THE INNOVATION REPORT

2022-2023

vineland
RESEARCH & INNOVATION CENTRE

The future for horticulture in Canada

Ian Potter, PhD, President & CEO

Being able to predict what the future holds would be an amazing skill to have, although obviously, impossible to achieve. However, it is possible to try to steer towards a desired future by understanding the pressures on a sector and defining the possible system interfaces and our responses to them.

In Vineland's work with the Canadian horticultural sector, we seek not only to define and address today's challenges and opportunities but also to discern and tackle the unknown questions the sector may face in the next 5, 10, 15 and even 20 years. As we think longer term, a level of uncertainty is increasing, however horticulture in Canada today is strong because of the strategic thinking and decisions made by the sector stakeholders decades ago.

As a core delivery agent for horticultural innovation in Canada, Vineland has honed our sector specific strategic planning skills by carefully targeting the areas where we and our stakeholders believe positive impacts and outcomes can result. These skills utilize Vineland's core scientific and technical capabilities and also embrace a wider perspective of the future of Canadian horticulture, such as:

1. Understanding how Canadian consumer demands will change over the next few decades.
2. The global economy, food security and supply are now and will become even stronger controlling factors.
3. The need for enhanced Canadian specific crop varieties to address changing growing seasons in widely variable environments and weather conditions.
4. Disease and pest pressures and the required responses as they are constantly evolving.
5. Supply chains require to be more robust and able to accommodate perturbations in the chain/system without failing.
6. The toolkit of skills and equipment being proposed in helping companies and the sector grow is forever increasing but existing horticultural practices and the introduction of new tools have to be carefully judged and validated to be fit for purpose.
7. Labour availability and additional skill requirements in all aspects of the sector will be a dominating business pressure.

I believe that the future for horticulture in Canada is robust, and in some respects, at the cusp of even greater outcomes and impact to support the lives and wellbeing of all Canadians. There will always be challenges to overcome, both daily and on a longer term, but the sector has historically learned to adapt and re-invent itself and the future will be no different.

I'm proud to be part of the Vineland team that has a mission focused on the very sector we serve by improving the economic viability, sustainability and competitiveness of horticulture in Canada. Yes, a lofty mission and one that has steered Vineland for over a hundred years and will continue to serve us well into the future.

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A collaborative approach to automation innovation

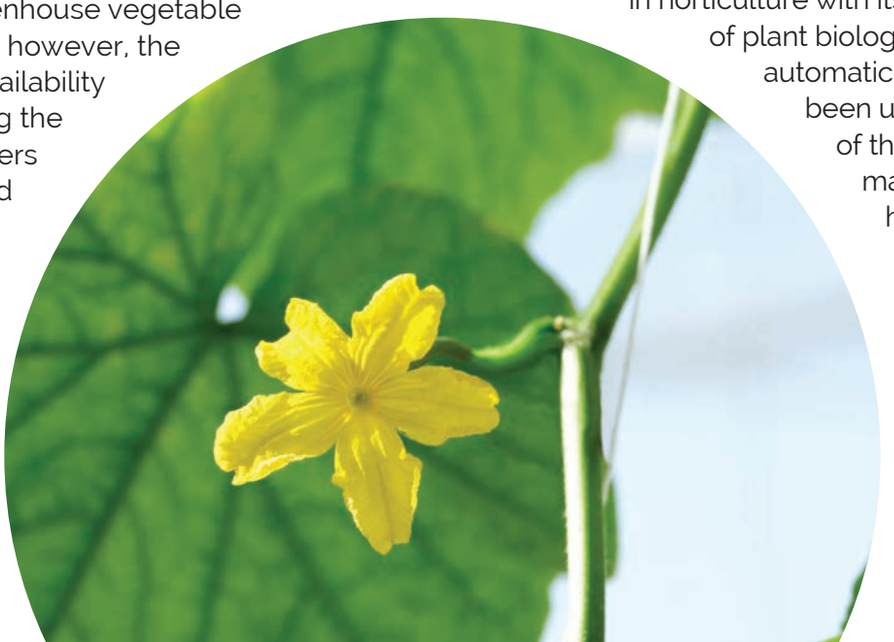
Canadian horticulture, like most other sectors in agriculture, is suffering from a growing labour shortage. Overall, an agri-food workforce shortfall is predicted to reach more than 123,000 jobs by 2029, as such the search is on for ways to do more with less. At the same time, labour-intensive horticultural crops increase the cost of labour, often representing 40 to 60 per cent of production costs for growers.

That's why the industry is increasingly turning to solutions to automate certain tasks — addressing the labour crunch while also boosting production efficiencies to help growers remain profitable and competitive.

The greenhouse sector, for example, is readily adopting automation for tasks aimed at the management of growing environments, irrigation and fertigation.

A future major threshold is the development of an autonomous greenhouse vegetable harvesting technology, a challenge embraced by the Vineland Automation team. Initially focused on the advancement of a robotic harvesting system for long English cucumbers, this platform technology is evolving to be applied to other crops such as peppers.

Canada is the world's fourth largest cucumber exporter at over $320 million annually. The potential for growth in the greenhouse vegetable industry is significant; however, the cost and restricted availability of workers are holding the sector back. Cucumbers are harvested by hand and growers spend approximately $27 million annually just on this labour-intensive task.



"We know there are various companies working on autonomous vegetable harvesting solutions around the world, but most indicators for successful deployment are still four to five years away," says Hussam Haroun, Director, Automation. "At Vineland, we've been able to develop a platform that can be ready earlier."

Vineland's cucumber harvesting robot is a proof-of-concept solution that moves along rows of plants within the greenhouse. This technology includes a vision system to identify the fruit on the vine, assess ripeness and determine a precise location. It then selects the fruit ready for harvest, cuts it from the plant and places it into a harvest bin utilizing a robotic gripper.

The system has performed well in trials at Vineland's research greenhouse and through further development, could be adapted to other tasks, such as pruning or applied to other greenhouse crops like peppers, for example.

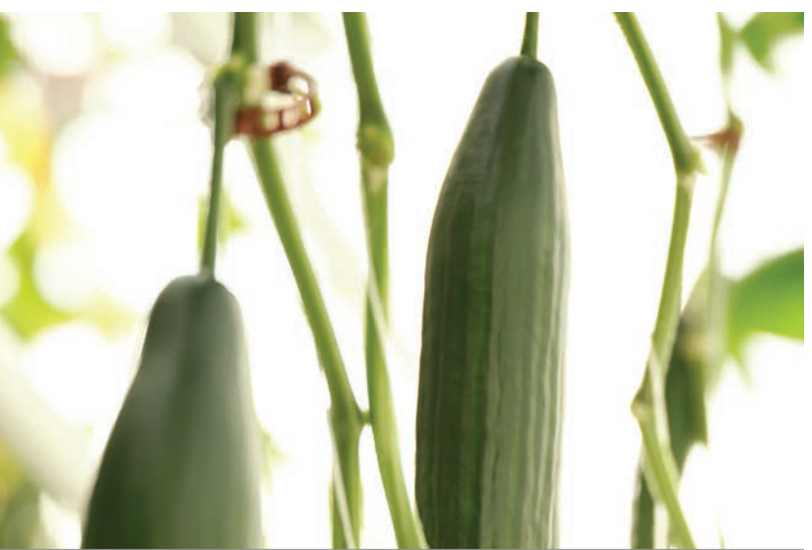
"We are now looking for one or more partners who can help develop a next stage prototype to pilot in a commercial greenhouse setting," Haroun says. "We are able to align or integrate our system with other companies in this space when they are ready to collaborate to bring it to market."

Although automation is still somewhat in its infancy in horticulture with its added complexity of plant biology and production, automatic systems have long been used in other sectors of the economy including manufacturing and health care. It's a complex field where partnerships are critical to innovation success.


KINOVA

For instance, when it came time to source an arm for Vineland's cucumber harvesting robot, the team turned to existing technology providers for a solution. The search ultimately led Vineland to Quebec-based Kinova, a robotics company whose specialty lies in biomedical research and assistive devices for humans.

Their off-the-shelf arm was ideal for adaptation and optimization in a greenhouse environment and the collaboration soon went beyond the initial technology.



At a glance

- **Automation is helping the greenhouse sector address labour shortfalls while attaining production efficiencies.**
- **Automated vegetable harvesting solutions can alleviate the increasing cost of labour-intensive tasks.**
- **Vineland is now seeking a partnership to prototype a pilot of its cucumber harvesting robot in a commercial greenhouse setting.**

"As we began working with Kinova, we realized that their expertise in robotics could also help us improve our technology and make it faster," says Brian Lynch, PhD, Senior Research Scientist, Field Robotics. "Working with partners in allied industries is key to adapting and introducing automation technologies into horticulture."

Working with the Vineland team has simultaneously helped Kinova gain an understanding of the growth potential in the horticultural sector. According to Haroun, that's where Vineland can play a key role in helping companies understand the nuances of horticulture and adapt their systems to the market's needs.

Vineland's close ties to the horticultural industry can help automation and robotics companies in other fields map out opportunities in the sector, with validation testing critical to ensuring grower engagement and buy-in.

Greenhouse production in general is also moving towards a more data-driven, scientific management approach and there are other horticultural crops in need of autonomous solutions. All of this combines to spell an opportunity for innovators, companies and growers, believes Haroun.

"The Vineland approach to innovation, focused on partnerships and collaboration, can help bring these types of solutions to the Canadian industry to address labour shortages and increase the productivity and profitability of the sector," he says.

In 2018, Vineland was named lead agency for Agriculture and Agri-Food Canada's Automation Cluster to address labour costs and availability through automation, artificial intelligence and precision agriculture technologies in the horticultural space. Applied research through this program led to the development of Vineland's automated vegetable harvester, smart greenhouse irrigation technology and robotic mushroom harvester.

...Working with partners in allied industries is key to adapting and introducing automation technologies into horticulture."

Construction began on Vineland's new TreeCulture Research Park in May 2022.

TreeCulture Research Park hosts first urban greening research project

The first trials are now underway at Vineland's new phase one TreeCulture Research Park, marking the start of the latest chapter in the organization's longstanding work in urban greening.

These initial research trials, focused on storm water management, will support decision making at the Town of Lincoln.

The TreeCulture Research Park is the first of its kind in Canada and when fully constructed will also include laboratory and flexible spaces for collaboration, education and demonstration.

The new open-air laboratory features Canada's only individually instrumented in-ground and at-scale tree compartments for replicated testing allowing researchers to mimic a range of urban conditions. Integrated sensor technology in each compartment log trees' responses to stress in real-time to weather, soil properties and function and moisture levels.

Phase one of the park's roll-out brought 36 of the planned 80 tree compartments online, which are now being used for the storm water management project. This phase is financed primarily by Vineland with the design funded through the Canadian Agricultural Partnership. Phase two will include the remaining compartments, as well as, the pavilion building.

"Being a brand-new type of facility, this is incredibly exciting and also challenging from a building and design perspective because there are no existing blueprints to work from or adapt to," explains Darby McGrath, PhD, Vice President, Research and Development, adding that a phased approach enabled Vineland to proceed with initial trials while leaving room for additional design and adaptation elements.

The current trials involving storm water management are part of an effort to find solutions in creating absorbent landscapes for cities that will make better spaces for trees and shrubs — an approach called multi-functional landscape design.

This open-air laboratory features 36 in-ground and at-scale tree compartments with planning for future expansion.

"If you do the groundwork properly, cities and municipalities will be able to meet their demands for storm water management, while simultaneously fostering better tree establishment and hitting their tree canopy targets," says McGrath.

Extensive laboratory trials using specialized equipment at Vineland that focuses on understanding the soil's ability to absorb and store water were used to develop the project's parameters and help researchers identify different soil and organic amendment combinations to test.

Four different soil mixes were identified and are each being replicated in nine different compartments, using *Acer freemanii* 'jeffersred' (Freeman maple) and *Liriodendron tulipifera* 'Arnold' (Tulip tree). The research team is also applying different watering regimes to mimic various storm events and conditions to understand how both the soil and trees respond to these situations.

"Our partnership with the Town of Lincoln has been essential in launching the TreeCulture Research Park, as the start of this research project marks a big milestone," she says. "At the end of the project, we will have a set of recommendations that we will hopefully soon see in their landscapes."

The tree compartments were designed to be convertible so that soil can easily be installed and removed as new projects are brought online. Each compartment is 4.5 metres square by 1 metre deep so it can accommodate a semi-mature root system. This isn't possible in most conventional research settings, where trials usually involve trees in containers or field settings and where conditions cannot be controlled.

Once the storm water management project wraps up in summer 2023, the Vineland team will continue to use the research set up for other projects related to soil health and tree stress.

"This research environment we've created is good for nurseries too, so we will be using it for a project that will aid tree nurseries in understanding how proper soil management leads to better outcomes in the long run," she notes.

At a glance

- **Vineland's TreeCulture Research Park is the first of its kind in Canada.**
- **The new open-air laboratory features individually instrumented in-ground and at-scale tree compartments that can mimic a range of urban conditions.**
- **On-site research will provide data to optimize soil absorption and water storage that can allow for better management of storm water, tree establishment and the vitality of urban tree canopies.**

Finding opportunities in waste

New uses for under-used horticultural by-product streams.

Reducing waste and repurposing by-products can be good for both the environment and the bottom line. In the horticultural sector, finding the best and most profitable opportunities for these waste by-products isn't always easy, but that's where Vineland's Consumer, Sensory and Market Insights team helps companies navigate these uncertainties and aid with business processes.

"This is what we call opportunity scoping, where we look at the current market and gaps in that market to identify new business prospects," says Alexandra Grygorczyk, PhD, Research Scientist, Sensory & Consumer Services. She also adds Vineland explores both food and non-food value-added transformation options including growing substrates and plant biostimulants.

Once opportunities have been identified, the team undertakes consumer, sensory and market research at all stages of the product development cycle: from a cost-benefit analysis of various value-added options to profiling sensory properties of raw materials or final versions of transformed value-added products. They also work closely with other multidisciplinary teams of scientists at Vineland.

According to Grygorczyk, this includes working with the biochemistry, plant responses and the environment and engineering teams to figure out how waste streams can be separated for repurposing. This could involve looking at what type of technology can be developed, how it can be implemented in a real product and then getting feedback from end-users — whether consumers or growers — to get the product market-ready.

The team has just completed a project, fully funded by the Canadian Agricultural Strategic Priorities Program via Agriculture and Agri-Food Canada, looking at under-used waste streams from the seven most produced Canadian fruit and vegetable crops and identified untapped opportunities with repurposing potential. These include potatoes, apples, field tomatoes, greenhouse tomatoes and cucumbers, onions and carrots.

Vineland's Mithun Shrivastava, Consumer and Market Researcher, Consumer Insights; Alexandra Grygorczyk, PhD, Research Scientist, Sensory & Consumer Services and Amy Bowen, PhD, Director, Consumer, Sensory & Market Insights.

The fruit and vegetable processing sector is one option for produce that can't be sold on the fresh market. For instance, very few fresh carrots, potatoes, onions, field tomatoes and apples are wasted since a strong processing market exists. By comparison, there are virtually no processing opportunities for greenhouse vegetables. All edible tomatoes and cucumbers not meeting fresh market specifications are discarded.

The processing sector also generates large volumes of unavoidable waste in the form of peels, cores or pomace (what is left of the fruit after juice production) with large volumes going into landfills. Diverting this waste by identifying value-added products is one goal of Vineland's on-going innovation support to the sector.

Grygorczyk notes for instance, that apple pomace has the potential to be repurposed into higher value products, such as thickeners and a source of added fibre. A natural enzyme found in apples can also be used as a gelling agent in sausage or to help in bread production in place of microbial enzymes. Apples contain a lot of pectin, which is already used in some fruit fillings and other products as a thickener.

"What is required to make dried apple powder suitable for smooth products like yogurt? How low do you have to reduce the particle size and how does that influence sensory properties like taste?" she says. "For food processors, this could be an opportunity to use more attractive ingredients to develop cleaner labels."

Finding value in waste isn't just limited to fruit and vegetable production, however. Grygorczyk and Vineland's Plant Responses and the Environment team have also looked at waste stream opportunities in non-edible horticulture. In a collaboration with Dr. Yiridoe from Dalhousie University and a commercial nursery, they found that composting culled trees, spent substrate,

At a glance

- Repurposing waste by-products can provide new product development opportunities that are environmentally sustainable by reducing landfill waste.
- Waste up-cycling can provide both food and non-food value-added options.
- Services offered by the Consumer, Sensory and Market Insights team can help identify these transformational market opportunities for commercial enterprises and inform product life-cycle decisions at any stage.

organic waste and branches presents both financial and non-market benefits for tree nurseries.

That compost can then be re-used in a nursery's production cycle, where data shows it helps get trees ready for market in four years instead of five or six and has better water holding capacity leading to usage savings of 20,000 gallons of water per acre.

In addition to completing publicly funded projects, Grygorczyk and the Vineland team can help companies directly either identify how they can turn a waste stream into a product or find waste streams that might be suitable for a project idea they have.

The key to making any new business opportunity work, regardless of whether it's in edible or inedible horticultural production, lies with partnerships and networks, which is a particular strength at Vineland.

"A lot of this is about building a value chain and connecting primary producers with processors and consumer packaged goods companies. That's where Vineland is in a strong position as we understand the market players and have those connections across the value chain that can bring in all players to work together," she says. "Knowing who needs to work together is vital to the success of new ventures like this."

Up-cycling can help identify products, such as dried apple powder, that can be repurposed into higher value products.

Case Study

Speeding up new plant variety development

Vineland's game-changing innovation for plant breeding.

A powerful technology developed at Vineland is shortening the amount of time needed to discover and bring new plant varieties to market. Vineland's proprietary Deep Variant Scanning (DVS) approach is a fast and cost-effective technology allowing plant breeders and seed companies worldwide to speed up the plant breeding process.

The spin-off company, Platform Genetics Inc., was launched in 2017 and in the last five years, more than 75 contracts for over 30 crops with more than 30 clients have generated significant revenues, with an excess of 80 per cent of sales originating from clients outside of Canada.

The opportunity

- Develop varieties with new traits matching consumer and production requirements
- Climate change and global population growth
- Existing genetic technologies limited by regulatory challenges and consumer distrust

The answer

- Sustainable and rapid non-genetically modified organism (non-GMO) technology
- Reliable technology with no usability barriers
- Any gene, any crop

From Illinois to Israel to the Ivory Coast, the world is coming to a Niagara region start-up company that grew out of innovative research at Vineland and became the go-to, trusted expert in crop trait development.

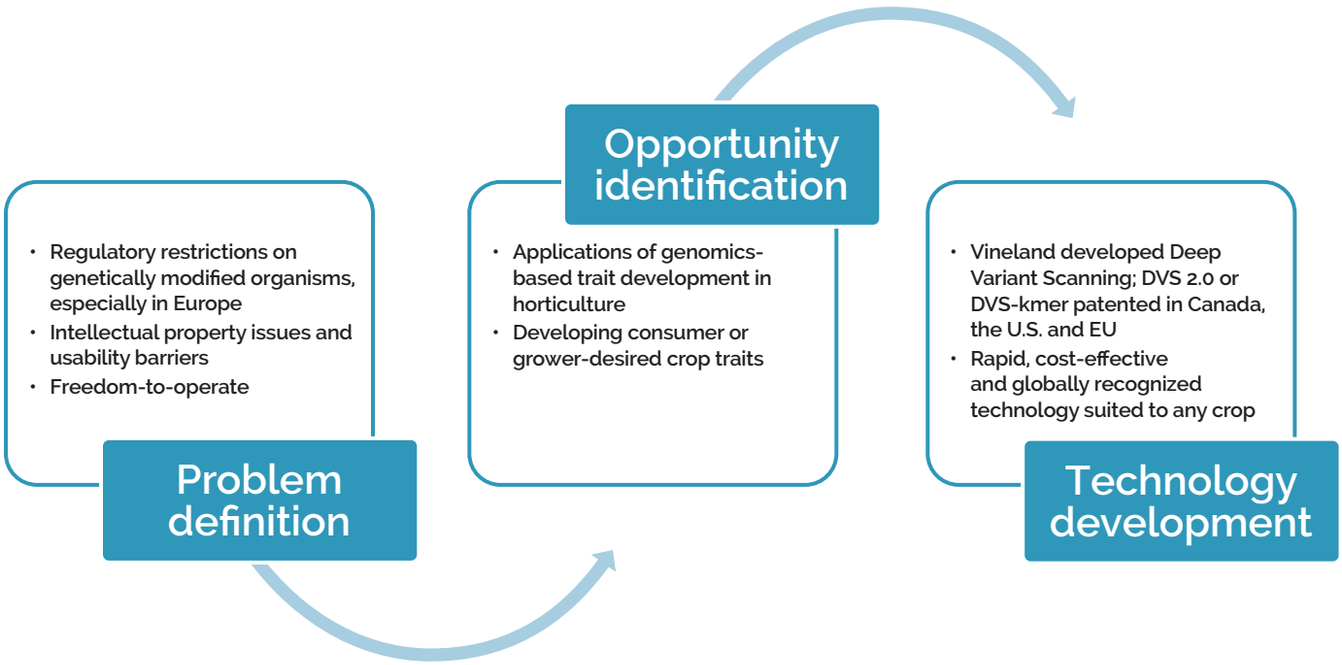
The need

With climate extremes becoming more frequent and the global population expected to approach 10 billion by 2050, the agriculture sector is continually looking for new ways to ensure the world has enough nutritious and affordable food.

One way is by breeding new plant varieties with higher yields that are better adapted to endure climate stress like drought and heat and require less fertilizer or crop protection products while also meeting consumer demand for taste, texture and nutrition.

Traditional plant breeding is a labour-intensive process taking years to develop and bring new varieties to market. Bioengineering tools introduced in the 1990s that could speed up the breeding process in field crops including corn, soybeans or cotton, faced consumer distrust and significant regulatory barriers in many countries around the world.

Through conversations with industry leaders in the vegetable and ornamental sectors, researchers at Vineland realized there was an opportunity to combine new DNA sequencing methods with chemically-induced variation to speed up the identification and development of important new plant traits.



The solution: Deep Variant Scanning

In 2012, Vineland launched the research program Developing Improved Traits for Horticultural Products which complemented traditional breeding and crop selection by developing traits that met specific consumer or grower needs.

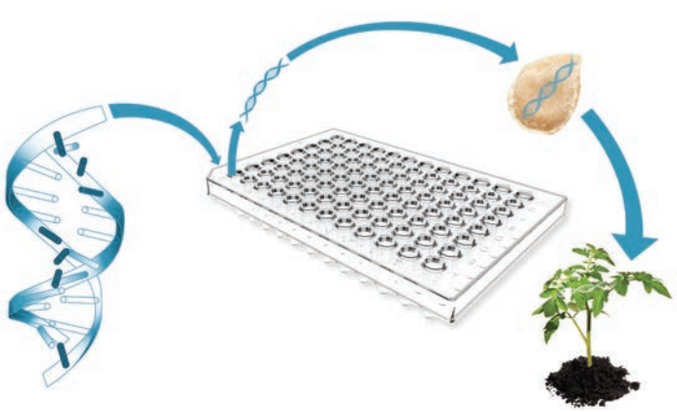
The first major breakthrough was the introduction of Deep Variant Scanning, Vineland's proprietary approach to trait discovery patented in 2016.

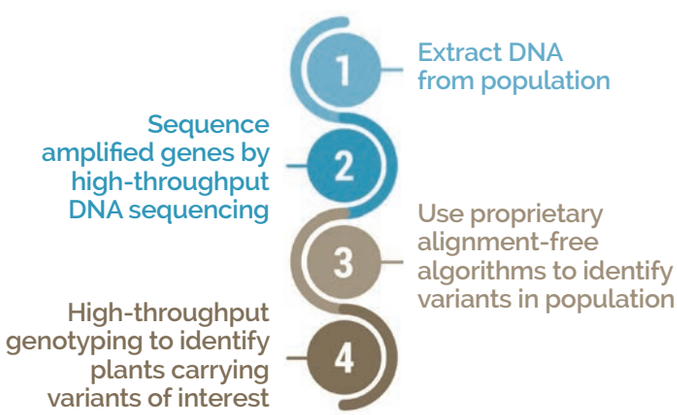
DVS uses genomic technologies that are able to sequence millions of DNA molecules at a time and combined with bioinformatics — the science of gathering and interpreting biological information like genetic codes — to identify new plant varieties with improved traits and higher yield or better quality.

Deep Variant Scanning enables the improvement in the efficiency of plant breeding programs by accelerating the development and selection process in bringing new varieties to market faster. It can be used to find variants in any gene for any crop, and because it is considered a non-GMO technology, it is not subject to similar regulatory challenges as genetically modified organisms or even other gene editing technologies like CRISPR.

Vineland began using this proprietary technology in its own breeding programs, such as developing more flavourful greenhouse tomato-on-the-vine varieties. And to bring this technology to the broader market, Vineland launched Platform Genetics in 2017, a spin-off company offering trait development and genomics services to the global seed industry. It is the exclusive licensee of the DVS technology.

DVS workflow





The impact

Over the past seven years, approximately $1.5 million CAD has been invested to develop and commercialize the DVS platform. The result is a rapid, cost-effective, powerful and proven technology for discovering rare genetic variants in large plant populations.

By using it, plant breeders and seed companies worldwide can move from gene target to seed carrying genetic variation in less than four weeks, harnessing the technology's platform for rapid trait development and crop improvement.

Platform Genetics has been growing rapidly since it was launched, surpassing major revenue milestones ahead of schedule and demonstrating the global demand for this technology.

Currently, the company works with a wide range of clients, from leading multi-nationals to venture-funded start-ups. This includes seven of the world's top 15 seed companies, public sector plant breeders, and academic and research institutions in nine different countries across four continents.

More than 75 contracts for over 30 crops — from tulips and marigolds to soybeans, potatoes and beyond — with more than 30 clients have generated significant revenues in the last five years. The company's global impact is evident with 80 per cent of sales originating from clients outside of Canada.

In addition to Vineland's tomato-on-the vine research program, Platform Genetics has been involved in projects as diverse as improving pea and soybean varieties to be better suited for processing, developing new oilseed crops for the Canadian Prairies and helping resolve genomics technology intellectual property disputes between seed companies.

"Platform Genetics is home to great scientific knowledge but also great understanding on how

DVS at Vineland

Before issuing an exclusive licence for DVS to Platform Genetics, Vineland successfully employed the technology to create flavourful tomatoes-on-the-vine. Several of the lines identified could be distinguished by trained sensory professionals and were preferred by average consumers. These desirable traits are being combined with other key production traits and the resulting commercial varieties will hit the market two to three years from now.

that knowledge needs to be applied in the industry for product development. That is a rare combination of skills. I have found with other providers that we needed to really direct the data analysis to the detail in order to get the desired output. Not with Platform Genetics."

— Mercedes Murua, Chief Technology Officer, The Plant Pathways Company

Looking to the future

Vineland will continue to work closely with Platform Genetics in providing access to research expertise, molecular biology and biochemistry laboratory spaces and equipment, research farm and a state-of-the-art pre-commercial research greenhouse.

Platform Genetics continues to expand its service offerings to ensure seed companies have the ability to make quick and well-informed decisions. Platform Genetics has progressed beyond a single-technology company and positioned itself as a strategic outsourcing partner to allow seed companies to manage risk and expand their innovation capacity.

What Vineland delivered

By the numbers (to date):

1 successful spin-off company

3 patents

30+ clients,
nine countries, four continents

75+ contracts for **30+** crops

Here comes the sun


Photo credit: J.C. Bakker & Sons Ltd.

Vineland adds Yukon Sun™ to its Canadian rose collection.

Rose breeding has been a core activity at Vineland for the better part of a decade, led by the popular Vineland's 49th Parallel Collection of made-in-Canada roses.

This year marks the latest addition to the collection, Yukon Sun™. Released by Vineland, it will be available in Canadian garden centres next spring.

The rose blooms a golden yellow colour that stands in stark contrast to its dark green foliage and will flower early and all season long. Growing to about 1 m in height, it shares the same characteristics that have made the other collection roses popular with Canadian gardeners: it is winter hardy to -35˚C and tolerant to black spot and powdery mildew.

The collection was first launched in 2017 to mark Canada's 150th anniversary and a new rose has been released every two years since. This includes the red Canadian Shield® released in 2017, the coral Chinook Sunrise® available in 2019 and the pink Aurora Borealis® released in 2021.

"Canadians have embraced these stunning Vineland roses since we first introduced the collection in conjunction with Canada's 150th anniversary celebrations in 2017. We are excited to expand the collection once more with the addition of the first yellow rose," says Ian Potter, PhD, President & CEO. "Yukon Sun™ was specifically bred for the Canadian climate and will brighten any outdoor living space with its warm, sunny hues."

The roots of Vineland's rose breeding program date back decades to the Agriculture and Agri-Food Canada (AAFC) hardy rose breeding program which was launched in the 1950s. In 2010, the Canadian Nursery Landscape Association (CNLA) obtained the rights to the AAFC germplasm and established a collaboration with Vineland to take over the research program.

The Vineland team carries out up to 15,000 controlled crosses a year in an effort to combine traits from hundreds of rose varieties and breeding lines. Between 5,000 and 10,000 seedlings are then planted in the fields at Vineland's research farm every year and the best ones — less than one per cent of those initial plants — are selected for off-site testing.

That's when they are sent to CNLA-member nurseries across Canada in British Columbia, Alberta, Manitoba, Ontario and New Brunswick for further evaluation, where they are rated for cold tolerance, from climate zone 8 right down to zone 3.

Following two to three years of rigorous outdoor testing without fungicide sprays and winter protection, a few of the best performing cultivars are selected annually for commercialization.

"We value the ongoing partnership with CNLA and its members who are helping us deliver what Canadian gardeners across the country are looking for: hardy, beautiful and easy-to-grow roses thriving in Canada's varied climates," adds Potter.

More information about Yukon Sun™ and the rest of the collection is available at **49throses.com**.

At a glance

- **Vineland's 49th Parallel Collection is a product of Canada's national rose program established in 2010 in partnership with the Canadian Nursery Landscape Association.**
- **The collection was formally launched in 2017 to commemorate Canada's 150th anniversary.**
- **With the addition of Yukon Sun™, the collection now features four distinct varieties that respond to unique growing conditions in Canada.**

Yukon Sun™

Science opens a window in the inner-workings of plants

Metabolomics analysis supports the development of new pest control strategies.

It might seem counter-intuitive to use science to make plants less nutritious but that's exactly what researchers at Vineland are working on to help greenhouse growers deal with a common flower pest.

According to flower growers, western flower thrips is one of the most common pests in their crops and also one of the most difficult to control. Effective solutions include a good biological control program and also what is called cultural control — manipulating fertilizer rates in the greenhouse to make plants a less appealing food source for pests.

Vineland researchers are using metabolomics to determine the most effective way to do this without comprising plant health and crop quality. This analytical method measures as many metabolites or natural chemicals in a plant as possible to determine how and why it reacts the way it does under specific conditions.

Vineland's Rose Buitenhuis, PhD, Senior Research Scientist, Biological Control and David Liscombe, PhD, Research Scientist, Biochemistry

According to Rose Buitenhuis, Senior Research Scientist, Biological Control, it's one of the "omics" tools. Genomics, for example, is all about DNA or the written instruction book of an organism and metabolomics is the study of what the organism is actually doing with those instructions.

"This allows us to look at thousands of chemicals a plant is producing and understand what it is actually doing. This gives us an insight into how plants are reacting to different stimuli in their environment or treatments that we apply in an experiment," she explains. "We get actual insight into the process, not just the outcome of the process."

"Metabolomics offers a very high-resolution picture of what the plant is experiencing," adds David Liscombe, PhD, Research Scientist, Biochemistry. "For example, is it producing chemicals that enable it to grow or is it producing defense compounds?"

In recent greenhouse trials with chrysanthemums, the Vineland team found that adjusting plant nutrition — feeding less fertilizer — could reduce populations of thrips by 30 to 50 per cent because the plant itself became a less appealing food source for the pest.

Unfortunately, the results were highly variable across different cultivars and the fertilizer rates that reduced thrips levels the most, also affected plant quality. So the team turned to metabolomics analysis in their search for answers.

"Metabolomics showed us that if we give mums less fertilizer, they produce less amino acids or food for the thrips while making more defense chemicals but this varied between cultivars," says Buitenhuis. She also adds this is the first project at Vineland looking at metabolomics applications for pest control. "The selection of resistant cultivars is very important, as we found large differences in susceptibility to thrips, which we wouldn't have known without metabolomics."

The team experimented with adding biostimulants to the chrysanthemums in an effort to compensate for the decreased fertilizer levels. However, metabolomics testing showed very quickly that it didn't improve plant quality or make the plants more resistant to thrips.

This technology has applications beyond pest management. In fact, it can be used across many different plant and insect species. Liscombe has been experimenting how it can help with tree management. For example, how metabolomics analysis can identify whether a tree is experiencing drought or water-logging stress, which can be difficult to tell simply by its appearance.

The ultimate goal of the work, notes Liscombe, is to identify biomarkers — chemicals known to increase or decrease in concentration based on what a plant is experiencing — that will accelerate future testing and make it less expensive.

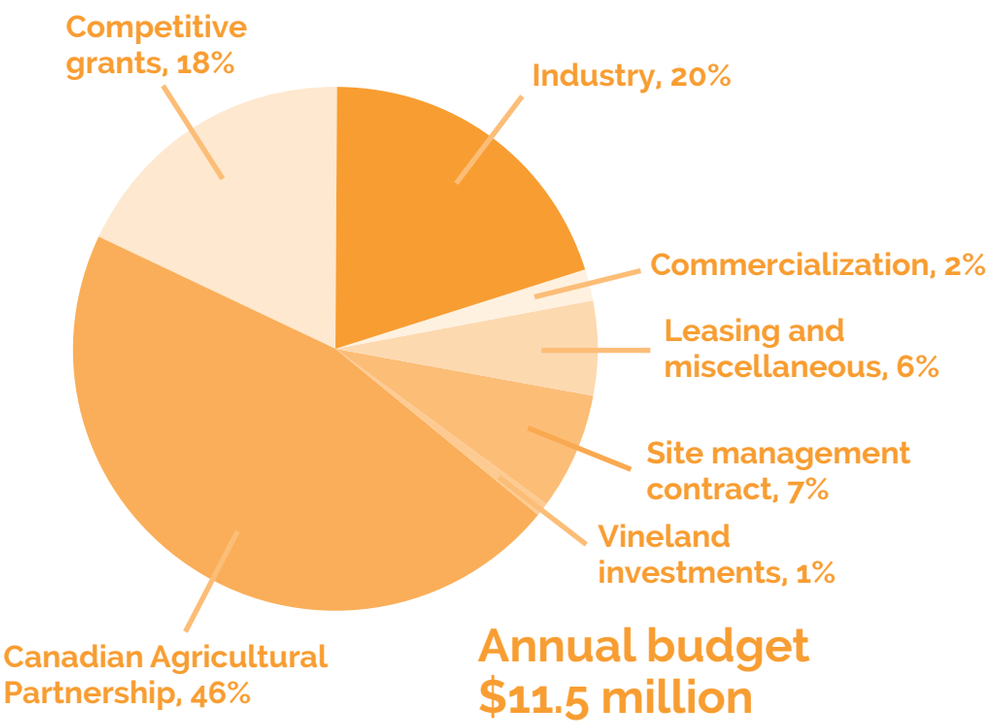
"This is one of the tools where the advancement in technology is allowing such a technique to be used in everyday agricultural research," he says. "As an innovation centre, Vineland has invested in this technology, one that is widely applicable to horticulture and we are working diligently to become experts in this evolving field of research which will help us develop new products for the sector."

At a glance

- **Metabolomics is an emerging field that can help determine how and why a plant reacts the way it does.**
- **Vineland's team is testing the application as an innovative approach to pest control management.**
- **This evolving research can help identify biomarkers that could be adapted broadly in agricultural research.**

Vineland at a glance

Revenue April 1, 2021 – March 31, 2022



Annual budget
$11.5 million

Partnerships

190 partners*

132 industry **17** academic

41 government

From

9 **Canadian provinces** (Alberta, British Columbia, Manitoba, New Brunswick, Nova Scotia, Ontario, Prince Edward Island, Québec and Saskatchewan)

5 **countries** (Canada, France, Germany, The Netherlands and United States)

*For fiscal year 2021-2022

Commercialization

7 Vineland developed technologies with patents issued/filed

32 plant varieties protected by PBR and/or U.S. plant patents

12 trademark applications filed

51 technologies commercialized

92 per cent of Vineland's protected IP is out-licensed and/or under further collaborative R&D with business partners

Research capacity and performance*

19 research scientists

$263,000 research intensity
(research revenue generated per researcher)

$9,863 innovation strength
(royalties generated per researcher)

88% grant application success rate

69 peer-reviewed publications (cumulative total)

2,352 citations (cumulative total)

*For fiscal year 2021-2022

Giving back

Did you know? Vineland has a strong history of giving back to the community. It has supported local not-for-profit groups in a variety of ways, including:

- Providing farm land to Start Me Up Niagara and Land Care Niagara.
- Providing office space to the Friends of Lincoln's History.
- Donating what we grow and don't use for research to local non-profits that help support our local community. Some of these organizations contribute to low income, youth or homelessness populations by providing food, arranging shelter, supporting employment and other basic needs.
- Donating tree seedlings to Heartland Forest.

Over the past two years

Over **10,000 kg** of fruit and vegetables donated

12 local participating organizations

Spanning from **Toronto to Hamilton** and across the **Niagara Region**

Karen Belaire
Board Chair

Vineland's Board of Directors (2022-23)

- Karen Belaire, Board Chair
- May Chang, Board Vice Chair
- Liz Stokes Bajcar
- Tony DiGiovanni
- Kristin Ego MacPhail
- John Groenewegen, PhD
- Lori Hall
- Dieter Jentsch
- Fred Koornneef
- Mark Picone
- Ian Potter, PhD, Vineland President & CEO
- Ray Price

Job creation, education and training*

81 full-time staff

57 highly qualified positions

19 scientists

2 PhD students

*For fiscal year 2021-2022

Vineland Research and Innovation Centre is a uniquely Canadian results-oriented organization dedicated to horticulture science and innovation. We deliver innovative products, solutions and services through an integrated and collaborative cross-country network to advance Canada's research and commercialization agenda.

We are an independent, not-for-profit organization, funded in part by the Canadian Agricultural Partnership, a five-year federal-provincial-territorial initiative.

We are located in Canada's Niagara Region, on the traditional territory of Anishinaabeg, Ojibway/Chippewa and Haudenosaunee peoples. This territory is covered by the Upper Canada Treaties.

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