



THE ²⁰¹⁴ INNOVATION REPORT

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vineland
RESEARCH & INNOVATION CENTRE



The many paths to innovation

I recently attended a seminar given by one of our research scientists. The purpose was to explain how various insights that are identified by our highly-specialized Consumer Sensory Panel feed into Vineland's innovation and commercialization process.

I found the presentation really interesting. What struck me most, besides learning how the consumer insight process works, was the results-oriented approach that our researchers take at every turn to ensure that our science has true impact, both for our industry and for our partners.

Since I joined the Vineland team last year, I've learned a lot about what it means to be part of a partnership-driven culture. We ask lots of questions about how to deliver on our mandate and we rally all kinds of resources in order to produce innovative solutions. Consumer insights are one such resource. But we also spend a great deal of time consulting with our partners, listening to growers, scoping out the competitive landscape and evaluating the supply chain – and that's even before, and quite often while, work takes place in the lab. That's because in our world, strong science is informed science. And informed science is what delivers real-world results. Results that help our partners to succeed. Results that help to solve supply chain issues. Results that help boost productivity and prosperity for Canada.

Collaboration is central to everything we do at Vineland. From my perspective, two stories in this issue really stand out when it comes to illustrating this point. In the cover story on automation, Rob Shwery at CMP Automation talks about how transformational his experience of working with Vineland was because it opened up a new revenue stream for his company in Ayr, Ontario. In the article on 'deep variant scanning', Dr. Daryl Somers describes a seminal partnership with Dr. Keiko Yoshioka's lab at the University of Toronto, which produced some important basic science to which Vineland obtained the license and proceeded to use it in the development of a new breeding technology platform. These stories highlight the true spirit – and breadth – of our partnership culture.

There are some great examples in this issue that illustrate the many and varied ways in which Vineland works to achieve real results. I hope you enjoy reading about our collaborative efforts and our partners, as much as I've enjoyed collecting their stories.

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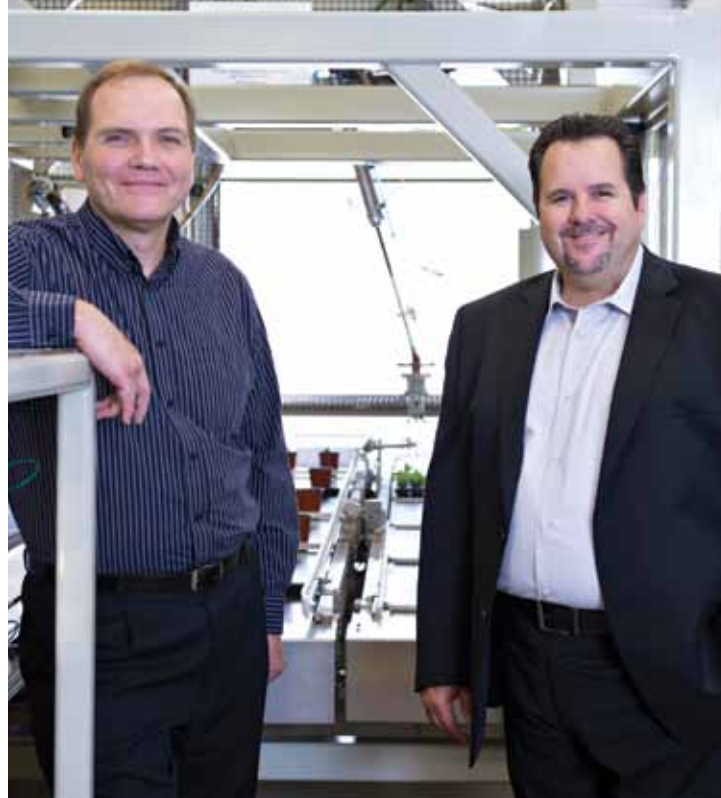
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John Van de Vegte, Vineland's Project Manager, Robotics and Automation and Rob Shwery, General Manager, CMP Automation

Robots pack plants and profits: Borrowing from the automotive industry's playbook

New automation technology will help drive growers' overall efficiency and productivity



They say that necessity is the mother of invention, and if you're a greenhouse owner, there is no greater need than to control production costs – and nothing more innovative than introducing robots into commercial greenhouses.

He won't take credit for the idea of developing customized robotic systems similar to those used in the automotive industry where he used to work, but John Van de Vegte, Vineland's Project Manager, Robotics and Automation, will admit that automating certain aspects of greenhouse production is not as counter-intuitive as it sounds.

"Our starting point is that if it helps growers to better manage their costs, particularly their labour costs, then transferring what we know from the world of cars to the world of horticulture makes sense. And if developing this kind of advanced technology here in Ontario also helps the local economy to become more productive and more competitive by creating highly-skilled jobs, even better," says Mr. Van de Vegte.

The robotic planting system that Vineland developed in partnership with CMP Automation, an automation design/build company located in Ayr, Ontario, was two years in the making. Through discussions with local growers Sunrise Greenhouses, Pioneer Flower Farms and Westbrook Floral, the team identified three of the most labour-intensive processes for their development work, including bulb planting, seedling plug planting and cuttings sticking.

After careful consideration of how each of these tasks is undertaken in the commercial setting, Vineland engaged CMP Automation as a partner to develop customized equipment as a prototype system. The system consists of a series of 20-foot-long conveyer belts, an overhead robot with arms designed to pick up, plant, and move from side to side, and an automated control panel to manage delivery. At peak performance, the equipment proved during trials that it could successfully plant 1,900 seedlings per hour.

"In the automotive industry, a good result is when a robot reaches an overall equipment efficiency of 85 per cent based on three metrics, including availability, efficiency and productivity," says Mr. Van de Vegte. "For

seedling plug planting, our equipment performed at this level. This gives us a high degree of confidence that for this particular task, we're ready to go to market."

According to CMP Automation General Manager, Rob Shwery, the sweet spot for growers is equipment that allows them to achieve a return-on-investment of less than five years. "A four or five-year pay-back is completely within reach, based on this design. The other benefit is that this equipment is produced locally, so there are none of the same risks associated with buying equipment elsewhere in terms of currency exchange, language, parts and service."

Vineland recently announced that it has licensed the new technology to CMP Automation, which will look to commercialize the equipment to growers across North America.

"This is a perfect example of our business model," says Lana Culley, Director of Business Development. "For Vineland, it's about leveraging great science and technology to deliver innovative solutions that help our partners to address real-world issues."



"...a good result is when a robot reaches an overall equipment efficiency of 85 per cent based on three metrics, including availability, efficiency and productivity."

It's pay-back time

In a 2013 study prepared by the Vineland Research and Innovation Centre for the Horticulture Value Chain Roundtable (and commissioned by Agriculture and Agri-Food Canada), 30 per cent of Canadian growers from a variety of industries said that one of the main barriers to using more automation technology in their operations was the perception that the pay-back period for capital investment was too long.

Other key observations from the survey, entitled *State of the Industry: Labour-Saving Technologies for Horticulture*, include:

- 67 per cent of respondents said that a reasonable pay-back period for an investment in innovative technology would be three to five years, and 16 per cent believed that a pay-back period of over 5 years was acceptable.
- 79 per cent of respondents rated their operation to be 'Somewhat' or 'Not' automated.
- Labour costs make up 41 per cent of total operational expenses for 33 per cent of respondents. Labour costs tend to be a larger percentage of total expenses.

According to respondents, the top gains in competitive advantage realized from innovation or automation were seen to be reduced labour costs (32 per cent), higher productivity (30 per cent), and enhanced product quality (20 per cent).

To put the issue of labour costs in perspective, the study estimates that the cost to package 6,400 potted tulip plants per acre is approximately \$576,000, where 50 per cent of the tasks are performed manually. Such costs include: manually removing plants from the crate; applying a colorful Mylar sheet and ribbon around each pot; affixing a pre-printed barcode label to each pot; inserting each pot into a clear plastic sleeve; loading pots into a cardboard carton; and labeling for shipment to the customer.



Bravely going where his company had never gone before

Rob Shwery is not a betting man. But when he got a call from John Van de Vegte, asking whether he'd be interested in building a robotic system for use in horticulture, he figured it might be worth a shot.

At the time of the call, Mr. Shwery was working as general manager for CMP Automation, an Ayr-based, vertically-integrated manufacturer of turnkey automation equipment that provides custom manufacturing automation solutions to various industries including the automotive industry. He joined the company in 2000 as a 20-year veteran of the automotive sector.

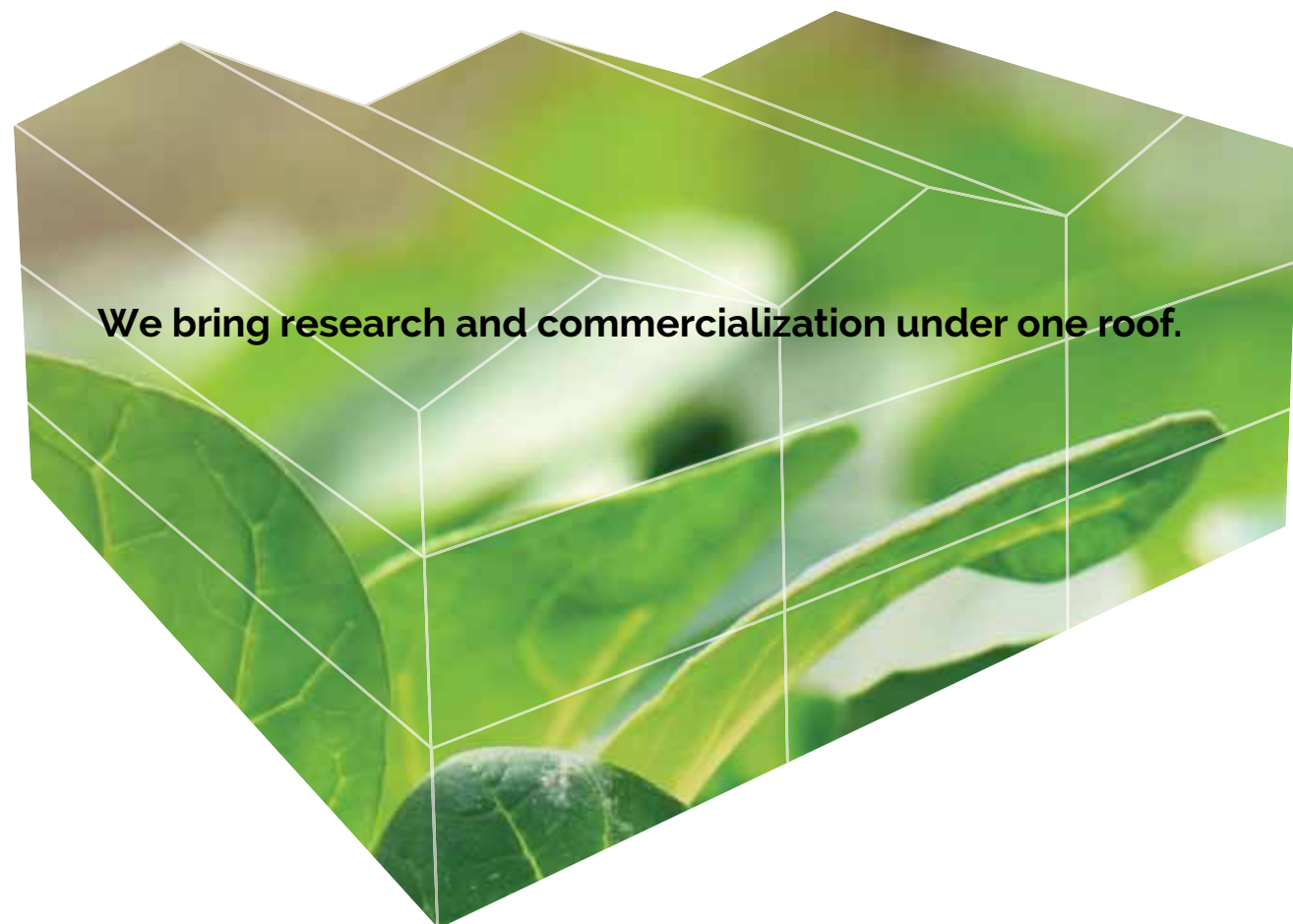
Prior to speaking with Mr. Van de Vegte, horticulture was the farthest thing from Mr. Shwery's mind, as was the development of new automation technology for the horticulture industry.

But today, one partnership, and two years later, that early conversation is ancient history. CMP Automation recently signed a licensing agreement with Vineland and is ready to commercialize the new equipment it developed in partnership with Vineland.

"Our partnership with Vineland has been a game-changer for CMP Automation," says Mr. Shwery. "The relationship has allowed us to develop new equipment for a sector that was new to us, and more importantly, to diversify our business in the area of commercialization. It truly has been a win-win for us, and Vineland has more than lived up to the spirit of our partnership."

New pre-commercial greenhouse set to revitalize economic development in Niagara

Built for industry, in consultation with industry, new structure will act as an agri-technology hub for the region

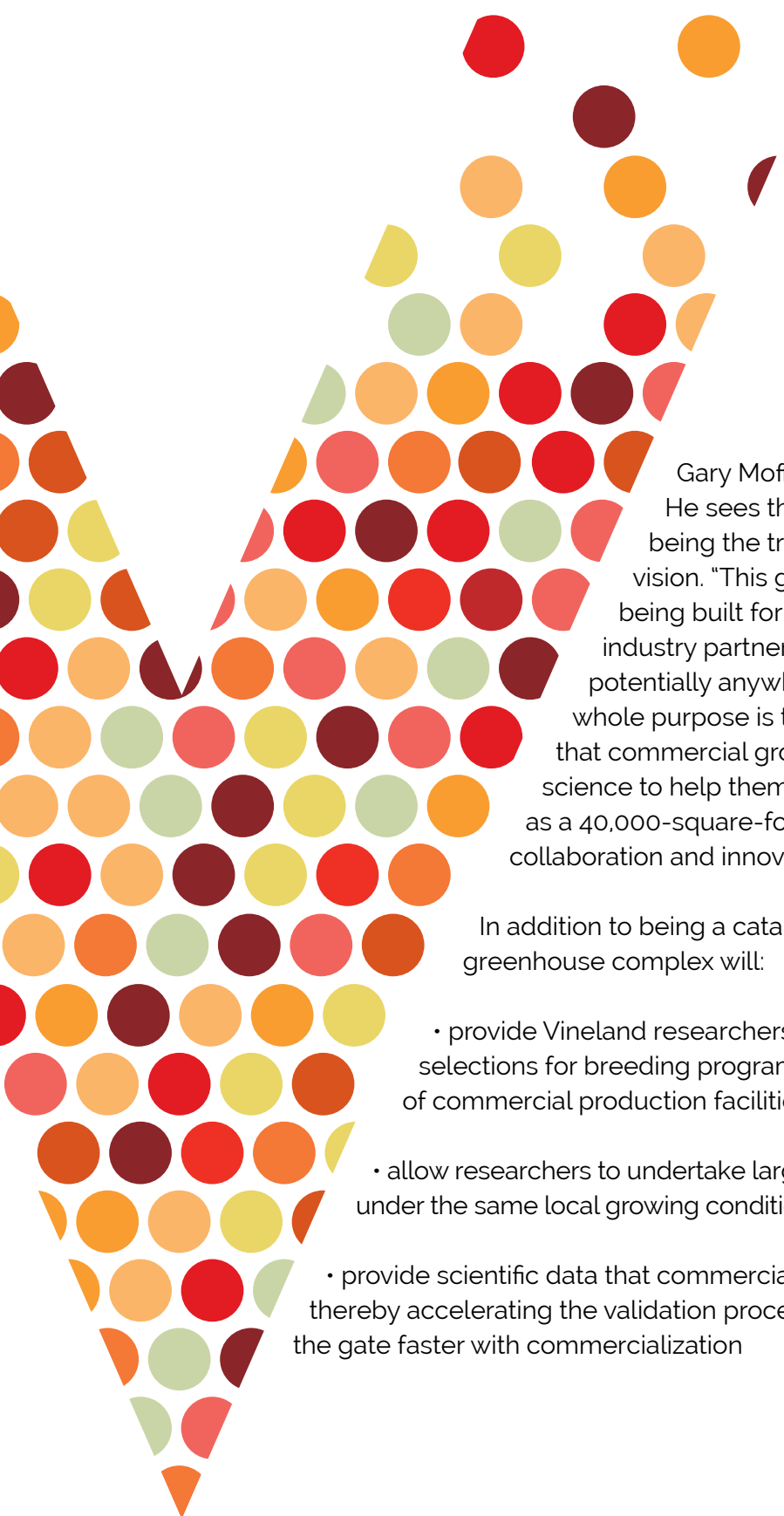


“Agriculture is a hi-tech industry, and the decision-makers at the Vineland Research and Innovation Centre clearly understand this.”

There's a new regional economic development plan for Niagara – and Vineland is poised to play a leading role, paving the way for the creation of more highly-skilled, higher-paying jobs and attracting new hi-tech companies and head offices to the area.

The Town of Lincoln, in which the Vineland Research and Innovation Centre is located, is developing its economic development strategy to align with the regional plan. "This is not pie-in-the-sky idealism, and with Vineland's new pre-commercial greenhouse complex, we're well on our way to making it happen," says Anne Louise Heron, Chief Administrative Officer for the Town of Lincoln. "Agriculture is a hi-tech industry, and the decision-makers at the Vineland Research and Innovation Centre clearly understand this. The new greenhouse complex is a great example of how Vineland is pushing the envelope by showing growers how new technology like robotics can drive down their labour costs and how automation can make them more competitive."

Research is a key driver for change in the agriculture sector, and according to Ms. Heron, the research being done at Vineland is not only directly aligned with the priorities of the region and the Town, it has the potential to be a strong economic driver. "Vineland's preferred approach is to work in partnership with key stakeholders in the agricultural supply chain," says Ms. Heron. "The Town is working with Vineland and others to find ways to encourage more hi-tech companies to relocate here. It's a very exciting time for the Town, the broader Niagara region and for Canada."



Gary Moffatt is Vineland's Chief Operating Officer. He sees the new research greenhouse complex as being the truest expression of Vineland's strategic vision. "This greenhouse is state-of-the-art, and it's being built for industry, with the full support of our industry partners, not only from the Niagara Region, but potentially anywhere in Canada," says Mr. Moffatt. "Its whole purpose is to provide answers to the big questions that commercial growers are wrestling with, using applied science to help them become more competitive. I see it as a 40,000-square-foot example of our commitment to collaboration and innovation."

In addition to being a catalyst for economic development, the new greenhouse complex will:

- provide Vineland researchers with information to help make informed selections for breeding programs, mirroring the scale and infrastructure of commercial production facilities
- allow researchers to undertake large-scale pre-commercial production, under the same local growing conditions as its commercial greenhouse partners
- provide scientific data that commercial growers can replicate in their facilities, thereby accelerating the validation process and enhancing their ability to get out of the gate faster with commercialization

The collaborative art of greenhouse building

Jon Neuert is a firm believer in collaboration, and nowhere is this more obvious than in the approach that his firm, Baird Sampson Neuert Architects, is taking to the design/build of Vineland's new greenhouse complex.

"Our direction from Vineland was first and foremost, the facility was to be a pre-commercial greenhouse for industry research, not a greenhouse for purely academic research," says Mr. Neuert. "We took that direction to heart and made it a central focus in the facility design approach."

Last June, Mr. Neuert initiated a consultation process that gave key stakeholders the opportunity to learn more about the project at a high level and to provide input on their specific needs over the next 30 years. From these discussions, Mr. Neuert identified several key priorities, including the need for flexibility to run multiple trial-sized research projects simultaneously, while delivering a high level of environmental control necessary to achieve research results relevant to the industry.

"Vineland's collaborative approach with industry was demonstrated through the stakeholder process established for the project, which sought input from the nursery sector, flowers group, vegetable producers and research communities. From my perspective, collaboration is essential to understanding industry needs and to delivering long-term utility from the facility. Reaching out to engage multiple perspectives makes the process real, and more importantly, it's the foundation for achieving excellence."

Did you know?

- The idea of growing plants in environmentally-controlled settings dates back to ancient times. The Romans planted cucumbers in wheeled pots that were placed in the sun daily and took them inside at night. Cucumbers were stored under frames or in cucumber houses that were glazed with special materials to keep plants warm and protected.
- The French botanist Charles Lucien Bonaparte is often credited with building the first practical modern greenhouse in Leiden, Holland during the 1800s to grow medicinal tropical plants.
- The greenhouse at the Palace of Versailles measured more than 500 feet (150 m) long, 42 feet (13 m) wide, and 45 feet (14 m) high.
- Fast forward: Today, in Ontario, there are 224 vegetable greenhouse operations totaling 2,272 acres of production and employing more than 10,000 people.
- Ontario growers produce more than 80 varieties of fresh cut flowers and 120 varieties of potted plants, representing 50 per cent of all greenhouse flowers grown in Canada.



“...we want our science to improve the economic prosperity of Canadian farmers.”

Vineland CEO says strategic vision is working

World-class research organizations don't just happen, says Dr. Jim Brandle. They're the result of great science, innovative thinking, strong local and global partnerships and sheer tenacity. In the following interview, Dr. Brandle explains the many paths Vineland is taking to position itself on the world stage.

Innovation Report (IR): Lots of organizations describe themselves as 'world-class' when what they should say is that they're doing business in markets around the world. When you describe Vineland as a world-class research organization, what exactly do you mean?

Jim Brandle (JB): I mean that we not only work in the world of science, we collaborate in the world of science, with feet firmly planted in the real world. Vineland is a collaboration-based research organization, and that approach informs everything we do.

IR: Isn't all form of scientific research collaboration-based?

JB: Yes and no. From the get-go, our vision at Vineland was to differentiate ourselves from other pure science research organizations by committing to what we refer to as 'real results' – results that are meaningful in the greenhouse, in the fields, on supermarket shelves, for growers, for industry and for consumers. In order to deliver those results, we do two things. First, we partner with the best in the world. And second, we look for ways to commercialize our science around the world. The second point is important because that's how we will ensure our own sustainability as a research organization.

IR: Can you provide some perspective on the extent of Vineland's partnership approach?

JB: We currently work with 168 partners from around the world – everyone from research scientists to industry partners to growers to retailers. We have a rock-solid science advisory committee made up of people who are able to assess the big picture, identify the problems that need to be solved and monitor the quality of research in order to be sure it's where it needs to be. We also have a stakeholder advisory committee that ensures our research is consistently relevant and focused on the right issues for our industry.

IR: What about Vineland's international presence?

JB: Our researchers are extremely active in the world's scientific community, where they present their results at conferences and submit them for publication in peer-reviewed journals. Beyond that, in terms of commercialization, we have a business development team whose primary role is to establish bridges with growers and companies around the world, with a goal of developing licensing agreements and creating new revenue streams.

Our Canadian hardy rose program is a terrific example of taking our science and making it successful in Canada and then pitching it to the nursery industry in other northern countries with similar growing conditions and challenges. We're seeing some of this material move to the U.S. and Europe this year for testing.

Our world crops program is also yielding some very promising results in terms of helping Ontario growers to compete with imported world crops and feed consumers' growing demand. Our new Pixie® grapes sold well, across the country last year, and this year we are moving to the U.S. market through our partner, Sunrise Greenhouses. The Greening Highways program has moved into Alberta from Ontario and will lead, we hope, to some new insights for growers planting along highways and in new sub-divisions. These are all examples of what we do every day to grab the world's attention and meet real-world demand.

IR: When Vineland was established in 2007, you said it was built on a promise. What was that promise and have you made good on it?

JB: The promise was to do things better. And when I say better, I mean that we wanted our science to improve the economic prosperity of Canadian farmers. Our goal, always, is to act as a catalyst for change, which means helping growers to compete. Whether it's technology and automation to help improve their bottom-line, new varieties of peaches, pears or tomatoes to make them more profitable, new approaches to pest management to make them more cost-effective or new markets to make their products more sought after by retailers and consumers, our job is to enable their success.

IR: What impact do you think Vineland is making, as far as its partners are concerned?

JB: Our partners and stakeholders have told me how confident they are with our results. They see tangible proof, in the lab and in the fields, that we're developing new products and new pipelines. They see new researchers coming to Vineland who believe in the work that we do and want to be part of it. They see that we're making good on our promise and want us to continue on.



Build it and (know why) consumers will come

Top priority for Consumer Insights team is to ensure Vineland's commercialization pipeline is always in lock-step with consumers' tastes and preferences



Dr. Amy Bowen, Vineland's Research Program Leader, Consumer Insights

Amy Bowen wants to get inside your head.

As Research Program Leader, Consumer Insights, she's as interested in knowing what your taste preferences are, as she is in asking whether you'd pay more, or less, for a certain type of fruit and how the appearance of fruits, vegetables and flowers might ultimately affect your purchase decisions.

A key member of an inter-disciplinary team at Vineland, Dr. Bowen's main focus is ensuring that no matter what new product her colleagues develop, consumers will like it and, most importantly, will buy it.

"There's absolutely no point in waiting until the end of the commercialization process to find out that consumers won't buy your new product, no matter how fabulous you happen to think it is," says Dr. Bowen. "At Vineland, we do in-depth sensory and consumer research up front so that we understand consumer preferences. This, in turn, provides the Genomics team, for example, with breeding targets that meet consumer expectations, while ensuring they have agronomic characteristics required for growers."

At every point in the commercialization process, Dr. Bowen feeds information into the pipeline, using data about the drivers and detractors behind consumers' preferences, as well as profiles of competitive products that are already in the marketplace, to guide the innovation process. The information she gleans from Vineland's highly-specialized Trained Sensory Panel, and also from untrained consumer groups, means that her team is not only able to provide hard facts about how to position a new product but can also give marketers the confidence – and the scientific data – to sell their products based on well-defined characteristics.

“Data about the drivers and detractors behind consumers’ preferences, as well as profiles of competitive products that are already in the marketplace, help to guide the innovation process.”

Alexandra Grygorczyk works as a Research Scientist in Dr. Bowen’s Consumer Insights group, focusing primarily on the non-edible aspects that affect consumers’ purchase decisions. Using online consumer testing, she probes consumers for their reactions to everything from price to appearance to production practices. According to Dr. Grygorczyk, there’s more to a product than just taste. “Consumers are complex creatures and when it comes to understanding their motivations, it’s always interesting to see what’s really behind their purchase decisions. Some of it is psychology, but a lot of it is related to biology and chemistry.”

In addition to their work on specific products, the Consumer Insights team also tries to understand the conceptual biases that may underlie consumers’ purchase decisions. Recent work on consumers’ perceptions of ‘biocontrol’ and ‘biotechnology’ are a case in point.

No matter how she comes at it, Dr. Bowen says her job boils down to one thing: taking as much of the guesswork out of the development process as possible so that the breeding and production teams can figure out the most expedient way of delivering a new variety. “Having an in-house Consumer Insights team working in tandem with Applied Genomics and Horticultural Production Systems is one of the key things that sets Vineland apart from other research organizations. It’s a really strategic part of the whole innovation process.”



Ordinary people, extraordinary talents

Helen F.* works in a veterinary clinic. Sue T.* is retired now but in an earlier life, she worked in the financial services sector.

Different as they are, both women share a love for food and enjoy cooking. Both have a superb sense of taste and smell. And both are members of Vineland’s highly-specialized Trained Sensory Panel – Helen for the past year, Sue for the past four.

The 19-member panel provides Vineland’s researchers with key insights about how horticultural products differentiate based on their sensory characteristics – perceptions that help researchers to zero in on the attributes they may ultimately breed into new varieties of fruits and vegetables.

It’s interesting work, says Helen, and with the intensive training she received from Dr. Amy Bowen and Senior Research Technician Amy Blake, she is now able to break food down into its basic components (smell, taste, appearance, texture) and help to create a valuable lexicon of terminology that informs the development of new varieties.

“I had no idea that I had this ability before I started working on the panel,” says Helen. “I wouldn’t say that I can perceive every single taste and smell there is, after all we’re not machines, but I have certainly learned to identify and describe what I do perceive. And I hope that’s helpful to the panel and to the industry.”

Sue takes a slightly different tack when describing her work on the panel, saying she does it to support local farmers. “This is my small way to use my talent to ensure that local farmers continue to be able to feed local communities. I love the work. It’s interesting, it’s teaching me how to understand what I’m tasting and smelling, and it’s definitely changed the way I cook.”

While their work on the panel can be intense, both women acknowledge that it’s important not to overload the senses for fear of becoming de-sensitized. And both say that even with all the peaches, apples, pears and okra they’ve sampled, they still love food, enjoy experimenting with it and are curious to taste the next new thing.

“I discovered okra and eggplant, two of the new world crops that Vineland is developing,” says Sue. “These were new foods for me. I was very pleasantly surprised. Of course, I wasn’t allowed to express that kind of personal opinion to the panel. It’s all strictly descriptive when we’re on the job.”

* Last names withheld in respect of panelists’ privacy



Vineland set to commercialize new breeding technology platform

New technology platform developed at Vineland takes academic research to the next level

“... a proprietary technique called ‘deep variant scanning’ helps breeders bring plants with novel variations to market sooner.”

It can take years for horticulture breeders to adapt natural variation in plants and develop specific traits, but now Vineland has invented a cost-effective and proprietary technique called ‘deep variant scanning’ (DVS) that is designed to help breeders bring plants with novel variations to market sooner.

“We’re excited to be able to offer this technology to the horticulture community,” says Daryl Somers, Research Director, Applied Genomics. “It’s not a replacement for traditional breeding, rather it’s a way to introduce novel traits in crops. It jump-starts the process and ultimately brings varieties to market sooner that bear the characteristics consumers and growers are looking for.”

Using specially-created computer algorithms, DVS scans for small changes in genes associated with traits like nutrient uptake, drought tolerance, visual appearance or disease resistance in each plant’s genome. These changes can translate to variability in the plant’s characteristics – known as phenotypes – and this variability can be bred into new varieties, in order to improve the plant’s performance and quality.

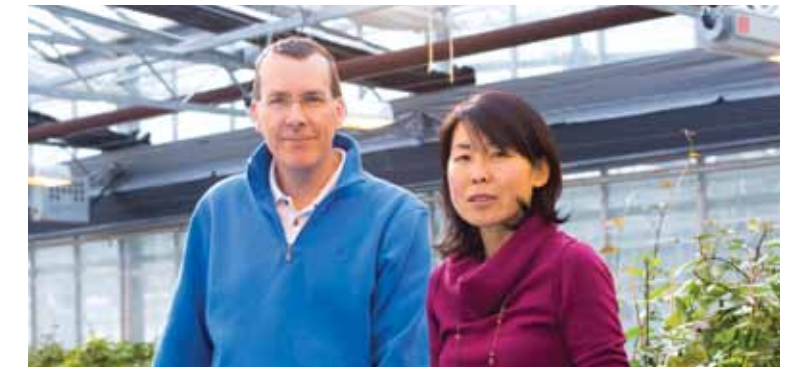
Dr. Somers and Research Scientist Travis Banks had been developing a computer-assisted approach to help horticulture breeders streamline the process when they heard about the work that Dr. Keiko Yoshioka was doing at the University of Toronto three years ago. Dr. Yoshioka had discovered that turning off a particular gene enhanced plants’ resistance to a number of pathogens. The Vineland team immediately saw the potential benefit for the horticulture industry and acquired a license for the intellectual property. They are currently using their proprietary DVS technique, along with Dr. Yoshioka’s gene target, to breed broad spectrum disease resistance in tomatoes and peppers.

“This is a perfect example of what makes Vineland’s approach to innovation so effective,” says Dr. Somers. “We recognized the potential opportunity of a discovery that was made in an academic lab and now we’re leveraging that opportunity to help meet the very specific needs of the horticulture industry.”

The next step, now that the platform has been refined and patent protection filed for, is commercialization, and according to Lana Culley, Vineland’s Director of Business Development, there are several ways in which industry might want to take advantage of the new

technology platform. Breeders might decide to obtain a license for Vineland’s computational algorithms to do their own research in-house. Alternatively, they might contract Vineland to do the work for them, to develop a specific trait. Or they might simply license a new variety from Vineland that exhibits specific traits.

“The beauty of this technology is that there are all sorts of ways to benefit from it, and any number of partners to work with,” says Ms. Culley. “We’re putting it out there, for the horticulture industry, because we know that ultimately the science we’ve developed at Vineland will help drive their profitability.”



Dr. Daryl Somers, Vineland’s Research Director, Applied Genomics and the University of Toronto’s Dr. Keiko Yoshioka

Three years in the making, the new ‘deep variant scanning’ (DVS) platform was developed by Research Scientist, Travis Banks and Research Director, Daryl Somers. Here’s how Vineland is using it to unlock the mysteries involved in breeding more disease-resistant greenhouse tomatoes:

- Starting with a pool of 5,000 identical seeds, researchers treat the seeds with a solution that causes them to produce random changes within the genome, resulting in 5,000 different plants.
- Using DNA sequencing, they examine certain genes within the genome of the 5,000 plants to identify all the induced changes to these genes.
- Once they pinpoint the changes in the gene sequence, they use other computer software to make predictions about the effect that change will have on the function of the target gene.
- When they determine that the target gene has become non-functional, they test the new plants to confirm the creation of favourable traits.

“We’re way beyond the proof-of-concept stage. This is hi-tech for horticulture and we’ve proven that it works,” says Mr. Banks.



MiSeq accelerates the pace of innovation

Before Vineland invested in new DNA sequencing equipment, the search for specific traits in the DNA sequence of fruits like peaches, apples and tomatoes was like looking for a needle in a haystack. Now the long wait is over.

There are 225 million nucleotides in the peach genome, and looking for the region associated with 'early maturity' is a daunting task, unless your name is MiSeq and you share lab space with Research Scientist Travis Banks.

The MiSeq is a revolutionary piece of sequencing equipment that allows Mr. Banks, a bioinformatician and molecular biologist by training, to analyze genomes for specific breeding traits, sometimes within a matter of days, and at relatively low cost.

"Our primary interest at Vineland is to help our partners to be as productive and competitive as possible, and that is what the new DNA sequencer is all about. By accelerating the breeding process, we can start testing new products sooner in the greenhouse and in the fields, which means we can help growers to get them into stores and onto grocery shelves sooner. We're very much catalysts in the innovation and commercialization process, and this equipment is a great example."

Using the MiSeq, Vineland has already identified a region of the peach genome that controls how early in the season a peach ripens. This discovery, based on a collaboration between Mr. Banks and University of Guelph Associate Professor and tender fruit breeder Dr. Jay Subramanian, will allow breeders to select early ripening peach trees years before they set their first fruit. It will also allow breeders to focus their resources on the desired material, while undesired trees can be discarded before they are even planted.

Mr. Banks is also using the equipment to identify the regions of the apple genome that align with various human taste and sensory preferences. Working closely with Dr. Amy Bowen in the Consumer Insights lab, he has successfully located the regions related to 'fresh green apple' and 'fresh red apple' sensory attributes.

"Matching up the insights gleaned from Vineland's consumer panel with their specific DNA markers is where the rubber really hits the road in terms of helping growers," says Mr. Banks. "When the stars align, it's exciting to hand off that information to our breeders because it's information that ultimately helps growers."

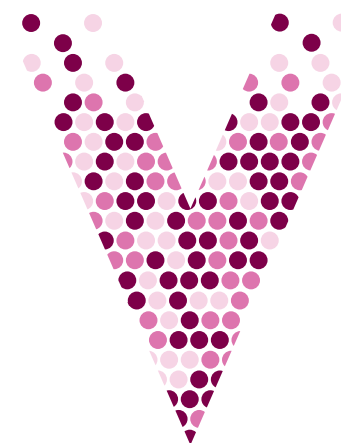
The MiSeq also has its sights set on greenhouse tomatoes and the work being done in Research Scientist Valerio Primomo's lab. To date, the genomes of 283 varieties of tomatoes have been analyzed, allowing Dr. Primomo to isolate the top 50 which he believes will lead to the breeding of tomatoes which are better adapted to the climate and disease pressures of Ontario greenhouses, as well as exhibiting new flavour profiles.

If he can crack the code, consumers will have the MiSeq to thank, not only for improved fruit but also for seeds that are fully compatible with local tastes and local growing conditions.



Travis Banks, Vineland's Bioinformatics Research Scientist

Lana Culley, Vineland's Director of Business Development and
Dr. Rumen Conev, Vineland's Research Scientist, Horticulture Crops Breeding



According to Dr. Conev, Research Scientist, Horticulture Crops Breeding, the new roses will focus on disease resistance, cold hardiness and ornamental display. "Once the results from these trials confirm that the new selections perform well in locations from coast to coast, our intention is to begin the commercialization process, which will focus on Canadian and global markets."

Research conducted by Vineland's Consumer Insights Team in April 2013 confirms that Canadians have very specific preferences when it comes to their roses. For example, colour was the most important factor driving their purchase decisions while the number of petals was the least important factor. Unsurprisingly, red was the most preferred rose colour.

Other consumer preferences identified in the study included:

- Overall, the ideal rose would be a black-spot resistant red rose, with full petals on an upright bush that blooms continuously throughout the season and has a low price.
- Consumers disliked expensive roses and roses that had no low-maintenance characteristics.
- 91 per cent of consumers felt it was important for roses to have fragrance.
- Consumers most liked dark green glossy foliage.
- Consumers who resided in colder climates tended to have an expectation that cold hardy roses should be cold hardy to lower temperatures. Typically consumers from cold hardiness zones 1-4 expected cold hardy roses to withstand temperature of at least minus 35°Celsius; consumers in zones 5-6 expected cold hardy roses to withstand temperature of at least minus 24°Celsius; and consumers in zones 6-8 expected cold hardy roses to withstand temperatures of at least minus 14°Celsius.

Vineland's hardy rose breeding program began in 2010 in partnership with the Canadian Nursery Landscape Association, using the wealth of genetic resources that Agriculture Canada began developing in the 1950s.

As sure as summer follows spring, Rumen Conev is determined that come the summer of 2018, nursery growers across the country will be marketing the newest member of the Canadian hardy rose collection to gardeners the world over.

Shipping of the top-performing new selections began in May, and seven volunteer nurseries from the Canadian Nursery Landscape Association, in addition to two academic institutions and Vineland's own evaluation site, will take part in the pan-Canadian trials.

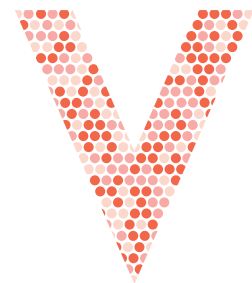
Bob Osborne, owner of Corn Hill Nursery in New Brunswick, has been involved in rose production since 1982, and his operation now has a collection of over 125 varieties of roses. "We welcome the opportunity to be among the first to propagate and sell the released selections. While there is an economic advantage to participating in the program, much of our interest is more research driven. We are a small nursery and our production levels are low, but we are continually searching for the most exciting new material for our line."

On the West coast, DeVonne Friesen at Van Belle Nursery says he, too, is looking forward to testing out the new varieties. "Vineland's rose breeding program helps us deliver to our Canadian customers what they want and need – hardy roses that will thrive in the Prairies. The focus on introducing disease-resistant varieties fits perfectly with a market dominated by consumers who appreciate the beauty of a rose, but have no interest in providing intensive plant care and maintenance. Our consumers are also environmentally conscious, which makes the no-spray care a natural lifestyle match."

Hardy rose breeding program moves to next level, with testing at sites across Canada

Trials bring Vineland one step closer to broadening global markets for Canadian roses

“Our intention is to begin the commercialization process, which will focus on global markets.”



Vineland opens new product pipeline for growers

Unique licensing agreement gives growers access to new varieties, gives consumers more choice



Lana Culley, Vineland's Director of Business Development, is working to open new pipelines for innovative new varieties

A new licensing agreement signed in March with Adams County Nursery in Pennsylvania, for access to Rutgers University varieties, is good news for consumers and even better news for peach and nectarine growers.

Under the terms of the agreement, Vineland acquired the rights to 11 varieties of peaches and nectarines from Adams County orchards and has begun to sublicense them to local nurseries. The varieties have already been tested at Vineland's orchards, and 2013 was the first time the varieties were commercially planted in Canada.

"With faster access to newer varieties, growers can fill in production gaps and respond to changes in consumer demand in a timelier manner," says Sarah Marshall, Manager, Ontario Tender Fruit Producers Marketing Board.

According to Vineland's Director of Business Development, Lana Culley, what makes the agreement with Rutgers University so significant is that it allows growers to tap into the pipeline right away without having to wait years for breeders to do their work.

"It's a great example of how Vineland is putting tried-and-tested science to work for the benefit of Canadian growers. We believe that our point of differentiation with academic research labs is the emphasis we place

on working directly with partners to get new products into the market as quickly as we can. In this case, we're leveraging research done elsewhere so that growers and marketers can access new varieties as early as possible. Combined with the varieties from Canadian-based breeding programs such as the tender fruit program at the University of Guelph, this approach gives our growers the best of all possible worlds and results in a pipeline that is continuously primed."

The agreement with Adams County Nursery also opens up a new revenue source for Vineland, making it possible for the organization to self-fund some of its research programs rather than relying exclusively on public funding with support from industry. Vineland will take a similar approach with its other programs, including the hardy rose program, which is currently in pan-Canadian trials and will soon be tested in Europe and the United States, opening up a potential new global pipeline for the top-performing rose varieties.

"Vineland was built on the premise that public investment for our research would decrease over time," says CEO Jim Brandle. "This agreement is proof-positive that our vision is working. Whatever royalties come in through licensing will go right back into more commercially-driven, partner-focused research. When we succeed, our partners and growers succeed."

New sweet potato varieties head into on-farm trials

*Results could add up to new revenue
stream for growers and more competitive
operations for processors*



Starting in June, fifteen new varieties of sweet potato – adapted to local growing conditions and suitable for fresh market and processing – moved from small plot trials to larger on-farm trials to see how they stand up against the commercial standard Covington.

The trials are the result of a concerted effort by a newly-formed consortium of Ontario growers, one Nova Scotia grower, three large food processors operating in Canada, several public and not-for-profit research organizations, and the Vineland Research and Innovation Centre - all of whom have joined forces to try and off-set U.S. imports and establish a foot-hold in Canada for locally-grown sweet potatoes.

The consortium, which includes McCain, Campbell's and Pride Pak from the processor side, Berlo's Best Sweet Potatoes, S & I Agricultural Commodities Ltd, Round Plains Plantation, and C.O. Keddy Nursery Inc. from the grower side, and Perennia, the Ontario Ministry of Agriculture and Food (OMAF) and the University of Guelph from the research side, is the first of its kind in Canada.

"We're always on the look-out for new and better varieties," says Peter VanBerlo, Sr., Berlo's Best Sweet Potatoes, P & S. VanBerlo Ltd. "The most important thing for me would be if Vineland came up with a variety that suits our colder growing conditions, provides better yields, is disease-resistant and performs well in-store. These trials are a good opportunity to see if newer is really better."

According to Research Scientist, Valerio Primomo, the only way to gauge the true performance of the fifteen new sweet potato lines is to test them in larger trials and at several grower locations. "These are varieties that we've adapted for Canada's shorter growing season and cooler climate, and if all goes well in the trials, we'll have varieties that will be suitable for both fresh market and for processing."

Demand for sweet potatoes is growing

Sweet potatoes represent a new – and potentially lucrative – market for Ontario growers.

- In 2012, Canadian retailers imported over 60,000 tonnes of sweet potatoes from the United States, worth an estimated \$40 million, in order to meet Canadian demand. Ontario growers currently yield approximately 7,000 tonnes of sweet potatoes, with a farmgate value of \$7 million.
- An additional 6,000 acres would be required to displace the number of sweet potatoes that are currently imported from the United States.
- According to Agriculture and Agri-Food Canada's, *Quality is in our Nature* Report, October 2012, during the past five years, Canadians' sweet potato consumption has doubled. Total acreage for sweet potato Canada-wide is 1,500.

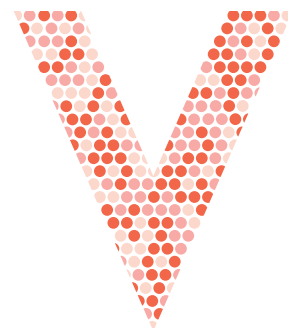


...this will be the first Canadian-bred, Canadian-developed, Canadian-marketed European-style pear."

Mike Ecker, Vineland Growers' Co-op President and John Thwaites, a second-generation grower photographed at Thwaites Farm Ltd. in Niagara-on-the-Lake

Pear-lovers get ready: New AC™ Harovin Sundown pear to arrive in-store this fall

Vineland's vision for a 'branded' tree fruit comes to life



It takes more than new seeds to build a commercial pipeline. It takes growers willing to test new varieties, partners willing to market their fruit, and retailers willing to make space on store shelves. When the much-anticipated AC™ Harovin Sundown Pear arrives in-stores across Canada this fall, Vineland's partners will have much to celebrate: a successful partnership, the commercialization of their first new product and proof that Vineland's business model is working.

Mike Ecker heads up the Vineland Growers Co-operative, which holds exclusive rights to the AC™ Harovin Sundown Pear in Canada. He is neck-deep in a new marketing campaign that will pitch consumers on the unique heritage of the Sundown Pear. The goal is to differentiate this pear from others by branding it and marketing it as the first Canadian-bred, Canadian-developed, Canadian-marketed European-style pear.

Developed by Agriculture and Agri-Food Canada and licensed to Vineland, the AC™ Harovin Sundown Pear variety is appealing to growers for its tolerance to fireblight, and to consumers for its firm flesh, light green skin and red blush, as well as its unique sweetness, reduced acidity and long storage life. Between 2011

and 2013, 35,600 trees were sold to growers in Ontario and Nova Scotia by way of a partnership between the Vineland Growers Co-operative and Mori Essex Nurseries, the pear's sole propagator. The first crop will be harvested in Niagara at the end of September.

Available in-store from mid-October through March, the new retail pipeline means consumers from coast to coast will be able to purchase the AC™ Harovin Sundown Pear in their local Wal-Mart, Loblaw, Metro, Sobey's and Costco stores.

According to Lana Culley, Vineland's Director of Business Development, the Sundown Pear is as much a story of partnership as it is of new product development. "We're very involved with the Vineland Growers Co-operative on the launch of the AC™ Harovin Sundown Pear through the intellectual property protection of the variety, supporting the various sub-license and grower agreements between the Co-op and its partners, and providing consumer and branding work. Obviously, we are all – from the growers to the retailers and everyone in between – looking forward to the success of the AC™ Harovin Sundown Pear in-store because that will confirm that all our hard work has paid off."

Good news for poinsettia growers

Vineland develops new two-step method for whitefly control



Poinsettia growing is not for the faint of heart.

With a narrow window of opportunity to sell their plants, and cuttings that often arrive from off-shore producers with some form of pest infestation, Ontario growers have to move quickly and decisively on the pest management front if they are to maximize their investment.

It was a serious whitefly infestation in 2012 shipments that first prompted Vineland's biocontrol experts to look for a cost-effective solution. Today, a new 'dipping' method has proven its effectiveness in the lab, and Vineland researchers are ready to partner with growers for a commercial trial, bringing them one step closer to making this technique available industry-wide.

"The results from this project benefit the floriculture industry by delivering a complete, safe and cost-effective IPM system for control of pesticide-resistant Bemisia in greenhouse poinsettia," says Lou Schenck, Schenck Farms & Greenhouses. "We now have the tools to compete in the marketplace, offering poinsettias grown without pesticides."

In the lab, Research Scientist Rose Buitenhuis found strong results using a two-step process to manage whitefly infestations. As soon as they arrive from production facilities in Central America, South America or South Africa, cuttings are dipped

in a widely-available commercial insecticidal soap combined with an entomopathogenic fungus, where roughly 70 per cent of the pests are killed before the cuttings are placed in a misting range to root.

"It's really important to eliminate as much of the whitefly as possible, as soon as possible, so that growers can start off with a relatively clean slate," says Dr. Buitenhuis.

Once the worst of the infestation is cleared up, Dr. Buitenhuis introduces parasitoid wasps to manage whatever residual pests may linger on plants. The goal is to use these biocontrols to manage any resurgence of the whitefly population so that by the time the plants are ready for commercial sale, it has been completely eliminated.

"The results of our research to date are very promising, and we're pleased that the dipping method is so cost-effective," says Dr. Buitenhuis. "We're currently in discussions with the manufacturer to have information about this technique featured on the label, including the concentration that would be required for optimum results."

According to Statistics Canada, Ontario accounts for approximately 50 per cent of Canada's annual poinsettia production, with 4.2 million plants sold and an estimated value of \$12.6 million.



Grower alert: World crops target market's sweet spot

The supply of okra in Canada increased by over 54 per cent compared to 2008, all of it imported. Vineland's researchers are working to reverse the pipeline, helping Ontario farmers to gain a competitive advantage.

In 2012, consumption of okra in Canada increased by 55 per cent over 2008. There was a similar increase in consumption of eggplant: consumers ate 27 per cent more of it than four years earlier, and supply increased by 29 per cent.

Vineland tracks these Statistics Canada numbers very closely, because increasingly, the story they tell is of a population's changing consumption patterns – and the underlying opportunity this change represents for local growers.

To put Canada's changing demographics in perspective, Vineland conducted a Consumer and Growers Survey in 2013 in order to calculate the number of in-season acres that would be required for local growers to off-set imports for world crops such as okra, Asian long eggplant and Indian round eggplant.

Here's what they found:

- Statistics Canada says 470 acres is needed to offset in-season imports of okra in Canada. However, surveyed demand suggests that up to 1,639 in-season acres would off-set the national demand, based on an average marketable yield of 4,773lbs/acre.

- 359 in-season acres would counter-balance the demand of long eggplant, based on an average marketable yield of 15,183lbs/acre.

- 272 in-season acres would do it for round eggplant, based on an average marketable yield of 24,262lbs/acre.

Vineland researchers need more than one growing season to be sure, but for now, okra and eggplant seem to yield promising financial returns. According to combined survey research, and a 2013 study from the University of Kentucky Cooperative Extension Service, okra returns total between \$1,400 and \$3,500 per acre (after variable costs are factored in) and long eggplant returns total \$1,600 and \$3,300 per acre, fetching an average of \$20/20lb box and \$15/30lb box, respectively, at the Ontario Food Terminal.

"We'll know more as time goes on, but as it stands today, these world crops seem to represent a promising business opportunity for growers, and the really good news is that there is a market that continues to grow," says Research Director, Michael Brownbridge.





Greening Highways project heads west

Vineland joins forces with Landscape Alberta, three municipalities, local nursery growers and road builders to tackle tree sustainability issues in dense urban locations

You might think that the worst thing about a brand new sub-division is the lack of trees.

But ask a landscape architect and he'll tell you what's worse: planting trees in a new sub-division only to find they don't survive beyond one or two years.

Improved tree longevity in challenging locations such as new sub-divisions is good news for homeowners. But it's potentially even better news for growers. And that's the main reason why Landscape Alberta, three large Alberta municipalities and local growers are so eager to partner with Vineland on the next phase of the Greening Highways project, which began in Ontario over three years ago.

"Tree survivability is the bottom-line," says Cody Brown, Chair, Nursery Growers Group, Landscape Alberta, and General Manager of Tree to Tree Nurseries Ltd. "This is a great opportunity for everyone in the value chain to work together and figure out how to solve this issue. We need Vineland's researchers to tell us exactly, from a scientific perspective, what the soil conditions are in these challenging locations. Then we can all put our heads together to identify soil remediation strategies that will ensure our trees can flourish."

Tree survival is somewhat of a mantra for Darby McGrath. She's Vineland's lead researcher on the Greening Highways project, in Alberta and Ontario. According to Dr. McGrath, sometimes the wrong tree is planted in the wrong location, but mostly it's good quality trees being planted in poor quality soil. So before anything else goes in the ground, Dr. McGrath will spend the first year of the Alberta project figuring out what is actually in the soil along the highways and in select neighbourhoods in Edmonton, Calgary and Red Deer. "This up-front work is critical because it will tell us about soil quality and soil composition, as well as providing the data we need for making informed planting decisions," says Dr. McGrath.

Alberta is not unique in North America for the condition of its soil in dense urban areas. In fact, most highways and sub-divisions in North America have similar problems: Through the course of a construction project, healthy soil is stripped away, the subsoil is compacted to ensure it is structurally sound from an engineering perspective, and is ultimately depleted of any biological value.

In Alberta, these problems are compounded by the province's harsh winters and significant frost depth. And so Dr. McGrath will also be studying the effect that lack of moisture, weak moisture retention, wind velocity and de-icing practices have on tree survival.

To the east, the Greening Highways project in Ontario is currently in its third year and will continue for another three. According to the Ministry of Transportation, the project has so far managed to focus much-needed attention on the issue of sustainability along highway corridors.

"The work completed by Vineland has been of high value to the Ministry of Transportation and the Design and Contract Standards section," says Paula Berketo, Principal Landscape Architect, Ministry of Transportation of Ontario. "The project provides evidence that can be used to further greening efforts in the highway right of ways and will increase success and sustainability, allowing greening to proceed in a fiscally-responsible way."

"We need Vineland's researchers to tell us exactly, from a scientific perspective, what the soil conditions are in these challenging locations."

Dr. Darby McGrath, Vineland's Nursery and Landscape Research Scientist



Vineland Research and Innovation Centre is a world-class research centre dedicated to horticultural science and innovation. Located in Canada's Niagara Region, Vineland's mission is to deliver innovative products and product solutions that address the needs of the horticulture industry and advance Canada's research and commercialization agenda.

We are an independent not-for-profit organization, funded in part by Growing Forward 2, a federal-provincial-territorial initiative.

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