A NATIONAL STRATEGY FOR
Ornamental Horticulture Research and Innovation

Driving innovation and competitiveness across Canada’s ornamental value chain
ACKNOWLEDGMENTS

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NOTICE TO READER

The findings and opinions are not necessarily those of Agriculture and Agri-Food Canada.
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EXECUTIVE SUMMARY

Canada’s ornamental horticulture value chain is a core part of Canada’s economy representing over $8 billion in consumer purchases at retail and landscape services.

Canada’s ornamental horticulture value chain – from production agriculture (nursery stock, greenhouse floriculture and sod) through to landscape design and services – is a core part of Canada’s economy representing over $8 billion in consumer purchases at retail and landscape services.

Research and innovation are fundamental to growing the sector and strengthening its competitive position in a world in which trade in ornamental products is increasingly globalized. Research completed by Deloitte in 2009, showed a sector poised for double digit growth in the Canadian market as retiring baby boomers turn to gardening as a rewarding leisure activity. This opportunity cannot be taken for granted as consumers have many choices on where to spend discretionary income. Younger generations are conditioned to seek solutions that are convenient and easy and therefore require ornamental products that deliver instant satisfaction with minimal care.

To seize the opportunities for growth in the domestic market, the sector needs new products and services that will enable the value

FARMGATE VALUE OF INDIVIDUAL PRODUCTION SECTORS OF ORNAMENTAL HORTICULTURE
chain to earn a higher return and excite consumers. New products and services, in turn, require market research to understand what consumers are thinking and how their needs are changing. Investment in product research, that leads to commercialization and capitalizes on meeting those needs is an urgent priority of the sector. “Product” means the total presentation and experience. It includes, for example, packaging and container, environmental-friendly products and services, information and messaging, and the satisfaction gained by the consumer.

Among emerging market opportunities is the demand for plants for environmental purposes. These uses include:

1. phytotechnologies such as greenroofs, green walls, green corridors, greening of riparian strips, urban heat island reduction, and water management applications such as rain gardens,

2. phytoremediation applications in which plants are used for depolluting air, soil and water and

3. expanded use of ornamental plants for greening purposes in cities, semi-urban and rural areas.

Ornamental horticulture plants can provide solutions to climate change by mitigating its impact. Municipalities are devoting more of their budgets for building green infrastructure (versus grey infrastructure). Research will enable this sector to capture opportunities related to production, implementation, care and maintenance formations, systems and technologies (including plants species and varieties/cultivars) required to fill and grow this emerging domestic market need.

Canada also has the opportunity to build its penetration of export markets in countries with similar climatic conditions but which are water- and soil resource-challenged. China is undergoing rapid urbanization where plant solutions can make congested cities more livable and raise the quality of life. To compete globally in these markets, the sector needs market research, new product introductions, and new technologies to enable production, post harvest and shipping over long distances in compliance with import countries' phytosanitary regulations. The development of green infrastructure solutions is an emerging market with global potential.

International trade in ornamental products, as well as climatic changes, have increased the range of diseases and pests experienced by Canadian producers, including invasive species. The need for effective control strategies to manage these pressures – ideally using biocontrol technologies for minimal environmental impact – is an urgent priority so that growers are equipped with the advanced tools they need to maintain high yields and outstanding quality.

In the current intensely competitive merchandising environment, it is difficult to raise prices and therefore
managing costs of production of traditional products is vital to remaining competitive. **Research that enables growers to adopt innovative practices and technologies that will lower their costs of production is a high ongoing priority.** Cost reduction can be achieved through methods that allow more efficient use of inputs, including water, nutrients, energy and labour.

The sector needs to improve its environmental image and reduce its carbon footprint. The mass merchandisers and big box stores are more and more demanding products labelled with environmental indicators in their drive to expand adoption of sustainable practices. On account of the diversity of production types, systems and crops in ornamental horticulture, the development of best environmental practices that lower the carbon footprint requires research and then knowledge transfer to all the parts of the value chain where the research results can be adopted.

The sector's priorities reflect strategies for both seizing opportunities and mitigating competitive threats. **Research and innovation across the nine priority areas identified in this strategy are the solution to enabling the sector to reach its potential and contribute to Canada's future prosperity and quality of life.**
INTRODUCTION

IMPORTANCE OF THE SECTOR

Ornamental horticulture is a very significant part of Canada’s agri-economy representing $2 billion in sales at farmgate. The table below summarizes the farmgate value of certain segments that make up ornamental horticulture.

### TABLE 1 – FARMGATE VALUE OF INDIVIDUAL PRODUCTION SECTORS OF ORNAMENTAL HORTICULTURE

<table>
<thead>
<tr>
<th>Category</th>
<th>Farmgate value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potted flowers and plants</td>
<td>$669 million</td>
</tr>
<tr>
<td>Ornamental bedding plants</td>
<td>$158 million</td>
</tr>
<tr>
<td>Cut flowers</td>
<td>$136 million</td>
</tr>
<tr>
<td>Vegetable bedding plants</td>
<td>$103 million</td>
</tr>
<tr>
<td>Cuttings</td>
<td>$74 million</td>
</tr>
<tr>
<td>Nursery stock sales</td>
<td>$632 million</td>
</tr>
<tr>
<td>Sod sales</td>
<td>$137 million</td>
</tr>
</tbody>
</table>


The Canadian Ornamental Horticulture Alliance (COHA), under an Advancing Canadian Agriculture and Agri-Food (ACAAF) project, contracted with Deloitte to undertake an economic and environmental impact assessment of the Canadian ornamental horticulture sector of production agriculture. Published in 2009, *The Impact of Ornamental Horticulture on Canada’s Economy* noted that “consumers spent nearly $6.3 billion at the retail level on ornamental horticultural products and another $1.8 billion on landscaping services in 2007.” [p. 1] Based on the 2006/2007 data analyzed, the value chain is estimated to have a total economic contribution of $14.48 billion, comprised of $6.8 billion in output and $7.5 billion in value added impacts [p.1]. The farmgate value is substantially multiplied along the value chain in terms of the total economic impact on Canada.

Ornamental horticulture is unique, as part of agriculture, in that once the product is sold to the consumer, it has a “second life” under the care of the consumer that can last for decades. This “second life” also generates a significant economic impact through the services sector of ornamental horticulture. While the services sector is not considered as “agriculture”, it is an important integrated part of the value chain and also has significant research needs.

Growth in the sector has levelled off this decade and in some of the segments, exports have significantly declined. The slowdown in growth is partly due to currency rate adjustment as the Canadian dollar increased in value over the previous decade. The Canada-Colombia Free Trade agreement removed tariffs on cut flower imports from Colombia making them more competitive in the domestic market.

A sector this large and diverse needs an innovation strategy to ensure that public and private research investments are directed where they will collectively have the greatest return and positive impact. Thus, the consultative work done with sector stakeholders that led to the development and publication of this strategy is a necessary step. The strategy...
will serve as a blueprint to set direction for specific sector outcomes going forward.

Concurrently with the publication of the Deloitte report noted above, the sector developed a strategy under the name, Growing Canada Green for 2015. One of the six pillars of the strategy relates to research and innovation:

Ensure that publicly funded research is targeted to the sector’s highest priority areas and that there is accountability for results that are transferred to and able to be used by the sector.

This goal recognizes the need for determining priorities and targets, maintaining accountability for research outcomes, and ensuring that the research has value to the sector and is able to be adopted by it. The development of the innovation strategy in this document is consistent with this pillar and goes beyond it in including the role of privately funded research also. Individual firms in the sector and the trade organizations that represent them invest in research, understanding how important innovation is to the future competitiveness of the sector.

WHY IS INNOVATION IMPORTANT TO THE FUTURE PROSPERITY OF THE ORNAMENTAL HORTICULTURE SECTOR IN CANADA?

Innovation is essential to provide consumers with new products and services and the value chain with opportunities to break out of commoditized low margin products and earn better returns.

Innovation will be important to enabling new products to gain market share and establish higher, more sustainable margins: products tend to have better returns at the early and middle growth stages of their life cycle rather than at points in the life cycle where they are mature and have become commoditized. Innovation is therefore important to generating higher returns for growers, landscapers and merchandisers throughout the value chain by ensuring a stream of new products and services.

Commodity products

A container of potted mums sells for $3.20 today, at the same price point as twenty-five years ago.

In real terms, the price consumers are willing to pay for commodity plants (bedding plants, some potted flowers plants, etc.) in ornamental horticulture has declined over twenty-five years. The innovation strategy is important to enabling growers to break out of this low value cycle.

To the extent that there will always be a mainstream market for commodity plants in ornamental horticulture, the innovation strategy is important to enabling growers to produce high volume quality products at low cost – efficiently using energy and productively using labour and other inputs.
THE PROCESS FOR DETERMINING PRIORITIES

On December 6th 2012, Vineland Research and Innovation Centre, in partnership with the Canadian Ornamental Horticulture Alliance (COHA), organized an innovation strategy workshop. This event, for which simultaneous translation in French and English was offered, enabled sector leaders from across Canada to actively engage in the development of research priorities in a strategic context. Stakeholders provided input into the development of this strategy through this consultative forum.

COHA is composed of three partners: the Canadian Nursery Landscape Association (CNLA), la Fédération Interdisciplinaire de l’Horticulture Ornementale du Québec (FIHOQ) and Flowers Canada Growers (FCG). Each of these partners works with its members and stakeholders to develop research strategies that address their priorities. Together, the Alliance represents the whole value chain in ornamental horticulture. The research and innovation strategy set forward in this document is unique because it represents the convergent needs and priorities on a national level. The whole is greater than the sum of the parts. There is a critical mass factor that comes from the convergence of research needs.

When compared, there was a high level of convergence to which each COHA partners assigned their priority ranking:

TABLE 2 - CONVERGENT RESEARCH PRIORITY THEMES AS RANKED BY PARTICIPANTS ON DECEMBER 6

<table>
<thead>
<tr>
<th>Research Theme</th>
<th>FCG</th>
<th>FIHOQ</th>
<th>CNLA</th>
<th>Ranking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water (nutrient management)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Market and Consumer Research</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Environmental Best Practices</td>
<td>5</td>
<td>4</td>
<td>5</td>
<td>3*</td>
</tr>
<tr>
<td>Efficiencies (Energy, Other Inputs)</td>
<td>4</td>
<td>3</td>
<td>7</td>
<td>3*</td>
</tr>
<tr>
<td>Green Infrastructure</td>
<td>8</td>
<td>5</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Product Innovation</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Pest Control including biological</td>
<td>3</td>
<td>7</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Human Resources / productivity</td>
<td>7</td>
<td>8</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Post Harvest Technologies and N/R</td>
<td>N/R</td>
<td>9</td>
<td>N/R</td>
<td>8</td>
</tr>
</tbody>
</table>

*tied for third place
Floral greenhouse operators have more direct application opportunities for biological controls than nursery landscape growers and operators which explains why certain priorities were ranked differently. Agriculture and Agri-Food Canada’s Horticulture Value Chain Round Table (HVCRT) also identified broad research priorities. Participants in that process collectively identified water, market intelligence, human resources and environmental best practices as key priorities. (Participants represent all of Canadian horticulture not just the ornamental sector). The results reported in the table above for the ornamental sector are consistent with the work of the HVCRT and underscore the value of industry-government partnerships such as the HVCRT as working forums.
Participants at the innovation strategy workshop spent time addressing factors that are driving change in the external environment in which ornamental horticulture is positioned. Nine significant change drivers were identified:

>> Climate Change

While climate changes bring challenges to the sector, it also opens opportunities.

Climate change brings uncertainty related to precipitation patterns and temperatures and the adaptation of pests to certain areas where they could not survive in the past. Producers and merchandisers must be responsive to the need for ornamental plants that can thrive with less water and potentially greater temperature ranges including prolonged elevated temperatures in the summer. They must also be alert to the introduction of invasive pests.

On the other hand, plants represent one of the solutions to climate changes (mitigating urban heat islands, water run-off and soil erosion, etc.).

>> Global Population Growth

As global population expands by an estimated 2 billion people over the next forty years, and incomes rise for a growing middle class in developing countries, there will be more intense competition for resources including arable land and water. Phytotechnologies and green infrastructure offer solution to stormwater management, blue green algae control, remediating water, air and soil by removing contaminants. These green solutions can be implemented at a lower capital and operating cost than grey infrastructure requires. Plants are natural means for conditioning air and water, by removing contaminants, and for modulating temperatures. There will be an enhanced need for plant solutions in urban areas to make increasingly dense urban environments more livable. There will be a strengthened need for precise water conservation methods throughout all phases of the propagation and growing cycle as the competition for water becomes more intense and government, responding to society’s expectations, increasingly regulates and charges for the resource.

>> Expanded International Trade and Travel

As the number of consumers that travel internationally continues to rise
and international trade continues to expand – with Canada actively pursuing membership in the Trans Pacific Partnership trading bloc – Canadian consumers will be exposed to more international ideas and more imported products, with the associated risk of new pests and disease complexes. Ornamental horticulture will increasingly take on a global perspective.

>> Celebrating Canada’s Identity

There is an emerging counter-trend to globalization of trade in ornamental products in favour of native plants as part of the need to preserve biodiversity and to celebrate natural endowments that are uniquely Canadian expressions of form and beauty. Native plants are well adapted to our natural environment. A segment of the population is concerned about invasive species imported from other parts of the world. There is opportunity to develop native plants for commercial production that perform well in undisturbed environments and with minimal care. There is an important mainstream market for plant cultivars that perform well in modified and urbanized environments and that are cold hardy.

>> Discretionary Spending Options

Consumers will have an expanded range of products and services where they can spend their discretionary income including travel. Gen X and Gen Y consumers are particularly mobile in terms of where they spend and tend to have less loyalty than their parents’ generation to gardening activities. To attract consumer dollars to ornamentals, products will need to have outstanding quality and be easy to work with and receive satisfaction from the experience.

>> Changing Demographics of Canadian Consumers

Accounting for the major domestic population net increase year over year, Canada’s population continues to be shaped and defined by immigrants. Understanding the needs and tastes of immigrant consumers for ornamental horticulture products and services will open new markets. They celebrate and observe additional festive events and cultural occasions to those currently celebrated in Canada like Valentine’s Day, Easter and Mother’s Day. Some immigrants originate from nations which typically spend more per capita on ornamental plants than we do in Canada, representing an important opportunity for market growth.

The Deloitte report identified Canada’s Baby Boom generation as one with significant discretionary income for which gardening is a logical lifestyle choice and saw an expanding market for ornamentals this decade from that large demographic segment.

>> Canada is a High Labour Cost Economy

Relative to many other countries of the world, Canada is a high labour cost economy where labour is not plentiful. Therefore, Canadian ornamental producers and operators must utilize technologies that contribute to high levels of worker productivity. Research is needed to continue to develop
and apply these highly automated technologies. The use of advanced technologies, in turn, requires a highly skilled labour force to be able to operate and maintain the equipment. The more that the sector is able to employ its workforce year-round, as opposed to seasonally, the more it will be able to justify investment in upgrading the skills of its workforce and the better it will succeed in attracting and retaining talent.

>> Energy Costs

Energy is used by the ornamental sector throughout the value chain. Greenhouse floriculture is the most energy intensive segment of ornamental horticulture, as the greenhouses need to be heated especially during winter months and supplementary lighting frequently needs to be supplied to augment sunlight. Competitors at latitudes closer to the equator do not have the same heating cost factor but have to ship their product by air freight over much longer distances to reach the Canadian market. The cost of oil and natural gas are important factors in determining the relative competitive position of the sector. Technologies and genetics that allow less energy to be used will contribute to the competitive position of the sector. Certain crops thrive in cooler temperatures and can be well adapted to Canada’s growing conditions.

>> Government Regulation

Regulatory changes by Canada as well as provincial governments and municipalities can have an impact on the market for ornamentals products and services. They can also add to costs by making the market more regionally segmented. Regulatory changes by foreign governments can also affect access to export markets. Regulation and enforcement related to plant health can have a major bearing on grower profitability and risk. Research is important to helping the sector adapt to regulatory changes and for ensuring that there is a sound scientific basis for regulation.
INNOVATION STRATEGY GOALS

The foundation of every successful strategy lies in setting goals and targets that are attainable but which require the sector to stretch to reach them. The strategy is based on growing the sector, making a greater impact on the Canadian economy while also positively contributing to Canada’s environment and quality of life for Canada’s people. The strategy anticipates making measurable improvements in returns (profits) to the value chain, the value chain’s market share of the Canadian market for ornamental products and services, public perception of the sector’s role and value, effective risk management and the balance of international trade in ornamental products.

The goals of the innovation strategy of the Canadian ornamental horticulture sector are:

#1 Increase profitability throughout the value chain:

• Achieve increases in profitability by:
  – increasing the value proposition, i.e. that amount that the consumer is willing to pay
  – increasing yield (productivity) without increasing input costs and
  – reducing costs throughout the value chain including shrinkage and loss
• Profitability is also correlated to stability and predictability – to provide greater assurance of appropriate returns, it is important to mitigate risks that can be disruptive to markets and cost structures
• Achieve a higher level of integration along the value chain as measured by less reliance on foreign technology and imported products and greater domestic market share

#2 Grow the market across the value chain:

• increase the value perceived by consumers for the sector’s products and services by understanding consumer needs and effectively communicating with consumers
• position the sector as a solution-provider to urban needs for plants
• think globally to determine how to increase the overall market share of the Canadian ornamental sector, utilizing Canada’s resources and the sector’s technology to penetrate other temperate-zone markets

#3 Increase the favourable image and positive perception of the sector across society by being leaders in the adoption of best practices

#4 Enable the sector to adapt to and comply with regulations in line with society’s expectations and contribute information that allows regulations to be science-based
### Research Priority

#### 1 Efficient water use and effective nutrient management

The sector takes a holistic view of water use, from the beginning of the growth cycle through to the use of ornamental product by the end user (consumer, municipality, green space operator, etc.), seeking to optimize the use of water at each point in the cycle. Optimal water use requires research into such species/cultivar specific factors as:

- **Understanding how much water the plant requires and when and how it is best administered from production to consumer level**
- **Understanding what soil media best retain moisture and create optimal conditions for root development**
- **Understanding the minimum quantity of nutrients, including micro-nutrients, required by the plant at each stage of growth and how they are most effectively administered to minimize leaching**

Optimal water use also requires an understanding of technologies to optimize water usage and conservation, to collect and store water, to adjust its pH levels, and to treat it for recirculation to remove pathogens while allowing residual nutrients to be used by the plant.

### Outcome Targets

Adoption throughout the value chain, including consumers:

- To measurably reduce the amount of water used per unit
- To reduce the amount of nutrients applied per unit without compromising yield and plant health
### Research Priority

| 2 | Market and consumer research |

Ornamental horticulture has unique needs for understanding consumers. The sector competes for consumer dollars in the impulse category for spending on discretionary items like cut flowers; it must be current and responsive to trends. Many tree and shrub products have long cycle times (over ten years) while the product is growing in inventory before they are ready for sale. This extended lead-time for introducing new products requires an excellent understanding of consumer trends, including what factors motivate consumers to buy (or not buy), in order to be able to predict what product offerings might be in demand ten years ahead. Market and consumer research requires asking the right questions and obtaining the best answers to predict future purchase habits and consumer preferences to be able to position the value chain to have the right ornamental products and services to offer. Key questions include:

- **What are the criteria and key purchase decision drivers for each generational demographic segment and the trends for different plant categories (bedding plants, perennials, foliage, cut flowers, sod, trees, shrubs, fruits and vegetable plants, etc.)?**

- **As Canada’s demographic profile changes, the expectations of immigrant Canadians and the coming generation for ornamental horticulture experiences need to be understood – what products and services are they looking for, what information do they need?**

- **How can point of sale messaging be improved to better inform consumers, to increase their chances of obtaining satisfaction from their purchase and increasing their purchase frequency?**

| Outcome Targets |

To gain a clear understanding of the different segments of the Canadian market including what drivers motivate consumers to purchase ornamental products and categories in order to better respond to consumer needs and expectations contribute to the perception of value and the commitment to pay for it. This response involves not only offering the right products at the right price points but understanding how to communicate information to consumers to enable them to enjoy their ornamental product to the fullest extent.

To gain an understanding of opportunities in international markets where Canadian-grown products can supply a need as access to land and other resources for growing ornamentals becomes compromised in those destination markets.
## Research Priority

<table>
<thead>
<tr>
<th>Outcome Targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>• What markets outside Canada, with similar soil and climate conditions, could be supplied by Canadian-grown products?</td>
</tr>
<tr>
<td>• How are the needs of institutional (as opposed to consumer) buyers, such as municipalities, changing?</td>
</tr>
<tr>
<td>• What are the needs of emerging markets such as green infrastructure (as outlined in research priority #5)?</td>
</tr>
</tbody>
</table>

### 3 Environmental Best Practices

Environmental best practices concern a number of factors and, as climate change occurs, are dynamic. They include steps:

- to reduce the carbon footprint of the production cycle in sod, woody plants, perennials and greenhouse crops (bedding plants, potted flowering crops, cut flowers, etc.)
- to reduce the use of plastic materials in production equipment and product containers by identifying better alternatives
- to recover value from co-products
- to optimally utilize soil as a valuable resource and renew soil health in crop production cycles
- to use ornamentals to reduce nutrient runoff
- to overseed in turf for weed reduction

Sustainability indices have been introduced by major merchandisers in Canada. They provide one benchmark for measuring environmental impact. The sector’s target is to achieve progressively better scores for ornamental products as the overall environmental impact of the sector is reduced through such means as reducing packaging materials and carbon consumption while increasing carbon sequestration.
<table>
<thead>
<tr>
<th>Research Priority</th>
<th>Outcome Targets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>4 Efficient Use of Energy</strong></td>
<td>To reduce the overall energy required per unit of production and sales without affecting yield and plant health</td>
</tr>
<tr>
<td>Energy is used in the propagation of the product as well as in shipping. Research will include such measures as ones that:</td>
<td></td>
</tr>
<tr>
<td>• use less heat and electrical energy</td>
<td></td>
</tr>
<tr>
<td>• represent less heat loss</td>
<td></td>
</tr>
<tr>
<td>• more efficiently provide artificial light in wavelengths that can be absorbed by the plants</td>
<td></td>
</tr>
<tr>
<td>• diminish the use of any type of energy (Fuel, etc.)</td>
<td></td>
</tr>
<tr>
<td>• plant genetics that thrive at lower production temperatures or under lower light conditions</td>
<td></td>
</tr>
<tr>
<td>• enable less energy to be used by consumers by providing green solutions (shade trees, measures to counter urban heat islands, etc.)</td>
<td></td>
</tr>
<tr>
<td><strong>5 Development of Green Infrastructure</strong></td>
<td>To be leaders in the design and supply of green infrastructure and to drive double digit growth in this market</td>
</tr>
<tr>
<td>“Green infrastructure” refers to green roofs, green walls and green spaces developed in intensive urban areas.</td>
<td>To provide lower cost, more environmentally friendly alternatives to grey infrastructure for municipalities and commercial institutions. Increase ornamental horticultural applications to mainstream needs that have traditionally used other solutions</td>
</tr>
<tr>
<td>• As more building codes mandate green infrastructure in new building design, the sector needs to understand what ornamental plant products offer the best configuration for each application across Canada's different cities and hardiness zones</td>
<td></td>
</tr>
<tr>
<td>• In addition to questions of optimal design, there is a need to understand how to best grow, implement and maintain green infrastructure to ensure longevity and effectiveness.</td>
<td></td>
</tr>
<tr>
<td>Research Priority</td>
<td>Outcome Targets</td>
</tr>
<tr>
<td>-------------------</td>
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</tr>
<tr>
<td><strong>6 New Product Introductions</strong></td>
<td>To introduce new products each year that represent at least 1% of the Canadian market as measured by farmgate value (i.e. achieving approximately $20 million in sales annually)</td>
</tr>
<tr>
<td>• The ultimate goal is to have new product introductions for which the plant breeder’s rights are held in Canada so that royalties from licensing accrue back to Canadian researchers. The need for a steady stream of introductions across different product segments has been identified and requires understanding the genetic components and how they can be modified to achieve specific trait expression.</td>
<td></td>
</tr>
<tr>
<td>• Traits of interest include drought resistance, heat tolerance and winter hardiness.</td>
<td></td>
</tr>
<tr>
<td>• “Product” is defined broadly to include not only the plant itself but the container and presentation as well as new supporting products that could benefit the industry, such as new substrates, new fertilizers, etc.</td>
<td></td>
</tr>
<tr>
<td>• Participants expressed the view that there is a trend towards edible ornamentals and see demand potential for new products that answer this need.</td>
<td></td>
</tr>
<tr>
<td>Research Priority</td>
<td>Outcome Targets</td>
</tr>
<tr>
<td>-------------------</td>
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</tr>
<tr>
<td><strong>7 Integrated Pest Management Practices</strong></td>
<td>To expand the use of integrated pest management practices throughout the value chain; develop the use of biological controls in application to nursery crops and sod, and to strengthen Canada’s leadership position in the application of biological controls in greenhouse production</td>
</tr>
</tbody>
</table>

The goal is to achieve integrated pest management strategies in production and all across the value chain. Where feasible, the goal is to optimize the use of biological controls to maximum yield and plant quality while minimizing cost and environmental impact.

- As the disease and pest complex continues to adapt to existing technologies and new challenges are identified from imported stock, the need to stay ahead of the game with effective chemical and biological control tools (including biopesticides and bioherbicides) is essential.

- *Complete an integrated pest management strategy for every crop and types of production up to the municipalities’ and consumers’ level*

- *Expanded use of biological controls will reduce the environmental impact and increase the effectiveness of control measures against common pests such as aphids and white fly.*

- Research must be rapidly undertaken when crises arise in order to identify the pest or disease issue and determine how it can most effectively be addressed.

- *Biocontrol production systems are sensitive and integrated; when chemical crop protection agents are introduced it can severely impact the balance. There is much research needed on determining the compatibility of mutual interactions among agents to have a responsive biocontrol management system for diseases and pests.*

- *Biosurveillance to document and record disease and pest pressures and track how they are changing*
<table>
<thead>
<tr>
<th>Research Priority</th>
<th>Outcome Targets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>8 Human Resource Best Practices / Worker Productivity</strong></td>
<td>To increase worker productivity each year and reduce the cost of workers’ compensation premiums</td>
</tr>
<tr>
<td>There is a need to ensure that technologies are deployed that:</td>
<td></td>
</tr>
<tr>
<td>• maximize worker productivity</td>
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<td>• reduce the risk of repetitive strain injury</td>
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<td>The ability of robotic and other automation tools to be adapted in their application from one crop to another will increase their utilization and return on investment.</td>
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<tr>
<td><strong>9 Post Harvest Technologies and Handling</strong></td>
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<td>To service export markets, it is necessary to further develop soil free technologies for long distance shipping and plant viability.</td>
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<tr>
<td>In the domestic market, to improve the shelf life of products at consumers’ level including cut flowers and potted flowering crops.</td>
<td>To improve the sector’s capacity to improve products’ shelf life (cut flowers, potted crops) and ship product over long distances while maintaining high plant quality</td>
</tr>
</tbody>
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