 125 years as Atlantic Canada's oldest research farm

As the Atlantic Food and Horticulture Centre celebrates its centennial in 2011, its satellite research farm in Nova Scotia, the Nappan Experimental Farm, is marking an even more historic milestone – its 125th anniversary.

Located on 223 hectares just west of the town of Amherst in north-central Nova Scotia, Nappan is one of the original five research farms created by the Dominion of Canada in 1886.

Agriculture and Agri-Food Canada's research network now includes 19 research centres and 20 research farms across the country.

"There is a real sense of history there," says soil scientist and nutrient management specialist, Vernon Rodd.

"You could go back in the office and look at leather-bound reports from 1886 and 1887 and see just how labour-intensive farming and research were at the time."

As the first federal agricultural research facility in Atlantic Canada, Nappan has played a major role in the development of almost every aspect of agriculture in the region. Over the years, research included fruit and vegetable crops, grains, horses, sheep, swine, beef and dairy cattle, poultry and bees.

Unique to Nappan has been its soil research on the dykelands around the Bay of Fundy in Nova Scotia and New Brunswick. The 30,000 hectares of fine, rich soil created by the bay's famous tides were reclaimed from the sea with mud dykes and farmed by the Acadians in the 17th century.

"It's probably the youngest soil in North America and probably one of the first soils used by European settlers because of its fertility," says Rodd, whose research demonstrated that soil conservation practices could still produce good crop yields while protecting the fertile but fragile dykeland soil.

Today, researchers continue to conduct soil and water research on the dykelands and other soils. The Nappan research station also contributes to beef research by studying the production of sustainable perennial pastures and forage stands to improve forage quality, growth, and seasonal distribution.

Centennial tree

Tree fruit plot manager Robert Gammon checks a graft on an apple tree that is being used to celebrate the centennial of the Atlantic Food and Horticulture Research Centre in a unique way. One hundred different apple varieties are being grafted to the tree. The varieties include heritage varieties like Pink Lady and varieties developed at the research centre, including Nova Spy. The tree is expected to have 100 different varieties of apples hanging from the branches in 2013.

Original home of apple research is now home to its history

For decades, it was home to research directors who worked with scientists, farmers and processors to improve the apple. Today, Blair House Museum is home to their shared history.

Standing among vintage cider jugs, barrel-making tools, microscopes and photographs, Dela Erith says the museum strikes a chord with the hundreds of visitors who stop by every summer, many who don't know anything about agriculture.

"People seem to like finding out the story behind the apples they buy in the supermarket," says Erith, executive director of the Nova Scotia Fruit Growers' Association, the organization that created the museum in 1981.

"It's a bit of an eye-opener for them. "They don't realize that the apple industry has such a long history in the province."

The house itself is part of the history.

Named after the Kentville Research Station's first Superintendent, Saxby Blair, the museum was originally Blair's living quarters and shared office space.

It was built for $8,500 in 1911 on the newly cleared research land in the arts and crafts style popular at the time which emphasized simple designs and natural materials. Wood for the house came from a forested ravine on the site which still is a thriving natural habitat with stands of old-growth trees.

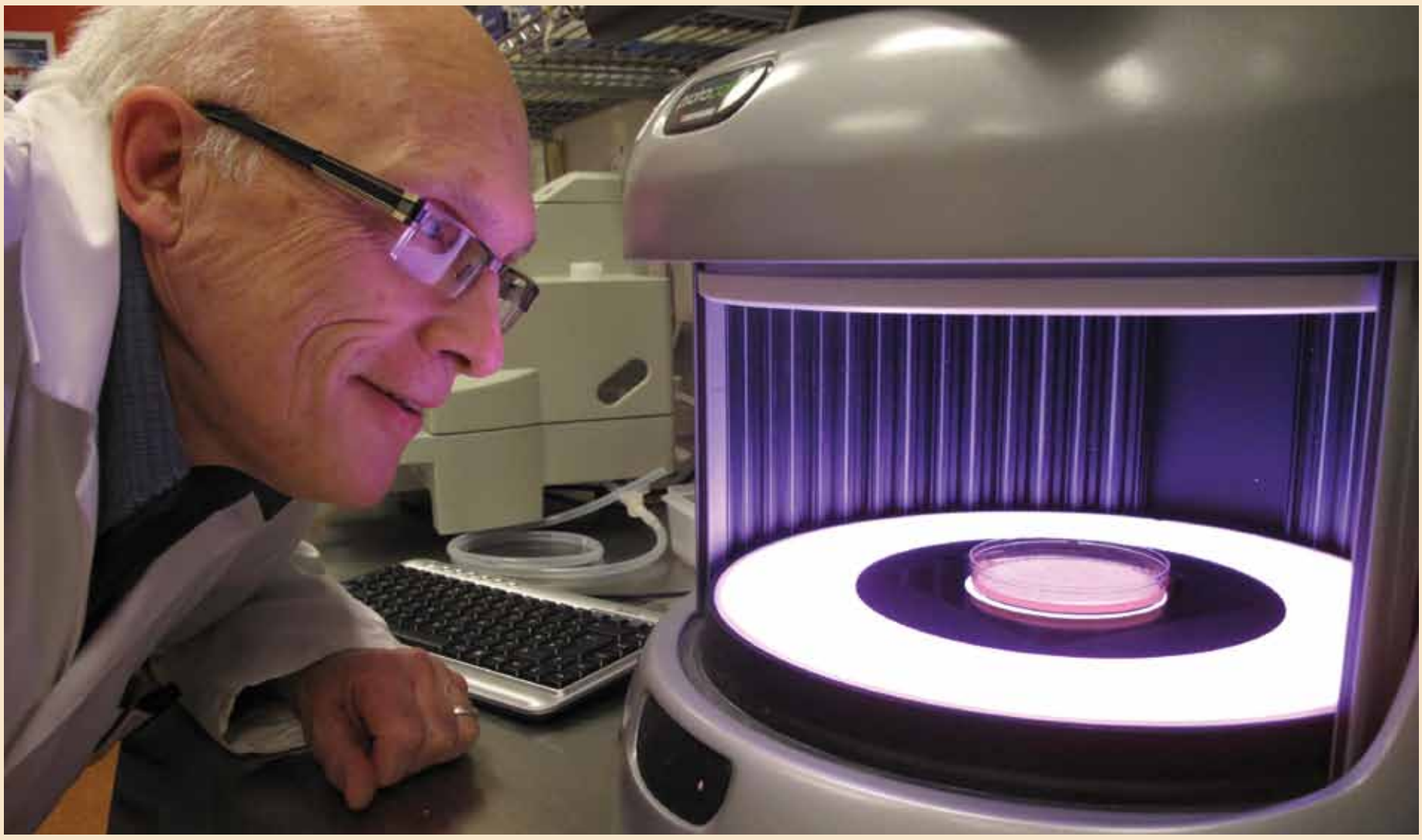
In what was once a living room and dining room, the museum now traces the history of apple research and the apple industry.

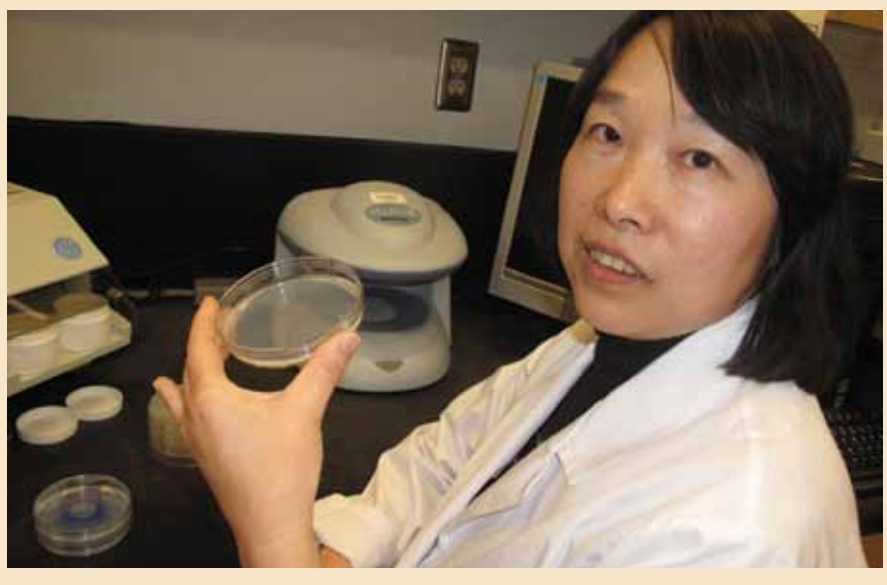
For history buffs, there is an ancient sprayer, old photos, orchard tools, early apple juice cans and advertising signs promoting their products with prices in the pennies.

For the inquisitive, displays explain how researchers developed new varieties and production and processing techniques that have helped make the Annapolis Valley internationally known for its apples.

The Blair House Museum is open weekdays during the summer and admission is free.

Food Safety





Keeping food safe from bacterial contamination is one of the areas of research at the Atlantic Food and Horticulture Research Centre. Clockwise from the top, microbiologist Dr. Greg Bezanson completes a bacterial count on a sample; a close-up of a bacterial sample; microbiologist Dr. Lihua Fan; Dr. Tim Ells prepares bacterial samples; research technician John Daborn is magnified in the food safety lab.

Pilot plant has helped processors take wing

Its name has the ring of an aviation school. But it is food processors rather than pilots who have taken off with the help of the pilot plant at the Atlantic Food and Horticulture Research Centre in Kentville.

For more than 80 years, scientists at the centre have been designing and adapting innovative food technology to help farmers and processors bring new food products to the marketplace.

The centre's pioneering research in large-scale food dehydration, canning, freezing and blanching created export opportunities for fruit and vegetable production that had outgrown local markets.

And it's gained a reputation as a troubleshooter for young processing companies trying to get off the ground.

"Agriculture and Agri-Food Canada has been instrumental in supporting the development of cutting edge technology in food processing," says Sandro Bertossi, chief operating officer of Oxford Food Group, the world's largest supplier of frozen blueberries.

The Oxford, Nova Scotia company turned to the pilot plant in its early years in the 1970s. Researchers did a complete evaluation of the equipment being used by the blueberry industry in the United States and Canada at the time and made recommendations to the company on how to improve their quality.

They also developed a flotation system for removing green berries, moss and stones from blueberries that were going to be frozen.

"This research has allowed Oxford Frozen Foods to be competitive in existing markets and has opened up new countries as users of wild blueberries," says Bertossi.

Dr. Bob Stark says that type of collaboration has been typical at the plant.

"It's been a place for scientists, engineers and entrepreneurs to get together and take great food product ideas and find ways to turn them into something that works," says Stark, who worked in the plant from 1968 until his retirement last year.

Food processing research began at the centre in 1929 when Cecil B. Eidt developed a forced-air food dehydrator that revolutionized the production of dehydrated fruits and vegetables.

The Eidt Dehydrator produced thousands of tonnes of dehydrated vegetables in Canada during the Second World War and was the leading dehydration technology until the 1960s.

In 1940, while the centre was looking at canning technology, researcher Herbert Aitken suggested that adding ascorbic acid to apple juice might reduce Canada's dependence on American citrus juice for needed winter diet supplements of vitamin C.

The suggestion led to the production of the first vitaminized apple juice in 1943.

By 1950, the pilot plant had been equipped to handle almost any phase of fruit and vegetable processing. Researchers evaluated potato chip production, jellies and juices, frozen fruit confections and even wine.

During the energy crisis of the 1970s, the food industry, as a heavy energy user, was particularly vulnerable to escalating fuel costs.

Stark and others at the centre worked with ABCO Industries Limited of Lunenberg, the largest manufacturer of fish processing equipment in Canada, to develop an energy efficient steam food blancher.

The ABCO Steam Blancher became an industry favorite.

Since then, researchers have worked with the latest in food technologies – filtration systems, breathable packaging and processes to better preserve food quality and nutrients. They developed new extraction procedures for blueberry juice, improved processes for french fry and mashed potato production and rehydration processes for dry field beans and other pulse crops.

"It's a good feeling to look back and see how we have been able to help," says Stark. "At the end of the day, all scientists want to see their research being implemented by the industry and making a difference, whether it be in global competitiveness, reducing energy consumption, reducing waste and effluent discharged to the environment or the introduction of products with improved quality and nutritional value."

Graduate student Megan Fisher checks a spinach sample in the pilot food processing plant.

Charlie Eaves, left, and H.J. Lightfoot treating apples with nitrogen in a cold storage warehouse in 1958.

Wildly successful blueberry juice a blend of good business and science

In February, New York Times food columnist Florence Fabricant raised a toast to wild blueberry juice produced by Van Dyk's Health Juice Products Ltd. of Caledonia, Nova Scotia.

"Sip some rich, intense Van Dyk's Wild Blueberry Juice from Nova Scotia and instead of wintry gloom, think camping among the pines in August and berry picking near a meadow," Fabricant wrote.

The column triggered orders for the juice from around the world, proving once again that if you can make it in New York, you can make it anywhere.

It was the latest chapter in what is not only a business success story, but a success story for the Atlantic Food and Horticulture Research Centre.

Van Dyk's Wild Blueberry Juice is 100 per cent wild blueberry juice. But it is also a blend of entrepreneurial savvy and agricultural science.

As a wild blueberry grower in Caledonia, company owner Casey Van Dyk had seen the success Europeans were having marketing the juice of the bilberry, a cousin of the wild blueberry, as a medicinal drink.

"He knew about the growing body of research into the health benefits of wild blueberries," says company general manager Randy MacDonald. "He was ahead of the curve in seeing the shifting consumer interest in health-related food products."

Van Dyk took his concept to a consultant to see whether his idea would fly. The consultant told Van Dyk there was nothing like it on the market.

"It was virgin territory," says MacDonald. "Wild blueberry juice looked like a winner."

Van Dyk and MacDonald turned to the Atlantic Food and Horticulture Research Centre for help in turning the idea into a product.

MacDonald was the company's first employee in 1998 when he met researchers Bob Stark, Katherine Sanford, Eric Jackson and other scientists and technicians.

"To take that step from primary producer to processor is a giant leap," says MacDonald. "Without the research we wouldn't be doing what we are doing."

MacDonald says creating a juice was more difficult than it sounds. While Stark focused on extraction and processing, Katherine Sanford concentrated on the taste, aroma and look of the juice, working with consumer panels.

Jackson's microbial work focused on making sure the product was stable and safe to market.

Stark says the research centre played the role of business incubator for the company, providing research support for three years as the juice moved to a commercially viable product.

"We worked on the processing methodology, quality characteristics and microbiological stability," he says. "It allowed us to solve problems that occurred as the company scaled up its production and it was an important part of the successful development of the juice."

Ken McRae was head of the Centre's statistics team at the time and designed the experiments, their analysis and interpretation.

"The group brought an extensive amount of knowledge to the project," recalls McRae. "There were three challenges – production, extending shelf-life and the sensory aspect, which was the taste and formulation. We had to look at all three together and that was the hard part."

McRae says the research group was excited by the project.

"For our small and dedicated team we saw it as a challenge to create a local, high quality product," says McRae. "I couldn't have wished for a better workplace."

McRae still sees it as a great example of partnership.

"A company like Van Dyk's couldn't afford this kind of product research and development on its own."

"All that knowledge and technology was crucial," agrees MacDonald. "It made us confident taking our juice to the marketplace."

The product was test marketed in Halifax in the fall of 2000 and quickly expanded to other locations in Nova Scotia, then Atlantic Canada and into Ontario, Quebec and the West.

About five years ago, Van Dyk's started exporting outside the country with sales as far away as South Korea, China and parts of the United States, including a chain of stores in New York City that picked up the product.

The company sold 180,000 bottles of wild blueberry juice in 2010.

Recreating traditional Italian wine-making in Nova Scotia

In the grey light of a cool Atlantic fall day, the covered plastic containers of grapes in the controlled environment rooms of the Atlantic Food and Horticulture Research Centre seem far removed from traditional Italian wine-making under the warm Mediterranean sun.

But centre scientists Dr. Robert Prange and Dr. John DeLong have helped a local winery re-create the drying Mediterranean wind to produce award-winning, ultra premium red and white wines.

Since 2005, L'Acadie Vineyards of Gaspereau Valley has been using modern science to produce a Nova Scotia version of straw wine, a centuries-old practice going back to the Romans in which harvested grapes are spread out on straw mats and dried in the sun. This concentrates the juice and causes natural chemical changes in the cells, producing a richer, more flavourful wine.

When it comes to climate, Nova Scotia is no Italy. DeLong and Prange replaced the mats, sun and wind with plastic trays on pallets and large propeller fans in a temperature-controlled room.

"It's a bit like the ice wine industry," says Prange. "The cold weather changes the internal chemistry of the grape to produce something different. In our case, we are taking a living grape and putting it in a slow drying environment, allowing it to become sweeter and to produce richer, more complex flavours before making it into wine."

For L'Acadie Vineyards, the process has resulted in wines that are being toasted by connoisseurs. A red wine, 2006 Alchemy, won the gold medal at the All Canadian Wine Championships while its 2008 Soleil, a white dessert wine, took Double Gold.

Vintner Bruce Ewert also used the process to produce a silver award-winning red dessert wine, the 2007 Leon Millot Soleil.

"When we started this project six years ago, we were pioneers," says Ewert. "Now there is talk about this being a very promising process for Ontario and other areas."

As novel as this approach may be for Nova Scotia, it's not the Research Centre's first foray into wine-making. Researchers were evaluating wine grape cultivars as early as 1913.

Larger than life

Electron microscope giving new perspective to agricultural research

When Dr. Paul Hildebrand wanted a closer look at how a destructive fungus was invading blueberry crops, he brought one of the infected leaves to Dr. Deb Moreau.

Magnified 5,000 times, the fungus looked like a winding, white root moving along the bumpy landscape of the leaf surface. Suddenly a small, breathing pore opened and the root moved towards it and slipped inside.

“The fungus was getting a signal when the leaf was respiring,” recalls Moreau. “Basically, it was infecting the plant as it breathed.”

Welcome to the larger than life world of next-generation electron microscopes. Here the detective work of science plays out on alien landscapes where pollen is the size of battered baseballs and the smallest crevices are teeming with life.

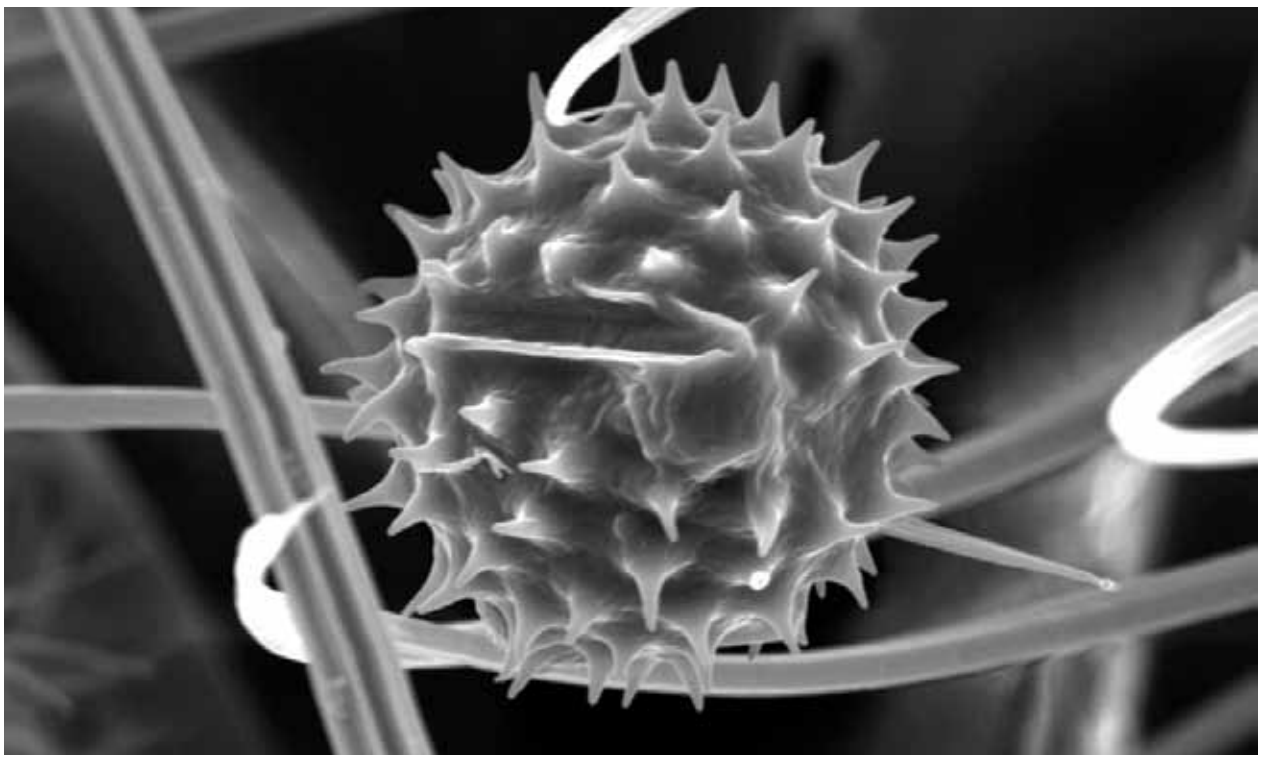
Moreau, a biologist at the Atlantic Food and Horticulture Research Centre, operates the facility’s $500,000 Environmental Scanning Electron Microscope.

If it looks a little plain – a metal box a bit bigger than a microwave – its power is giving researchers a whole new perspective on agriculture.

Unlike other electron microscopes, the Environmental Scanning Electron Microscope allows researchers to look at a specimen under a number of conditions, including while it is still alive.

Using a stream of electrons and magnets, the microscope magnifies up to 100,000 times and allows the specimen to be viewed at multiple angles in images that look 3-D.

A pollen grain caught on the hair of a fly under the electron microscope



Compare that to the double-barreled microscope that would have been used at the research centre in its earliest years, and to the modern upgrades still used by scientists today. They are limited to a maximum magnification of 2,000 times.

After that, the images are too faded and blurry to see. Chalk that up to the physical laws of light waves.

But that limit couldn’t keep up with the probing nature of scientists who wanted to see inside the cells of plants and into the inner workings of insects and diseases.

Science broke through the door in the 1960s by replacing light with electrons in the microscope.

“The technology is letting us see further than we ever could,” says Moreau, who admits the viewpoint has given her a new appreciation of agriculture and the world around her.

“At this magnification, you are seeing life-forms living on life-forms that live on other life-forms and on and on.”

The up-close insights are benefiting farmers, food processors and consumers by helping researchers develop new techniques for dealing with plant diseases and pests and for improving food safety.

The eureka moments come in seeing how the internal structure of yogurt affects probiotic bacteria or how weevil larvae are feeding on the roots of strawberries.

“It gives scientists another tool to work with, another angle to explore,” says Moreau. “Sometimes it’s just a closer look, sometimes it’s a different look.”

Ironically, the computer software used by Moreau and her team to analyse the microscopic images also works on the world at large – everything from photographs of ripening fruit to ground cover images from fields.

“The software lets us precisely measure pigment changes in vegetables and how the smallest differences on the surface of a piece of spinach or blueberry affect where bacteria or fungus hang out,” says Moreau. “It’s additional information that can be used by our scientists.”

In the end, she says, big or small is all a matter of perspective.

“The trickiest thing for people to understand is the scale of something as seen under a microscope,” she admits. “When people see the magnified image on the screen, they don’t know what they are looking at. It’s too close. You have to back them up, so to speak, and tell them what the big picture is.”

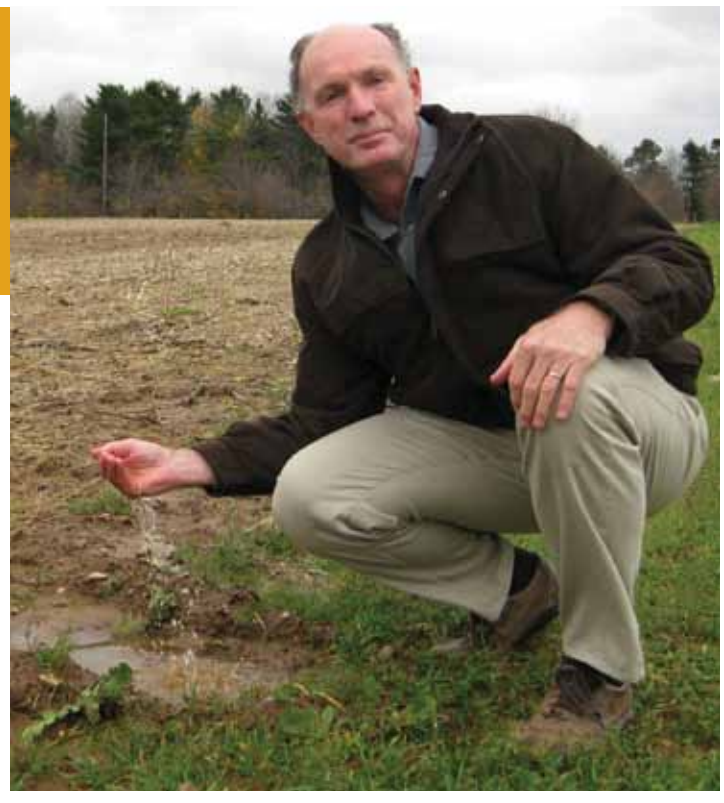
She loves the opportunity to contribute to so many different research projects.

“I’m a big fan of Horton Hears a Who,” says Moreau of the Dr. Seuss children’s book about the world contained on a speck of dust on a tiny plant that only an elephant can hear because of the size of his ears.

“I was just drawn to this kind of work.”

Dr. Deb Moreau with the research centre’s environmental scanning electron microscope

As farms get larger, environmental science focuses on the details



Keith Fuller in his outdoor environmental laboratory.

Keith Fuller's computer begins to squeal and squawk like a dial-up connection on hold. Fuller smiles. "That's my field calling," he says.

The caller is a data collection unit in a field of corn, wheat, soybeans and forages behind the Atlantic Food and Horticulture Research Centre. Numbers appear on the computer screen. They are the latest measurements on the flow of water draining out of a dozen perforated plastic pipes called tile drains buried three feet below the crops.

It's one of four calls that will be made today. They are part of an on-going 10-year research project that is giving farmers more precise information on how to fertilize with manure while protecting the quality of water in streams, rivers and underground water tables.

In fact, detailed soil, water, crop and climate information is changing the way farmers and researchers are looking at the impact agriculture has on the environment.

"I think we all realize that environmental stewardship doesn't stop at a general set of best agricultural practices," says Fuller, a soil and water specialist who has worked at the research centre since 1998. "We have to start breaking things down.

"If you have 200 hectares of corn, it doesn't mean that you necessarily do the same thing on all 200 hectares. You have to look at the nuances."

Fuller has been identifying some of those nuances for more than a decade in the back field that he calls "my outdoor laboratory." The project was developed with funding support from Dairy Farmers of Nova Scotia.

The research focuses on the relationship between two things the provincial agriculture sector usually has in abundance – precipitation and manure – and the 14,000 kilometres of perforated tubing that has extended the growing season by weeks on agricultural soils across the province. These tile drains have opened the door to new crops and varieties.

Tile drainage is irrigation in reverse. It collects and drains excess moisture from fields, allowing soils to dry off and warm up in the spring. Without it, tractors would be mired in muck and the season would be too short for many crops.

But the water that tile drainage collects can also create a conduit for fertilizer, farm chemicals and pathogens like E.coli.

The third part of the equation is manure. Canadian livestock produce 360 tons of manure a day, about 20 per cent from dairy cattle. It's an abundant, natural and effective fertilizer widely used in farming.

In his 1.5 hectare research field, Fuller is testing the impact of fertilizer applications on water quality when different crops are used and different tilling methods are involved. The field is divided into four different crop sections. Excess water runs through the tile drainage and is collected and analyzed.

The research is showing that manure applications need to be adjusted for different crops, soil types and terrain to protect water quality.

"It's all about looking at what your land is best suited for and making sure you are monitoring the right things in the soil and making the best management decisions," says Fuller.

"Our research has a role to play in bringing out those nuances between different soil types, terrains and micro-climates."

Brian Newcombe agrees. A dairy, egg and cash crop farmer near Port Williams, he has been participating in Fuller's research for nine years.

"We're always looking for ways to tweak our production or change the way we do things to be more efficient and to create some environmental benefits," says Newcombe.

The combination of environmental and economic benefits was the reason he chose not to plough his fields every year, going with a no-till system instead.

"You use less gear, less fuel because you are making fewer passes in the field with your equipment and you can do it in less time and with fewer people," he says. "At the same time, there are environmental benefits in using less fuel and reducing erosion."

Newcombe says he'll continue to look to research to help fine-tune the economic and environmental performance of his farm.

"We are involved in a lot of research," he says. "I'd rather be on the cutting edge than following on the path that everyone else is already on."

A watershed moment in farm environmental practices

The Thomas Brook is just a little ribbon of water in the Annapolis Valley, barely six kilometres long and rarely more than two metres wide.

But as a watershed, the brook collects water from 750 hectares of the Annapolis Valley and flowing from this is a torrent of scientific data shedding light on the impact of farming on the environment.

For the last seven years, a research team led by Agriculture and Agri-Food Canada and the Nova Scotia Agricultural College has been kneeling along the banks of the brook and walking through farm fields. Researchers have been monitoring stream water, soil nutrients, greenhouse gasses and even the health of small bugs living in the water.

For their part, area farmers have been adopting environmental practices known as beneficial management practices. They have fenced off streams and installed in-pasture watering for their cattle, diverted farm run-off away from waterways and developed nutrient management plans, among other things.

The research team is evaluating these beneficial management practices and the economic costs and environmental benefits for farmers and down-stream communities.

James Kinsman is one of the farmers participating in the study. Thomas Brook runs through his 400-head dairy farm and he welcomes the research.

"We want to know if what we do on the farm helps the brook and the watershed as a

> continued on page 23

Researchers look for ways to keep wild bees happy, healthy and at home on the farm

The irony is not lost on him. Steve Javorek could be one of the best friends that wild bees have in Canada, but that doesn't prevent the occasional sting.

"Wild bees are usually very gentle and reluctant to sting," he says in their defence. "But as part of our research I handle a lot of bees over the run of a season, often in ways that can result in an encounter with their business end."

It's an occupational hazard the Atlantic Food and Horticulture Research Centre landscape ecologist is willing to live with.

That's because wild bees, the little-known cousins of the honey bee, play a critical role in pollination.

With scientists and farmers worried about the decline in the population of all bees, Javorek is on a mission to get more buzz on the farm.

The trick, he says, is to re-think farmland as community developments for bees, complete with good restaurants, enough housing and short commute times.

That's why he is spending his springs and summers following the movement of wild bees in different landscapes across Canada.

"We know that these bees require a place to nest that gives them adequate access to forage over their lifespans," Javorek says. "What we want to learn is what habitat is important, where it should be and how much of it is needed."

Driving the research is the key role bees play in agriculture. Along with managed honey bees, whose hives are often rented to farmers, the Maritime region's 180 wild bee species provide needed pollination for up to 40 per cent of crops.

That includes multi-million dollar commodities like apples and blueberries.

"One out of every three mouthfuls of food is the result of the pollinators' work," Javorek says.

But bees and their pollination services are in trouble. In 2007, a massive disappearance of honey bees called Colony Collapse Disorder reduced North American honey bee populations by millions, leaving farmers and beekeepers scrambling to find replacements to pollinate their crops.

"It made people aware that there is a looming vulnerability in our food system and highlighted the vital role of pollination in our everyday lives," says Javorek.

There is mounting evidence that native wild bee populations are also declining because exposure to bacteria, viruses, parasites and pesticides, as well as changes and loss to their natural habitat.

For the most part, however, Javorek says wild bees and their amazing contribution to pollination have remained out of the public eye.

"When we think of bees, we think of honey bees living in a hive with a queen and her workers. Honey bees are really the oddballs in the bee world around here."

The reality is that most bees are solitary. Each queen constructs her own nest and provisions it with pollen and nectar to feed her larvae.

"There is an astonishing myriad of nests among different species, from a series of leaf-lined brood cells in pre-existing holes in wood to multi-galleried tunnels excavated in the ground," he says.

"The only wild bee that forms a colony is the bumble bee."

Javorek is hoping the information he is gathering by tracking bees in their natural habitat will form the basis of bee-friendly agricultural landscape designs for the future.

A key player is the region's growing blueberry industry. Nearly 70 of the region's wild bee species are involved in the pollination of the crop.

"It's a major pollination force but it's highly variable," says Javorek. "We need to figure out the main factors that affect their populations if we are going to meet the future pollination needs of the industry."

Jasper Wyman and Sons Canada Inc., the largest blueberry producer and processor in Prince Edward Island, has been working with Javorek on a three-year project to test his theories in the field, both on the Island and in the company's larger blueberry fields in Maine.

"As we bring new blueberry fields into production, we will be looking at landscape features that can be maintained to encourage native pollinators," says Homer Woodward, the company's Canadian sales manager.

"Our company believes in sustainable agriculture," he says. "We look at this as not only being a benefit to us in our blueberry fields but as something that is beneficial to the whole ecosystem."

The company is currently examining the results of the work done last spring and summer during the first year of the project.

"You can see the influence of local landscape on bee pollinations when you look at blueberry fields," says Javorek. "Fields just 10 kilometres apart can be significantly different when it comes to the abundance of native bees.

"We need to know what kinds of habitat bees need and how these pieces of habitat need to fit together to drive their populations.

"Solving this puzzle will give us a template for future land development and land restoration activities that provide for the habitat requirements of native wild bees."

The research centre's apiary in 1946. The first apiary was set up on the centre grounds in 1913, providing farmers with much-needed information on the effect of local sources of nectar and climate conditions on pollination and the quality and quantity of honey.

New insights into insect behavior helping to get bugs out of the system

Environmental biologist Sonia Gaul uses a stick and screen to collect live insect samples from an apple tree.

If you think swatting a few fruit flies and mosquitoes during the summer is a chore, imagine trying to save an entire apple orchard from thousands of insect pests.

There are dozens of species of moths and flies in Nova Scotia and plenty of other insects you have not heard of that can take a big bite out of a fruit crop and a grower's profits.

But there are just as many species of insects that are beneficial. Bees and butterflies perform the important task of pollination and predator insects make a meal of many pests.

Recently retired entomologist Dr. Mike Hardman studied insect populations for 29 years at the Atlantic Food and Horticulture Research Centre.

It's a field of study that has changed dramatically in the 100 years since the research centre opened.

Where farmers once used crude chemicals to keep insect pests down, they are now opting for an approach called Integrated Pest Management, or IPM. IPM uses knowledge about insects, regular monitoring of their populations and a variety of control techniques to minimize the ecological impact in the orchard, on the farm and beyond the property lines.

"We now know that using a blend of techniques to control pests works best," says Hardman, whose work is being continued by entomologist Dr. Suzanne Blatt.

It's an approach that recognizes that the mere presence of a pest does not always mean there is a pest problem.

Instead, researchers have developed population threshold numbers based on the type of insect, the damage it does, the value of what is being damaged and the cost of control treatments.

If the pest population stays below that number, a farmer can let it go. If the number goes up, control measures kick in.

Those measures can include traps, natural enemies and mechanical barriers like screens and sticky bands on trees and chemical sprays.

The solution might also be found in the way the crop is grown. For example, increasing ventilation by thinning excessive growth in fruit trees can reduce the number of some pests and incidence of plant diseases.

The stakes are high. An infestation of codling moths, for example, can make an entire orchard of apples unmarketable.

Hardman says pest pressures could become more intense as a warming climate brings more insects north.

It was an insect outbreak in the early 1900s that was partly responsible for the creation of the Kentville Research Station.

An explosion of brown-tail moths was destroying trees, including apple trees. The Dominion Entomological Laboratory, a small white-framed field station in Bridgetown, was built in 1911 to deal with the moth and other insect pests as part of the new Kentville Research Station.

By 1915, researchers were looking at chemical controls. But they tended to act as crude chemical fly swatters that affected both pests and their predators.

"Sometimes the result would be a pest outbreak where you didn't have enough natural enemies to keep them under control," says Hardman.

During the 1940s and 1950s, Kentville researchers turned their attention to insect population ecology, studying the causes of outbreaks that led to crop damage.

As a result, more ecologically friendly chemical controls were developed.

New insights into insect life continue to open new avenues for pest control.

"To deal effectively with insects, you have to understand their behavior," says Kentville chemist and environmental biologist Sonia Gaul.

For example, researchers now know that insects respond to chemical cues to locate food, mates, and egg laying sites, and to avoid natural enemies. The information is being used to improve control strategies.

Today, farmers have insect traps in the orchard to track populations, are using an insect's own scent to throw off mating and egg laying, and are changing the way they run their orchards to reduce insect pests.

Fourth-generation farmer Gordon Spurr of Spurr Brothers Farms in Kingston, Nova Scotia, has championed innovative and more ecologically friendly insect control for years.

During the 1990s, he didn't like the battle he was waging with the mites damaging his family's fruit orchards.

"The sprays we were using were expensive and they were killing other beneficial insects," Spurr recalls. "We wanted to try something different."

He turned to Hardman who suggested a fight-fire-with-fire approach. The mites, he said, could be controlled by a predator mite that would eat the pest species.

"We worked with Mike to introduce the predator mites into our orchard and it worked," says Spurr.

Since then, the farm has participated in several insect control experiments with the research centre.

Hardman says that kind of partnership between researchers and farmers is what continues to drive improvements in pest control.

"They love helping us in our research and are quick to adopt any new techniques," says Hardman. "In the case of mite predators, they helped me spread them throughout their orchards, reducing the need for sprays.

"The result has been lower cost and better fruit. It is a saving for the growers, the consumer gets better quality apples, and everybody comes out ahead."

Checked mate

Who knew insect control was so sexy?

During the 1970s and 1980s, researchers at the Atlantic Food and Horticulture Research Centre turned to the birds and bees in the search for alternatives to chemical insecticides to control fruit pests.

The first test subject was the codling moth.

For anyone who has ever bitten into an apple and discovered a worm, that's the codling moth larva.

It can devastate an apple crop.

While sprays are available to kill the moth before it lays eggs, isolation of the moth's mating pheromone opened the door to a seduction switch.

Pheromone is a chemical emitted by female moths during mating. By placing traps containing the pheromone in an orchard, male moths are tricked into entering the traps. No mating takes place and no eggs are laid.

It's called mating disruption.

In 1989, Kentville researcher Rob Smith became the first person in the world to go beyond moths to identify a bug pheromone. It was the mullein bug, another apple pest that deforms the fruit.

All's fair in love and pest control.

With crop disease, prevention is part of the cure

Dr. Paul Hildebrand looks for signs of disease in a blueberry plant.

Cold, wet weather can be tough on the health of Maritimers. It's no picnic for the region's crops either.

Dozens of plant diseases caused by fungi and bacteria thrive in nasty weather. They can devastate a crop and a farmer's livelihood and in the process deplete the local grocery produce section. In some cases, they can shut the door to exports.

With names like scab, bitter rot and blight, they sound as unappealing as their impact. Some reduce crop yields by killing plants or slowing their growth. Others leave their signature in the form of disfigured fruit that can't be sold.

A century ago, the fight to keep those diseases in check was a lonely and frustrating one for farmers.

Today, communications and science are supporting new approaches to disease control that is saving crops, money and the environment.

Dr. Paul Hildebrand sees the results annually with an early warning system he helped develop for wild blueberry growers 15 years ago. It teams up the immediacy of a hotline with a growing database linking the effects of temperature, humidity, dew and rain on disease outbreaks.

"It's a province-wide monitoring program that predicts when certain diseases will appear based on climatic models," says Hildebrand, a plant pathologist at the Atlantic Food and Horticulture Research Centre for the last 28 years.

The big three blueberry diseases being tracked these days are two types of blight caused by fungus and a new disease, Valdensinia leaf spot, which researchers are just getting to know.

The hotline is run by the Nova Scotia extension agency AgraPoint and the Wild Blueberry Producers Association of Nova Scotia. It provides twice-a-week updates during the danger zone of April, May and June.

"We provide as much information to growers as possible on the likelihood of disease development before it's too late," he says.

"As a result, costly sprays are applied only when necessary. Some years, no sprays are needed at all. It reduces production costs and the pesticide load to the environment."

Keeping diseases under control is critical for all crops. Apple scab can leave an entire orchard of apples unmarketable. Several wild blueberry diseases can cut production in half.

While breeders continue to search for new varieties of fruit that are resistant to disease in the first place, pathologists like Hildebrand try to get a better handle on the weather sparks that can fan a disease outbreak.

In 1925, the study of plant diseases was a more modest business. Researchers used a homemade still to sterilize the media on which plant pathogens were grown and studied them through microscopes with narrow fields of view and low magnifications.

By the 1930s, the Centre was providing an early version of the disease hotline, providing early warning bulletins to farm organizations and the media on when apple growers should be spraying their orchards.

Hildebrand says chemical fungicides were a post-war breakthrough that paved the way for bigger and better crops. But they also raised questions about how often they should be used.

It was a university summer job with a crop spraying company that got Hildebrand thinking about the question.

"I was responsible for applying pesticides and I began to realize that some of the applications did not appear to be necessary," he recalls.

Hildebrand returned to university and graduated with a degree in plant pathology and a new appreciation for plant diseases.

"I was fascinated with the intricate relationship between plant diseases and the weather," he says. "Most of the fungi and bacteria that cause diseases are microscopic, but the destruction they can cause to plants is truly remarkable."

"Some of the diseases don't develop symptoms until several weeks after the initial infection has occurred, so it is very important to have a thorough understanding of the life cycle of these diseases," he says.

"Once the disease occurs, it is often too late to effectively control them."

Hildebrand's latest challenge is called bacterial angular leaf spot in strawberries. Although it doesn't affect the plant's growth, it leaves spots on the leafy crown of the strawberry, making it unmarketable.

The disease is also a problem for nurseries that ship young plants to Florida for berry production from December through March.

The bacteria can multiply undetected on the plants in Canada but then explode in numbers once exposed to the warm Florida sunshine.

"I am working with my colleagues Dr. Gordon Braun and Dr. Andrew Jamieson on an eco-friendly non-toxic spray for this disease and on breeding bacterial resistance into strawberries," Hildebrand says.

"Just like human diseases, we continue to find new and better ways to deal with diseases in plants."

A shot in the bark

Taking a page from the doctor's office, Dr. Gordon Braun is giving apple trees a needle that may prevent disease and save apple growers some future headaches.

The organic agriculture specialist at the Atlantic Food and Horticulture Research Centre believes that a metre-long heavy-duty syringe full of acetylsalicylic acid delivered through the bark of apple trees may help prevent some common diseases in the fruit crop, including the apple industry's most costly disease, apple scab.

"It helps activate the tree's defence system," says Braun. "It's sort of like a flu shot for trees."

He has also experimented with a byproduct of lobster shells called chitosan and with an extract from the apple scab fungus itself to help the trees build up immunity to the disease.

"Trees, like humans, have a number of defence mechanisms to fight off diseases and we are currently exploring ways to help trees defend themselves."

Braun, who has been working in organic research for the last 15 years, says organic agriculture's exposure to disease and pests demands some novel approaches.

Those have included dusting growing apples with clay to prevent sun and insect damage and planting mustard around the orchard to control some root diseases.

He hit on the idea of the syringe while trying to figure out how to deliver a disease resistance booster shot through the thick bark and into the plant's system.

"You can treat a tree in under a minute," he says.

Dr. Julie Reekie uses a laptop to collect climate data in an organic orchard of young Honeycrisp apple trees.

Organic research takes the floor

A 400-tree orchard at the Atlantic Food and Horticulture Research Centre has become an outdoor laboratory to test the latest research in organic agriculture and get a new crop off the ground.

The establishment of the three-year-old orchard of Honeycrisp apples was partially funded by the Nova Scotia Fruit Growers' Association.

"Organic products are a fast-growing trend and there is demand for produce free from pesticides and herbicides," says Julia Reekie.

The research biologist is leading a research team that is using the orchard to test ways of controlling insects, diseases and weeds that meet organic production standards.

While the centre has conducted organic research in the past, the new orchard provides a unique opportunity to look at organic agriculture from the ground up.

Nova Scotia's climate suits the Honeycrisp and the premium apple would have a higher market value than most other apples grown organically.

However, knowledge on the successful establishment of young organic Honeycrisp orchards is limited.

"Weeds are one of the main problems in an organic apple orchard and control products are limited," says Reekie.

The team is focusing on a new field of research called orchard floor management for answers. The group is looking at half a dozen approaches, including a reflective plastic mulch, composted manure and companion plant covers.

"When we put these on the orchard floor, they act as a barrier to weed growth," says Reekie. "They basically suffocate the weeds."

The reflective plastic mulch could be especially effective, shedding light on a host of benefits.

"When used as a ground cover it can increase the amount of available light by reflecting light back to the trees, almost like a mirror," says Reekie. "It has also been shown to enhance the color of the apples, conserve soil moisture and repel certain insects."

Andy Hammermeister, director of the Organic Agriculture Centre of Canada in Truro, Nova Scotia, says he likes the research.

"The orchard floor is a pivotal part of the orchard ecosystem," he says. "It affects nutrients, pest control, beneficial insects, water and the overall aesthetics of the orchard landscape."

"I think Dr. Reekie's research is going to be very important for organic apple production in the future."

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whole but we also want to know if those things are going to help our bottom line," says Kinsman. "We have been doing a lot of things for years and years and years because we haven't seen the research to tell us anything different."

The Thomas Brook Watershed is one of nine Canadian watersheds being studied under Agriculture and Agri-Food Canada's Watershed Evaluation of Beneficial Management Practices project.

Dale Hebb is an environmental biologist at the Atlantic Food and Horticulture Research Centre. He is leading the research team that also includes Dalhousie University, the Nova Scotia Federation of Agriculture and the Nova Scotia Department of Agriculture.

"There is a lot of interest in watershed research on this scale because we are not just doing an environmental study on a single farm," he says.

Local farms and the local watershed group, the Cornwallis Headwaters Society, are key players in the project.

The watershed team is also partnering with a growing circle of researchers like the Centre of Geographic Studies, Environment Canada and the Geological Survey of Canada.

"There is an expanding wealth of knowledge," says Hebb. "What we learn with this watershed study can be applied to other areas in the Maritimes."

Kinsman says the research will help him and his farming neighours make environmental choices with more confidence.

"We always try to do the right thing," he says. "We want to know we are on the right track."

Hebb says the research is pointing out some areas of concern in the watershed but there is also encouraging news.

"Typical of watersheds in the area, Thomas Brook shows signs of impairment in stream health, like elevated levels of phosphorus and sediment, but overall there is an abundance of biological activity in and along the stream.

"This research is giving us a much more complete backdrop against which we can evaluate the effectiveness of beneficial management practices on the farm."

Team approach makes research more than a job

For some people, the work week never ends. But for the 120 staff at the Atlantic Food and Horticulture Research Centre, time flies by.

“I can’t believe it was 24 years,” says research scientist Robert Prange, who retired in March. “It seems like yesterday when I walked through those doors for the first time.”

In the last century, over 400 employees have walked through the doors. What they’ve shared in common, says research manager Dr. Mark Hodges, is a dedication to making agriculture the best it can be.

“Good science really comes down to good people, not just in the labs but also in the fields, in administration, in financing and maintenance and engineering,” says Hodges.

“Science is a team effort and it always has been. When people are working well together, there’s an energy that makes things happen.”

Linda Hudson Taylor, a processing clerk, agrees. The centre’s newest employee commutes from Sackville every day, an hour in good weather, but says she would travel even further to work with this team.

“I knew during my interview that this place had the right chemistry,” she says. “This is more than a building, more than just a job. It’s an awesome place to be.”

Dr. Sonia Gaul joined the staff in 1973 as a technician and went on to receive her PhD in Environmental Biology while working at the centre.

“I really enjoy working with the students,” she said. “It gives me the opportunity to share my knowledge and skills with them.”

Over the years several scientists have joined the full time staff after working as research fellows or students at the centre.

“There’s a great mix of people here, with varying levels of education and experiences,” says Human Resources Coordinator Janice Carter. “We’re lucky that we’ve been able to preserve the knowledge of those who are retiring through our research fellows and other programs.”

Dr. Prange is one of the research fellows who will continue to share his knowledge even in retirement.

“I’m happy to be able to continue to contribute in a new way,” he says.

Eugene Chipman remembered

When Eugene Chipman passed away on April 6, 2011 at the age of 97, he left behind a horticulture industry strengthened by his research during a 34-year career at the Atlantic Food and Horticulture Research Centre.

“He was a true gentleman and one of our longest surviving horticultural researchers,” says Donna Crawford, Executive Director of Horticulture Nova Scotia.

Chipman was a vegetable specialist and soil scientist at the research centre from 1946 to 1978. During the 1940s and 1950s, he annually evaluated between 300 and 400 varieties of broccoli, Brussels sprouts, cabbage, cauliflower, corn, cucumbers, melons, onions and tomatoes.

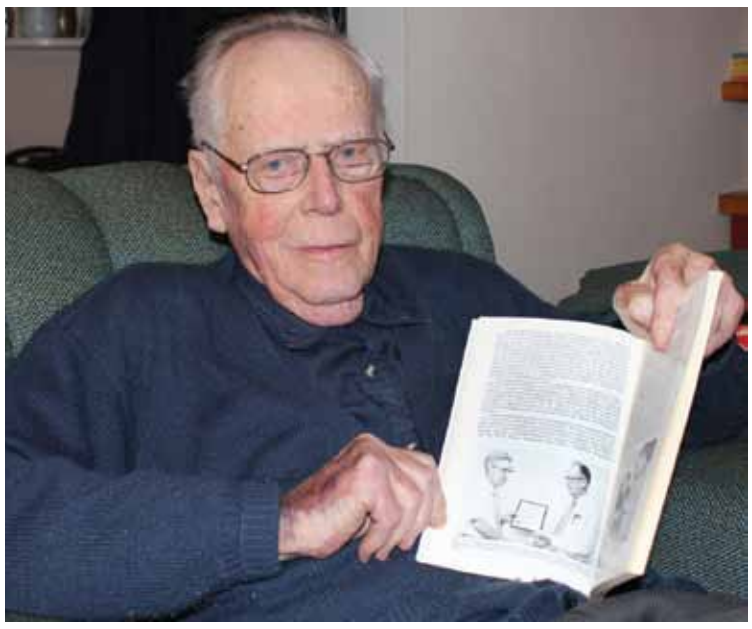
His own breeding work led to the development of seven new tomato varieties for the Maritime climate.

In recognition of his contributions of the industry, Horticulture Nova Scotia presented him with an honourary life membership in 2007.

In an interview a month before he passed away, as he was preparing for another season of farming, Chipman reflected on the changes he witnessed in agriculture over nearly a century and on his work as a researcher.

“It’s hard to believe how much agriculture has changed in my lifetime,” he said. “As a boy on the farm, agriculture was really pretty primitive. It was a time before tractors and electricity.

“Now when I see how far science and technology have taken us, I’m glad to have been part of that journey.”



Eugene Chipman in February, 2011, with a history of the Atlantic Food and Horticulture Research Centre that included a chapter on his work as a researcher.

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