



Agriculture et  
Agroalimentaire Canada

Agriculture and  
Agri-Food Canada



# Avancées et défis de la lutte biologique aux insectes ravageurs agricoles du Canada dans une perspective durable

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*Colloque Santé du végétal, Une Santé et seul Monde (Paris, 28 janvier 2020)*

Canada 



## Canada – some facts

**Population:** ca. 37 million inhabitants (4 people per km<sup>2</sup> - the 228<sup>th</sup> most densely populated country)

**Surface:** 9 984 670 km<sup>2</sup> (second after Russia)

**Neighbor:** 6 414 km shared land border with the USA, a major agricultural partner

**Fresh Water:** 10 million lakes - more lakes than the rest of the world combined

### **Agriculture:**

One of the largest agricultural producers and exporters in the world.

As an exporter, must be competitive and comply with requirements of client countries, notably food safety and environmental stewardship.

As a country, must respect bi- and multilateral treaties / agreements.

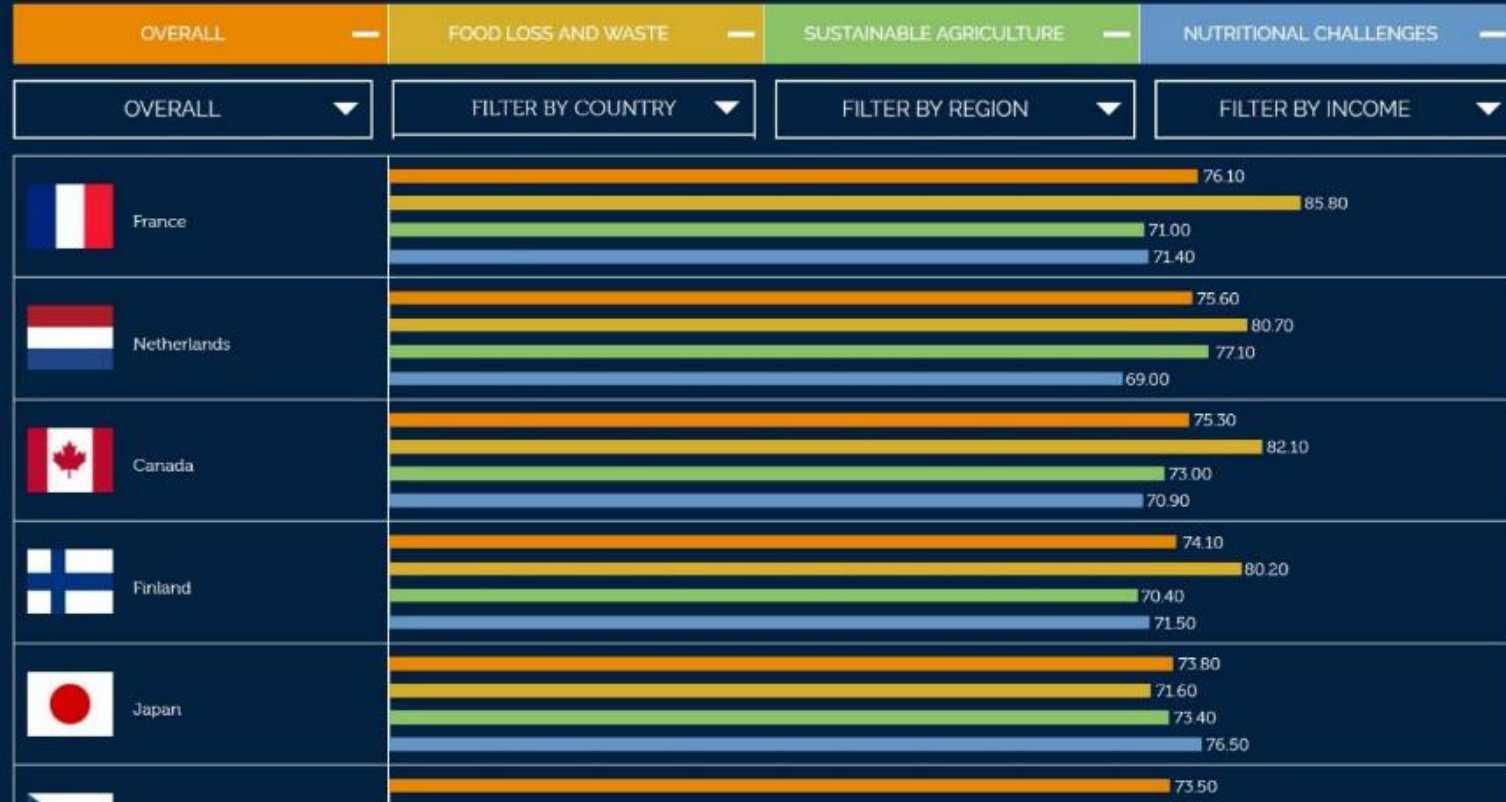
Developed by



(2019)

<http://foodsustainability.eiu.com/country-ranking/>

The ranking model below allows you to view the results in different ways. The drop-down menu allows you to select an individual pillar which will alter the country ranking. You can also change the number of pillars in the ranking by selecting the plus or minus signs in each coloured box.

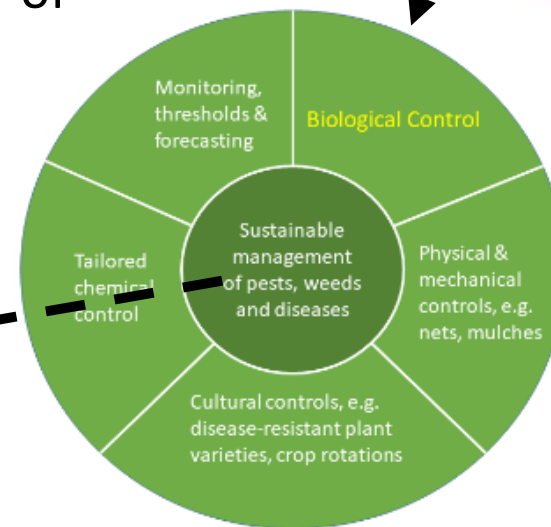
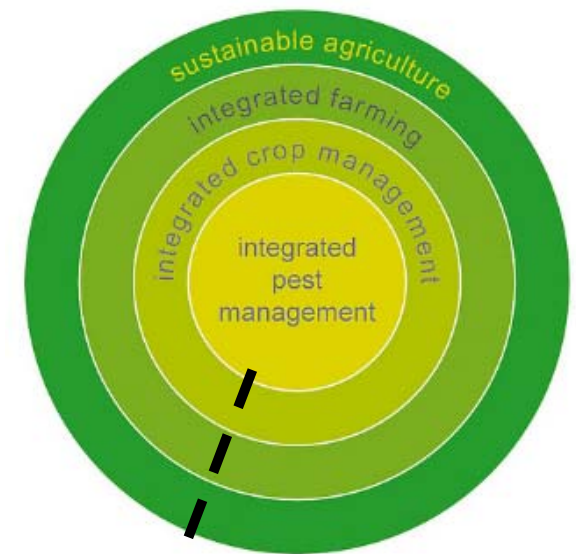
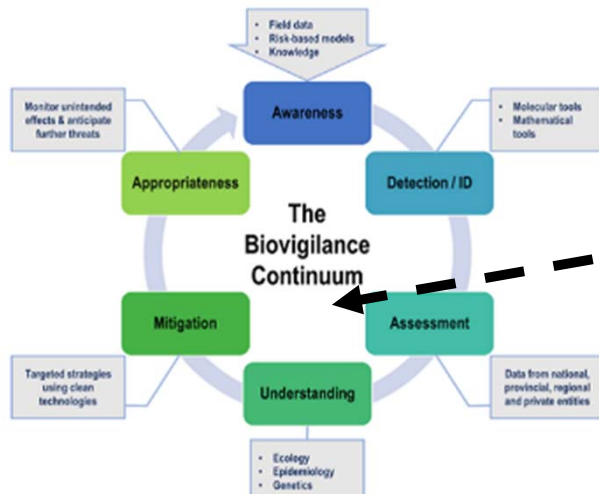


3



# Dealing with problem species

- FAO promotes Integrated Pest Management (IPM) as the preferred approach to crop protection, considering it as a *"pillar of both sustainable intensification of crop production and pesticide risk reduction"*.
- IPM feeds into The Biovigilance Continuum
- **Biological control** is a cornerstone of IPM. Value of services = CDN\$5.03 billion/year (Etilé 2013)



Integrated Pest Management

# Introduction pathways

## ASIA

Spotted wing drosophila



Japanese knotweed



Brown marmorated stinkbug



## MEXICO

Pepper weevil



Diamondback moth



## EUROPE



Leek moth



Spotted knapweed



Common reed

## USA



Brown marmorated stink bug



Dog strangling vine

# Conservation Biological Control

- Very few studies have examined the effect of the landscape context on pests and their natural enemies (eastern Canada)
- In Canada, the issue of geographic scale is particularly important (Étilé 2013)



*Env. J. Entomol.* 105: 521–529, 2008  
<http://www.zej.org/scripts/viewabstract.php?abstract=1360>  
 ISSN 1210-5759 (print), 1802-8829 (online)



## Apple aphid, *Aphis* spp. (Hemiptera: Aphididae), and predator populations in an apple orchard at the non-bearing stage: The impact of ground cover and cultivar

BRUNO FRÉCHETTE<sup>1</sup>, DANIEL CORMILR<sup>2</sup>, GÉRALD CHOUINARD<sup>2</sup>, FRANZ VANOOSTHUYSE<sup>2</sup> and ÉRIC LUCAS<sup>2</sup>

<sup>1</sup>Université du Québec à Montréal (UQAM), Groupe de Recherche en Écologie Comportementale et Animale (GRECA), Département des Sciences Biologiques, C.P. 8888, Succ. Centre-Ville, Montréal, Québec, H3C 3P8 Canada; e-mail: [frechette\\_bruno@yahoo.ca](mailto:frechette_bruno@yahoo.ca)

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**Key words:** Predation, aphids, *Aphis* spp., aphidophagous predators, *Harmonia axyridis*, *Aphidoletes aphidimyza*, spiders, apple orchard, biological control, conservation biological control

## Reduction of European Corn Borer (Lepidoptera: Pyralidae) Damage by Intercropping Corn with Soybean

RALPH C. MARTIN,<sup>1</sup> J. THOR ARNASON,<sup>2</sup> JOHN D. H. LAMBERT,<sup>3</sup> PIERRE ISABELLE,<sup>4</sup> HARVEY D. VOLDENG, AND DONALD L. SMITH<sup>1</sup>

Plant Research Centre, Central Experimental Farm, Agriculture Canada, Ottawa, Ontario K1A 0C6 Canada

*J. Econ. Entomol.* 82(5): 1455–1459 (1989)

# Augmentative Biological Control

## Industry driven

- Commercially mass-produced natural enemies:
  - Applied Bio-nomics (11 species) - *Gaeolaelaps gillespiei* and *Neoseiulus fallacis* are native to Canada
  - Koppert (16 species)
  - BioBest (26 species) - *Sphaerophoria rueppellii* is native to Canada
  - Anatis Bioprotection (27 products)
  
- Okanagan-Kootenay Sterile Insect Release Program



The screenshot shows the 'History' page of the Applied Bio-nomics website. The header includes the company logo, the tagline 'Best in first', and navigation links for 'Home', 'Products', and 'Crops'. The main heading is 'Greenhouse Biological Control Commercial Development in Canada and the Development of Industry Standards'. The text describes the history of greenhouse biological control in Canada, starting with the whitefly parasite *Encarsia formosa* in 1935. It mentions that mass production was started by J.H. McLeod at the Dominion Parasite Laboratory in Ontario, and that he shipped more than 18 million parasites to Canadian greenhouse growers from 1938-1954. A photograph shows a person in a dark jacket and hat working in a greenhouse, with a caption 'Distribution of Persimilis on leaves'. The text continues to describe the resurgence of interest in biological control in the 1970s due to pesticide-resistant spider mites and whiteflies, and mentions that researchers in Canada and Europe began work on parasite and predator mass rearing. The page concludes with a URL: <https://www.appliedbio-nomics.com/history-canadian-greenhouse-biological-control/>



The screenshot shows the homepage of the Anatis Bioprotection website. The header features the Anatis logo and navigation links for 'HOME', 'PRODUCTS', 'CONTACT', 'NEWS', 'STORE', and 'COMMERCIAL'. The main image is a photograph of a man in a light blue t-shirt standing in a field of tall green plants. The text 'Biological control products for farmers and greenhouse growers' is overlaid on the image. A small red box in the top right corner of the image contains the word 'Français'.

# Importation Biological Control

## Government driven

- AAFC main player (weeds, arthropods)
- CFS re-engaged (arthropods)

## Successes

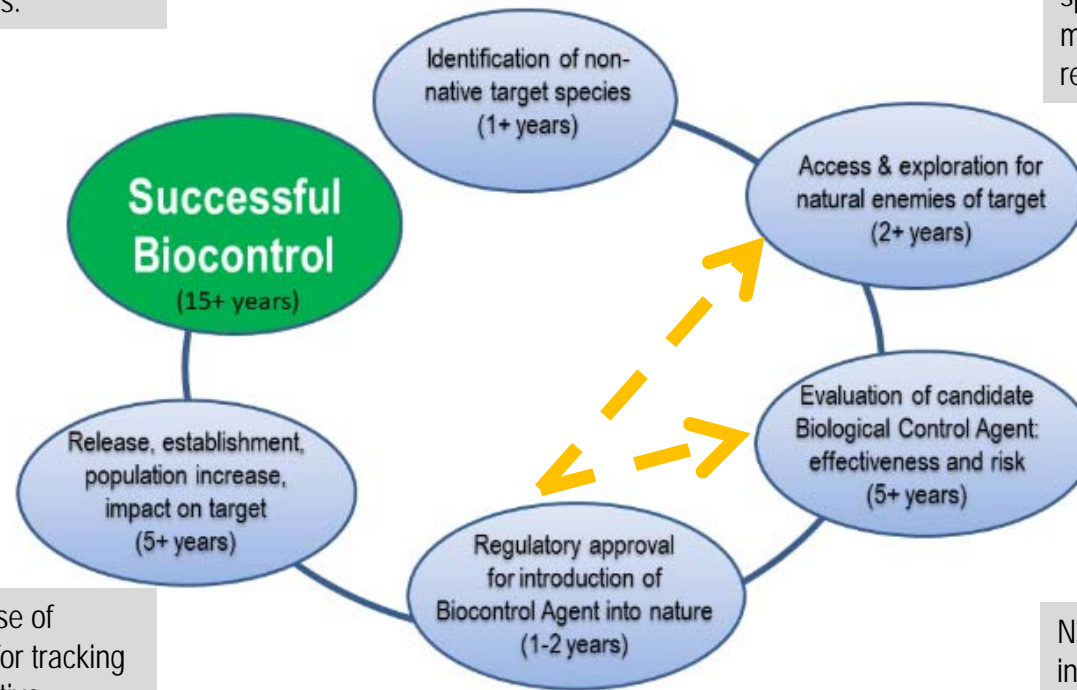
- Weeds (18)  
(Vankosky et al. 2017)
- Forest arthropod pests (15) (MacQuarrie et al. 2016)
- Agriculture arthropod pests (16)



# Importation Biological Control Framework

Innovative integrated pest management programmes; new predictive models; novel benefit-cost analysis parameters.

New species discovered, taxonomic reviews of important groups; new specimens for morphological and molecular studies; new distribution records; new hypotheses on invasion.



Innovations for scale-up and release of biocontrol agents; novel methods for tracking spread and impact; validate predictive hypotheses on outcomes; better understanding of biodiversity.

Improved science-based regulation.

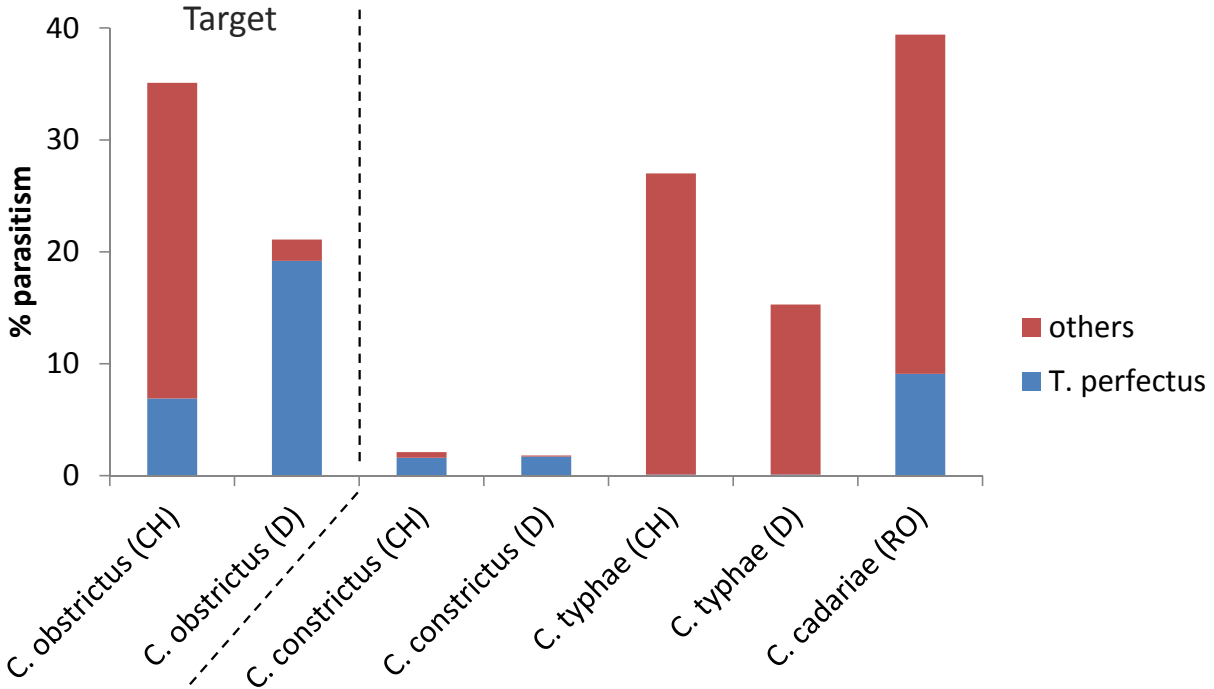
New information on species biology and interactions; better understanding of biodiversity; novel methods for assessing risk; predictive hypotheses on outcomes.

# Ecological host range

Cabbage seed pod weevil (*C. obstrictus*)



Charançon de la graine du chou



Larvae	1817	2287	5754	6137	3100	3625	2247
Parasitoids	638	482	122	110	838	556	884
<i>T. perfectus</i>	126	438	<b>90</b>	<b>107</b>	<b>2</b>	<b>5</b>	<b>204</b>

- Field data confirm hosts identified in lab tests
- Biological control agent probably not specific enough

# Petition for Release

*Canadian Entomologist* (2011) 143:524-537

524

**The parasitoid communities associated with an invasive canola pest, *Ceutorhynchus obstrictus* (Coleoptera: Curculionidae), in Ontario and Quebec, Canada**

P.G. Mason, J.H. Miall, P. Bouchard, D.R. Gillespie, A.B. Broadbent, G.A.P. Gibson

Journal of Applied Biological Control

Biological Control

Mortality factors affecting the cabbage seedpod weevil, *Ceutorhynchus obstrictus* (Marshall), in its area of origin: A life table analysis

T. Hays<sup>1</sup>\*, P.G. Mason<sup>2</sup>, L.M. Dondall<sup>3</sup>, U. Kuhlmann<sup>4</sup>

\*Full range biological control release, 1998 to date; long-term population and agrifood Canada, agriculture and Agri-Food Canada, Ottawa, Ontario, Canada; <sup>1</sup>Department of Applied and Molecular Sciences, 4-10 Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada; <sup>2</sup>Agri-Food Canada, Ottawa, Ontario, Canada; <sup>3</sup>Department of Applied and Molecular Sciences, 4-10 Agriculture and Agri-Food Canada, Ottawa, Ontario, Canada; <sup>4</sup>Agri-Food Canada, Ottawa, Ontario, Canada

*Canadian Entomologist* (2014) 146:224-235

224

**The parasitoid communities associated with *Ceutorhynchus* species (Coleoptera: Curculionidae) in Ontario and Québec, Canada\***

P.G. Mason,<sup>1</sup> J.H. Miall, P. Bouchard, A. Brauner, D.R. Gillespie, G.A.P. Gibson

*Canadian Entomologist* (2011) 143:399-410

399

**Larval phenologies and parasitoids of two seed-feeding weevils associated with hoary cress and shepherd's purse (Brassicaceae) in Europe**

Franck J. Müller, Lloyd M. Dondall, Peter G. Mason, Ulrich Kuhlmann

Biocontrol Science and Technology 2015  
Vol. 25, No. 1, 21–47. <http://dx.doi.org/10.1009/09583157.2014.945900>

Springer & Francis  
Taylor & Francis Group

**RESEARCH ARTICLE**

**Determining the host specificity of the biological control agent *Trichomalus perfectus* (Hymenoptera: Pteromalidae): the importance of ecological host range**

T. Hays<sup>1</sup>\*, P.G. Mason<sup>2</sup>, D.R. Gillespie<sup>3</sup>, J.H. Miall<sup>4</sup>, G.A.P. Gibson<sup>5</sup>, A. Disceva<sup>6</sup>, A.M. Brauner<sup>6</sup> and U. Kuhlmann<sup>7</sup>



<sup>1</sup>CABI, Delémont, Switzerland; <sup>2</sup>Agriculture and Agri-Food Canada, Research Centre, Ottawa, ON, Canada; <sup>3</sup>Agriculture and Agri-Food Canada, Research Centre, Agassiz, BC, Canada; <sup>4</sup>Institute of Biological Research, Jan. Bontasov

(Received 10 April 2014; returned 17 June 2014; accepted 14 July 2014)

**Petition for release of *Trichomalus perfectus* (Walker) (Hymenoptera: Pteromalidae) as a Classical Biological Control Agent for cabbage seedpod weevil, *Ceutorhynchus obstrictus* (Marshall) (Coleoptera: Curculionidae) in Canada**

- Date Submitted to CFIA: May 30, 2017
- Petitioners:
 

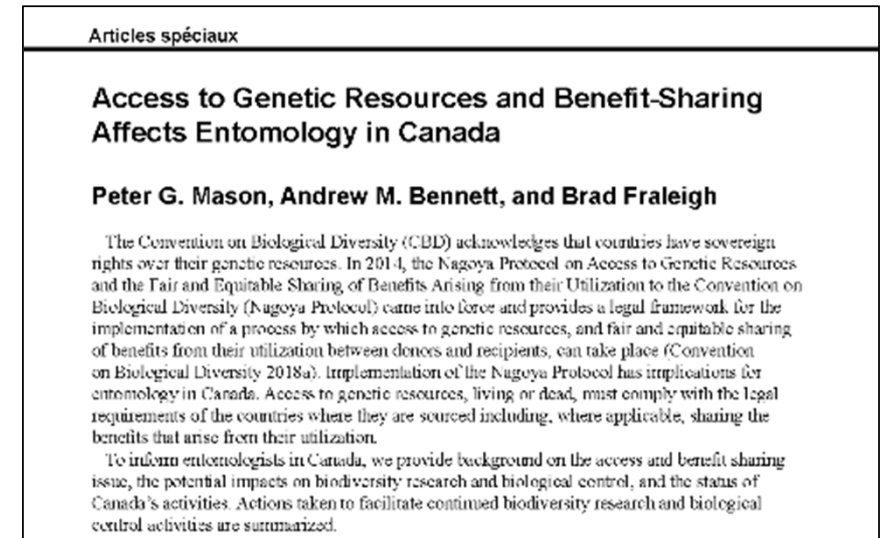
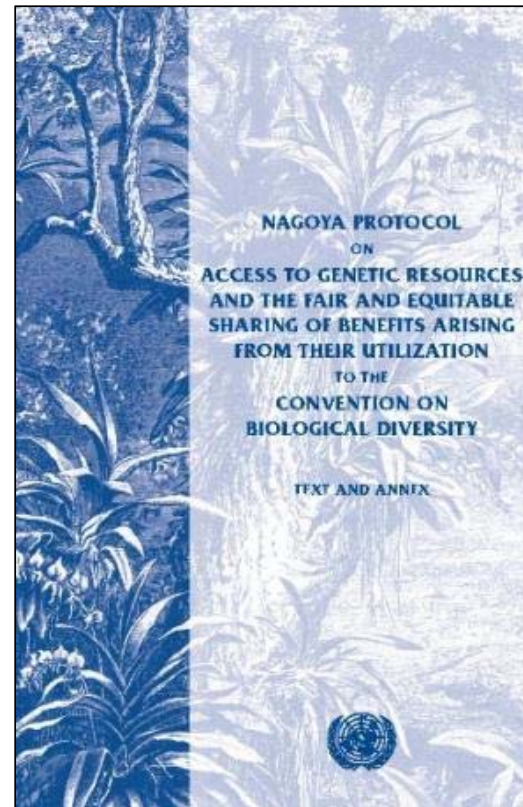
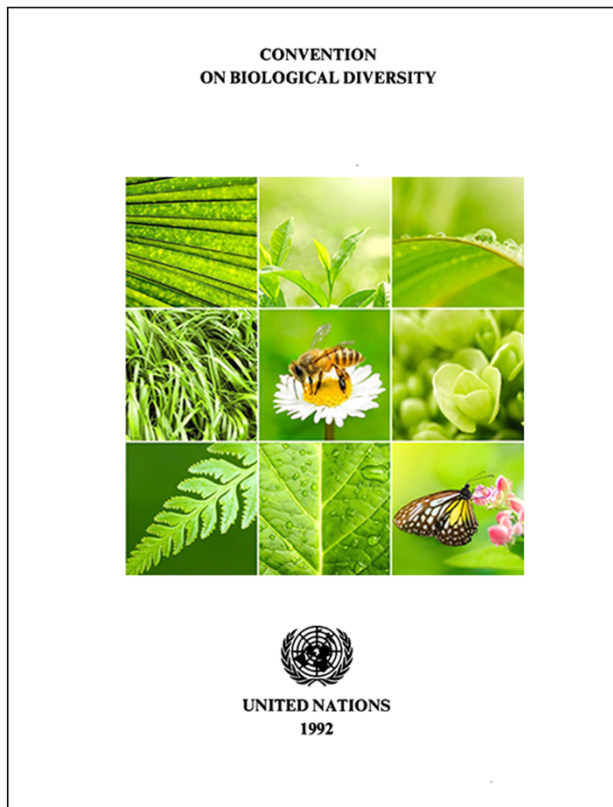
Dr. Peter Mason AAFC, Ottawa Research Centre 960 Carling Avenue, K.W. Neathy Bldg Ottawa, ON K1A 0C6 Phone: 613-759-1908 Fax: 613-759-1701 Email: <a href="mailto:Peter.Mason@agr.gc.ca">Peter.Mason@agr.gc.ca</a>	Dr. Tara Gurioppy AAFC, London Research Centre 1300, Sanford Avenue London, ON N6M 1A0 Phone: 519-953-6669 Fax: 604-796-0359 Email: <a href="mailto:Tara.Gurioppy@agr.gc.ca">Tara.Gurioppy@agr.gc.ca</a>
Dr. Tim Hays & Dr. Ulrich Kuhlmann CABI Europe – Switzerland Rue des Grillons 1 CH-2800 Delémont Switzerland Phone: +41-32-421-8882 / +41-32-421-8883 Fax: +41-32-421-4871 Email: <a href="mailto:U.Kuhlmann@cabi.org">U.Kuhlmann@cabi.org</a> <a href="mailto:T.Hays@cabi.org">T.Hays@cabi.org</a>	Dr. Dave Gillespie AAFC, Agassiz Research Centre P.O. Box 1000, 6947 Hwy. 7 Agassiz, BC V0M 1A0 Phone: 604-796-6079 Fax: 604-796-0359 Email: <a href="mailto:Dave.Gillespie@agr.gc.ca">Dave.Gillespie@agr.gc.ca</a>
- Target pest: *Ceutorhynchus obstrictus* (Marshall) [Curculionidae], cabbage seedpod weevil
- Proposed agent: *Trichomalus perfectus* (Walker) [Hymenoptera: Pteromalidae]

- Location of studies: CABI Europe – Switzerland, Delémont, Switzerland; Agriculture and Agri-Food Canada, Ottawa, Ontario, Agriculture and Agri-Food Canada, Agassiz, British Columbia

# Access to natural enemies

- Convention on Biodiversity (195 countries signed + European Union) including Canada
- Nagoya Protocol on Access and Benefit-Sharing (121 countries signed + European Union) not Canada

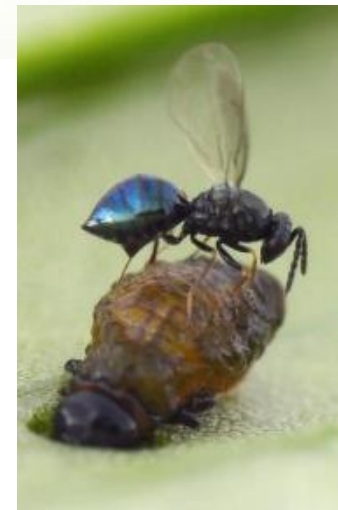
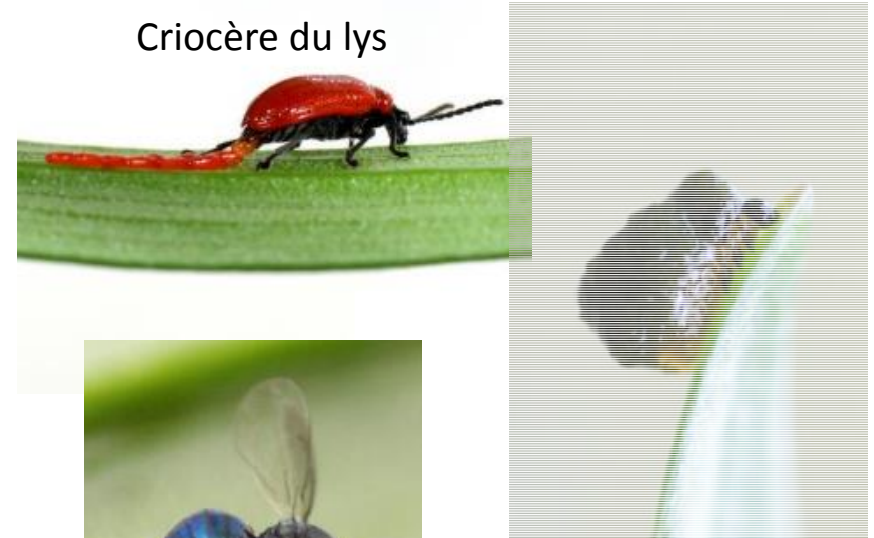


*Bulletin of the Entomological Society of Canada* (2018) 50: 120–126.

# Successful Biological Control of lily leaf beetle

- *Tetrastichus setifer* (Eulophidae) released in 1999 (2010 in Canada); *Diaparsis jucunda* (Ichneumonidae) and *Lemophagus errabundus* (Ichneumonidae) released in 2003
- *Tetrastichus setifer* most successful, widespread, up to 100% parasitism
- Current work includes: introduction of *T. setifer* into areas newly invaded by lily leaf beetle (e.g. western Canada); monitoring dispersal of *T. setifer* to lily leaf beetle on novel plant hosts; developing a bioclimatic model to predict dispersal of *T. setifer*; release of *L. errabundus* in Canada

Criocère du lys



*Tetrastichus setifer*



# Successful Biological Control of Diffuse knapweed

- 12 agents released beginning in 1970, including *Urophora affinis*, *U. quadrifasciata*, *Sphenoptera jugoslavica*, and *Larinus minutus* (1996)
- *Larinus minutus* was the most successful: feeds on leaves of rosettes and seedlings and the parenchyma of bolting stems
- “Field observations show that diffuse knapweed densities declined at sites in British Columbia Canada where the weevil *L. minutus* became established. Decline in diffuse knapweed density did not occur where densities of *L. minutus* were low.” (Myers et al. 2009)



# The State of Biological Control in Canada

- A recognized strategy for dealing with problem non-native species (CBD 2018, FAO 2019)
- A science-based discipline
- Provides a wealth of data for addressing ecological and evolutionary questions
- Importation and inundative biological control activities are regulated by CFIA
- **Natural BC**- needs to be better understood
- **Conservation BC**- greater effort is needed to enable implementation
- **Augmentative BC**- a thriving commercial industry
- **Importation BC**- has resulted in some successes BUT need to improve predictability

# Acknowledgements

Big thanks to the taxonomists at the Canadian National Collection, Insects, Arachnids and Nematodes

Without them biological control research in Canada would not be possible