# THE INNOVATION REPORT 2018-2019



vineland
RESEARCH & INNOVATION CENTRE

# Solving horticulture's labour challenges

Jim Brandle, Vineland's CEO

**Finding fruits and vegetables that growers love to cultivate as much as consumers enjoy eating is critical to the success of Ontario's — and Canada's — horticulture industry.**

When Vineland opened its doors 11 years ago in pursuit of profitable, tasty crops for everyone's benefit, it was clear horticulture had another major need: managing labour costs.

The reliance on manual labour to plant, maintain, harvest and pack crops was becoming unsustainable.

Returns on crops weren't keeping pace with minimum wage increases. Price-conscious consumers, swayed by pennies difference on imported versus local produce, left growers even more vulnerable.

Meanwhile, technology to reduce manual labour was slow to develop, and resulting inventions moved even slower. While it's often been faster to work manually, the drawback is labour typically eats 60 per cent of production costs in horticulture.

"If you're in any other business, the target is not only to manage but to reduce costs," said Jim Brandle, Vineland's CEO.

"We're at a critical juncture in our industry. We've created a solution to the labour force availability with the Temporary Foreign Worker Program and the Seasonal Agricultural Worker Program but it doesn't address the labour cost issue. We couldn't ignore the biggest problem of the industry."

Vineland has gathered a team of talented engineers who've designed and developed technology for harvesting and packing mini-cucumbers, and picking mushrooms.

"We're building the prototype for a tulip planter that drops 10 bulbs at a time, right side up, into soil, offsetting the work of 11 labourers," said Brandle. Smart irrigation technology that eliminates the need to water greenhouse crops by instinct is also in the works.

Advancements in artificial intelligence and safe, accessible data sharing mean growers can alter production based on market demands, too.

"(Data) gets aggregated, so you know how you're doing and then can adjust," said Brandle. "You can do a better job, where crop quality is more consistent at a lower cost."

All of this makes Vineland the ideal epicentre for a national automation cluster, overseeing projects tackling labour costs in horticulture.

Add to that the research centre's proximity to Canada's auto and manufacturing industries, capable of producing this much needed technology. Both Vineland and Ontario are poised to be significant change agents in horticulture worldwide.

This isn't about eliminating jobs, however, Brandle noted. A shift in labour brings new career opportunities, including people to program, operate, and service machinery.

Most importantly, automation means local growers can compete globally, he said. And that's good news for the industry.

"What you don't want is to lose food sovereignty. You don't want to say 'Well, apples are too expensive. We'll buy them from somewhere else' (because of labour)," Brandle said. "You can build a solution for a problem here and sell it anywhere in the world. This helps both the horticulture and manufacturing industries."

**Read the latest on Vineland's new agricultural automation cluster on page 4.**

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**Cover – Vineland's new tastier hybrid greenhouse tomatoes-on-the-vine**

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# Leading the way on automation

**Finding workers to help grow and harvest full crops of buttons, cremini and portobello is a serious challenge for the mushroom industry.**

"It's hard work requiring training and there simply isn't the labour pool available to draw from," explained Tania Humphrey, Vineland's director of strategic planning and research management.

But mushroom growers aren't the only ones having a hard time finding help.

Availability and cost of labour are two of the greatest challenges facing growers today, especially in horticulture.

Labour is the biggest cost of doing business, making it difficult for producers to expand operations, survive wage increases and compete with cheaper imports.

"It's pushing the limits of profitability for some growers," Humphrey said. "In horticulture, most tasks are still done by hand. It's not like field crops where large-scale operations can be handled by machine."

Thanks to a significant grant from Agriculture and Agri-Food Canada, Vineland is positioned to transform farm labour and change the prospects of growers in the process.

The investment formalizes Vineland as the centre of an agricultural automation cluster, overseeing a national network to develop automation, artificial intelligence and precision technology to improve productivity.

The new cluster will focus on creating technologies that can replace or augment human labour, and improve yield and efficiency by harnessing big data and artificial intelligence, which growers can use to make more informed management decisions.

"For Vineland, this is a big deal to build nationally and test the waters beyond horticulture," Humphrey noted.

So far, three cluster projects led by Vineland researchers have received funding to move them through experimentation and into the prototype phase. They are:

- A robotic mushroom harvester that will increase productivity and improve yield and quality of harvested mushrooms via intelligent, selective harvesting.
- Smart greenhouse irrigation that can monitor water status in floral and potted vegetables and decide when to water plants. This will reduce water consumption and ensure plants are watered based on need, not the grower's perception.
- An automated cucumber harvester to replace human labour and improve yield and quality by using big data to optimize plant management and harvesting decisions.

"There's still a lot of work before transferring technology to growers but that's the purpose of the cluster," Humphrey said.

Then it's a matter of licencing a manufacturer to produce the technology, she noted, making the cluster work beyond agriculture.

"We see this as a win-win for agriculture and manufacturing. It's good for Canada, too. The expertise, the companies, the people are here. It's getting the manufacturing sector to focus on agriculture."

Humphrey and Vineland are currently seeking projects in other sectors starting in 2019. The ideas used to solve labour issues on one type of farm may benefit others, she noted.

"There will be a lot of overlap in skills and research with what's happening in horticulture," Humphrey said. "We need to begin discussions now and get these projects underway."

**Mohamed Kashkoush, Vineland's data mining & optimization research scientist and Tania Humphrey, Vineland's strategic planning & research management director**

***"...For Vineland, this is a big deal to build nationally and test the waters beyond horticulture."***

# Testing, Testing, TOV

**Travis Banks knows the pressure of a deadline.**

The research scientist, who's overseeing Vineland's program to enhance flavour and production traits in greenhouse tomatoes, is feeling it right now as the target date nears to bring a new, tastier hybrid tomato-on-the-vine (TOV) to market by 2022.

That might sound like all the time in the world, but it's not when there are six candidate tomatoes that need to be trialled in Ontario greenhouses and whittled down to one winner — their performance scrupulously evaluated in the process.

Did they grow easily, holding their own against disease while turning out enough clusters of tomatoes that are just the right shape and size?

Then there are the tomato seeds that need to be produced and marketed to farmers so they can start growing the juicy red tomatoes already taste-tested by consumers, by fall of 2021.

Travis Banks, Vineland's bioinformatics research scientist

"It's a very, very ambitious timeline," Banks said. "It's an ambitious timeline just for getting product to people. It's also ambitious in that it only works if, in the first trialling of hybrids, we find something that works better than what's already on the market."

And therein lies Banks' and the tomato breeding program's raison d'être: to develop new varieties of TOVs for consumers looking for more flavourful options beyond what's currently available.

Sixty per cent of consumers say they like the most commonly available greenhouse tomatoes sold in grocery stores, but that leaves a good number hungry for something different.

In the process of filling that void, Vineland scientists are also tackling resistance to pepino mosaic (a disease that makes tomatoes blotchy), bacterial canker and other afflictions that can cause headaches for growers.

The program is a partnership with Ontario Greenhouse Vegetable Growers (OGVG), who have helped identify growers willing to trial Vineland's top TOV hybrids for the first time this year to evaluate their performance.

"Every grower has their own production practices and these subtleties can impact how tomatoes grow in their hands," Banks explained. "The hope is what we're asking growers to produce will do well but we're also hoping they'll taste great."

It's expected the six varieties will be narrowed to three by the end of the 2018 growing season, then down to two by 2019. By 2020, Banks anticipates that three years of OGVG growing data will point to a clear winner.

All the while, researchers at Vineland are still continuing their breeding work to identify new tomatoes that will go through the same trialling process, improving upon what they've already done.

"This year is an important step and the wheel has to keep turning to keep the pipeline full," Banks said. "We have a lot of activity going on around tomatoes. Right now nobody else in the world is breeding new greenhouse tomatoes for the Ontario market."

That doesn't mean only Ontario growers stand to benefit from the work happening here and Vineland's tomato breeding program is generating interest from unexpected places, including the Yukon and Alberta.

Finding a way to get the tomato seed to market is the next critical step after growing trials, and it could be the most challenging. There are no greenhouse seed production companies in Canada. Vineland's business development team will determine the tomato's best path to market.

"You have to find a company that can produce a lot of seed. Then you have to treat that seed and do quality assurance on it. Then you have to package the seed, market it and distribute it," Banks explained.

"We have an aggressive target of getting seed to market and the entire team is focused on this goal. To meet it we have to anticipate and manage problems coming our way. So far, so good."

***"...Right now nobody else in the world is breeding new greenhouse tomatoes for the Ontario market."***

Courtesy of Brisbin Brook Beynon Architects

# Growing the urban canopy in a new direction

**Cities aren't the only places growing up instead of out.**

It turns out forests are going vertical, too, with buildings around the world being constructed with trees and green spaces incorporated into their design to combat the heat and smog of the concrete jungle.

While the vertical forest has already taken root in cities like Milan and Singapore, and throughout China, this type of metropolitan reforestation is new to North America. That's about to change, however, thanks to one visionary architect set to build the continent's first vertical forest in Toronto.

He'll be helped along by Vineland, which will literally write the book on proper sustainable perpendicular design.

"The idea is as a city gets older and buildings need replacing, plants and integrated green space will take centre stage in new high-rise building design," said Darby McGrath, Vineland's nursery and landscape research scientist.

"It marks a sea change in the way we'll design buildings and cities, where plants are considered at the start of the design process as an integral part to the building."

It will start with a 27-storey luxury condo drafted by architect Brian Brisbin and slated for Toronto's Yorkville neighbourhood.

*"...It marks a sea change in the way we'll design buildings and cities, where plants are considered at the start of the design process as an integral part to the building."*

*…We hope that our results will allow for this model to be replicated elsewhere."*

Darby McGrath, Vineland's nursery and landscape research scientist

The terraced building, designed with open parkettes and as many as 500 coniferous and deciduous trees, takes Toronto's existing policies to increase the urban canopy and manage storm water runoff with green roofs on new construction to another level.

In Milan, for example, two residential towers built as vertical forests include as many trees, plants and shrubs to cover 20,000 square metres on flat land. Green roofs, despite their benefits, don't have the scale of such upward woodlands.

Most cities, however, don't have an approval process for these types of developments despite Environment Canada and the Canada Mortgage and Housing Corporation promoting vertical forests in green building construction.

Thanks to Vineland's help, Brisbin's development is poised to be the template they can use for future vertical forests.

"We couldn't really find anyone else really capable of doing this. Vineland had the deepest level of resources and PhDs, like a university, but its pragmatic aspect of real-world and usable science gave us the comfort that they should be the quarterbacks on this project," Brisbin said. "Hopefully this will lead to a movement like in Italy and China."

McGrath, whose work at Vineland has focused on urban tree survival and health, was chosen by Brisbin to help select trees suitable for a high-rise urban ecosystem.

She'll consider how trees fare when faced with many environmental variables, particularly temperature and wind exposure.

The higher up trees are planted, the more extreme weather conditions can be expected, especially in Canada. For safety reasons, trees must be structurally sound to withstand winds on higher levels. Trees that drop fruit, nuts and bark will then be weeded out during the selection process.


Courtesy Brisbin Brook Beynon Architects

McGrath, who will work on this project with experts from the University of Toronto and the Toronto and Region Conservation Authority, will use data from 3D models of each candidate tree to make selections.

This will show the environmental pressures trees will face based on the orientation, micro-climate and structural capacity of every terrace on the building and ensure they're suited to the conditions.

"Trees can be supported in challenging environments with continual maintenance but it's important to select trees that don't require excessive amounts of care to ensure the design meets sustainability objectives," McGrath said.

The chosen vegetation should also benefit the greater urban ecology; for example by offering songbird and wild pollinator habitat.

"This project moves well beyond contemporary green roofs and balcony gardens," McGrath said. "The trees are integrated into the building design and we'll be monitoring their responses to this unique urban ecosystem as well as trying to understand the benefit they provide."

There also needs to be connectivity between the building's ecosystem and the greater urban environment. The vertical forest design should support the city's environmental objectives, McGrath noted.

The conservation authority will contribute their expertise on storm water management modelling to create a system that captures and reuses storm water — a challenge for the city.

McGrath's work won't finish once the building is constructed and inhabited, either.

She's set to study for several years how the vertical forest performs.

By the end of the project, McGrath will have produced a manual of best management practices, covering design, maintenance and monitoring, to help municipalities and developers see the vertical forest for the trees.

"We hope that our results will allow for this model to be replicated elsewhere," McGrath said. "We want this project to have an impact and provide quantifiable ecological benefits for Canadian cities."

# Slipping into sweet potato production

Adrian Roelands, owner of Roelands Plant Farms Inc.

*"...It's about doing a good job and getting great quality."*

**February tends to be a slow time at Roelands Plant Farms Inc.**

The greenhouse vegetable propagator in Lambton Shores, ON, has usually shipped the last of its orders for the year's tomatoes, cucumbers and peppers to clients throughout North America, and its busy season winds down.

But not this year. Once those vegetables destined to grow under glass were on their way, owner Adrian Roelands and his team started ramping up production of a new baby plant crop: sweet potatoes.

Roelands was tasked with propagating sweet potato slips to trial Vineland's made-in-Canada variety of the popular storage vegetable on about 25 Canadian farms this year.

"It's a nice fit for our organization," Roelands said. "When we heard about the opportunity (to propagate slips), we thought this fits well with our business plan."

In the process, Roelands and Vineland are establishing a domestic slip production industry, which didn't exist previously.

The Vineland sweet potato, called Radiance (a variety bred in collaboration with Louisiana State University), matures in less time than the usual commercial varieties typically grown in the long, hot seasons of the southern U.S.

Radiance has also been deemed a winner in the flavour department by consumers who are hungry for the versatile root vegetable enjoying superfood status.

Prior to the breeding of Radiance, however, Canadian sweet potato growers relied on slips from the U.S., often in short supply once American farmers' orders are filled. Those sweet spuds also require long growing seasons, which can be elusive on this side of the border.

The hope is Radiance will be ready for harvest in time for Thanksgiving and offset some of the nearly 66 million kilograms of sweet potatoes imported into Canada to keep up with demand.

"In order to commercialize our variety, we had to develop that (slip) industry here," said Valerio Primomo, the Vineland research scientist who bred Radiance.

So far Radiance is getting solid reviews from growers, which bodes well for Roelands, currently the only licensee to produce the slips for this variety. This year, the operation turned out about 200,000 slips to fill 15 acres throughout Canada with Radiance.

If the sweet potato checks all the performance boxes come harvest, slip production could increase tenfold in 2019, Roelands said.

It will likely only increase from there. It would take 24 million slips just to fill the 2,000 acres of sweet potatoes currently grown in Ontario, Primomo explained.

An additional 48 million slips are needed to grow another 4,000 acres of Radiance in Canada and offset sweet potato harvests imported from the U.S.

The potential for Roelands, Radiance and the Canadian slip industry is huge.

It took Roelands about four months to propagate the sweet potatoes required for this year's trial.

The process starts in a propagation chamber under conditions that cause the vegetables to sprout. Those shoots are cut, then grown in small soil beds in a greenhouse.

Once they reach the right size, the shoots are harvested and delivered to growers to plant in their fields.

Roelands is no stranger to propagating field crops but sweet potatoes are a first.

Vineland provided support to Roelands throughout, with staff from the research centre visiting as often as every week to offer guidance and oversee the process.

The biggest challenge, Roelands said, was ensuring they produced enough slips that were the right size by the promised shipping date.

In the process, he and Vineland came up with ideas to streamline and increase production next year, all within the same tight timeline, and potentially at a lower price for growers buying slips, Primomo said.

"There was definitely a big learning curve," Roelands said. "We know, even for next year, there are some changes we can make, and hopefully improve moving forward. The first year is not about making money. It's about doing a good job and getting great quality. Our main goal is to show improvement over the next year."

Sweet potato slip propagation trials at Roelands Plant Farms Inc.

# Consumer insights go beyond Vineland

**For the past five years, Amy Bowen has leaned on consumers to describe or give the 'yea' or 'nay' to crops the research centre develops. It's all in an effort to determine whether people will buy new fruits, vegetables and flowers if growers cultivate them.**

But over the past few years, Bowen's ability to zero in on what consumers like has attracted companies and organizations needing in-depth data to inform significant business decisions.

One-off and continuing partnerships with grower groups and private enterprises to determine consumer preferences and position products are now an important part of what Bowen and Vineland does. It's everything from figuring out how a brand resonates with consumers to pinning down their preferences for taste, flavour, appearance, texture, even their attitudes, beliefs and buying habits.

Bowen, Vineland's research director of consumer insights, can define segments of consumers related to preference and demographic differences. In addition, she can tap into Vineland's trained sensory panel to create taste and flavour profiles of new products in relation to existing ones and help companies with brand development.


Vineland's David Ly, consumer insights research technician, Amy Bowen, consumer insights research director and Amy Blake, consumer insights senior research technician.

> ***…It's really about creating knowledge you can feel confident in, that will help you go forward in building your business."***

Focus groups, online or in-person surveys are other ways Bowen and Vineland's consumer insights team have gleaned quantitative and qualitative information to help organizations fine-tune business plans.

"We work on both edible and non-edible products, anything that falls under horticulture — fruits, vegetables, flowers and trees," Bowen said. "It's really about creating knowledge you can feel confident in, that will help you go forward in building your business."

Some of Vineland's consumer insights partnerships have entailed:

- Development and introduction of new varieties of wine grapes bred by Château des Charmes in Niagara-on-the-Lake, ON. Vineland used blind consumer tastings to rank wines on the market that are similar to the new varieties and determined the one consumers most preferred.
- Product positioning of new apple varieties in Ontario for both Washington State Stemilt Growers and Summerland Varieties Corp. in British Columbia. Vineland was commissioned to find out where their respective new apple varieties "sit on the (consumer) preference map," including how they compare to popular varieties grown in Ontario. Vineland also determined which consumers the new varieties appealed to most.
- Helping to clarify and simplify descriptive language of Vintners Quality Alliance (VQA) Ontario wines, ultimately helping consumers identify and understand Ontario's wine styles and regions.
- Introducing a new raspberry variety for firms in Washington State and New Zealand. Vineland profiled and compared it to existing raspberries on the market, particularly when used as an ingredient in foods like smoothies.
- Understanding consumer and retailer landscapes for the Fresh Grape Growers of Ontario. Vineland surveyed consumers online about their grape preferences to understand opportunities for marketing new-to-Canada varieties scouted for production here. Vineland also conducted consumer and retailer taste tests to glean whether any of the new varieties had commercial potential.

"We see this as a way to better support the horticulture industry," Bowen said about the consumer insights partnerships. "There are lots of opportunities for people to approach us on how to better understand the market, new opportunities, new market placement and how to better evaluate the consumer landscape."

# Biocontrol big for flower growers

**More greenhouse growers are buying into biocontrol thanks largely to the work of a team of Vineland researchers.**

Ask one of them, though, and she'll give credit elsewhere for an uptick in more ornamental flower growers using living organisms instead of chemicals to control pests and disease.

Rose Buitenhuis, Vineland's biological control research scientist and Ashley Summerfield, biological control research technician

"I think it can be summarized in one word," said Rose Buitenhuis, Vineland's biological control research scientist. "Thrips."

Ninety-two per cent of floriculture growers who responded to Vineland's 2018 survey measuring the research centre's impact on finding and promoting effective biological agents said they use biocontrol.

That's up from 69 per cent just four years ago (Vineland's 2014 survey results). All the while, thrips, the most common pest threatening greenhouse grown ornamentals, have become increasingly resistant against chemical pesticides found on the market. Thrips will damage flowers and cause leaf discolouration, making plants unmarketable.

"With some pests you don't see the damage as much so they can be tolerated more, that's not the case for thrips," explained Ashley Summerfield, Vineland's biological control research technician who assisted with both the 2014 and 2018 surveys.

"Thrips are still the most common and challenging pest for growers."

Recent findings validate Vineland's work in biocontrol — one of the research centre's flagship industry-driven programs.

Biocontrol, including predators, parasites and entomopathogens, which cause disease that suppress pests, are among several strategies growers can use to protect crops.

Pesticide resistance is the number one reason why growers use biocontrol against predators and disease.

"To grow a successful crop, you need to deal with pests and disease. There is the potential for crop losses, even up to total crop failure. In the case of western flower thrips, there is no good chemical control," she explained.

Still, there are other reasons to switch to biocontrol.

"Growers are doing it out of concern for health and safety," Buitenhuis said.

More growers are now using biocontrol against disease, too. Seventy per cent said they use biological agents to fight disease, not just pests, up from just 30 per cent four years ago.

In such cases, plant health is the reason more growers are turning to biocontrol, Summerfield noted. Again, worker health and safety is a close second.

Still, Buitenhuis and Summerfield discovered that, despite the high adoption rate of biocontrol, growers want more information on how to properly use and integrate biocontrol into their production practices. Others are curious about more efficient use of biocontrol to keep costs low.

The survey findings are more than a pat on the back for Vineland. Now that Buitenhuis and Summerfield have a sense of what's important to growers, they will use those numbers to determine biocontrol research priorities — thrips will likely stay at the top of the list — and how to effectively communicate their findings to growers.

"This is a snapshot of the whole industry and it's moving in the right direction," Buitenhuis said. "We're feeling confident what we're doing is hugely beneficial to the industry and survey results indicate growers are seeing the value and are getting on board."

***"...We're feeling confident what we're doing is hugely beneficial to the industry and survey results indicate growers are seeing the value and are getting on board."***

*Case Study*

# Bringing World Crops to market

Changing Canadian demographics and evolving consumer tastes bring fresh opportunity to the marketplace in the form of crops not traditionally grown in Canada.

Canadians can now buy fresh, high quality and locally grown okra, Asian long eggplant and Indian round eggplant – and that's due to Vineland's research with consumers, growers and retailers into non-traditional crops adapted to Canada's growing conditions.

### *What are World Crops?*

Vegetables popular in other parts of the globe but not traditionally grown in Canada like okra, Indian round and Asian long eggplant, yard long beans, bok choy, Asian greens, callalloo and others.

## The World Crops opportunity in Canada

Canadian immigration patterns are changing. Statistics show that Chinese and South Asian immigrants form the largest segment of new Canadians and are expected to continue to do so in the foreseeable future, particularly in larger urban centres.

In fact, between 2011 and 2036 nearly half of Canada's immigrants are estimated to hail from China and South Asia – and eggplant and okra are two vegetables that figure prominently in the diets of this region.

Canadian consumption of eggplant and okra is growing as the traditional Canadian diet evolves alongside immigration patterns. Between 1978 and

2016, annual Canadian eggplant consumption rose from about 0.3 pounds per person to approximately 1.26 pounds, and okra consumption increased from almost zero to approximately 0.38 pounds per person.

Most of these vegetables are currently imported into Canada from the United States, the Caribbean and Asia. And although those imports have been growing in tandem with consumption, research has shown a preference for fresh, locally grown produce if prices are comparable.

Projections of current trends estimate that Canadian okra consumption will grow by 68.2% and eggplant by 45.9% between 2016 to 2026. That's an average annual growth of 3.3% and 5.1% and 2.7% to 3.5% respectively. Prices are expected to be sufficient to both appeal to consumers and generate a profit for growers.

**Growth in consumption in next 10 years (2016 to 2026)**

| **68.2%** | **45.9%** |
|---|---|
| **Okra** | Eggplant |

## Vineland's contribution: Defined the opportunity for the best World Crops

### *Why World Crops in Canada?*

- Changing Canadian demographics
- Rising consumption
- Growing import replacement opportunity
- Increasing market potential

## A collaborative approach

Vineland's mission for new crop development is simple – to develop what the market wants in collaboration with the people who will grow, sell and eat it.

Vineland's agronomic team tested different varieties of World Crops vegetables at its research farm and greenhouse in partnership with Canadian growers, staff from the Ontario Ministry of Agriculture, Food and Rural Affairs and researchers from the University of Guelph.

This helped Vineland narrow crop selection to eggplant and okra, which could be produced reliably and profitably, as well as determine varieties best adapted to Canada's growing conditions. It also included establishing cost of production, evaluating in-field and greenhouse production systems, and developing best growing practices.

Vineland's consumer insights research team identified which World Crops had the most potential to resonate with different groups of new Canadian consumers and which characteristics were most important to them when buying this type of produce.

There was also a close working relationship with retailers who marketed the different crops and were able to provide valuable feedback on sales as well as how they withstood storage, handling and retail display environments.

One major Canadian retailer reported an increase of local sourcing of Asian long eggplant by almost 50 per cent in 2016 compared to the previous year.

## Vineland's contribution:

### Defined cultivars and best practices for growers to help maximize profitability

### Established linkages with consumers and market buyers for locally grown produce

***Developing what the market wants through:***

- Variety trails
- Agronomic practices
- Consumer insights
- Retail connections

***What is okra?***

A tropical perennial plant with large edible green seed pods popular in Indian, Southeast Asian, West African, Brazilian and Creole cuisine.

***What is Asian long eggplant?***

A close tropical relative of tomatoes and peppers, this longish dark to light purple vegetable is part of traditional dishes in China, Japan, India, Thailand and the Philippines.

***What is Indian round eggplant?***

Sometimes called baby eggplant in North America, it ranges in colour from purple to white, brown or green and is often used in Indian, Thai and Sri Lankan food.

*"We would never have started with World Crops without Vineland. Through their work we know that these markets are growing rapidly and that it is possible to grow these crops here. The availability of their research team and being able to collaborate in a research trial has had a big impact on our production – their support has been invaluable to us."*

**Guillaume Cloutier and Yvon Van Winden, Delfland Inc., Napierville, QC**

## Impact and outcomes

These new World Crops create real impact for everyone along the supply chain, from growers to consumers.

For retailers, World Crops offer many opportunities to carry locally grown, in-season produce available to their customers and for consumers, it's a chance to buy fresh, good quality tastes and flavours that they are familiar with.

But the biggest impact potential lies with growers. World Crops present an alternative for growers interested in diversifying into new crops and products and Vineland's research program has significantly reduced the risks associated with investing in new production.

Vineland's work has identified the potential of this market opportunity and built economic calculators that include financial information and tools supporting cost-of-production, cash flow overview and break-even point evaluations by growers for their individual businesses.

Years of research at Vineland's farm and with commercial growers has generated valuable agronomic data and grower-friendly recommendations for in-field and greenhouse production, including:

- hybrid varieties
- fertility management
- spacing
- grafting for field production
- direct seeding
- season extension
- pest control
- genetic yield advantages

Delfland Inc. is a large Quebec grower of field vegetables like carrots, onions, dry shallots, and lettuce that is always looking for new markets and new opportunities.

After reading an article about the World Crops program and visiting Vineland, Delfland began experimenting with growing okra and adapting Vineland's agronomic recommendations to their local growing conditions.

In 2017, their harvest was 10 to 15 boxes a week which were sold to a local buyer. Acreage has increased in 2018, both growing their markets and filling in down- time between their more traditional crops.

## Vineland's contribution:

### Removed barriers to growing World Crops by identifying market opportunities and developing tools to manage risk

### *Expected marketplace impact*

Initial growth in production of both crops is expected to be gradual over 10 to 15 years. Previous new crop introductions in Canada have shown that growers need time to become familiar with the crop, establish production infrastructure, and build market connections before the full market potential can be realized.

However, market predictions for both eggplant and okra paint a positive picture for Canadian production of these crops.

Growth trends for both okra and eggplant were projected using a combination of Canadian consumption data and import statistics.

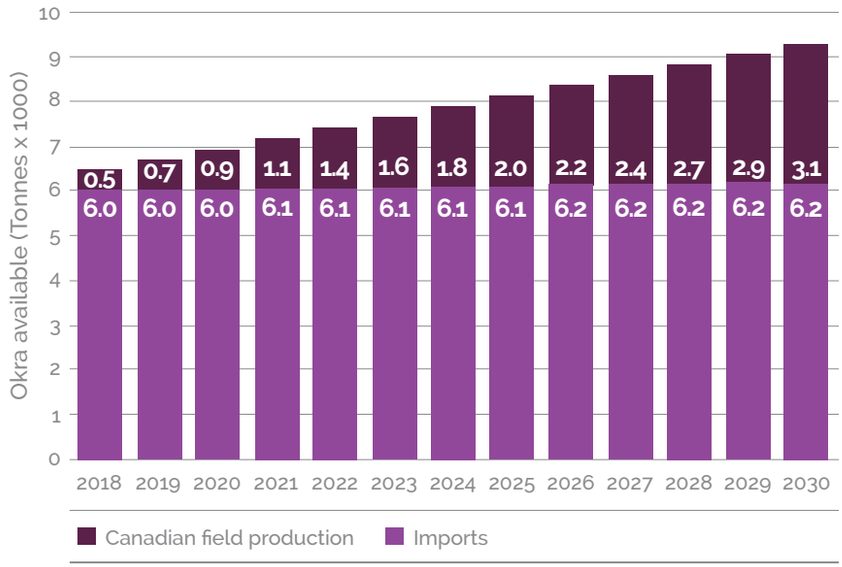
Canada's shorter growing season, past experiences with adoption of new crops by Canadian growers, and greenhouse production trends were also considered.

## Okra

For okra, it is expected that domestic field production will rise from current levels to 30 per cent of the market by 2030, resulting in 3,100 metric tonnes (MT) of Canadian-produced okra and 6,200 MT of imports. Trials at Vineland found okra to be unsuitable for greenhouse production.

This represents 437 acres of okra across Canada by 2030, at an average yield of 17 MT per hectare and with a farm gate value of approximately $24.3 million per year. That figure is based on an estimated wholesale price of $7.82/kg in 2030, calculated using the 2018 wholesale price of $6.17/kg and assuming two per cent inflation over the 13-year period.

Total projected okra imports and domestic in-field production, 2018 - 2030

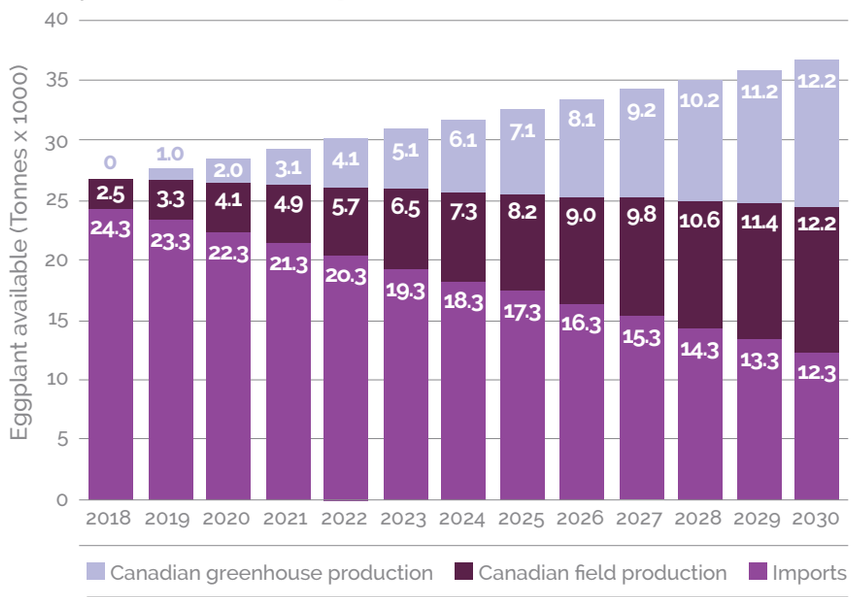



## Asian long and Indian round eggplant

Canadian field production of Asian and Indian eggplant is estimated to increase from its current level of less than five per cent of Canadian consumption to 30 per cent by 2030. This translates into 12,200 MT of ethnic eggplant produced in Canada by 2030.

It represents 586 to 835 acres of field eggplant crops across Canada by 2030, with an estimated annual farm gate value of $32.8 million. A wholesale cost of $2.69/kg in 2030 was used to calculate this figure, based on the 2018 average price of $2.13/kg and assuming two per cent inflation over the 13-year time period.

Total projected eggplant import and potential import replacement by domestic in-field and greenhouse production, 2018 - 2030




## In the greenhouse

If greenhouse production of eggplant is included, domestic production would increase by an additional 12,200 MT and imports would drop to only 12,300 MT per year. The combined farm gate value of field and greenhouse eggplant is estimated at approximately $65.6 million annually by 2030, representing 586 to 835 acres of field eggplant and 87 acres of greenhouse eggplant across Canada.

Greenhouse production offers yield advantages, a longer growing season, and more effective pest control over field production. It is not yet possible for nine-month greenhouse eggplant production to be economically feasible due to high lighting and energy costs. This is expected to change with the emergence of new technology in this area, providing future opportunity for a potential nine-month growing season.

Given Canada's short growing season and maximum four-month harvest window, 30 per cent of the market is the maximum level possible of home-grown production for both okra and eggplant. This would be higher if greenhouse eggplant production is added in the future.

## Market potential by 2030

### Okra

**437** acres of Canadian field production for four months of the year

Farm gate value of **$24.3** million/year

**30%** of consumption home-grown

### Eggplant

**586** to **835** acres of Canadian field production for four months of the year and **87** acres of greenhouse eggplant production for nine months

Farm gate value of **$65.6** million/year

**60%** of consumption home-grown

**12.3** MT of imports displaced

## Success at a glance

Through its World Crops program, Vineland has been able to develop new crop opportunities for Canadian growers and new market opportunities for Canadian retailers and consumers built around locally grown food.

- Crops were selected that are in demand by new Canadian consumers and grow well in Canada
- Agronomic information tells growers which varieties to use and how to grow them for best results, whether in-field or in the greenhouse
- Economic calculators are available to provide cost of production information to growers
- Connections with retailers have reinforced market demand
- Extensive market analysis has established future growth potential

Through detailed, multi-faceted research, a de-risked diversification opportunity for growers is available for implementation, supported by extensive background information and economic calculators at http://feedingdiversity.vinelandresearch.com/

## *World Crops – an opportunity ready to grow*

- **De-risked opportunity for growers to diversify crop production**
- **More fresh, local produce for a growing market**
- **Import displacement**


### Funding partners

Vineland's World Crops program would not have been possible without the support of many funders and collaborators, including growers, retailers, the Ontario Food Terminal, crop specialists with the Ontario Ministry of Agriculture, Food and Rural Affairs, and researchers at the University of Guelph.

Funding was provided by multiple partners, including Agriculture and Agri-Food Canada, the Ontario Ministry of Agriculture, Food and Rural Affairs, Ontario Fruit and Vegetable Growers' Association and the Friends of the Greenbelt Foundation.

*Case Study*

# Greening Canada's roadways

Trees are often planted alongside roads or in urban areas to beautify the landscape and provide natural habitats. Many struggle to survive and rarely reach full maturity. That's because soils are often compacted with low organic matter, trees are exposed to salt and pollution, there is no after-planting care, and not every species can grow in this setting.

**Did you know...**
***the typical lifespan of a tree along a major roadside is only five to 10 years[1]?***

Research trials conducted throughout Ontario and Alberta by Vineland scientists over several years have focused on how to build an ecological environment that can withstand lack of water and care, tolerate pollution and weed competition. This led to the development of species selection guidelines and best management practices for soil remediation that dramatically improves tree survival.

[1] Nowak et al. 2004

## Impact at a glance

- Extraordinary tree survival rates of almost 100 per cent compared to standard plantings with a 45 per cent survival rate
- 66 per cent higher carbon sequestration levels, equal to taking four times as many cars off the road as standard plantings
- Four times more storm water runoff intercepted than standard plantings
- Three times more water available per acre than standard plantings due to higher soil organic matter


CA
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150
CA
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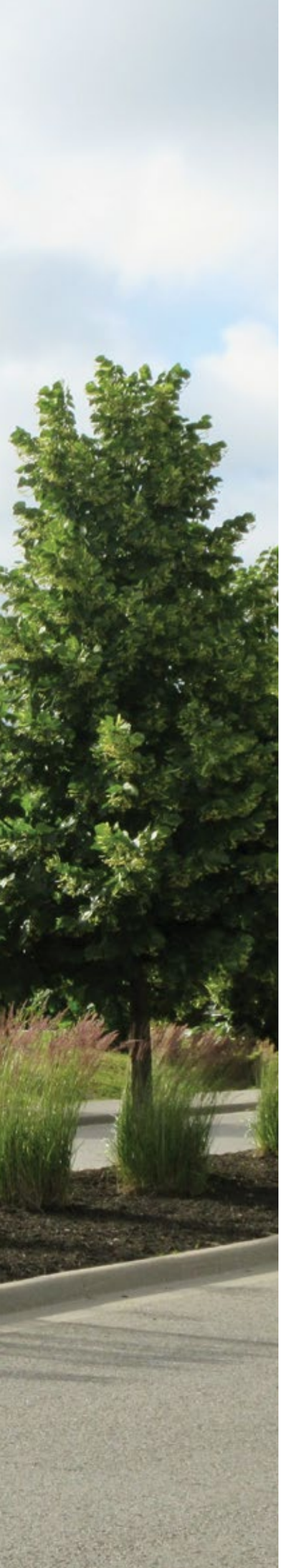
150



## Giving urban plantings in high stress areas a chance

Several years of research has culminated in two unique online tools – a soil remediation calculator and a tree species selector – to help transportation planners, municipalities, conservation authorities and landscape contractors make the best decisions based on specific soil and site conditions for greener, more resilient landscapes.

The Vineland method for best tree growth success:

- Bed-style site preparation
- Deep-ripped soil to break up compaction
- Compost to boost soil organic matter

Vineland's soil remediation method is significantly less expensive than standard cost estimates for roadside tree planting in Ontario, costing approximately $95,000 to plant 1,000 trees compared to $200,000 (dependent upon contractor's business model and pricing).

### Vineland's contribution:

***Developed a "how-to" manual for trees and shrubs to thrive in challenging urban and suburban environments and a more cost-effective method for soil remediation.***

**Online tools for more successful plantings**

- **Soil remediation calculator:** Assess and improve the soil specific to each planting project
- **Tree species selector:** Pick the species best suited to a planting project's unique needs

## Highway of Heroes Living Tribute

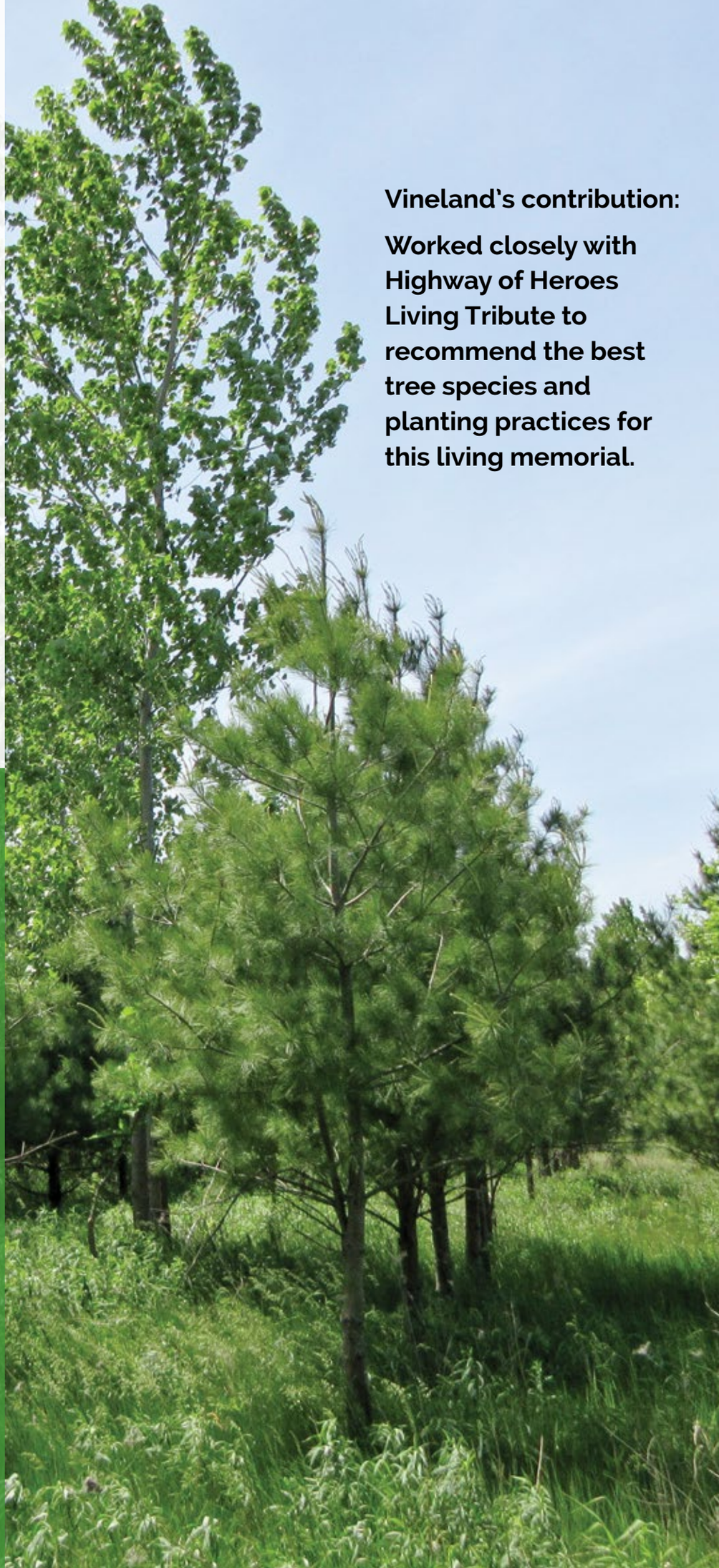
Vineland's method has been successfully put to the test in a high profile partnership with the Highway of Heroes Living Tribute project.

Four years ago, the Highway of Heroes Living Tribute was established with the goal of planting a tree for each of Canada's war dead alongside the stretch of Highway 401 in Ontario known as the Highway of Heroes. This living memorial will include 117,000 trees representing every Canadian war casualty dating back to 1812.

Living Tribute partnered with Vineland to follow their tree selection recommendations relative to soil conditions, salt spray, wind exposure, and established planting protocols.

***"Maximizing the survival rate of trees is very important to us – if we are taking money from individual Canadians, businesses and government, we want to plant trees that won't die. Partnering with Vineland was a natural fit – and as a result, the survival rate of our first highway planting is extraordinary."***

**-Mark Cullen, Highway of Heroes Living Tribute co-founder**



**Vineland's contribution:**

**Worked closely with Highway of Heroes Living Tribute to recommend the best tree species and planting practices for this living memorial.**

## Impact and outcomes

In addition to greening the Canadian landscape, better tree survival and growth significantly impact our air, water and soil – as well as economic benefits to the Canadian nursery landscape sector, municipalities and organizations undertaking the plantings.

### *Tree growth and survival rate*

Trees planted using Vineland's approach had an almost 100 per cent survival rate five years after planting compared to only 45 per cent survival when standard planting methods were used. The trees are also larger (as measured using height and trunk cross sectional area).

- The typical tree lifespan along major roadsides is five to 10 years – but trees planted using Vineland's method had an almost 100 per cent survival rate five years after planting.

### *Carbon sequestration*

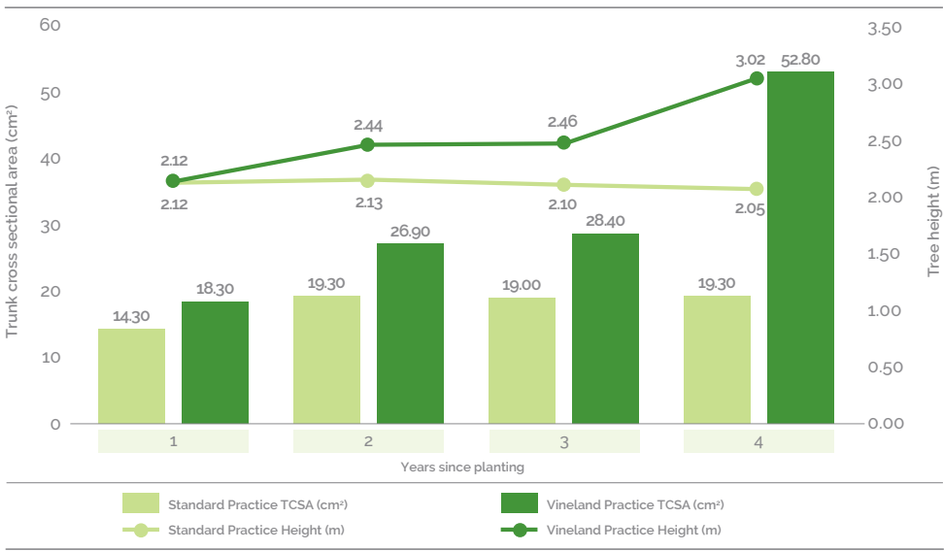
Trees "lock up" or sequester carbon in their leaves, branches and trunks as they grow, removing it from the atmosphere.

Using the Highway of Heroes Living Tribute project as an example, by year five, the average size of a Living Tribute tree planted using the Vineland method is estimated to be 66 per cent larger than the standard.

This means each Living Tribute tree will sequester 66 per cent or two-thirds more carbon from the atmosphere per year than standard planting trees. Including all Living Tribute trees, that's equivalent to taking almost 1,600 cars off the road per year – or almost four times as many as the standard planting method[2].

- Living Tribute trees planted using the Vineland approach remove 66 per cent more carbon from the atmosphere – equal to taking almost four times as many cars off the road as the standard planting method.

Average tree growth responses to planting methods




[2] Based on a mid-sized sedan that generates 4,989 kg (11,000 pounds) of CO2 per year, and average annual driving distance of 19,312 km (12,000 miles) (http://www.treebenefits.com/calculator/ReturnValues.cfm?climatezone=Northeast)

### *Soil remediation*

Soil on an estimated 180 acres of land will be prepared for the 117,000 Living Tribute trees being planted. The Vineland method adds on average nine per cent soil organic matter content compared to only three per cent using the standard method – that's because higher organic matter content means healthier soil that can absorb more water[3].

For the Living Tribute planting, that translates into an estimated 920,000 litres of available water per acre for plantings using the Vineland method, compared to only 306,000 litres for standard plantings. That means the newly planted trees and shrubs using Vineland's approach will have access to almost three times more water than conventional plantings.

- Vineland's approach boosts soil organic matter, making three times more water available for newly planted trees and shrubs that don't have access to irrigation.

### *Storm water management*

Storm water runoff washes oil, salts, gasoline, litter and other substances from roads and parking lots into streams, wetlands, rivers, and oceans. Trees help reduce runoff by holding moisture on leaves, branches and bark, and filtering and storing rainwater in their root systems.

By year five, each Living Tribute tree is expected to intercept almost 6,200 litres of storm water runoff per year. That's compared to approximately 4,100 litres per tree planted using the standard method. As a whole, Living Tribute trees will intercept approximately 725 million litres of storm water runoff annually.

- By using Vineland's approach, the Living Tribute trees will help intercept almost four times as much storm water runoff every year compared to the standard planting method.

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[3] "Every 1% increase in organic matter results in as much as 102,000 litres (27,000 gallons) of available soil water per acre" (https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1082147.pdf)

### *Economics and cost savings*

Tree replacement costs fall on the landscaper or landowner including municipalities and trees are not always replaced. Improving tree survival and longevity reduce the need for tree replacement, lower costs for municipalities and improve revenues for landscaping companies thanks to fewer warranty claims.

- For every 1,000 trees planted using Vineland's method, the increase in tree survival saves municipalities $575,000[4] and landscaping companies $615,000 in replacement costs.
- Vineland's soil remediation method costs less than half the standard Ontario estimate for roadside tree planting – $95,000 to plant 1,000 trees compared to $200,000 (dependent upon contractor's business model/pricing).
- Estimated cost savings related to the Highway of Heroes project for soil remediation are $11.1 million using the Vineland approach vs. $23.4 million using standard estimates – less than half the cost (dependent upon contractor's business model/pricing).

### *Expected success of the Vineland method on the Highway of Heroes Living Tribute*

To date, 25,000 Living Tribute trees have been planted and the oldest are now two years old. By the time all trees are planted and are five years old, they are expected to make a significant positive impact on the air, water and soil thanks to Vineland's proven approach for tree survival and growth.

Using the Vineland method and demonstrating its application via the Living Tribute project, trees boast:

- Extraordinary tree survival rates of almost 100 per cent compared to standard plantings with a 45 per cent survival rate
- 66 per cent higher carbon sequestration levels, equal to taking four times as many cars off the road as standard plantings
- Four times more storm water runoff intercepted than standard plantings
- Three times more water available per acre than standard plantings due to higher soil organic matter

[4] Vineland analysis

## Greening the roadways – an opportunity ready to grow

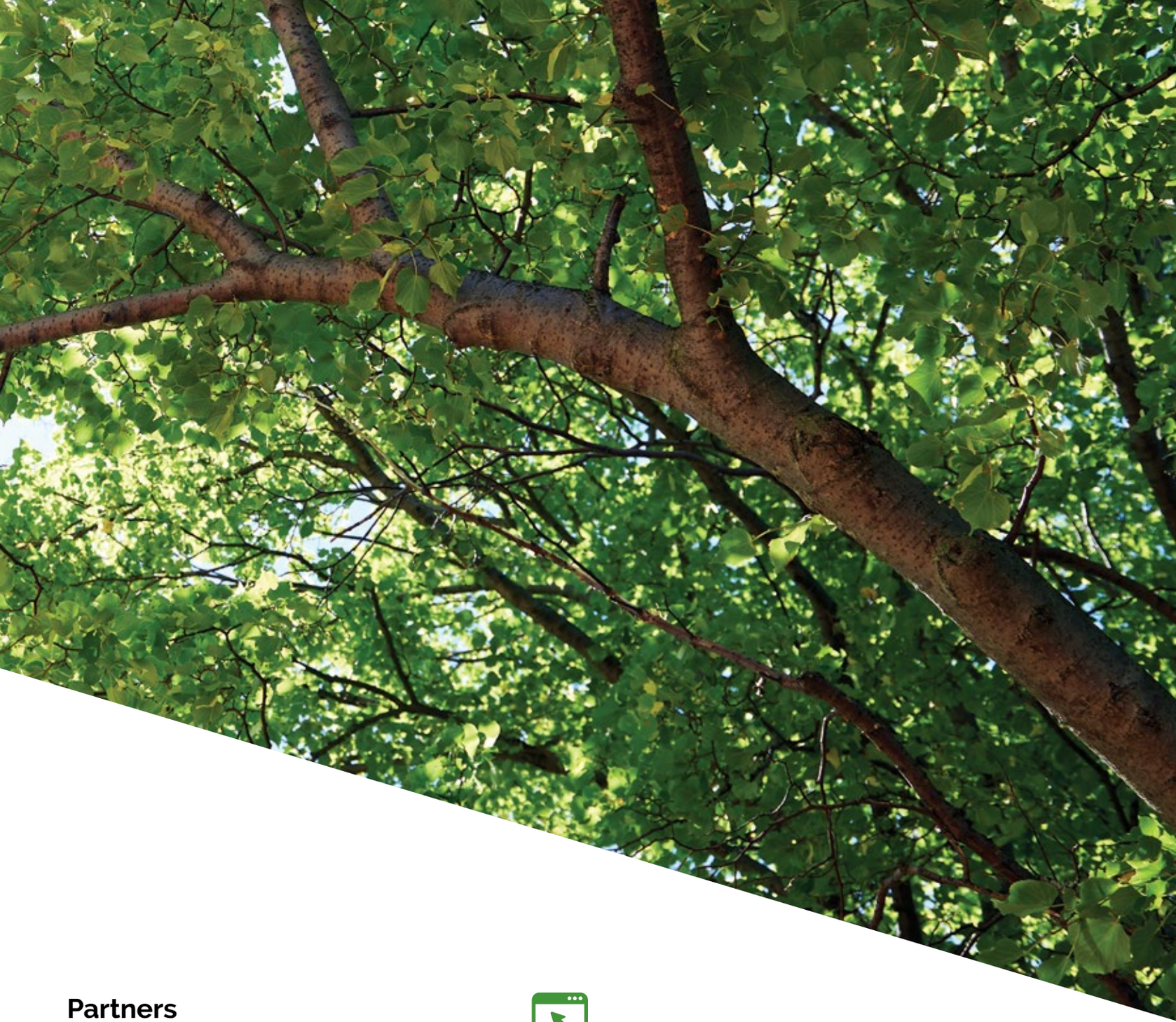
The Highway of Heroes Living Tribute is just one example of the Vineland method at work.

Vineland's practice-proven and research-based recommendations on improved tree survival and growth in challenging urban environments are available for use by those planning tree planting projects.

Tools include:

- Soil remediation calculator
- Tree species selector
- Best management practices for soil remediation and management
- Techniques proven in challenging urban environments

Vineland continues to work with a number of partners across Canada to test and improve tree establishment in challenging locations. Soil remediation and species selection trials in Ontario were conducted with the Ministry of Transportation. In Alberta, soil remediation trials in Airdrie, Calgary and Edmonton were done in partnership with Alberta Transportation, bringing benefits to these communities and increased sales to local nursery and landscape suppliers.



## Partners

Funding for Vineland's Greening the Canadian Landscape program was provided by the Canadian Ornamental Horticulture Alliance research and innovation cluster, and through the *AgriInnovation program of Growing Forward 2*, a federal-provincial-territorial initiative.

**www.greeningcanadianlandscape.ca**

# Vineland by the numbers

Since our start in 2007, Vineland has established horticultural research capacity including 15 research scientists in a range of disciplines from biology to engineering and social sciences.

The calibre of our scientists and their extraordinary focus on research is illustrated by their ability to compete for research funding. Vineland maintains a high success rate on grant applications with a research intensity on par with Canada's top universities.

What really differentiates Vineland, however, is our impact-focused operating model.

Connections to industry are critical and given our size we maintain a significant number of partnerships including collaborators, clients and commercial licensees.

This strength allows us to take a business approach to our research and helps to quickly translate results into commercial success and impact for the sector.

## Partnerships

**122** partners*

**92** industry **16** academic **14** government

From

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

**13** **countries** (Australia, Belgium, Canada, France, Greece, Germany, Luxembourg, Netherlands, New Zealand, Spain, Taiwan, United Kingdom and United States)

*Covering *Growing Forward 2* five-year funding cycle

## Commercialization

**9** Vineland developed technologies with patents issued/filed

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

**7** trademark applications filed

**37** technologies commercialized

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

## Research capacity and performance

**15**
research scientists

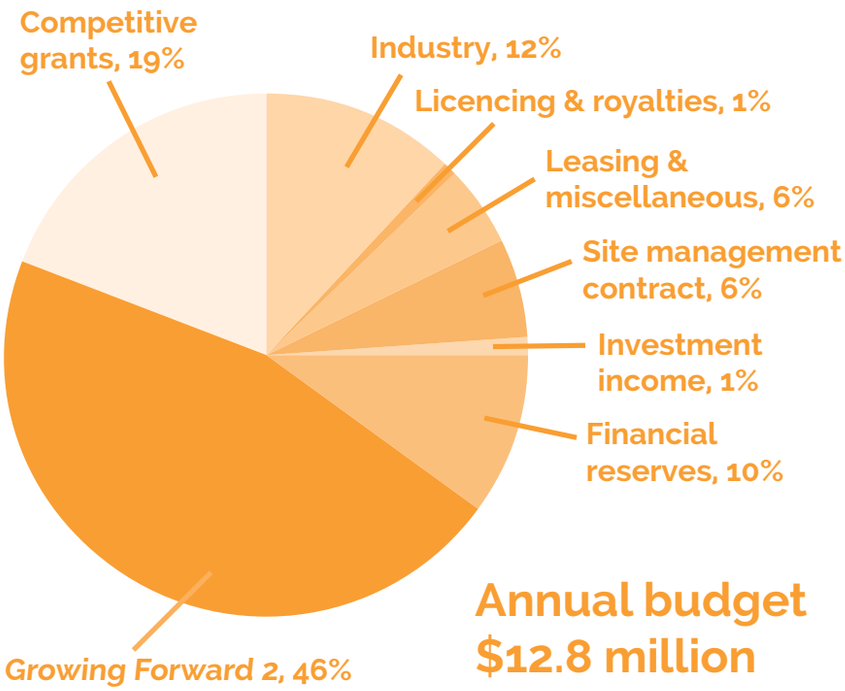
**$262,000**
research intensity (research revenue generated per researcher)

**$12,200**
innovation strength (royalties generated per researcher)

**69%**
grant application success rate

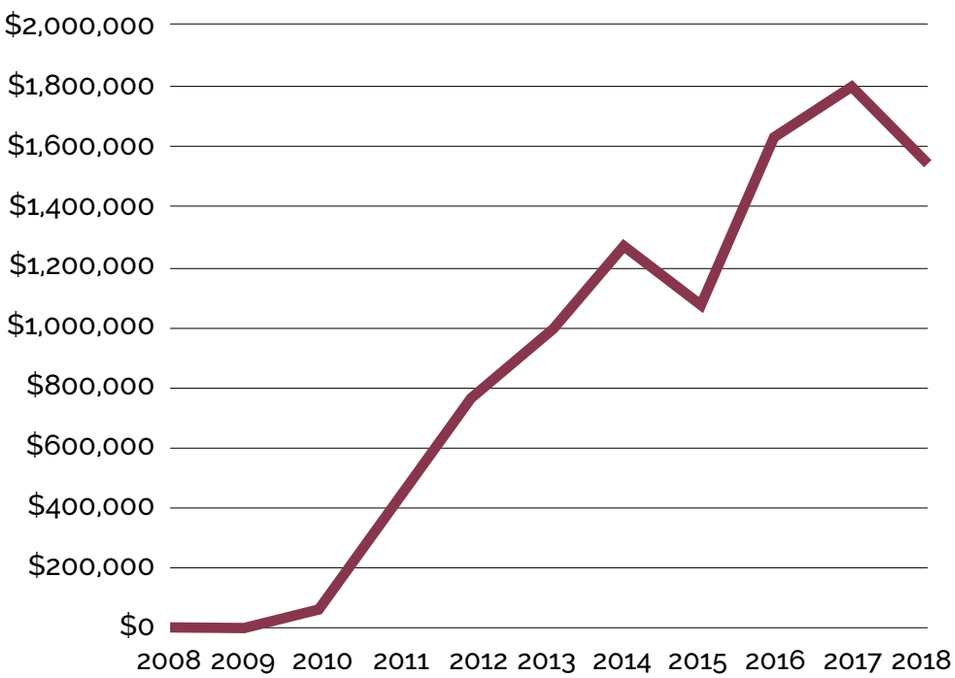
**54**
peer-reviewed publications of Vineland's research have been cited 326 times

## Revenue 2017-18




**Annual budget $12.8 million**

## Industry investment




## Job creation, education and training

**83** full-time staff

**53** highly qualified positions

**3** PhD students graduated, 3 more underway

**7** MSc students graduated, 6 more underway

Average of **26** summer/ co-op students hosted each year

With a highly-skilled research team, oversight from an independent Board of Directors, engagement from an international Science Advisory Council and collaboration with 86 global partners including a Stakeholder Advisory Council, Vineland's goal is to enhance Canadian growers' commercial success through results-oriented innovation.

We are an independent, not-for-profit organization, funded in part by the *Canadian Agricultural Partnership*.

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