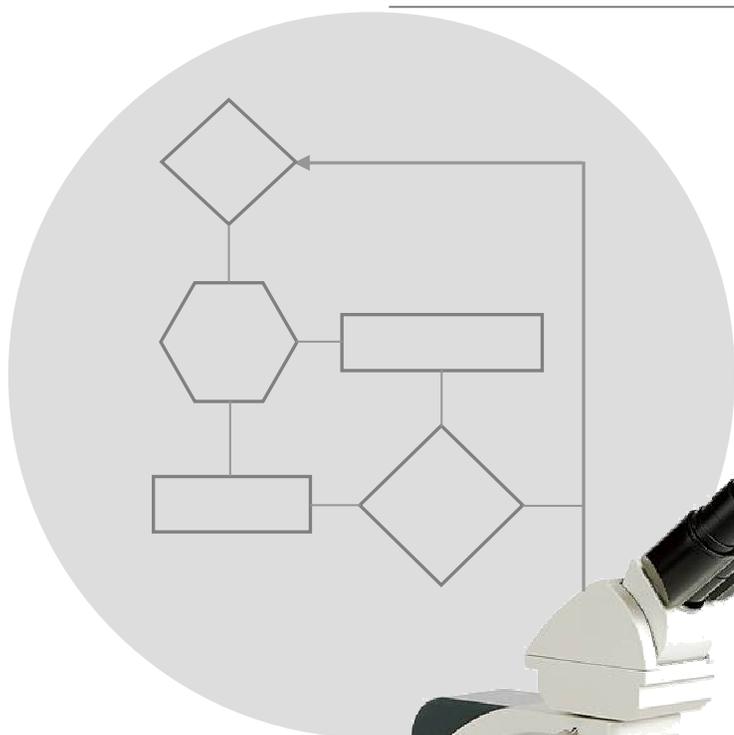

THE USE AND REGULATION OF MICROBIAL PESTICIDES IN REPRESENTATIVE JURISDICTIONS WORLDWIDE

J. Todd Kabaluk
Antoniet M. Svircev
Mark S. Goettel
Stephanie G. Woo





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Editors

J. Todd Kabaluk

Biologist, Agriculture and Agri-Food Canada
Pacific Agri-Food Research Centre
Agassiz, British Columbia

Antonet M. Svircev

Research Scientist, Agriculture and Agri-Food Canada
Southern Crop Protection and Food Research Centre
Vineland, Ontario

Mark S. Goettel

Research Fellow, Agriculture and Agri-Food Canada
Lethbridge Research Centre
Lethbridge, Alberta

Stephanie G. Woo

Life Sciences Cooperative Education Student, University of British Columbia
Vancouver, British Columbia

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PREFACE

When there is potential for harm to human and environmental health from the introduction of a pest control product, regulatory procedures for pre-market assessment of safety are common in most countries. An effective regulatory framework provides protection from harm, while still facilitating the availability of useful products. It recognizes the needs of farmers, society, and the commercial interests of the pest control product proponents i.e. registrants. The latter are recognized by being provided clear communication of the terms of the regulatory system and the stepwise process of product registration, and by being charged reasonable costs for registration so products move seamlessly from the application for registration through to the market.

The risks assumed with the introduction of microbial pest control products are related to their toxicity, infectivity, pathogenicity to and displacement of non-target organisms, and the potential irreversibility of introduction into the environment. These are the types of risks which are assessed during a pre-market safety evaluation (Cook et al. 1996; Jaronski et al. 2003; Mensink and Scheepmaker 2007; Organization for Economic Cooperation and Development 2003).

Predictable and efficient regulatory processes ultimately allow registrants to begin to recover their research, development, and registration costs in a timely manner following registration. This is particularly important for industries in the microbial pest control sector, which are mainly small and medium enterprises for whom lengthy regulatory delays may act as a significant deterrent to investment in product development (Cook et al. 1996; Jaronski et al. 2003; Laengle and Strasser 2010).

Regulatory systems for pest control products are designed to achieve several purposes. They must protect human health and the environment from potential risks associated with the use of pest control products. They must also allow nations to meet their needs for food and fibre production by facilitating the availability of pest control products and ensuring that products have acceptable efficacy. In Canada, for example, federal pesticide legislation stipulates that the regulatory system should encourage the development and use of innovative and lower-risk products and pest control strategies, and where consistent with the primary objective to protect human health and safety and the environment, should minimize any negative impact on economic viability and competitiveness (Minister of Justice 2002). An effective regulatory system achieves these goals by putting in place the following elements:

- ◆ A system of data requirements to guide the assessment of human health and safety, value (including efficacy), and environmental safety;
- ◆ Clear and predictable procedures for assessing the risk and value of pest control products, with sufficient flexibility to allow expert opinion to contribute to the assessment process;
- ◆ Mechanisms which afford opportunities for public and industry input into the decision-making process, including the right to appeal decisions;
- ◆ Policies which establish reasonable timelines for assessment of various classes of products, and an agency with a good track record with regard to these timelines;
- ◆ The flexibility to modify regulatory procedures in line with new scientific information;
- ◆ Regulatory fees which are affordable to registrants;
- ◆ Enforcement of legislation and regulations related to product use, sale, distribution, and other regulatory requirements.

It is commonly agreed that one way to streamline and speed product registration processes is through international harmonization of a regulatory framework e.g. for data requirements, fees, timelines, criteria for approval, and risk assessments. Indeed, major steps have been taken to increase both the harmonization and transparency of data requirements and the procedures for risk assessment at OECD, North American, and European Union levels. It should be borne in mind, however, that while harmonization is desirable, because microbial agents have a wide range of mechanisms of action, and because their properties are generally poorly understood relative to chemical pesticides, regulatory assessment frameworks must retain a degree of flexibility and reliance on expert opinion in order to comply with the “intra- and interspecific variation of microorganisms and their constituents” (Mensink and Scheepmaker 2007).

The presentation of the regulatory systems in the following chapters provides a means to compare and contrast the variety of approaches taken by selected jurisdictions (countries or groups of countries) in establishing a framework that offers protection from harm, while offering pest control products with utility for farmers, and their degree of success in doing so. Harmonization activities will be apparent, particularly among member states of the European Union and between Canada and the United States, the latter of which is evolving rapidly. Significant gains are still to be made in Africa, but in the meantime, continental harmonization is loosely achieved by following principles of the Food and Agriculture Organization for the registration of synthetic pesticides. The regulation of pesticides among the Newly Independent States of the former Soviet Union has understandably become disjointed, and despite Ukraine being the birthplace of microbial pest control, microbial pesticide use in Eastern European countries is minimal. China demonstrates, however, that a regulatory system can be created rapidly and streamline the inherent complexity involved in the widespread use of unregistered and unformulated active ingredients. India too has experienced a rapid development of microbial pesticide programming in support of poorer farmers and to support the continuing biotechnological advancements arising from Green Revolution of the 1980s. Cuba may in fact be a leader in the use of microbial pesticides under the state mandate of ecologically-based pest management, together with a network of state-supported microbial pesticide production facilities to supply the agricultural sector.

These chapters also indicate the degree to which countries have provided institutional support of microbial pesticides in facilitating their development and adoption, and show the international reach of microbial strains and products.

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Vijay Cuddeford
Regulatory Consultant
North Vancouver, British Columbia
Canada

Todd Kabaluk
Agriculture and Agri-Food Canada
Pacific Agri-Food Research Centre
Agassiz, British Columbia
Canada

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REFERENCES

- Cook, R.J., W.L. Bruckart, J.R. Coulson, M.S. Goettel, R.A. Humber, R.D. Lumsden, J.V. Maddox, M.L. McManus, L. Moore, and S.F. Meyer. 1996. Safety of microorganisms intended for pest and plant disease control: a framework for scientific evaluation. *Biol. Control* 7: 333-351.
- Jaronski, S.T., M.S. Goettel, and C.J. Lomer. 2003. Regulatory requirements for ecotoxicological assessments of microbial insecticides – how relevant are they? p236-260, *In* H.M.T. Hokkanen and A.E. Hajek (ed.), *Environmental Impacts of Microbial Insecticides*. Kluwer Academic Publishers. Dordrecht, The Netherlands.
- Laengle, T. and H. Strasser. 2010. Developing a risk indicator to comparatively assess environmental risks posed by microbial and conventional pest control agents. *Biocontrol Sci. Technol.* 20: 659–681.
- Mensink, B.J.W.G. and J.W.A. Scheepmaker. 2007. How to evaluate the environmental safety of microbial plant protection products: A proposal. *Biocontrol Sci. Technol.* 17: 3-20.
- Minister of Justice. 2002. The Pest Control Products Act. Available online through www.laws.lois.justice.gc.ca
- Organization for Economic Cooperation and Development. 2003. Guidance for Registration Requirements for Microbial Pesticides. Environment Directorate. ENV/JM/MONO(2003)5. Available online at www.oecd.org/dataoecd/4/23/28888446.pdf

ARGENTINA

Claudia C. López Lastra

Centre of Parasitological and Vector Studies (CEPAVE), University of La Plata - National Research and Technological Council of Argentina (UNLP-CONICET), La Plata, Buenos Aires, Argentina

OVERVIEW AND USE

Bacteria are the most widely used biocontrol agents in Argentina, with the greatest number of registered products (Table 12). *Bacillus thuringiensis* (*Bt*) products were first used in 1950 against *Colias lesbia* in alfalfa (Botto 1996). There are three imported products that are being used for insect pest control in agricultural crops (lepidopteran pests). These imported products, based on *B. thuringiensis* subsp. *kurstaki* (*Btk*), are used for the control of *Rachiplusia nu* and *Anticarsia gemmatalis* (Lepidoptera: Noctuidae): Bactur, Dipel PM, and Vendaval *Bt*. Based on the small-scale and isolated use of these products, the future of the development of pest biocontrol agents in Argentina is uncertain, partially due to a lack of national political strategies focussing on biocontrol programmes (Botto 1996).

The first virus-based product ('Carpovirus plus' based on a granulosis virus of *Cydia pomonella*) was registered in 2000 by Agro Roca. Field applications were initially conducted on apples in the Rio Negro and Mendoza provinces, and afterwards in walnut tree plantations in La Rioja and Catamarca provinces. Basic studies and efficacy trials were carried out by the National Institute of Agricultural Technology (INTA) and the Institute of Agriculture Microbiology and Zoology (IMIZA) in cooperation with two private companies: Agro Roca in Argentina and Natural Plant Protection in France (Sosa Gómez et al. 2008). Currently, *Epinotia aporema*, a granulosis virus, is undergoing the registration process by researchers at INTA and IMIZA.

Published research studies on fungal biocontrol are mostly associated with laboratory and small scale field trials. The use of a product based on *Beauveria bassiana* for controlling *Triatoma infestans* and *Musca domestica* was first published by Alves et al. (2008b). This product is currently undergoing registration by the National Service of Sanitary and Agro-alimentary Quality (SENASA) (J. Willemoes, Biagro, pers. comm.). Current field trials using *B. bassiana* are using the product, L-Naturalis, which was formerly used in experiments to control *Trialeurodes vaporariorum*, *Myzus persicae*, and *Aphis gossypii* in tomato and pepper crops. Some oil and water formulations based on *B. bassiana* were also evaluated for control of *T. infestans* by INTA (Alves et al. 2008a and 2008b).

Formulated products based on the microsporidians *Antonospora locustae* and *Nosema locustae* (Canning 1953; Slamovits et al. 2004), were applied to control locusts in natural grasslands in the Buenos Aires, La Pampa, and Chubut provinces (Henry and Oma 1981; Lange and De Wysiecki 1999). These are the only records of protozoans used for pest control in Argentina (Sosa Gomez and Moscardi 1991; Briano 1999; Garcia et al. 2008). Lange (2002) reported that *A. locustae* was naturally established in the locust populations for several years after its introduction. There is no record of the registration of nematodes for insect control in Argentina.

Table 12. Microbial pesticides in Argentina.

	Taxus	Products	Targets
Fungicides			
<i>Trichoderma</i> spp.	Fungus	Biagro TL	Phytopathogenic fungi
Insecticides			
<i>Bacillus sphaericus</i>	Bacterium	Summit-Agro ¹ Rosembuch ¹	Mosquitoes
<i>Bacillus thuringiensis</i> subsp. <i>israelensis</i>	Bacterium	Chemotecnica ¹ Rosembuch ¹ Biagro BT ²	Mosquitoes, black flies
<i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i>	Bacterium	Dipel ¹ Bactur ¹ Vendaval ¹	Lepidopteran pests
<i>Beauveria bassiana</i>	Fungus	Biagro Bb-vinchuca ¹ Biagro Bb-mosca (registration in progress)	<i>Triatoma infestans</i> , <i>Musca domestica</i>
<i>Cydia pomonella</i> granulosis virus	Virus	Agro Roca ²	<i>Cydia pomonella</i>
<i>Epinotia aporema</i> granulosis virus	Virus	Registration in progress	<i>Epinotia aporema</i>
<i>Anticarsia gemmatalis</i> nucleopolyhedrosis virus	Virus	Registration in progress	<i>Anticarsia gemmatalis</i>
Serum-free media nucleopolyhedrosis virus	Virus	Registration in progress	<i>Spodoptera</i>

¹imported; ²produced in Argentina

REGISTRATION AND THE REGULATORY SYSTEM

The regulatory institutions in Argentina are as follows: SENASA, Vegetal National Committee of South Cone (COSAVE), Secretary of Agriculture, Livestock, Fish and Food (SACPyA), and the National Administration of Drugs, Food and Medical Technology (ANMAT), the latter of which is exclusively responsible for the regulation of products to control vectors of medical importance. Information relating to pesticide registration, restrictions, commercialization, and use of agrochemicals and biological products is issued by SENASA through their 'Coordination of Agrochemical and Biological Products' department. There can also be province-specific registrations, and these are regulated by individual state departments, for example the Buenos Aires Province Department of Health in the case of Buenos Aires State. The National Agriculture Department and Environmental Policies Secretary is also involved in the regulation process. Specifications for the registration of biological (including microbiological) products are provided in the Resolution 350/1999 (Chapter 12, Agents for Microbial Control), available from SACPyA at www.infoleg.gov.ar/infoleg/internet/anexos/55000-59999/59812/texact.htm

SPECIAL CONCESSIONS AND ORGANIZATIONS PROMOTING BIOCONTROL

Despite the claim by Botto (1996) that a lack of national political strategies focussing on biocontrol programmes makes it's future in Argentina uncertain, some activities are taking place. Several programmes were successfully developed by INTA for controlling *Cydia pomonella* with the granulosis virus in Rio Negro, and for controlling *Epinotia aporema* (soybean borer) with a second granulosis virus that is under experimental registration. *Anticarsia gemmatalis* was also controlled with NPV virus in the Tucuman province by researchers at the Research Centre for the Regulation of Populations of Harmful Organisms (CIRPON) (National Council of Scientific and Technical Research (CONICET), San Miguel de Tucumán). Currently, new control programmes

for *Spodoptera frugiperda* with nucleopolyhedrosis virus are underway at the Experimental Station Obispo Colombres, San Miguel de Tucumán, Santa Fe regional INTA stations, and IMIZA- INTA Castelar (IMIZA), Buenos Aires province.

There are a few organizations that are further promoting and developing biocontrol programmes in Argentina. While INTA is one major institution dedicated to biological control programmes in the country, various national universities are also developing research and extension programmes related to insect biocontrol and integrated pest management (IPM). There are also some programmes developed by the Department of Health in the Buenos Aires province, Salta, and Cordoba for the control of mosquitoes using *Bt* subsp. *israelensis* applications, and similarly to control blackflies in the provinces of Río Negro, Neuquén, and Mendoza. INTA agencies recommend *Bt kurstaki*-based products for controlling lepidopteran pests in some crops through their regional experimental stations in several provinces, but often, farmers favour synthetic products because they are more affordable (C. Salto, INTA Rafaela, Pers. Communication).

In recent years, the Centre for Parasitological Studies and Vectors (CEPAVE) (CONICET – University of La Plata), through grants from the University of La Plata, has undertaken biocontrol research and extension projects, culminating in new programmes to educate small farmers in the La Plata Horticultural Belt on the advantages of biocontrol using entomopathogenic fungi. The La Plata Horticultural belt is one of the most important horticultural regions in the Pampeana region, and fungal strains used are those acquired locally. CEPAVE has also engaged in a similar project in cooperation with the Institute for Research on Small-sized Family Agriculture (IPAF) (INTA for the Pampeana region).

REFERENCES

- Alves, S.B., R.B. Lopes, R.M. Pereira, and M.A. Tamai. 2008a. O controle microbiano na America Latina. p21-68, *In* S.B. Alves and R. Biaggioni Lopez (ed.), *Controle Microbiano de Pragas na America Latina*. FEALQ. Piracicaba, Brazil.
- Alves, S.B., R.B. Lopes, S. Vieira, and M.A. Tamai. 2008b. Fungos Entomopatogénicos usados no Controle de pragas na America Latina. p69-110, *In* S.B. Alves, and R. Biaggioni Lopez (ed.), *Controle Microbiano de Pragas na America latina*. FEALQ. Piracicaba, Brazil.
- Botto, E.N. 1996. Control biológico de plagas en La Argentina: informe de la situación actual. p1-8, *In* C. Zapater (ed.), *El control biológico en América Latina*. Buenos Aires.
- Briano, J.A. 1999. El protozoo *Thelohania solenopsae* (Microsporidia: Thelohaniidae) como agente potencial de control biológico de hormigas coloradas en los Estados Unidos. *Rev.Soc. Entomol. Arg.* 58: 17-25.
- Canning, E.U.A. 1953. A new microsporidian, *Nosema locustae* n.sp. from the fat body of the African migratory locust, *Locusta migratoria migratorioides*. *R. F. Parasitol.* 43: 287-290.
- García, J.J.M. V. Micieli, G.A. Marti, and S.A. Pelizza. 2008. Uso de protozoários entomopatogénicos em programas de controle microbiano nos países latino- americanos. *In* S.B. Alves, R. Biaggioni Lopez (ed.), *Controle Microbiano de Pragas na America Latina*.
- Henry, J.E. and E.A. Oma. 1981. Pest control by *Nosema locustae*, a pathogen of grasshoppers and crickets. p573- 586, *In* H.D. Burghes (ed.), *Microbial control of pests and plant diseases 1970-1980*. Academic Press. New York.
- Lange, C.E. and M.L. De Wysiecki. 1999. Epizootias of *Nosema locustae* (Protozoa: Microspora) en melanoplinos (Orthoptera: Melanoplinae) de Buenos Aires y La Pampa Argentina. *Rev. Soc. Entomol. Argent.* 58: 76-78.
- Lange, C.E. 2002. El desarrollo de *Nosema locustae* (Protozoa: Microspora) para el control biológico de tucuras (Orthoptera: Acridioidea) y las consecuencias de su utilización en la Argentina. *Rev. Soc. Entomol. Argent.* 61: 1-9.

- Slamovits, C.H., Williams, B.A.P., and P.J. Keeling 2004. Transfer of *Nosema locustae* (Microsporidia) to *Antonospora locustae* n.comb based on molecular and ultrastructural data. *J. Eukariot. Microbiol.* 51: 207-213.
- Sosa Gómez , D.R. and F. Moscardi. 1991. Microbial control and insect pathology in Argentina. *Ciencia e Cultura* 43: 375-379.
- Sosa Gómez, D.R., F. Moscardi, B. Santos, L.F.A. Alves, and S.B. Alves. 2008. Produção e uso de vírus para o controle de pragas na América Latina. In S.B. Alves and R. Biaggioni Lopez (ed.), *Controle Microbiano de Pragas na America Latina*. FEALQ. Piracicaba, Brazil.

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APPENDIX

SECTION AUTHORS AND CONTACT EMAIL ADDRESSES

Section	Authors	Contact	Email
Book	J. Todd Kabaluk, Antonet M. Svircev, Mark S. Goettel, and Stephanie G. Woo (editors)	Todd Kabaluk	Todd.Kabaluk@agr.gc.ca
Africa with special reference to Kenya	Roma L. Gwynn and Jean N. K. Maniania	Roma Gwynn	rgwynn@biorationale.co.uk
China	Bin Wang and Zengzhi Li	Bin Wang	bwang@ahau.edu.cn
India	R. J. Rabindra and D. Grzywacz	David Grzywacz	d.grzywacz@gre.ac.uk
South Korea	Jeong Jun Kim, Sang Guei Lee, Siwoo Lee, and Hyeong-Jin Jee	Jeong Jun Kim	jjkim66@hotmail.com
European Union with special reference to the United Kingdom	Roma L. Gwynn and John Dale	Roma Gwynn	rgwynn@biorationale.co.uk
Ukraine, Russia, and Moldova	Iryna Anishchenko, Svitlana Lapa, Liliana Cepoi, Nataliya Voloshchuk, Tetyana Bondar, Ivan I. Koshevskyi, Nataliya Goncharenko, Andrii P. Gryganskyi, and J. Todd Kabaluk	Andrii Gryganskyi	gryganski@hotmail.com
Argentina	Claudia Lopez Lastra	Claudia Lopez Lastra	claudia@cepave.edu.ar
Brazil	Drauzio E. N. Rangel and Marcos Faria	Drauzio Rangel	drauzio@biology.usu.edu
Cuba	Deborah E. Henderson and Jorge L. Ayala Sinfuentes	Deborah Henderson	Deborah.Henderson@kwantlen.ca
Canada	J. Todd Kabaluk, Victoria R. Brookes, and Antonet M. Svircev	Todd Kabaluk	Todd.Kabaluk@agr.gc.ca
United States	Michael Braverman	Michael Braverman	braverman@AESOP.Rutgers.edu
Australia	Caroline Hauxwell, Mike Tichon, Patrick Buerger, and Sarah Anderson	Caroline Hauxwell	carrie.hauxwell@gmail.com
New Zealand	Trevor A. Jackson, Mike Brownbridge, and Travis R. Glare	Trevor Jackson	trevor.jackson@agresearch.co.nz
