4.3 Access and Benefit Sharing: Best Practices for the Use and Exchange of Invertebrate Biological Control Agents

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The Convention on Biological Diversity (CBD) acknowledges the sovereign rights that countries have over their 'genetic resources'. The Nagoya Protocol that came into force in 2014 provides a framework for the implementation of a fair and equitable process by which access to genetic resources, and sharing of benefits from use between donor and recipient countries can take place. Biological control agents are genetic resources and countries which are signatories to the Protocol must develop a legal framework to ensure that compliant procedures are in place both to secure access to organisms from the donor country, and to share benefits arising from their use in the recipient country.

The International Organisation for Biological Control (IOBC) Global Commission on Biological Control and Access and Benefit Sharing strongly recommended that biological control agents should be considered as a special case with respect to access and benefit sharing (ABS) under the CBD (Cock *et al.*, 2010). Recently, IOBC has prepared a best practices guide to assist the biological control community to demonstrate due diligence in complying with ABS requirements (Mason *et al.*, 2017). The guide proposes that best practise should, where possible, include the aspects described below.

Collaborations to facilitate information exchange about what invertebrate biological control agents are available and where they may be obtained: Biocontrol practitioners have, over many years, developed an international 'community of practice' based on free and collegial exchange of biological control agents. Information on successful use of biological control agents is often not published and so informal communication between researchers has enabled access to knowledge of availability and efficacy of agents used elsewhere. An example of this, although not formalised under ABS protocol, is a recent

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collaboration where the United States Department of Agriculture - Agriculture Research Service provided information and specimens of the egg parasitoid, *Trissolcus japonicus* (Ashmead) to New Zealand where they have been used in pre-emptive risk assessment quarantine studies in advance, and in preparation for the possible incursion of the invasive brown marmorated stink bug, *Halyomorpha halys* Stål (Hemiptera: Pentatomidae). Under the Nagoya Protocol, such collaborations may need to be formalised and subject to contractual agreements. We recommend that agreements be developed in such a way that they will clearly benefit the source country by providing opportunities for capability building, joint research programmes, and joint publications.

Sharing of knowledge through freely available databases that document successes and failures: Compilations have been made of the introduction and impact of classical biological control (CBA) agents. Mic Julien's world catalogue of the use of CBAs for weeds (Winston *et al.*, 2015) provides comprehensive coverage. Hajek *et al.* (2005) catalogued the pathogens and nematodes used for CBA of insects and mites; an updated catalogue is in press and will be available on-line (A.E. Hajek, pers. comm. 2017). Cock *et al.* (2016) updated the BIOCAT database of introductions of insect CBAs to control insects to include information from publications to the end of 2010. Work is planned to make this database available very soon in a searchable format via the Plantwise knowledge bank (http://www.plantwise.org/KnowledgeBank/home.aspx). Thereafter, CABI plans to further update BIOCAT, and broaden the scope to the use of all CBAs to control invertebrates.

For augmentative biological control, van Lenteren *et al.* (2017) have compiled information about natural enemies and microorganisms available for pest and disease control worldwide; this publication is open access and thus widely accessible. Both biocontrol practitioners from developing and developed countries have collaborated in many augmentative biological control projects and in the compilation of the information published in the above mentioned paper.

Cooperative research to develop capacity in source countries: An example involves ongoing international research to explore options for biological control of an invasive bird-parasitic fly in the Galapagos Island that is threatening Darwin's finches with extinction (Boulton and Heimpel, 2017). This project builds upon a recent success in biological control of cottony cushion scale in Galapagos (Hoddle *et al.*, 2013) and involves universities in the USA, Argentina and Trinidad and Tobago as well as the Charles Darwin Center and the Galapagos National Park Service, both in Ecuador. The project has led to research collaboration and co-authorship among these and other institutions (Bulgarella *et al.*, 2015, 2017; Delvare *et al.*, 2017) and capacity building via construction of a new laboratory and renovation of a quarantine laboratory at the Charles Darwin Research Station in Galapagos. It has launched the careers of one Mexican and two Ecuadoran students, who have moved from this project to graduate degree programs in Chile, Austria and the USA. This ongoing project will likely continue to build capacity for biological control in Ecuador and provide valuable training for Latin American students.

A second example involves collaboration in an ongoing biocontrol program for invasive spotted wing drosophila. US scientists at the University of California at Berkeley and the USDA-ARS, along with Italian scientists at the Consiglio Nazionale della Richerche, are working with Chinese cooperators at the Yunnan Provincial Academy of Agricultural Sciences. The Chinese have been integrally involved in host surveys and exploration for natural enemies in the province. The US and Italian scientists have provided the Academy staff with training during exploration visits to China, and have hosted their visits to

laboratories in the USA for additional training which is expected to lead to a graduate degree in China.

In the biocontrol industry cooperative projects have been set up between individual companies and research institutes in provider countries, where local research institutes were involved in collection and screening of potential natural enemies. The institutes benefit from exchange of knowledge on culturing organisms and the development of solid screening protocols. For example, Koppert B.V. has collaborated closely with the University of Sao Paulo in Brazil to collect, identify and evaluate phytoseiid predatory mites. The work was carried out by Brazilian students supervised by Koppert at their R&D department in the Netherlands, and to date has led to a successful PhD study.

Transfer of production technology to provide opportunities for small-scale economic activity: During the past 50 years, when augmentative biological control has become increasingly adopted, members of IOBC have often assisted in and provided information for setting up mass rearing programmes for natural enemies and microbial organisms in developing countries. Also IOBC members have organised courses on setting up biocontrol projects, proper mass rearing techniques and quality control procedures for biocontrol agents.

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