Bio 2022 – A Biological Control Strategy for the Floriculture Sector in Canada

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

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Introduction

Biological control or biocontrol is the use of natural enemies (chiefly predators, parasites and pathogens) of a target pest or disease to bring their populations in a host crop below a desired level. These natural enemies are generally referred to as biological control agents (BCA's). In the growing of greenhouse flowers biological control is one of the tools growers use to manage pests and ensure the aesthetic perfection desired by consumers is achieved.

In Canada, the biological control industry is dominated by a relatively small number of manufacturers (approximately 4) supplying a number of biocontrol products mainly to the floricultural and horticultural industry. Most of the Canadian biocontrol firms undertake sales and distribution of biological control agents, along with testing and technical support, and are subsidiaries of multinational companies headquartered in Europe. The majority of biocontrol agent production for the Canadian floriculture sector takes place outside of Canada. Through its servicing of the Canadian floriculture greenhouse sector, the biocontrol industry contributes $15million to Canadian GDP and $2.6million in taxes to municipal, provincial and federal governments.

The biocontrol industry services a very significant sector of Canadian agriculture – greenhouse horticulture, over half of which is devoted to floriculture production. In 2012 Canada's floriculture farm gate sales were $1.36 billion dollars which is little changed from 2011 when the value was $1.38 billion dollars. Based on farm cash receipts, greenhouse floriculture ranked 5th compared to agricultural crops. Only corn, wheat, canola and soybeans surpassed flowers in farm cash receipts. Approximately 85% of floriculture farm cash receipts in Canada are distributed among three provinces; Ontario (50%), British Columbia (22%), and Quebec (14%). There are 1,910 commercial floriculture greenhouses with more than 500 square feet of growing area and in total they employ over 20,000 full time staff. Flowers Canada Growers (FCG) is the national trade association representing members of the Canadian floriculture sector. Members include greenhouse flower growers, suppliers and wholesalers.

One of the many challenges faced by Canadian floriculture growers is the management of disease and insect/mite pests. Many growers employ various pest control management techniques to reduce pest populations in their greenhouses. These include: cultural controls, physical controls, pesticides, biocontrols, biopesticides and/or a combination of these techniques. Canadian growers are leaders in the use of biological control in floriculture greenhouses. Ninety percent of growers have used some form of biocontrol at one time or another.

As BCA adoption rapidly increases, many growers are struggling with the dramatic transition required to shift a reactive pesticide-based control approach, often used for many decades, to one that requires a more proactive and patient approach even when pests are not yet visible in a crop. Adopting biological control on a greenhouse farm requires many years of trials, a dedicated and committed management and staff to stick with it for the long term, a strong network of technical experts and a strong biocontrol sector that can provide the right tools needed by growers.

In light of this struggle, Flowers Canada Growers is committed to helping its membership succeed with the adoption and implementation of biological controls. FCG has set an over-arching goal to develop a 10 year biological control strategy that will lead to biocontrol success on all flower farms in Canada by 2022. Floriculture is a strong player in Canada's agriculture and agri-food system; the attainment of this goal will contribute significantly to the attainment of the Goals of Canada set by AAFC under Growing Forward 2.

The Process for Developing the Strategy

The process to develop the Biocontrol Strategy relied heavily on industry input from flower growers, biological control suppliers, researchers, field consultants and government extension officers. Their input was gathered within three main activities:

1. SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis
    a. This was designed to investigate the strengths, weaknesses, opportunities and threats to the successful adoption of biological control in Canadian floriculture greenhouses. This analysis investigated greenhouse production as well as the Canadian biological control industry that services the greenhouse flower sector.
2. Economic Impact Study
    a. This was a study of the Canadian Biological Control Industry and its economic impact within the Canadian economy. One of the key outcomes expected here was a better understanding of the potential to increase the domestic production of biological control agents.
3. Research Needs Analysis
    a. This activity was designed to determine research that is required to grow the biocontrol industry in Canada vis-à-vis making implementation of biocontrol practices successful in all greenhouse flower growing situations.

The input from the participants in these activities, as well as the reports and results were used as the background information to develop Bio 2022 – A Biological Control Strategy for the Floriculture Sector in Canada.

A request for proposal process was implemented to select consulting expertise to perform the SWOT and Economic Impact Analysis. The firm MNP was selected and they worked with the project manager

and the project steering committee members to fulfill the research and analysis for these two items. The final report from MNP is included as Appendix A.

Three methods of primary data collection were utilised by MNP – an on-line survey, telephone interviews with seven major biocontrol companies/biocontrol distributors and two focus groups. One focus group was held in British Columbia and one was held in Ontario. Due to the busy spring season and multiple sector meetings occurring at the same time in Quebec, the focus group scheduled there needed to be cancelled and conducted via phone interviews by MNP. To supplement the data gathered with these methods, MNP also conducted extensive secondary research of published reports and information on the use of biological control in Canadian floriculture greenhouses.

The research needs analysis was conducted in conjunction with a research priority setting meeting organized by the Canadian Ornamental Horticulture Alliance (COHA) in December of 2012. This meeting brought together the research needs for all issues facing the ornamental sector in Canada, which includes floriculture, nursery, sod and landscape. However, considerable discussion focussed on biological control research needs in the greenhouse floriculture area and the results of those discussions were integral to developing this particular strategy.

Biological Control Strategy Goals

The overarching goal for Flowers Canada Growers was to develop a 10 year strategy that would lead to biological control success on all greenhouse flower farms by 2022. Such a strategy would need to focus on specific and achievable objectives that when combined would enable the sector to stretch and meet the challenge and attain this end.

In the Goals of Canada put forth in Growing Forward 2, Agriculture and Agri-Food Canada outlined two broad outcomes expected from its investments in the Canadian agricultural sector:

1. Competitiveness and Market Growth
2. Adaptability and sustainability

Areas to improve competitiveness and grow the market included increasing productivity, reducing costs and responding to consumer demands; focussing on high value products with specific attributes; and increasing the share of domestic and international markets. The goal of adaptability and sustainability would ensure that the Canadian agri-food system could anticipate and adjust to changing external environments. The two drivers to achieve these goals would be innovation and institutional and physical infrastructure.

Biological control is only one part of the complex growing process of greenhouse flowers. However successful pest management is a key component to delivering aesthetically perfect flowers to the consumer. Pest damage of any kind is not accepted in the flower market. Being able to control pests biologically can contribute to meeting increased retailer and consumer demand for sustainably grown

crops thereby increasing Canadian growers' share of domestic and international markets. Successful biological control in flowers also provides the sector with adaptive tools to weather pesticide resistance and de-registrations of currently used pesticides. Greenhouse flower farmers are by nature innovative and the Canadian flower sector is well positioned to partner with AAFC under Growing Forward 2 to achieve the goals set out in Bio2022 and contribute to a successful outcome to Growing Forward 2.

Bio 2022 - A Biological Control Strategy for the Floriculture Sector in Canada has these key strategies for achieving biological control success on all Canadian greenhouse flower farms by 2022:

1. Strengthen and further develop a biocontrol technical support network in all regions of Canada that includes scientists, extension experts, technical advisors from supply companies, consultants and flower growers.
2. Ensure all propagative material is free of pests and largely free of pesticide residues.
3. Continually identify barriers to biological control success and have a mix of public and private researchers seeking solutions to overcome those barriers.
4. Develop open access biocontrol recipes for all flowering crops grown in Canadian greenhouses.
5. Take advantage of the delayed pesticide resistance biocontrol offers to ensure a back-up exists in all cases where biocontrol does not provide adequate pest control
6. Educate consumers to recognize and request flowers "grown with the environment in mind"
7. Expand successes to outdoor grown horticulture in Canada

Roadmap to Achieve These Goals

1. **Strengthen and further develop a biocontrol technical support network in all regions of Canada that includes scientists, extension experts, technical advisors from supply companies, consultants and flower growers.**

Failures encountered in the first years of biocontrol implementation continue to impede flower growers from using biological controls for the long term. Even though biocontrol companies do provide technical support to growers at no cost with the purchase of biocontrol products, a strong support network is not available across all flower growing regions of Canada. In fact, 52% of survey respondents agree that there is a lack of **easy-to-access** and **reliable** information on the proper adoption of biocontrols. Accessibility of consolidated information and workshops on biocontrols are factors or significant factors impeding greater use of biocontrols in greenhouses.

Support for growers with freely shared technical advice, cost sharing opportunities and structured support groups where growers can interact and share their experiences through word of mouth have shown to be successful in improving biocontrol success in some parts of Canada and Europe. An integral part to achieving the end goal of this strategy is to encourage all forums for discussion (webinars, blogs, seminars, workshops) that bring together growers, biocontrol industry specialists, researchers, consultants and government extension staff.

Deliverable:

- An industry lead, such as Flowers Canada Growers, partner with government, growers, supply companies, researchers and consultants to help growers overcome some of the barriers to adopting biocontrols (increased costs in the initial years of implementation, inadequate technical support). This would include financial and technical support for on-farm trials, the gathering of technical support in one central easy-to-access portal, and the support of biocontrol research.

2. **Ensure all propagative material is free of pests and largely free of pesticide residues.**

All flower growers rely on the purchase of propagative material for some or all of the crops they grow. Suppliers of cuttings are under intense pressure to deliver a pest free product to their customers (flower growers) and oftentimes take a zero tolerance approach to pests. This approach generally relies on pesticides in an attempt to achieve complete eradication of pests. However, zero tolerance is an elusive goal and as pest pressures increase, propagators are forced to over apply products that have longer residuals in or on the plant surfaces/structures. Often propagators are established in jurisdictions outside of Canada that have greater access to pesticides – many that are unregistered in Canada. Alongside this, many of the regions that produce propagative material have fewer regulations and safeguards where pesticide use is involved. This can result in the early establishment of pesticide resistance to pesticides that have yet to be registered in Canada or those newly registered – leaving growers in difficult position in terms of control options. Coupled with this is that the residuals of these pesticides stay with the cutting and interfere with the establishment of many biocontrol agents. The other side of this coin is that the pesticide regimen may not have achieved zero tolerance objectives and pests come in undetected with the cuttings as well. It would be wise for the sector as a whole to accept a clean stock cuttings and/or small plants program that does not rely on zero tolerance policies. Cuttings need to be relatively free of pests but a cutting with two thrips and no pesticide residues may be preferred over a cutting with one thrips and heavy pesticide residues in biocontrol programs.

Deliverables:

- Invite the growers of cuttings to Canadian greenhouse farms to show them and explain to them in person the impacts pesticide residues have on establishing biocontrol programs.
- Continue research here in Canada to develop effective dips for cuttings that can eradicate any pests on imported cuttings as well as break down pesticide residues on the cutting.

3. **Continually identify barriers to biological control success and have a mix of public and private researchers seeking solutions to overcome those barriers.**

Canadian flower growers recognize that the disease and pest complex evolves and adapts over time to existing chemical or biological technologies. The need to stay ahead of the game with effective biological control tools (including biopesticides) is essential. The goal of the sector is to optimize the use of biological control agents in such a way that maximizes plant quality and yield while minimising cost and environmental impact.

Since biological controls are living organisms, the interactions they have with the environment, the host plant and the target pest become very complicated. Add to this complication the hundreds of varieties of flowering plants grown in greenhouses and it becomes clear that the permutations for biocontrol recommendations and technical advice become massive and very complex. Growers strongly identified this lack of knowledge on the interactions between specific crops and biological control agents as a hindrance to biocontrol success in the survey conducted by MNP. **Growers require a strong biological control research presence in Canada.** Publicly funded researchers are a very important piece of this network to be able to provide growers with un-biased technical advice not tied to the potential sale of any biological control agent.

Deliverables:

- Flowers Canada Growers poll growers annually on biocontrol research priorities and target sector research funds at research projects addressing these priorities.*
- Agriculture and Agri-Food Canada consistently invests in supporting greenhouse biological control and biopesticide research programs, scientists and infrastructure at its research stations.
- Biological control companies invest more heavily in research that seeks to understand the pest/flower crop/biocontrol agent interactions for the vast array of species grown in greenhouse floriculture.

*As of December 2012 the following biocontrol research priorities were identified by the Canadian floriculture sector:

- More effective biocontrols for aphids
- Improving cost effectiveness of pest control (i.e. optimal distribution rates for biocontrol agents) to maximize effectiveness at minimal costs
- The use of supplemental food sources for biocontrol agents to ensure high reproduction and fecundity throughout the entire year
- Determining the compatibility and mutual interactions among biocontrol agents to have a responsive biocontrol management system for diseases and pests
- Complete an integrated pest management strategy (recipe) for every crop and production system

4. **Develop open access biocontrol recipes for all flowering crops grown in Canadian greenhouses.**

Three key findings from the MNP survey paint an interesting picture for biocontrol in flower crops. Seventy-seven percent (77%) of growers agree that biocontrols are more effective than conventional pesticide methods. Eighty-three percent (83%) agree that a good balance between biocontrols and biopesticides is more effective than the use of pesticides alone. Ninety-seven percent (97%) of respondents agreed that not every pest problem in floricultural operations can be managed through the use of biocontrols only.

There appears to be an acceptance that biocontrols can form the basis for most floricultural pest management programs but that biologicals cannot be relied on completely for adequate pest control all the time and for all pests. The need to have other options within a biocontrol program does not necessarily point to short comings in biocontrol products. What it does is recognize the reality that biological systems are not predictable all the time. Therefore growers would benefit from a recipe book that outlines proven biocontrol processes for each flower crop as well as options for control that will minimally disrupt established populations of biocontrols if pest populations become too high.

Deliverable:

- On-farm trials by growers can be used to gather control options to populate recipes where gaps exist as long as one, un-biased organization (e.g. Flowers Canada Growers) is responsible for collecting the data and aggregating the results for each crop and each region of the country. The pest management recipe book would need to be available freely to all Canadian flower growers and be in a format that can easily be updated (e.g. on-line or electronic media) as new products and new solutions are discovered.

5. **Take advantage of the delayed pesticide resistance biocontrol offers to ensure a back-up exists in all cases where biocontrol does not provide adequate pest control**

Biological control adoption in Canadian flower greenhouse operations has increased mainly due to pesticide resistance, the scarcity of conventional pesticide products available to growers and delays in pesticide registrations in Canada. Growers unable to gain adequate pest control were experiencing crop losses and for many growers there was no other option but to attempt to use biocontrols. This evolution has brought to light the key improvements needed in floriculture biocontrol that are discussed in this report.

Biological control is a very effective pesticide resistance management and delay tool. Most pests are unable (or very slow) to develop resistance to biocontrols/biopesticides. Working towards ensuring all Canadian flower growers are successfully using BCA's will develop populations of pests that have been exposed to very few pesticides. As long as they are domestic populations, it is likely that pesticides will

be more effective in controlling these pests if biocontrol fails and a pesticide spray is necessary. This will lengthen the life of current and new active ingredients available in the Canadian market and lessen the investment burdens needed to be made by Flowers Canada Growers, Pesticide registrants and Agriculture and Agri-Food Canada in minor use registrations and label expansions.

Deliverable:

- Develop a list of active ingredients (pesticide and biopesticide) that can be utilized when needed to clean up a pest problem in flower crops. The list would prioritize products from those that will be least disruptive to the biocontrol agents down to those that will completely destroy biological agents, thus giving growers choices on how to proceed in their unique situations. This list will provide input as to where new active ingredients need to be registered and/or developed and where new biological control agents or application technologies would be of most benefit.

6. Educate consumers to recognize and request flowers "grown with the environment in mind"

Consumers do not generally question or understand pest management for flowers and are not willing to pay a significant premium for flowers grown with biological control. Since very few growers experience cost savings as a result of using biocontrols the industry would benefit from investigating the potential to use biocontrols as a marketing tool to increase consumer awareness of products grown with minimal pesticides. Consumers may be very interested to know that there is a very low probability of harmful effects to the environment by growing flowers with biological controls. Increased consumer support for, and purchases of, locally grown flowers would be a natural extension of this once consumer are aware and are assured that Canadian grown flowers are grown this way.

Deliverable:

- Develop a marketing strategy that educates the supply chain, especially retailers and consumers on the benefits of purchasing flowers that have been grown using biological controls.

7. Expand successes to outdoor grown horticulture in Canada.

The greenhouse environment is the most conducive of all agricultural environments for utilising biological control for pest management. The greenhouse structure contains insect populations and environmental growing conditions can be managed to a very fine degree of accuracy all year round. It is not surprising then that biological control agents have been developed primarily for greenhouse production (flowers and vegetables). However, what is being achieved in the greenhouse has brought about a great wealth of knowledge in pest/biocontrol interactions that could be of benefit to all areas of horticulture. Pesticide resistance and the never ending requirement for new minor use pesticides are

common to outdoor horticulture as well and biocontrols can offer the same benefits once the difficulties with outdoor environment/pest/biocontrol interactions are overcome.

Deliverable:

- Develop research clusters in the major horticultural areas of Canada where greenhouse biocontrol researchers and production researchers can jointly work together to test new biocontrol options for outdoor field horticulture. In some regions these teams exist already and this has begun.

Conclusions

At the current time, Canadian flower growers are recognized as leaders in the successful use of biological control as a pest management tool. This is in part due to the innovative nature of flower growers and in part due to the lack of effective pesticides available to combat serious pest threats. This dichotomy has meant that Canadian flower growers were somewhat reluctantly drawn to the front of the innovation curve with regards to managing greenhouse flower pest with biologicals. The result of this however has been some very large and significant knowledge gains and also the realization that there is still much more that needs to be known.

Bio 2022 sets out direction to tackle these unknowns so that the growth in biocontrol use in Canadian floriculture can continue and reach the point where all growers are proficient and successful in biocontrol use. The leadership and team needed to fulfillment these directions can be gleaned from the first deliverable:

"An industry lead, such as Flowers Canada Growers, partner with government, growers, supply companies, researchers and consultants to help growers overcome some of the barriers to adopting biocontrols (increased costs in the initial years of implementation, inadequate technical support). This would include financial and technical support for on-farm trials, the gathering of technical support in one central easy-to-access portal, and the support of biocontrol research."

As growers become more confident and more successful users of biological control technologies, the need for a high quality, and a consistent supply of biocontrol agents coupled with strong technical support will grow as well. The biological control companies and the Canadian economy stand to benefit from this growth. If growers increase their spending on biocontrol agents by just 15%, the biocontrol sector will contribute an additional $2.4 million to Canada's GDP, 22 more full time equivalent jobs and an additional $0.4million in taxes.

Flower growers will benefit as well as they will have embraced a very sustainable method for controlling greenhouse pests. The sustainable nature of a pest management program that is based primarily on biological control was a key driver that influenced Flowers Canada Growers' development of their goal for biocontrol success for all flower growers in 10 years. The results of the input and research that has led to Bio 2022 – A Biological Control Strategy for Canadian Floriculture confirms that the value chain that makes up the biocontrol sector in Canada all share this common sustainability ideal.