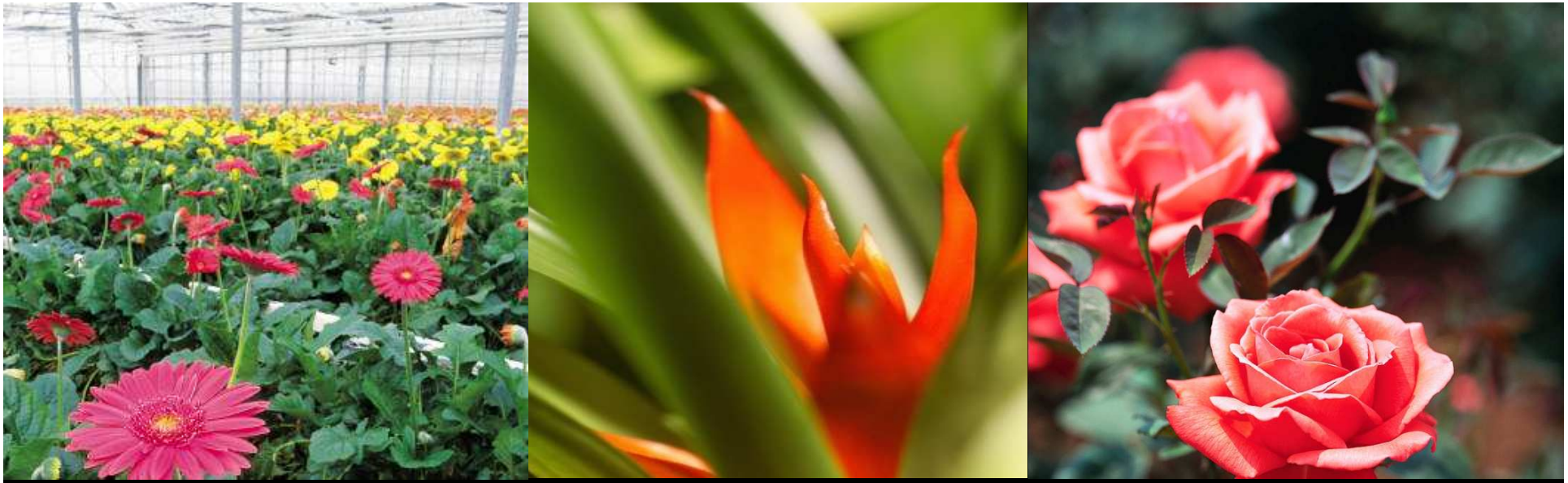


Prepared for the Flowers Canada Growers by MNP LLP
March 31st , 2013

Adoption of Biocontrol Agents in Canadian Floriculture Greenhouses: SWOT and Economic Impact Analysis

Outline

1. Executive Summary

Biocontrols in Canadian Floriculture Greenhouses, Advantages and Barriers to Adoption, Feasibility and Economic Impacts.

1.1 Biocontrols in Floriculture Greenhouses

- **Canada is a leader in biocontrol use in floriculture greenhouses**. According to a survey conducted by MNP of floriculture growers across Canada, 90% and 79% of respondents currently use biocontrols and biopesticides, respectively. The survey respondents accounted for 972,428 m2 or 12% of the total flower greenhouse area in Canada.
- **Biocontrol adoption in flower greenhouses is increasing.** According to biocontrol industry representatives, biocontrol adoption in Canadian flower greenhouse operations has increased mainly due to pesticide resistance, scarcity of conventional pesticide products available to growers in the market and high efficacy of biocontrols.
- **In Canada, the biocontrol industry is dominated by a relatively small number of manufacturers (approximately four)** supplying a number of biocontrol products mainly to the horticultural and floriculture industry. Most Canadian biocontrol firms undertake mainly sales and distribution of biocontrols, along with testing, research and technical support, and are subsidiaries of multinational companies based in Europe. The majority of biocontrol production for the floriculture industry takes place overseas.

1.2 SWOT Analysis

Main Strengths	Main Weaknesses
• Can effectively manage and delay pest resistance. • Can provide levels of control equal to or better than pesticides for some major pests. • Low probability of harmful effects on the environment. • Reduce chemical exposure to the grower, workers, applicators and consumers. • Increased safety, comfort and psychological well-being of workers due to the reduction of pesticide use. • Reduction of pesticide use lowers crop stress and thus improves crop quality and yield. • Easier access to crops due to the reduction and or elimination of Restricted Entry Intervals (REI).	• General lack of knowledge on availability and proper use of biological control agents. • There can be a steep learning curve in implementing biological controls. • Initially higher costs for using biocontrol agents. • Uneven technical support across biocontrol companies and provinces. • Can be difficult to get new biocontrol agents approved for release in Canada. • Biological controls can have slower efficacy than pesticides. • Lack of information on pesticides in propagative material can threaten the establishment of biocontrol programs.

1.2 SWOT Analysis

Main Opportunities	Main Threats
• Potential to increase consumer awareness of products grown using biological controls. • Partnering with and supporting growers to experiment with biocontrols. • Increasing understanding of how to effectively use biocontrols. • Increasing number of growers using biocontrol agents provides support/comfort to peers starting to use them. • Potential growth of domestic biocontrol production and native biocontrol sourcing. • Reduced market access to conventional pesticides increases growers' willingness and need to adapt alternative pest controls.	• Increased import barriers and inspections restrict market access to new biocontrols. • Few biocontrol agents control new pests / invasiveness. • Challenges faced in the first years of biocontrol implementation continue to impede growers from using biocontrols in the long term. • Pesticide residues found on imported propagative stock will continue to pose a risk to the efficacy of biocontrols and/or the IPM systems. • Decreases in biocontrol production could be a threat to Canadian floriculture growers.

1.3 Feasibility Analysis

- Our high level feasibility analysis showed that:
  - **Growers generally experience an increase in their pest control costs during the first years of biocontrol implementation.** This may be due to the fact that it takes roughly 1 to 3 years for growers to adapt to biocontrols and that gearing up an effective biocontrol program takes time and investment.
  - **Very few growers experience pest control cost savings initially from using biocontrols.** According to our survey, only 18% of survey respondents have experienced pest control savings from using biocontrols in the first three years following implementation. Generally growers experienced a reduction in their environmental and protective gear costs by 6% and 7% respectively.
  - **Although generally growers experience an increase in their pest control costs during the first years of biocontrol implementation, growers may also experience some costs savings and benefits from biocontrol that are difficult to put a value on, but which may be substantial** e.g. improvement of staff morale and health, improved crop quality, reduced crop losses. Also, the use of biocontrols can prevent/delay the development of resistance in key pests and preserve the activity in pesticides for use in emergencies or to clean up crops at the end of a growing cycle for export or retail.
  - **Growers generally experience very small increases in price received for products grown using biological control / IPM programs and in revenue from elimination of Restricted Entry Intervals (REI).** According to our survey, growers have experienced on average 2% increase in the price of products grown using biocontrols and 1% increase in their revenues from reduced REI.
  - **Biocontrol use contributes to growing $1.1 billion of annual cash receipts in flower crops in Canada.**

1.4 Economic Impact Analysis

- Below, MNP presents the annual economic impacts for the biocontrol industry in the floriculture sector in Canada (based on an analysis of grower spending and use of an input-output model).

	Output	GDP	Employment (FTEs)	Total Tax Revenue
Direct	$11,177,060	$5,770,383	73	$1,203,050
Indirect	$7,364,407	$4,041,153	39	$834,459
Induced	$5,343,009	$5,343,009	33	$609,077
Total	**$23,884,475**	**$15,154,545**	**144**	**$2,646,586**

- Please note totals may not add up due to rounding.

1.4 Economic Impact Analysis

- **Output -** Total direct, indirect and induced output generated by the biocontrol industry in the Canadian floriculture sector is estimated to be close to $24 million.
- **GDP -** Total direct, indirect and induced GDP generated by the biocontrol industry in the Canadian floriculture sector is estimated at $15 million.
- **Employment -** Approximately 144 direct, indirect and induced full-time equivalent positions (FTEs) are generated by the biocontrol industry in the Canadian floriculture sector. This employment supports close to $6.4 million in direct, indirect and induced wages and salaries.
- **Total Tax Revenue -** Aggregate direct, indirect and induced taxes generated by the biocontrol industry in the Canadian floriculture sector are estimated at $2.6 million.

1.5 Recommendations – Education and Marketing

- Educate the supply chain and especially retailers and consumers on the benefits of biocontrol use. This can be done through a comprehensive marketing strategy that resonates with consumers i.e. “produced with biocontrol”.
- Undertake focus groups with consumers to identify the price consumers are willing to pay for flowers produced with biocontrol and ways to communicate competitive advantages of biological controls.

1.5 Recommendations – Communication of Impacts

- Communicate intangible benefits related to human health (health care costs) and the environment.
- Communicate the economic contributions of biocontrol use in Canadian floriculture greenhouses.
- Convey how biocontrols are an important factor supporting the industry's ability to grow and sell floriculture crops (farm cash receipts from the sale of flowers in Canada totalled $1.1 billion). This enables crops to be grown that may otherwise not be feasible with the current registered materials.

1.5 Recommendations - Growers

- Partnering with growers can help them overcome some of the barriers of adopting biocontrols (i.e. increased costs in the initial years of implementation). This could include free technical support, on farm trials and research projects.
- Use growers' word of mouth on their experience with biocontrols as a biocontrol promotion and information sharing strategy.
- Create a forum for discussion for growers and biocontrol industry specialists to share their experience and knowledge of biocontrols e.g. webinars, blogs, seminars and workshops, among others.

1.5 Recommendations – Collaboration

- Increase collaboration and sharing of biocontrol experience between the floriculture and horticulture industries.
- Communicate and share Ontario's R&D findings and biocontrol experience with other provinces.

2. Introduction

Project Background, Scope, Definitions and Industry Overview.

2.1 Background

- FCG commissioned MNP to carry out a SWOT and economic impact study of biocontrol use in Canadian floriculture greenhouses.
- A Steering Committee of industry experts advised MNP on this important initiative. Please see Section 7.5 (Appendix) for a list of committee members.

2.2 Scope

- Secondary research of published reports and information on the use of biocontrols in Canadian floriculture greenhouses.
- Primary research in the form of:
  - A survey of 42 floriculture growers.
  - Interviews with 7 major biocontrol companies and distributors.
  - Focus groups with growers, biocontrol company representatives, consultants, researchers and government representatives (over 30 representatives).
- An analysis of the primary and secondary data to prepare a SWOT and high level feasibility analysis.
- An economic input output model of biocontrols in Canadian floriculture.

2.3 Definitions

- ***Integrated Pest Management (IPM) –*** means the careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest populations and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourages natural pest control mechanisms (Food and Agriculture Organizations of the United Nations; FAO).
- ***Biological Control or Biocontrol –*** is the use of plant pest's natural enemies, namely predators, parasites, and pathogens to reduce pest populations to a tolerable level. Biological controls are a major component of an IPM strategy (Government of British Columbia, Ministry of Agriculture and Lands, 2010).

2.3 Definitions

- ***Biocompatible Pesticides –*** pesticides that are compatible with biological control agents.
- ***Biopesticides –*** are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals (US Environmental Control Agency).
- ***Scouting –*** is a routine and systematic way to gather information on crop problems and treatment efficacy. The purpose of scouting is that it enhances and expedites pest management decisions through early detection of pests, extent of infestations, location of infestations, and helps growers determine if pest management strategies are effective (Cornell University, College of Agriculture and Life Sciences).

2.3 Economic Impact Definitions

- ***Output –*** the total gross value of all business revenue. This is the broadest measure of economic activity.
- ***GDP –*** the "value added" to the economy (the unduplicated total value of goods and services).
- ***Government Tax Revenue –*** the total amount of tax revenues generated for different levels of government.
- ***Employment –*** the number of additional jobs created.
- ***Direct impacts –*** are due to changes to front end businesses that receive expenses or operating revenue as a direct consequence of an industry.
- ***Indirect impacts –*** are due to changes in the activity of suppliers.
- ***Induced impacts –*** are due to shifts in spending on goods and services as a consequence of the payroll of the directly and indirectly affected businesses.

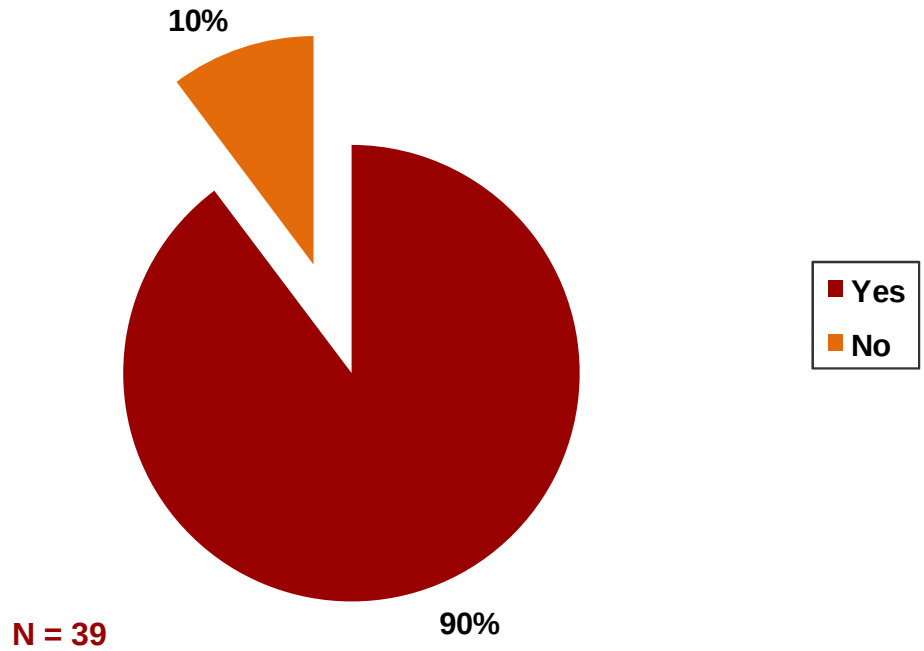
2.4 Biocontrol Industry Overview

- **Floriculture is an important and growing industry that contributes significantly to the Canadian economy.** In 2011, farm cash receipts from the sale of flowers in Canada totalled $1.1 billion or 4% of the total crop farm cash receipts in the country. Approximately, 85% of floriculture farm cash receipts in Canada are distributed among three provinces; Ontario (50%), British Columbia (22%); and Quebec (14%). Floriculture greenhouses produce a wide variety of crops, including bedding plants, flowering potted plants (seasonal and year round), cut flowers, perennials, and propagation material among others.
- **One of the many challenges faced by Canadian floriculture growers is the management of diseases and insects.** Many growers employ various pest control management techniques to reduce pest populations in their greenhouses. These include: pesticides, biocontrols, biopesticides and/or a combination of these techniques.

2.4 Biocontrol Industry Overview

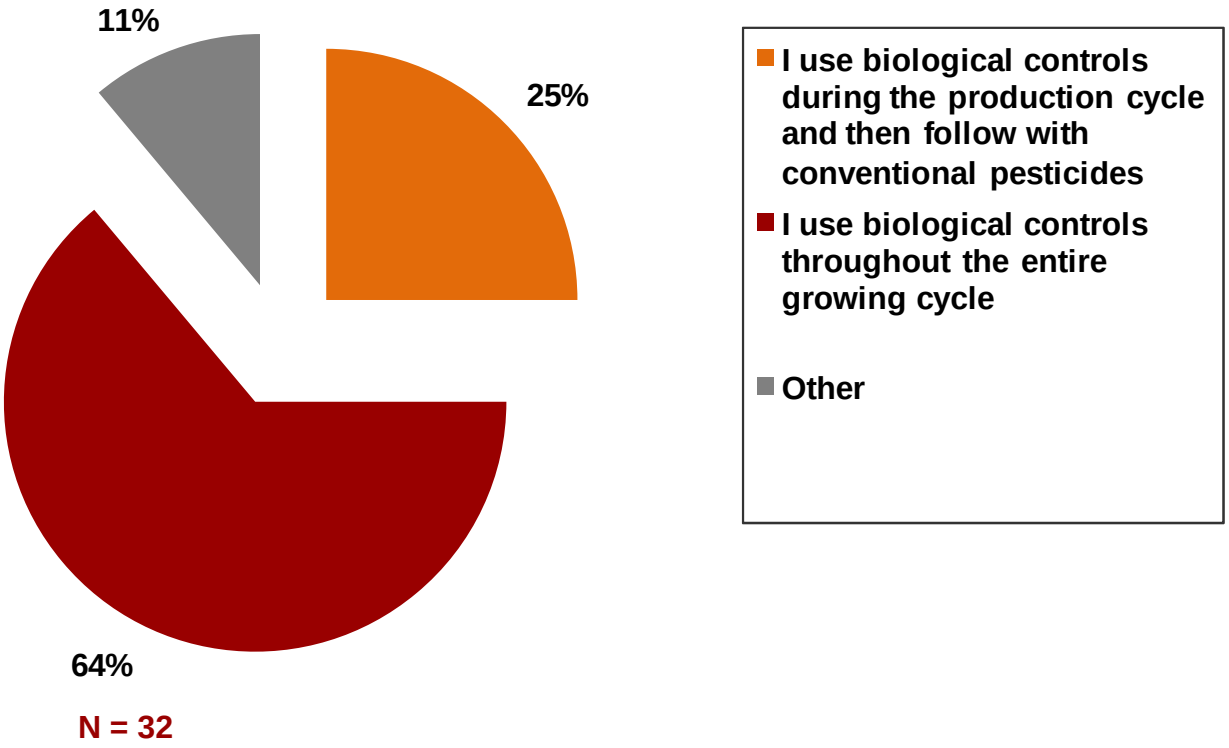
- **Canada is a leader in biocontrol use in floriculture greenhouses**. According to a survey conducted by MNP of floriculture growers across Canada, 90% and 79% of growers currently use biocontrols and biopesticides, respectively. The survey respondents represented 12% of the total flower greenhouse area in Canada. According to our survey, of 35 survey respondents who use biocontrol, on average 81% of their greenhouse area is under biocontrol.

Use of biocontrol pest controls



2.4 Biocontrol Industry Overview

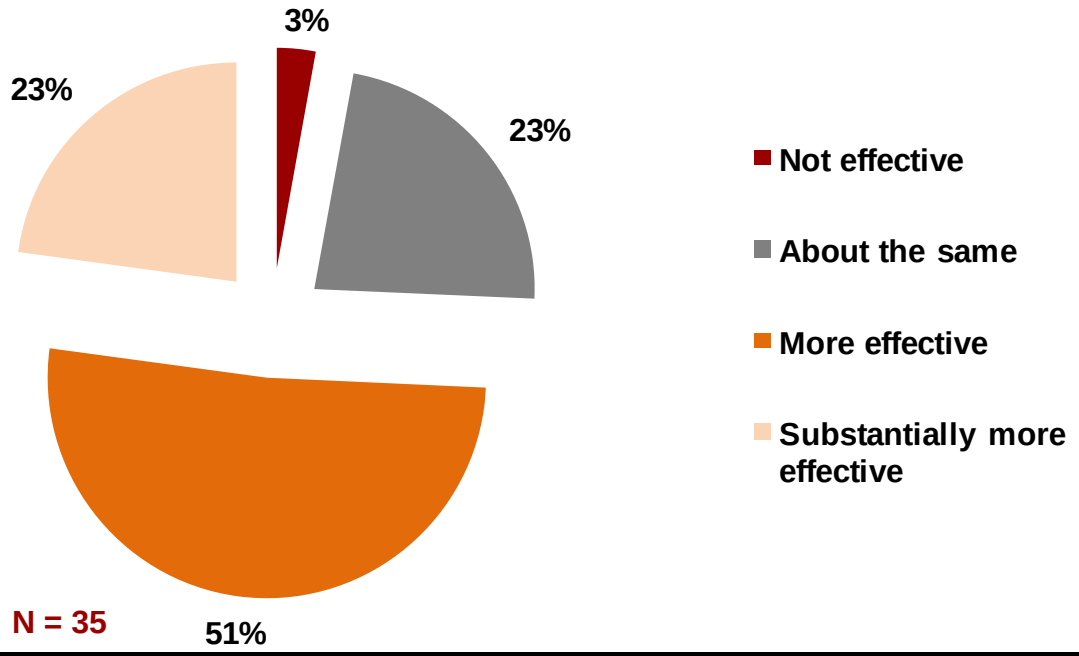
- **Biocontrols are used at different cycles of floriculture production.** According to our survey, the majority of growers (64%) use biocontrols throughout the entire growing cycle, whereas 25% of survey respondents use biocontrols during the production cycle but finish with conventional pesticides.



2.4 Biocontrol Industry Overview

- **Biocontrol adoption in flower greenhouses is increasing.** According to biocontrol industry representatives, biocontrol adoption in Canadian flower greenhouse operations has increased mainly due to pesticide resistance, scarcity of conventional pesticide products available to growers in the market and high efficacy of biocontrols. According to our survey, 74% of growers rated biocontrols more or substantially more effective than conventional pesticides.

Effectiveness of biocontrols compared to the use of conventional pesticides



2.4 Biocontrol Industry Overview

- **In Canada, the biocontrol industry is dominated by a relatively small number of manufacturers (approximately four)** supplying a number of biocontrol products mainly to the horticultural and floriculture industry. Most Canadian biocontrol firms undertake mainly sales and distribution of biocontrols, along with testing and technical support, and are subsidiaries of multinational companies based in Europe. The majority of biocontrol production for the floriculture industry takes place overseas.

2.5 Biocontrol Industry High Level Value Chain

Biocontrol Industry Value Chain

Inputs

- Market assessment
- Product research and development (R&D)
- Development of genetics
- Product monitoring/ stewardship
- Product trials
- Formulation
- Laboratory testing
- Domestic pest risk assessments

Production

- Operational functions:
  - Inventory
  - Quality control
  - Labeling control
  - Packaging
  - Product registration
  - Packaging innovation
- Administrative functions:
  - Sales
  - Customer service
  - Management and administration
  - Human resources
  - Book keeping

Transportation

- Exports controls and licensing
- Export registration
- Specialized storage services
- Specialized transportation services
- Transportation services:
  - Air transportation
  - Trucking

Sales and Distribution

- Exports
- Logistics
- Distribution
- Wholesaling
- Administrative functions:
  - Sales
  - Customer service
  - Management and administration
  - Human resources
  - Book keeping
- Operational functions:
  - Quality control
  - Inventory
  - Packaging
  - Labeling control

Product Implementation

- Consulting
- Technical support
- On farm quality control
- On farm residue testing
- On farm monitoring
- Customer service

Service and Support

- Financial services:
  - Accounting
  - Insurance
  - Other financial services
- Legal and professional services
- Consulting services

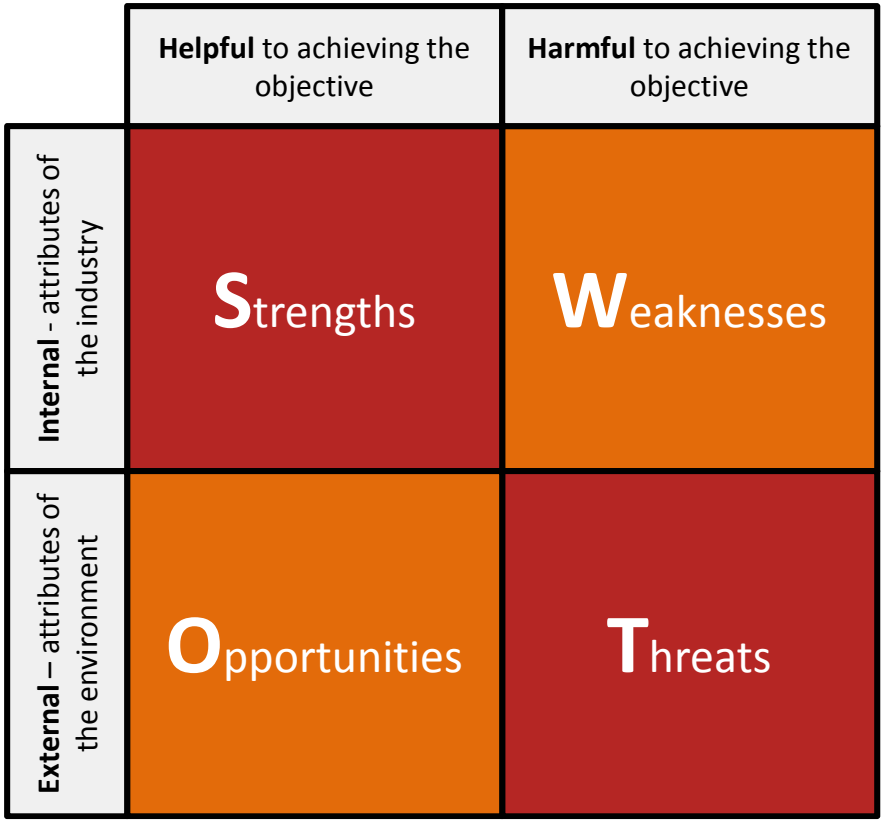
3. SWOT Analysis

Strengths, Weaknesses, Opportunities and Threats of the Successful Adoption of Biocontrol in The Floriculture Industry in Canada.

3.1 SWOT Overview

The SWOT analysis includes:

- **Strengths.** Internal attributes of biocontrol or the biocontrol industry that could be helpful to achieving success/or growth.
- **Weaknesses.** Internal attributes of biocontrol or the biocontrol industry that could be harmful to achieving success/growth.
- **Opportunities.** External conditions that could be helpful to the successful adoption of biocontrol in the floriculture industry in Canada.
- **Threats.** External conditions that could be harmful to the successful adoption of biocontrol in the floriculture industry in Canada.



3.2 Strengths

- Biocontrols have the potential to beneficially exploit pest systems with low probability of harmful effects on human health and the environment.
- Easier access to crops due to the reduction and or elimination of Restricted Entry Intervals (REI) required when using conventional pesticides.
- Reduction of pesticide use lowers crop stress and thus improves crop quality and yield.
- Integrated use of biocontrols and biopesticides can provide reliable and effective pest control.
- Pests are unable (or very slow) to develop a resistance to biocontrols.
- Biocontrols can provide levels of control equal to or better than pesticides for some major pests.
- Biocontrols can effectively manage and delay pest resistance.

3.2 Strengths

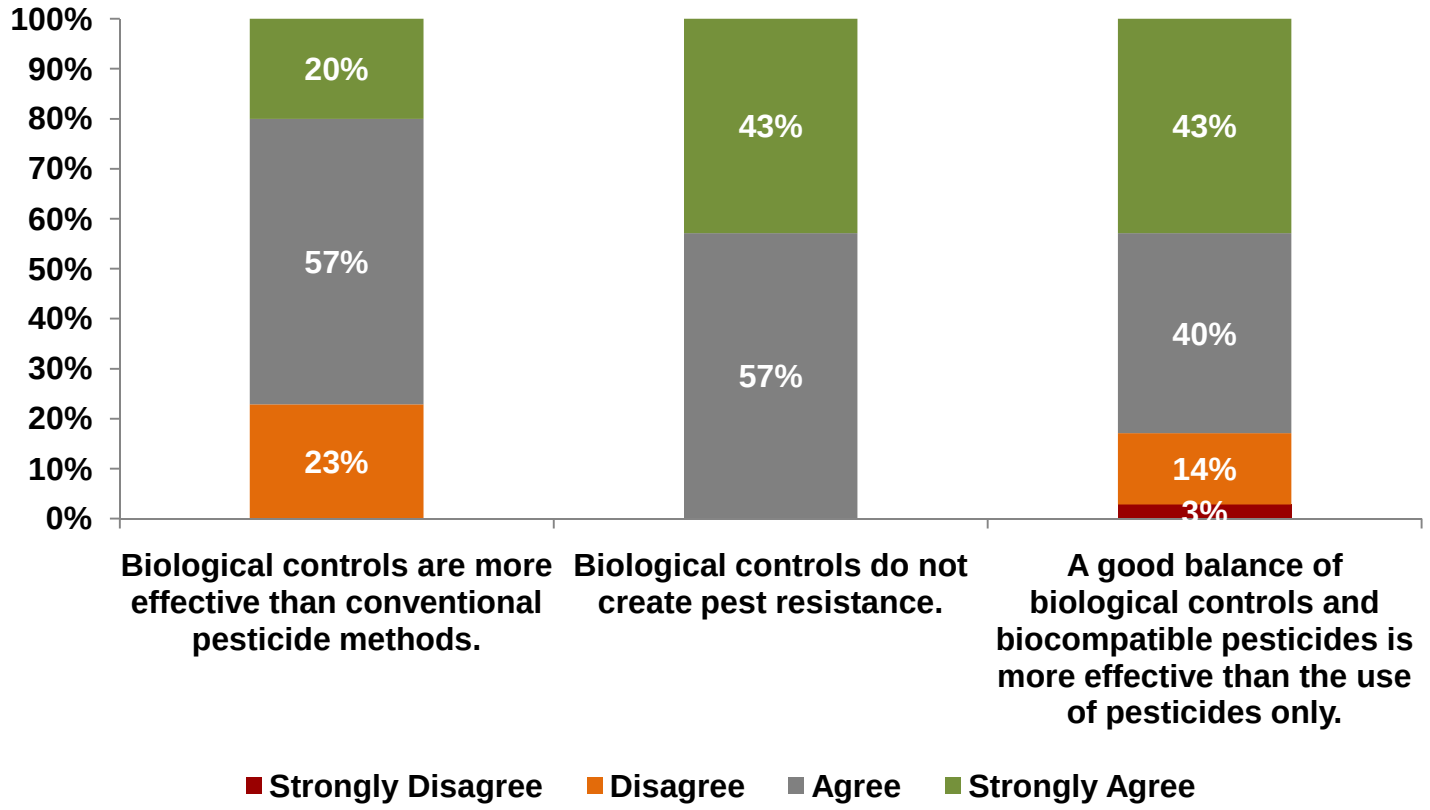
- Once properly implemented, biocontrols can be maintained because biocontrol population levels cycle proportionately with the population of the crop.
- Biocontrol implementation allows workers to diversify their pest control skills.
- Implementation of biocontrols can in some cases reduce pest management costs (as elaborated in the Feasibility section of this report).
- Biocontrols can provide pest control costs savings for growers in the long run.
- Canada is a world leader in biocontrol use in floriculture greenhouses.
- Adoption of less toxic pest control tools supports the industry's approach to sustainable floriculture production.
- Adopting biocontrol programs reduces chemical exposure to the grower, workers, applicators and consumers.

3.2 Strengths

- Increased safety, comfort and psychological well-being of workers due to the reduction of pesticide use.
- Small growers may find it easier to implement biocontrols due to the smaller area required to scout.
- Biological control products play an important role in pest management as pesticides become less accessible in the Canadian market.

3.2 Strengths

- Based on the MNP survey, 77% of growers agreed or strongly agreed that biocontrols are more effective than conventional pesticide methods. Eighty-three percent also agreed or strongly agreed that a good balance between biocontrols and biopesticides is more effective than the use of pesticides only.



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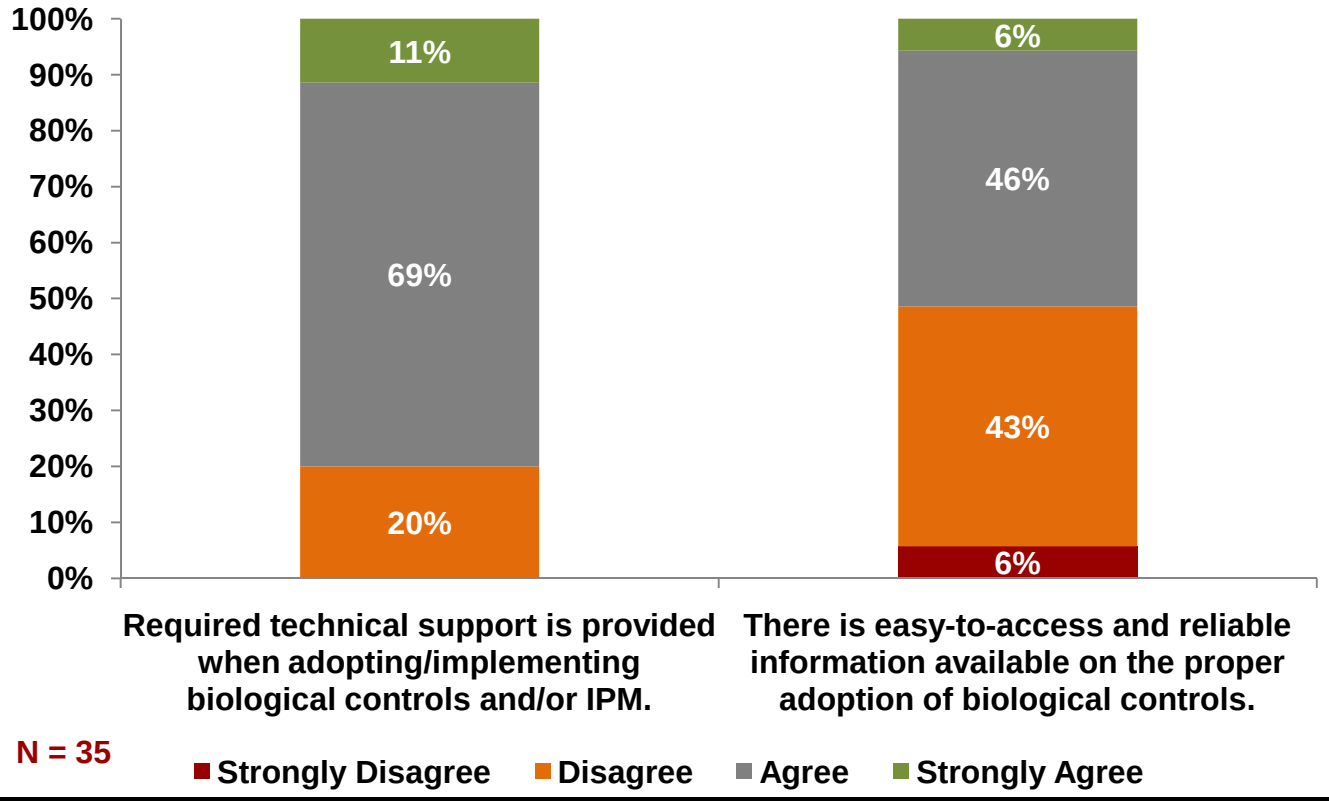
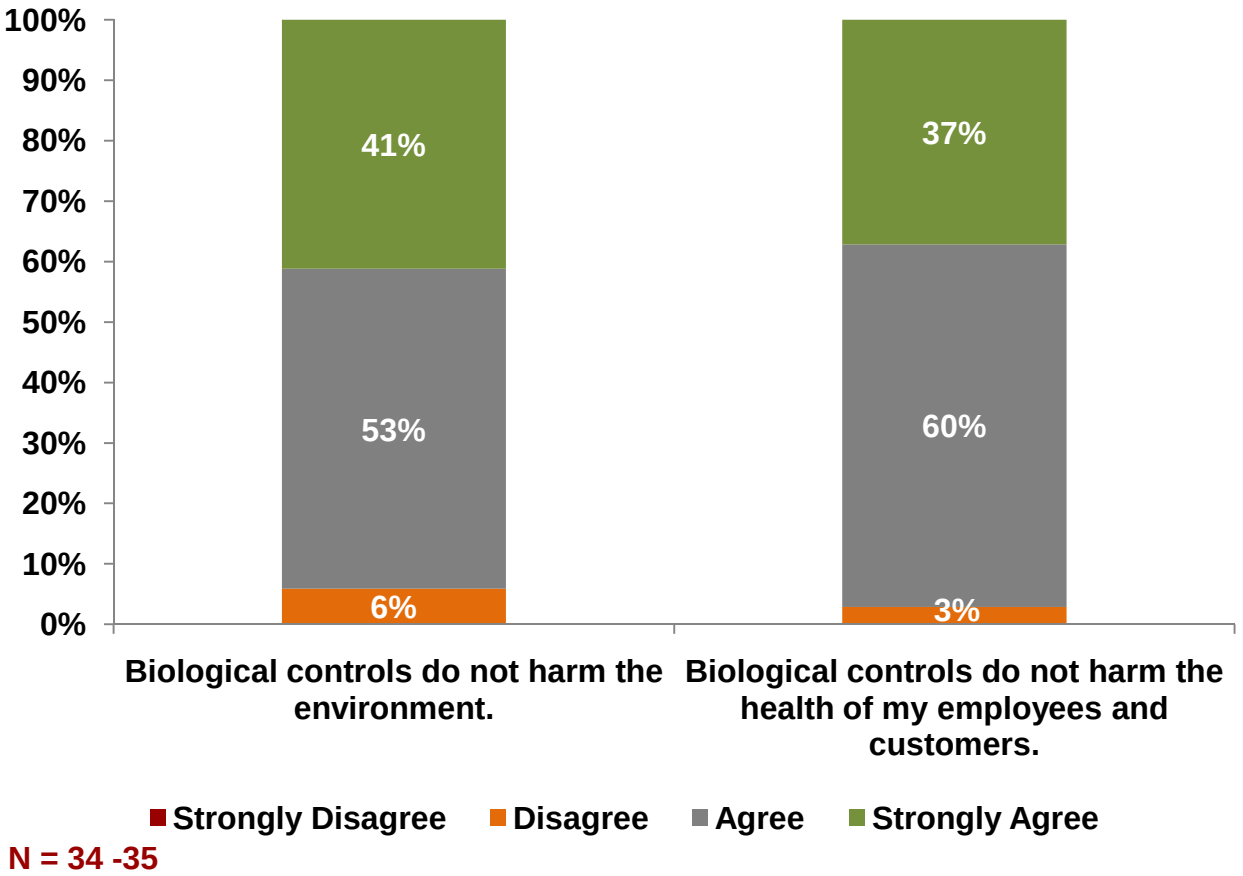
3.2 Strengths

- According to our survey, even though about half (52%) of survey respondents disagree or strongly disagree there is easy-to access and reliable information available on the proper adoption of biocontrols, 80% agree or strongly agree that required technical support is provided when adopting/implementing biocontrols and or an IPM system.



3.2 Strengths

- According to the MNP survey, 94% and 97% of growers agree or strongly agree that biocontrols do not harm the environment nor the health of their employees and customers.



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3.3 Weaknesses

- Lack of awareness by retailers and end-consumers on biological control.
- Consumers are less concerned about the inputs used in floriculture production as flower crops are non-edible.
- Floriculture crops are valued for their aesthetic value, which is diminished by the visual presence of biocontrols or pests.
- Lack of information on cost savings and benefits of biocontrol.
- Lack of easy to access and centralized information on how to properly adapt and implement biocontrols in floriculture greenhouses.
- Lack of knowledge on the interaction between specific crops and biocontrol agents and other crop management tools, including other biocontrol practices.
- General lack of knowledge on availability and proper use of biological control agents.
- Lack of information on pesticides in propagative material can threaten the establishment of biocontrol programs.

3.3 Weaknesses

- Biocontrol is a very knowledge-intensive strategy with a steep learning curve for growers when first implementing biocontrols.
- Biocontrol implementation requires intensive monitoring and scouting.
- There is a larger number of bioproducts and monitoring tools required (larger investment) when adopting an IPM system.
- Multiple crops under the same greenhouse area require a more dynamic pest control system.
- Inconsistency of biocontrols' quality and performance.
- Lack of biocontrol testing procedures.
- Biocontrols may have varying efficacy results depending on the geography and climate where they are applied.
- Biocontrols can have slower efficacy than pesticides.

3.3 Weaknesses

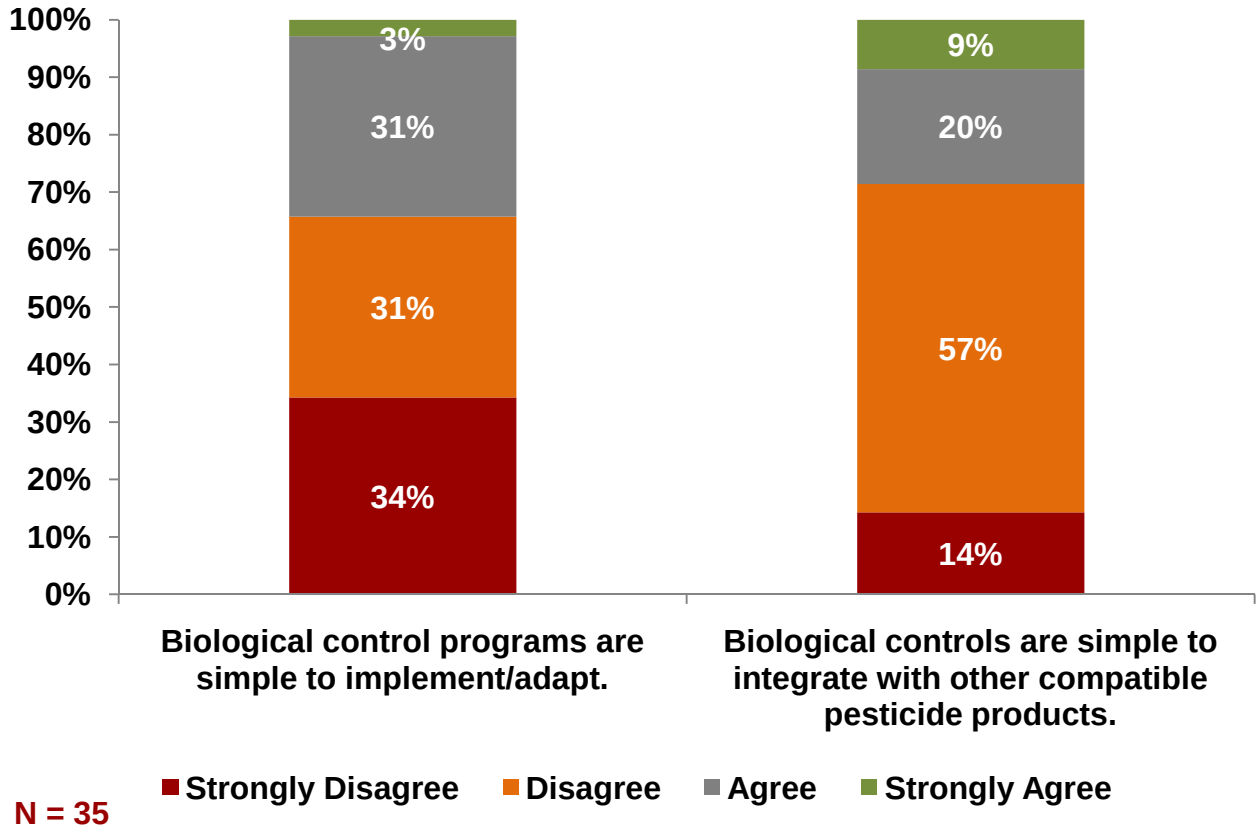
- There are compatibility issues between pesticides and biocontrols. This reduces the success rate of biocontrols when using pesticides in an IPM system.
- Not every flower pest has a biocontrol agent.
- Many pests are not easily controlled by biocontrols (e.g. Lygus and Aphids).
- Scientific Research and Experimental Development (SRED), a federal tax incentive program offered to business to encourage R&D, does not always recognize biocontrols as eligible R&D work.
- Can be difficult to get new biocontrol agents approved for release in Canada.
- Retailers can't distinguish between natural enemies and pests and may return and/or or penalize growers if products have visible biocontrol agents.
- Transportation of biocontrol agents from overseas and possible border delays to entry can compromise the viability/efficacy of biocontrols.
- Some biocontrol companies take time to build up populations of biocontrols. Thus, current supply of biocontrols may not always match growers' demand.

3.3 Weaknesses

- Lack of marketing efforts to increase the awareness of biocontrols and their benefits.
- Margins on ornamental products are decreasing, which is negatively impacting growers' willingness to invest in biocontrols.
- Initially higher costs for using biocontrols.
- Growers may feel that it is simpler to apply one pesticide that covers a range of pests versus the many biocontrols required to deal with all pests.
- Biocontrols have a shorter shelf life than conventional pesticides.
- Gearing up a functioning biocontrol program takes time and investment.
- Difficult to assess the quality of biocontrols prior to their application.
- Difficult to determine required quantity of biocontrols as its application varies from crop to crop.
- Uneven technical support across biocontrol companies and provinces.
- Biocontrols are highly perishable and have specific application and storage requirements.

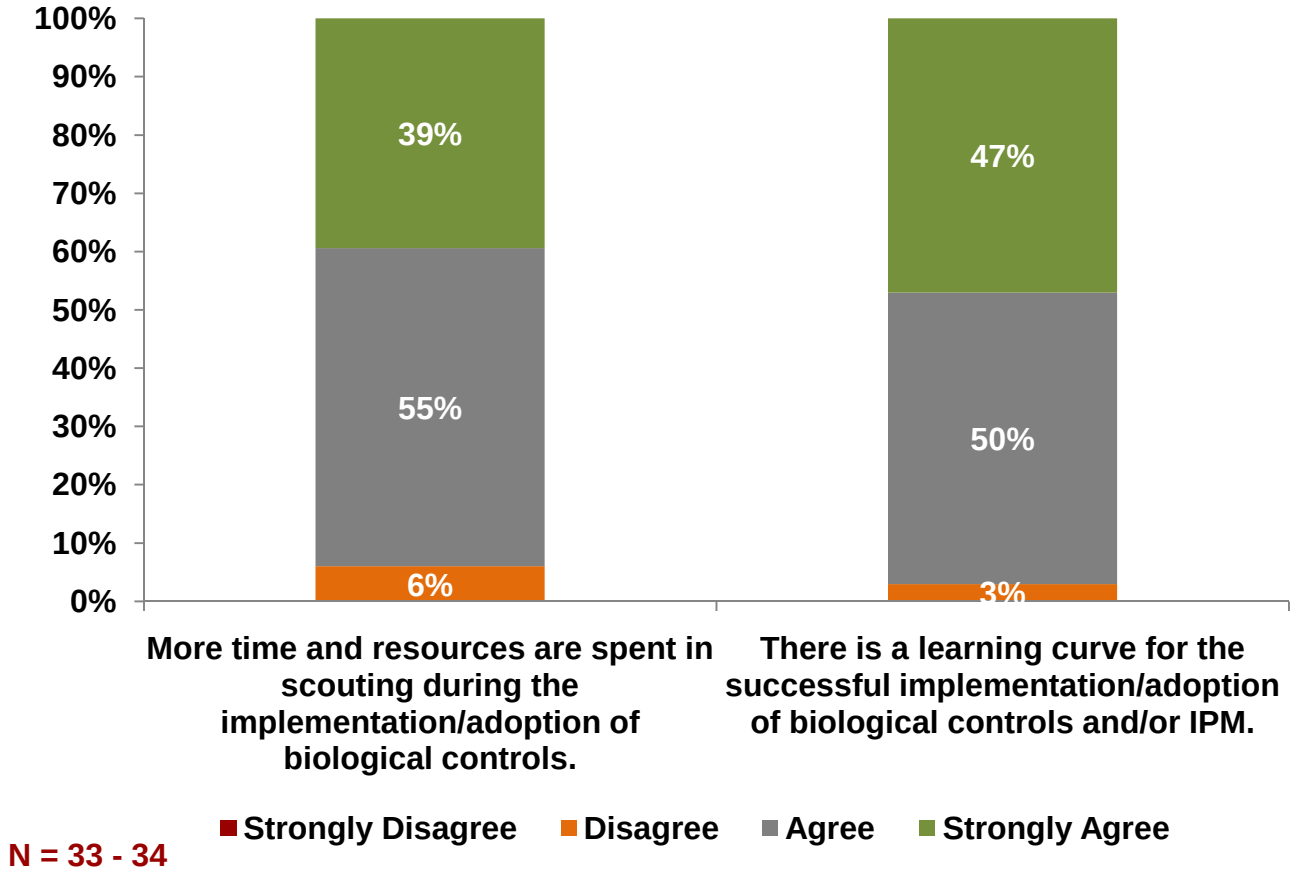
3.3 Weaknesses

- According to our survey, about two thirds (65% and 71%) of growers disagree or strongly disagree that biocontrols programs are simple to implement/adapt or integrate with other compatible pesticide products.



3.3 Weaknesses

- Approximately, 97% of growers agree or strongly agree that there is a learning curve for the successful implementation of biocontrols and/or IPM. Also, most growers (94%) agree or strongly agree that more time and resources are spent in scouting during the implementation of biocontrols.



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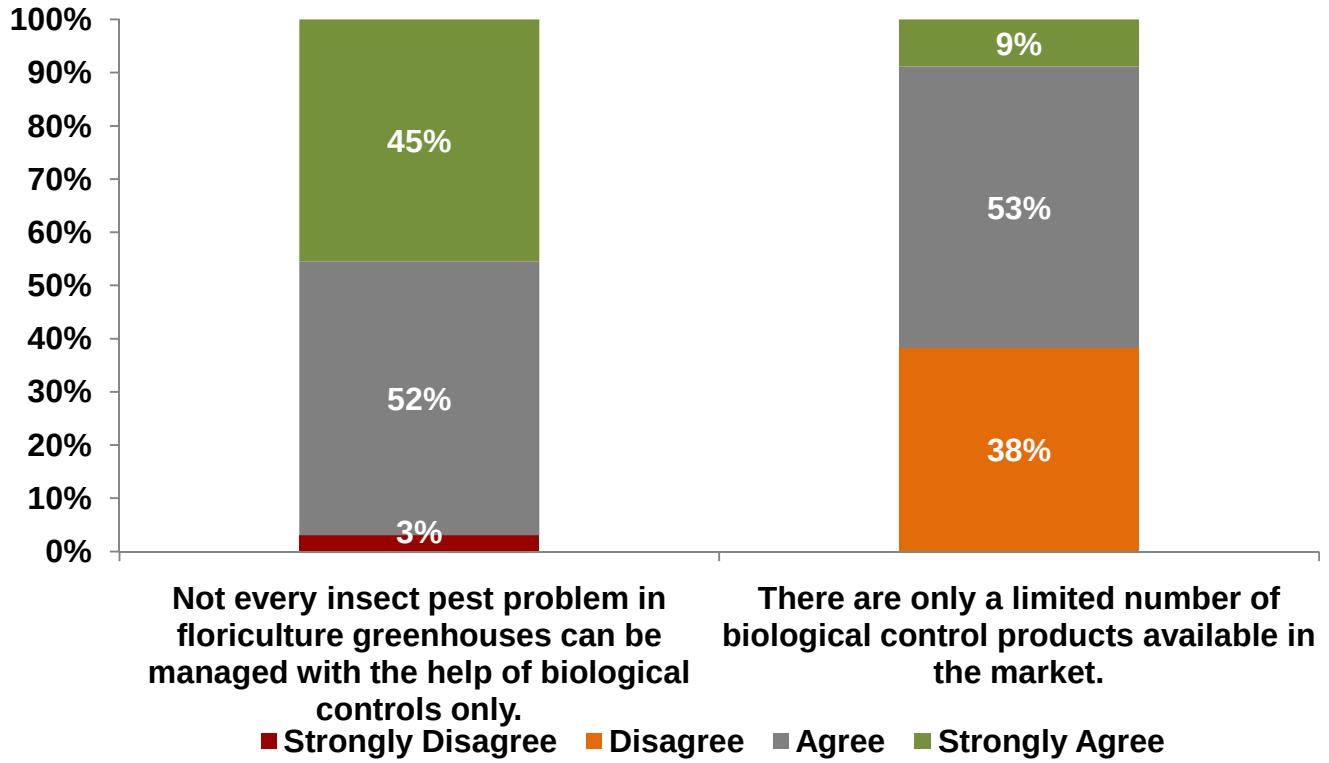
3.3 Weaknesses

- Of the survey respondents, 62% agree or strongly agree that there are only a limited number of biological control products available in the market. Also, most survey respondents (97%) agree or strongly agree that not every pest problem in floriculture greenhouses can be managed with the help of biocontrols only.



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3.4 Opportunities

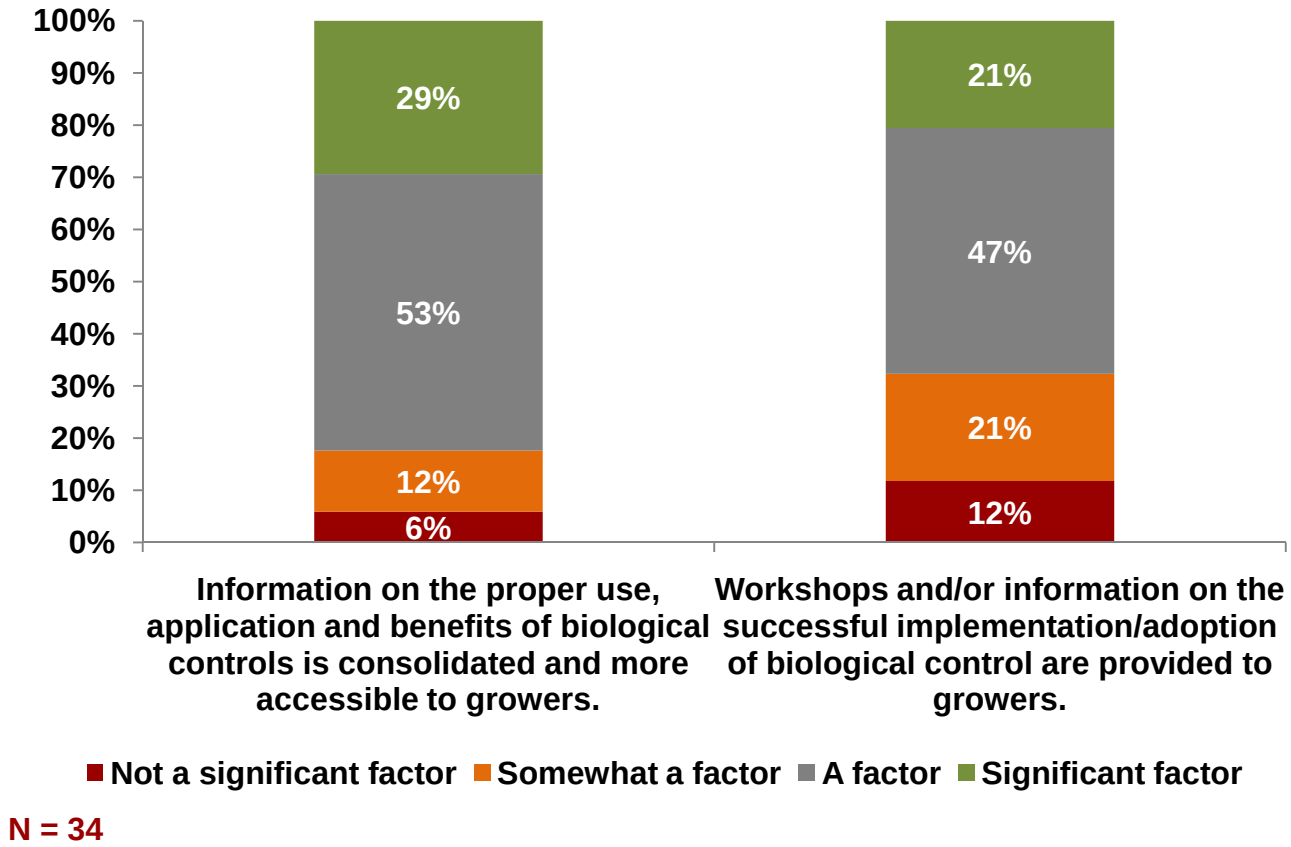
- Potential to increase consumer awareness of products grown using biological controls.
- Public appreciation of products grown with biocontrols is increasing.
- Increased public interest in IPM systems.
- Increased willingness of floriculture growers to transition to bioproducts and/or an IPM system.
- Diversification of flower greenhouse workers' skills as they become experienced in biocontrols.
- Reduced market access to conventional pesticides increases growers' willingness and need to adapt alternative pest controls.
- Biocompatible pesticides technology is improving.
- Pesticide resistance and green movement is a driving force to increasing biocontrol use.
- Opportunity to increase growers' knowledge on long term costs savings and benefits of biocontrols.
- Increasing growers' understanding of how to effectively use biocontrols.

3.4 Opportunities

- Generational trends of growers (older generations may prefer pesticides versus younger generations may prefer biocontrols).
- Potential to increase market access of biocompatible pesticides.
- Potential growth of domestic biocontrol production and native biocontrol sourcing.
- Potential to partner with and support growers to experiment with biocontrols.
- Use growers' word of mouth on their experience with biocontrols as a biocontrol promotion and information sharing strategy.
- Increasing number of growers using biocontrol agents provides support/comfort to peers starting to use them.
- Biocontrols become more effective when reducing pesticide use.
- Biopesticides increase the spectrum of non-chemical pest control tools available in the market.
- Potential to engage regulators to bring about change in the regulation and registration requirements for new biocontrol agents and biopesticides.

3.4 Opportunities

- According to our survey, consolidated information and workshops on biocontrols are factors that make growers more likely to use biocontrols (82% and 68% of growers believe these are factors / significant factors).



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3.5 Threats

- Increased import barriers and inspections restrict market access to new biocontrols and biocompatible pesticides.
- Emerging pests due to lack of broad spectrum of pest control tools available in the market.
- Biocontrols being more expensive in initial years than conventional pesticides continues to be a disincentive for growers to switch to biocontrols and/or an IPM system.
- Challenges faced in the first years of biocontrol implementation can discourage growers from later use of biocontrols.
- Steep learning curve for growers on proper biocontrol use continues to be a barrier for growers to transition to biocontrols and/or IPM system.
- Industry lack of education on the proper use and implementation of biocontrols imposes a risk to the success of biocontrol programs.
- Introduction of new invasive species (pests) into Canada.

3.5 Threats

- Pesticide residues found on imported propagative stock will continue to pose a risk to the efficacy of biocontrols and/or the IPM systems.
- Growers face increased competition from imports (i.e. cut flowers) from nations where more affordable pest control methods are accessible.
- Introduction of new and cost effective pesticides can reduce the attractiveness of biocontrols.
- Biosecurity and terrorism threats may restrict border access to biocontrols and biopesticides.

4. Feasibility Analysis

Comparative costs and benefits of using biocontrol agents versus conventional pesticide practices in floriculture.

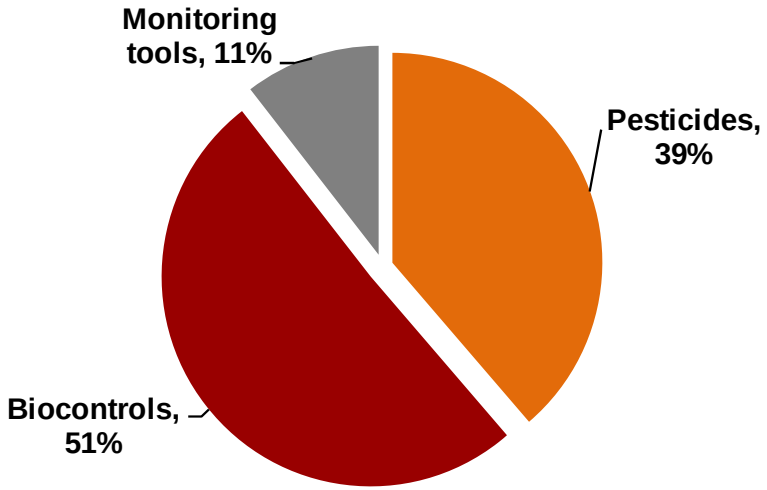
4.1 Feasibility Analysis

- Our high level feasibility analysis showed that:
  - **Growers generally experience an increase in their pest control costs during the first years of biocontrol implementation.** This may be due to the fact that it takes roughly 1 to 3 years for growers to adapt to biocontrols and that gearing up an effective biocontrol program takes time and investment.
  - **Very few growers experience pest control cost savings initially from using biocontrols.** According to our survey, only 18% of survey respondents have experienced pest control savings from using biocontrols in the first three years following implementation. Generally growers experienced a reduction in their environmental and protective gear costs by 6% and 7% respectively.
  - **Although generally growers experience an increase in their pest control costs during the first years of biocontrol implementation, growers may also experience some costs savings and benefits from biocontrol that are difficult to put a value on, but which may be substantial** e.g. improvement of staff morale and health, improved crop quality, reduced crop losses. Also, the use of biocontrols can prevent/delay the development of resistance in key pests and preserve the activity in pesticides for use in emergencies or to clean up crops at the end of a growing cycle for export or retail.
  - **Growers generally experience very small increases in price received for products grown using biological control / IPM programs and in revenue from elimination of Restricted Entry Intervals (REI).** According to our survey, growers have experienced on average 2% increase in the price of products grown using biocontrols and 1% increase in their revenues from reduced REI.
  - **Biocontrol use contributes to growing $1.1 billion of annual cash receipts in flower crops in Canada.**

4.1 Feasibility Analysis

- As shown in the graph below, biocontrols account for 51% of survey respondents' total pest management control costs. MNP analysed growers' biocontrol expenditures from the 2010 FCG Survey and 2013 MNP Survey. Overall MNP found a positive relationship between biocontrols and size of operation.

Distribution of Pest Management Control Costs

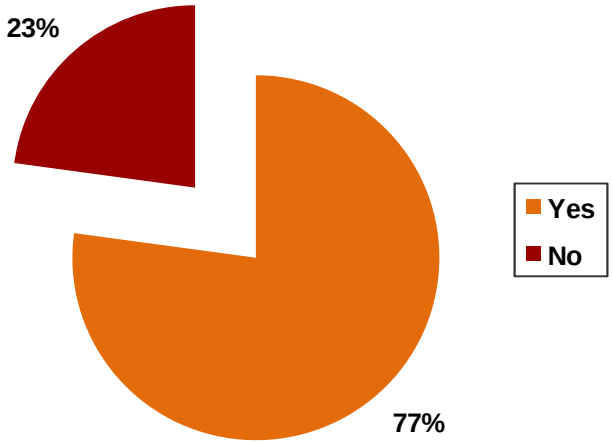


N = 11

4.1 Feasibility Analysis

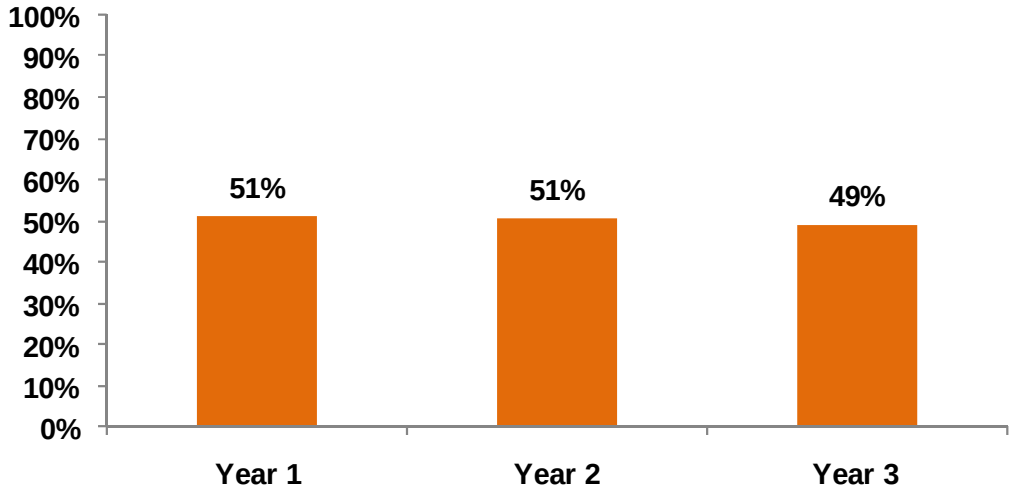
- According to our survey, 77% survey respondents experienced an increase in their pest control costs since they first implemented biocontrols. Over the first three years after biocontrol implementation, growers experienced an increase in their pest control costs by 51%, 51% and 49% in year 1, year 2, and year 3 respectively.

Have your pest control costs increased since you first implemented biocontrols?



N = 35

Changes in pest control costs since biocontrol implementation

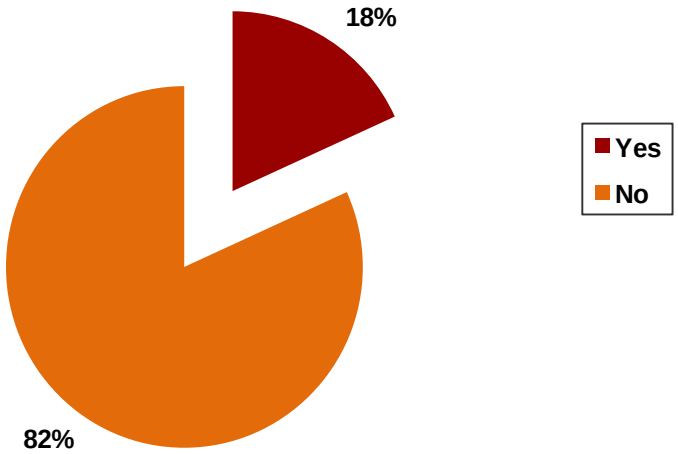


N = 20

4.1 Feasibility Analysis

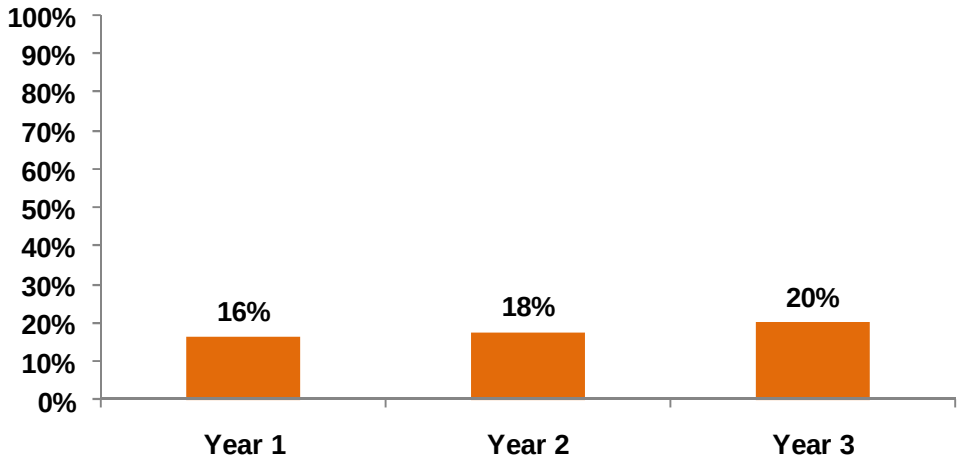
- According to our survey, only a few survey respondents (18%) have experienced pest control savings from using biocontrols. Over the first three years after biocontrol implementation, growers experienced a reduction in their pest control costs by 16%, 18% and 20% in year 1, year 2, and year 3 respectively.

Have you experienced any pest control savings from using bicontrols?



N = 33

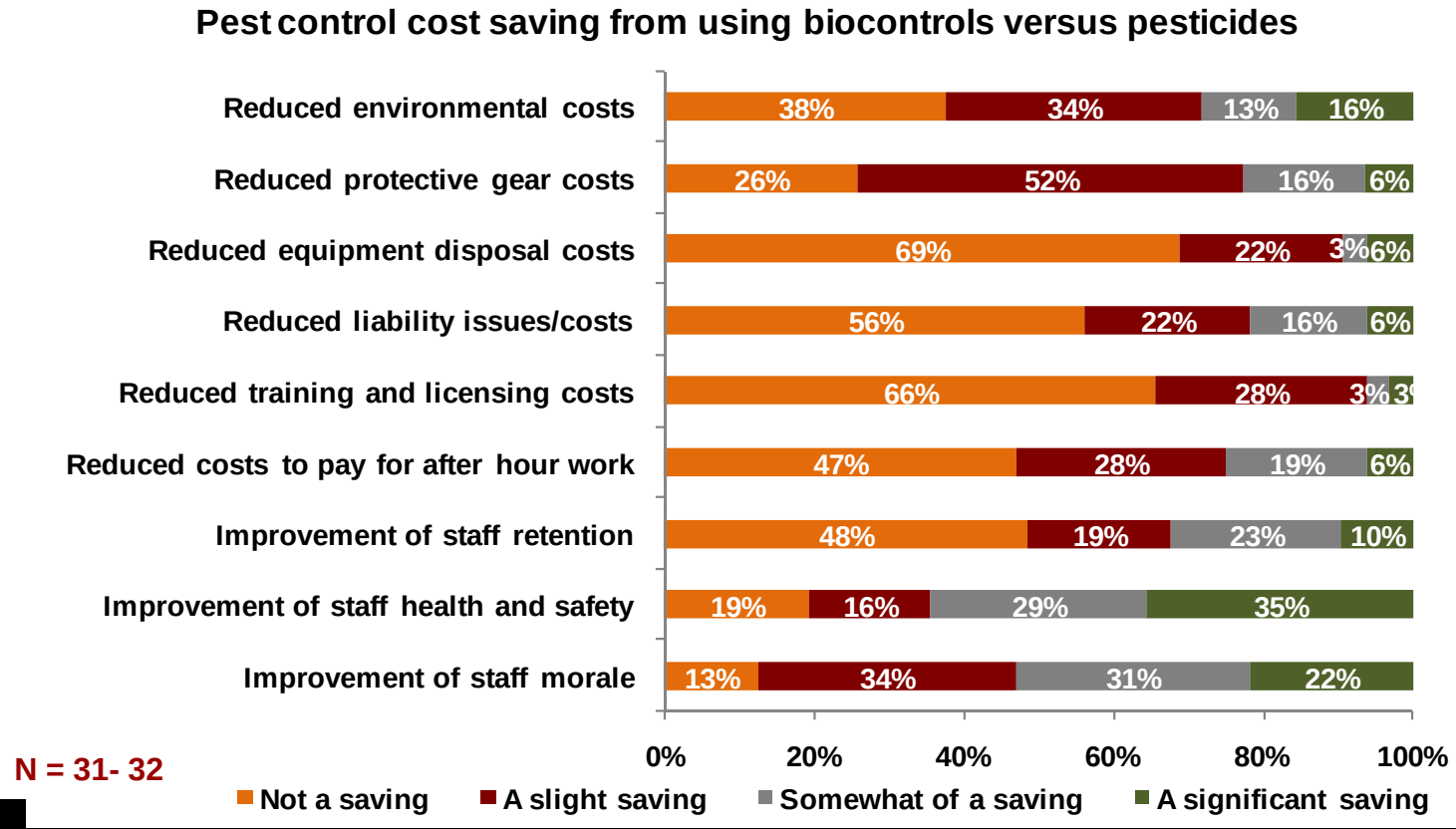
Reduction of pest control costs since biocontrol implementation



N = 4

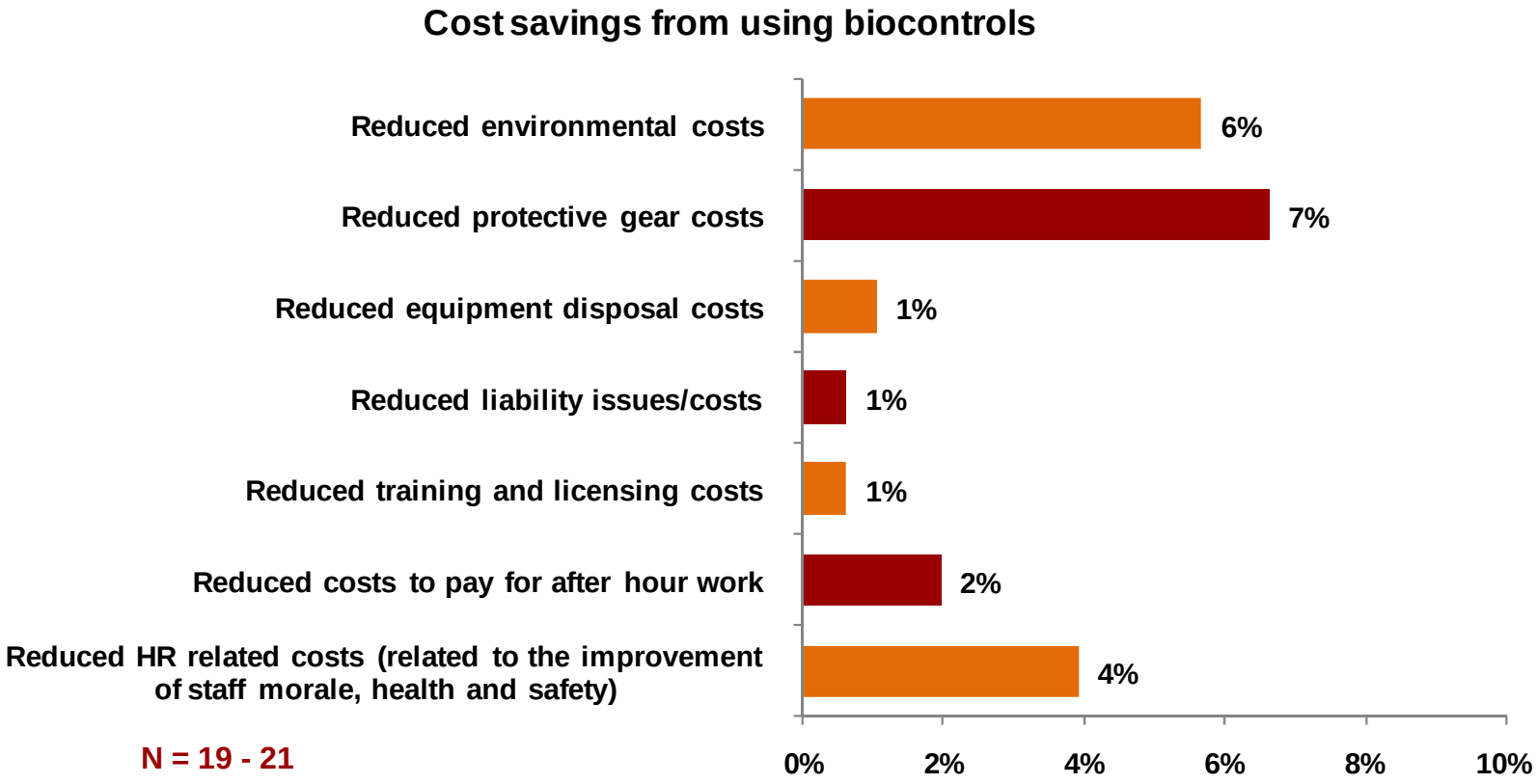
4.1 Feasibility Analysis

- Two thirds of survey respondents estimated a significant or somewhat of a cost saving related to staff health and safety. Fewer respondents reported cost savings in other categories (e.g. 53% estimated a significant / somewhat of a significant saving from improved staff morale, 33% from improved staff retention and 29% from reduced environmental costs).



4.1 Feasibility Analysis

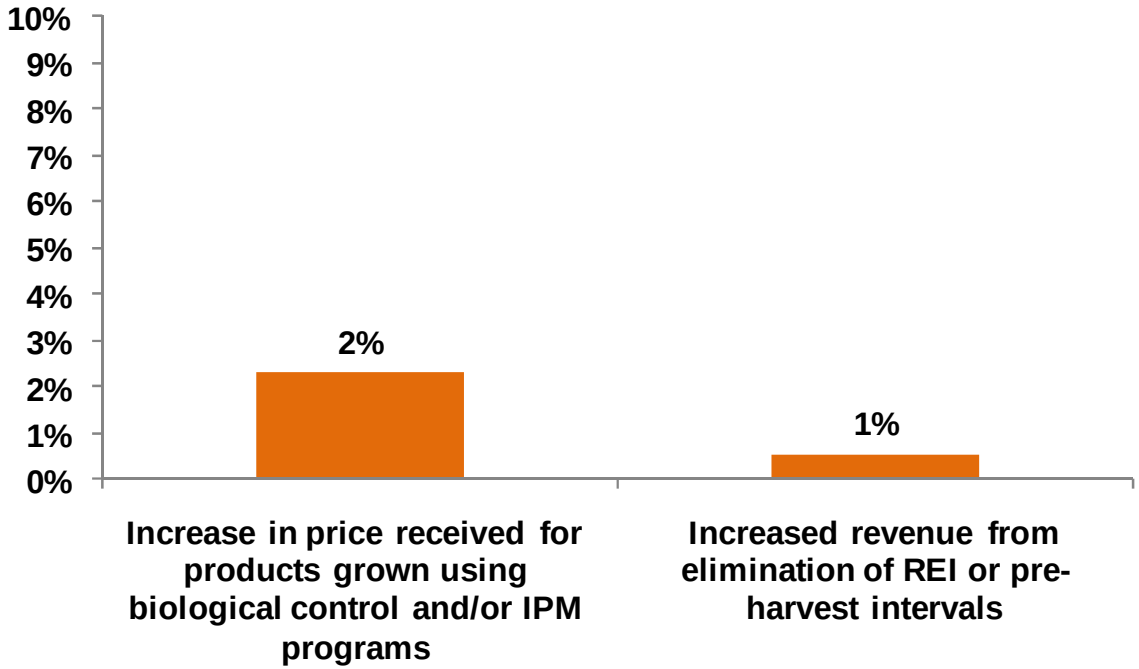
- As shown in the graph below, according to our survey, growers experienced a reduction in their environmental and protective gear costs by 6% and 7% respectively. Respondents also recorded a reduction in their HR related costs, pay for after hour work costs, training and licensing costs.



N = 19 - 21

4.1 Feasibility Analysis

- Growers experienced very small increases in price received for products grown using biological control / IPM programs and in revenue from elimination of REI.



N = 22

4.1 Feasibility Analysis – Protective Gear Example

- According to our survey, growers experienced a reduction in their protective gear costs by 7%. If we assume that:
  - the average total operating expenses for a typical flower greenhouse in Canada is roughly $545,017;
  - protective gear costs are approximately 1% a typical flower greenhouse's total operational expenses; and
  - that every flower greenhouse grower uses biocontrols and saves on average 7% on protective gear costs annually,
  - then the total savings for 1,960 flower greenhouses in Canada are estimated to be approximately $747,763.

4.1 Feasibility Analysis – REI Example

- According to our survey, growers experienced an increase in their revenues from reduced REI by 1%. If we assume that:
  - every flower greenhouse grower uses biocontrols and experiences an increase of 1% in their revenues from reduced REI,
  - then the total revenue increase for flower greenhouses in Canada is estimated to be approximately $11 million or 1% of the total farm cash receipts of the sale of flowers in Canada.

5. Economic Impact Analysis

Economic Impacts of Biocontrol Use in Canadian Floriculture Greenhouses.

5.1 Economic Impact Overview

- Economic impacts arise from direct expenditures on goods and services, the employment of support staff and the generation of tax revenues for local, provincial and federal governments. Indirect and induced impacts arise from the linkages that exist with suppliers and other industries.
- To measure impacts along the value chain, MNP followed an input-output methodology using economic multipliers published by Statistics Canada. For more information on the approach, please see Section 7.2 (Appendix).
- Please note that our model only looks at the economic impacts generated by the use of biocontrols in the Canadian floriculture industry. Our model does not account for any economic impact losses that may occur in the Canadian economy from growers reducing their use of pesticides due to the adoption of biocontrols or from replacing pesticide controls with biocontrols.

5.2 Spending on Biocontrols in Floriculture Greenhouses

- MNP assumed that spending of floriculture growers on biocontrols corresponds to biocontrol companies' revenues in the Canadian floriculture sector.
- MNP assumed total biocontrol industry revenues from the floriculture industry of **$11,177,060** (once leakage of biocontrol production that takes place outside of Canada had been removed). For more information on our analysis and approach please refer to Section 7.2 (Appendix).

Extrapolation Procedure	
Annual biocontrol expenditures per square meter *(2012 FCG and 2013 MNP Surveys)*	$1.51
Total area of Canadian floriculture greenhouses in square meters *(Statistics Canada, 2011)*	8,155,388 m2
Total annual biocontrol expenditures	$12,358,375
Total annual biocontrol expenditures adjusted for leakage of biocontrol production that take place outside of Canada	**$11,177,060**
Margin of error	+/- $3,533,983 at 95% confidence interval

5.3 Summary of Economic Impacts

- Below, MNP presents the economic impacts for the biocontrol industry in the floriculture sector in Canada.

	Output	GDP	Employment (FTEs)	Total Tax Revenue
Direct	$11,177,060	$5,770,383	73	$1,203,050
Indirect	$7,364,407	$4,041,153	39	$834,459
Induced	$5,343,009	$5,343,009	33	$609,077
Total	**$23,884,475**	**$15,154,545**	**144**	**$2,646,586**

- Please note totals may not add up due to rounding.

5.3 Summary of Economic Impacts

- **Output -** Total direct, indirect and induced output generated by the biocontrol industry in the Canadian floriculture sector is estimated to be close to $24 million.
- **GDP -** Total direct, indirect and induced GDP generated by the biocontrol industry in the Canadian floriculture sector is estimated at $15 million.
- **Employment -** Approximately 144 direct, indirect and induced full-time equivalent positions (FTEs) are generated by the biocontrol industry in the Canadian floriculture sector. This employment supports close to $6.4 million in direct, indirect and induced wages and salaries.
- **Total Tax Revenue -** Aggregate direct, indirect and induced taxes generated by the biocontrol industry in the Canadian floriculture sector are estimated at $2.6 million.

5.4 Scenario Analysis

- **Scenario 1**: If growers were to increase their spending on biocontrols by **5%,** the economic impacts of biocontrol use in the floriculture industry would be the following:

	Output	GDP	Employment (FTEs)	Total Tax Revenue
Direct	$11,735,913	$6,058,902	76	$1,263,203
Indirect	$7,732,627	$4,243,211	41	$876,182
Induced	$5,610,159	$5,610,159	34	$639,531
Total	**$25,078,699**	**$15,912,272**	**151**	**$2,778,916**

- Please note totals may not add up due to rounding.

5.4 Scenario Analysis

- **Scenario 2**: If growers were to increase their spending on biocontrols by **10%,** the economic impacts of biocontrol use in the floriculture industry would be the following:

	Output	GDP	Employment (FTEs)	Total Tax Revenue
Direct	$12,294,766	$6,347,422	80	$1,323,355
Indirect	$8,100,847	$4,445,268	43	$917,905
Induced	$5,877,310	$5,877,310	36	$669,985
Total	**$26,272,923**	**$16,669,999**	**159**	**$2,911,245**

- Please note totals may not add up due to rounding.

5.4 Scenario Analysis

- **Scenario 3**: If growers were to increase their spending on biocontrols by **15%,** the economic impacts of biocontrol use in the floriculture industry would be the following:

	Output	GDP	Employment (FTEs)	Total Tax Revenue
Direct	$12,853,619	$6,635,941	84	$1,383,508
Indirect	$8,469,068	$4,647,326	45	$959,628
Induced	$6,144,460	$6,144,460	37	$700,439
Total	**$27,467,146**	**$17,427,727**	**166**	**$3,043,574**

- Please note totals may not add up due to rounding.

6. Conclusion

Summary of Findings and Recommendations.

6.1 Summary of Findings

- This study confirmed existing advantages and barriers to using biocontrols in Canadian floriculture greenhouses through:
  - A review of existing studies and reports.
  - A survey of 42 floriculture growers.
  - Interviews with 7 major biocontrol companies and distributors.
  - Focus groups with growers, biocontrol representatives, government representatives and consultants (over 30 representatives).

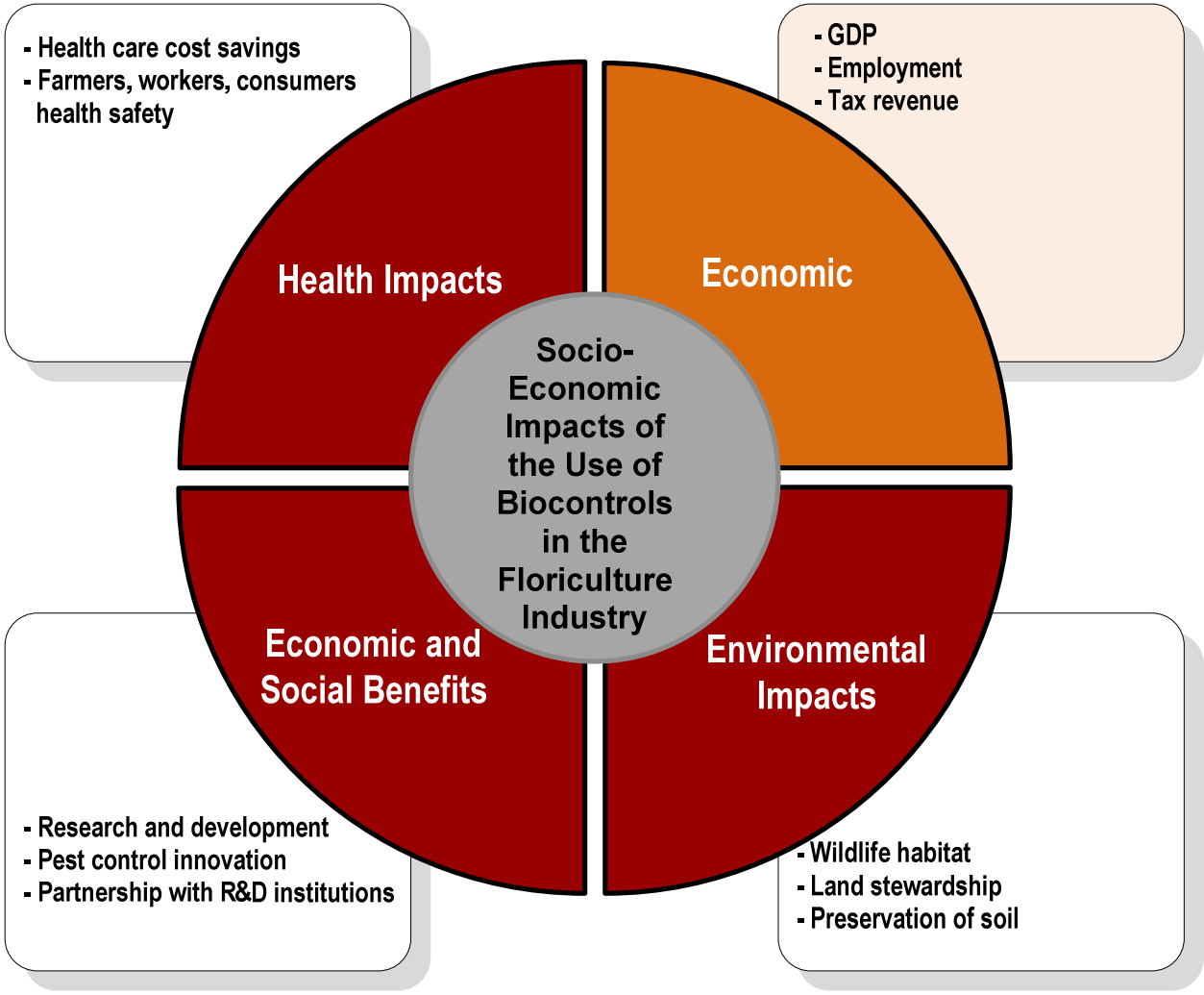
6.2 Recommendations – Education and Marketing

- Educate the supply chain and especially retailers and consumers on the benefits of biocontrol use. This can be done through a comprehensive marketing strategy that resonates with consumers i.e. “produced with biocontrol”.
- Undertake focus groups with consumers to identify the price consumers are willing to pay for flowers produced with biocontrol and ways to communicate competitive advantages of biological controls.

6.2 Recommendations – Communication of Impacts

- Communicate intangible benefits related to human health (health care costs) and the environment.
- Communicate the economic contributions of biocontrol use in Canadian floriculture greenhouses.
- Convey how biocontrols are an important factor supporting the industry's ability to grow and sell floriculture crops (farm cash receipts from the sale of flowers in Canada totalled $1.1 billion). This enables crops to be grown that may otherwise not be feasible with the current registered materials.

6.2 Recommendations



6.2 Recommendations - Growers

- Partnering with growers can help them overcome some of the barriers of adopting biocontrols (i.e. increased costs in the initial years of implementation). This could include free technical support, on farm trials and research projects.
- Use growers' word of mouth on their experience with biocontrols as a biocontrol promotion and information sharing strategy.
- Create a forum for discussion for growers and biocontrol industry specialists to share their experience and knowledge of biocontrols e.g. webinars, blogs, seminars and workshops, among others.

6.2 Recommendations – Collaboration

- Increase collaboration and sharing of biocontrol experience between the floriculture and horticulture industries.
- Communicate and share Ontario's R&D findings and biocontrol experience with other provinces.

7. Appendices

Project Methodology, Assumptions and Contributors

7.1 Data Sources

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7.2 Economic Impact Analysis Approach

Approach Overview and Audiences

Economic impact studies are conducted for a variety of purposes and are directed to a number of audiences. The following diagram illustrates some possible audiences for an economic impact study, together with issues that may be of concern to each audience.

Senior Government	• Importance of the sector; impact of changes in policy
Local Government	• Importance of the sector to local economy; linkages to other sectors
General Public	• Awareness of the social and economic contributions of the sector
Sector Members	• Industry monitoring, reporting and forecasting
Community Groups	• Social contributions to communities

Four Step Approach

- MNP used an approach involving the following four components to estimate economic impacts:
  1. Collection of Data
  2. Estimation of Annual Biocontrol Spending by Floriculture Greenhouses
  3. Estimation of Economic Impacts
  4. Final Results

Step 1 - Collection of Data

- Gathered information on annual biocontrol spending and greenhouse sizes for 49 floriculture growers from FCG's 2010 "Pest Control Survey" and MNP's 2013 "Adoption of Biocontrol Practices Survey".
- Gathered information on the total area of floriculture greenhouses across Canada from Statistics Canada's 2011 "Cansim Table 001-0047".
- Gathered information on the number of staff, activities and annual production of biocontrols in Canada through telephone interviews with the major biocontrol companies.

Step 2 - Estimation of Annual Biocontrol Spending by Floriculture Greenhouses

- Although there was considerable variability in the survey data, we found a general relationship between the size of operation and the biocontrol expenditures. Consequently, the most precise population estimates were obtained using a **ratio estimator** that relates the amount of biocontrol expenditures to the size of floriculture operation.

Step 2 - Estimation of Annual Biocontrol Spending by Floriculture Greenhouses

- Using the ratio estimator approach to approximate total biocontrol expenditures:
  1. We estimated biocontrol expenditures per square meter by adding biocontrol costs across the survey sample (2010 FCG Survey and 2013 MNP Survey) and dividing by the total square meters for survey participants.
  2. We then calculated the total biocontrol expenditures of the population by multiplying the cost per square meter for the survey sample with the total area of Canadian floriculture greenhouses.

Extrapolation Procedure	
Annual biocontrol expenditures per square meter *(2010 FCG and 2013 MNP Surveys)*	$1.51
Total area of Canadian floriculture greenhouses in square meters *(Statistics Canada, 2011)*	8,155,388 m2
Total annual biocontrol expenditures	$12,358,375
Total annual biocontrol expenditures adjusted for leakage of biocontrol production that takes place outside of Canada	**$11,177,060**
Margin of error	+/- $3,533,983 at 95% confidence interval

Step 3 - Estimation of Economic Impacts

- **We assumed that the spending of floriculture growers on biocontrols (from Step 2) corresponds to biocontrol companies' revenues in the Canadian floriculture sector.**
- Based on our interviews with biocontrol company representatives:
  - We estimated the percentage of biocontrol company revenues from A) production of biocontrol, B) technical support services and C) sales. We estimated the distribution of biocontrol company revenues by their key activities to be 26% from production of biocontrol, 20% from technical support and 54% from sales of biocontrols. We then disaggregated our estimate of total biocontrol expenditures in the floriculture industry in Canada using our estimate on the distribution of biocontrol companies' revenues by their key activities.
  - We estimated the percentage of biocontrol production that takes place outside of Canada ("leakage"; as shown in the table on the previous page) to be $1,181,315. This amount was removed and is not part of the economic impact model.

Step 3 - Estimation of Economic Impacts

- We then estimated quantitative economic impacts of biocontrol use in Canadian floriculture greenhouse using an input-output model with Statistics Canada multipliers. Input-output models are based on statistical information about the flow of goods and services among various industries.
- Since multipliers for the biocontrol industry currently do not exist, we applied the following multipliers to the key activities of biocontrol companies and removed leakage for production outside of Canada:
  - NAICS 111 & 112: Crop and Animal Production
  - NAICS 541: Computer Systems Design and Other Professional, Scientific and Technical Services
  - NAICS 41: Wholesale Trade

Step 4 - Final Results

- The economic impacts arising from the different activities of biocontrol companies were combined to estimate the total annual economic impacts related to biocontrol use in Canadian floriculture greenhouses.
- We estimated the following impacts:
  - **Output** – the total gross value of all business revenue. This is the broadest measure of economic activity.
  - **GDP** – the "value added" to the economy (the unduplicated total value of goods and services)
  - **Government Tax Revenue** – the total amount of tax revenues generated for different levels of government.
  - **Employment** – the number of additional jobs created.

Step 4 – Final Results

MNP also estimated impacts at the direct, indirect and induced levels:

- **Direct impacts** are due to changes to front end businesses that receive expenses or operating revenue as a direct consequence of an industry.
- **Indirect impacts** are due to changes in the activity of suppliers.
- **Induced impacts** are due to shifts in spending on goods and services as a consequence of the payroll of the directly and indirectly affected businesses.

Step 4 – Final Results

- Please note that our model only looks at the economic impacts generated by the use of biocontrols in the Canadian floriculture industry. Our model does not account for any economic impact losses that may occur in the Canadian economy from growers reducing their use of pesticides due to the adoption of biocontrols or from replacing pesticide controls with biocontrols.

7.3 Report Limitations

Report Limitations

This report is not intended for general circulation, nor is it to be published in whole or in part without the prior written consent of MNP LLP ("MNP") and Flowers Canada Growers (“FCG”). The report is provided for information purposes and is intended for general guidance only. It should not be regarded as comprehensive or a substitute for personalized, professional advice.

We have relied upon the completeness, accuracy and fair presentation of all information and data obtained from Flowers Canada Growers, the Project Steering Committee and public sources, believed to be reliable. The accuracy and reliability of the findings and opinions expressed in the presentation are conditional upon the completeness, accuracy and fair presentation of the information underlying them.

Report Limitations

As a result, we caution readers not to rely upon any findings or opinions expressed as accurate or complete and disclaim any liability to any party who relies upon them as such.

Additionally, the findings and opinions expressed in the presentation constitute judgments as of the date of the presentation, and are subject to change without notice. MNP is under no obligation to advise of any change brought to its attention which would alter those findings or opinions.

7.4 Survey Respondents Profile

Profile of Survey Respondents

- Approximately, 67% of the 42 survey respondents are located in Ontario, 17% in British Columbia, 10% in Quebec and 7% in New Brunswick.
- The majority (51%) of survey participants were small flower greenhouses (<10,000m2), 20% were medium greenhouses (10-25,000m2) and 29% were large greenhouses (>25,000 m2).
- One hundred percent of the surveyed flower growers grow crops 12 months of the year.
- Please note that some of the survey findings should be considered as indicative only due to the sample size.

7.5 Contributors

Survey, Interview and Focus Group Participants

We would like to thank all of the growers, biocontrol company representatives, government representatives, consultants and other stakeholders who contributed their time and invaluable insights to this study.

Steering Committee Members

In alphabetical order:

1. Jamie Aalbers (FCG)
2. Michael Brownbridge (Vineland Research and Innovation Centre)
3. Cary Gates (FCG)
4. Caroline Martineau (Quebec Institute for the Development of Ornamental Horticulture)
5. Graeme Murphy (OMAFRA)

7.6 About MNP

About MNP

MNP is the fastest growing chartered accountancy and business advisory firm in Canada. Founded in 1945, MNP has grown from a single office in Manitoba to more than 75 offices and 3,000 team members across Canada. MNP's agriculture team proudly works alongside producers, farmers and processors to keep their agricultural businesses current, competitive and profitable.

Our business advisors, financial experts and professional agrologists are intimately familiar with all aspects of the agriculture and floriculture industry; with many still involved in their family's farm operations to this day.