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# 16 Biological Control in Guatemala

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**Abstract**

Biological control was initiated in Guatemala in the 1990s, after costs for chemicals had increased substantially and had resulted in a drastic decrease in production of, for example, cotton and tomato. Most often, augmentative biocontrol is used in Guatemala. Examples of successful programmes are control of: (i) lepidopterans in cotton and vegetables by microbial agents and egg parasitoids; (ii) cotton leafworm by egg parasitoids and a predator in cotton; (iii) coffee berry borer with a parasitoid and a microbial agent; (iv) sugarcane borer with a parasitoid and a microbial agent; (v) diamondback moth with parasitoids in cruciferous crops; and (vi) white grub in maize with an entomopathogenic nematode. In 1998, populations of *Anopheles* mosquitoes, which are vectors of malaria, were successfully reduced by killing their larvae with microbial agents, resulting in a 50% lower malaria prevalence. A recently started project concerns classical biocontrol of the Asian citrus psyllid with a parasitoid. Biocontrol is expected to grow because of, inter alia, demands for residue-free food by countries to which Guatemala exports.

## 16.1 Introduction

Guatemala has an estimated population of almost 15.5 million (July, 2017) and its major agricultural products are sugarcane, maize, bananas, coffee, beans, cardamom, cattle, sheep, pigs and chickens (CIA, 2017).

## 16.2 History of Biological Control in Guatemala

Latin American books and research papers listed in Chapter 1 (this volume) provide very little information about the history of biocontrol in Guatemala and nothing could be found at all for the period 1880–1969. In fact, only Estrada Hurtarte (1996) gives data for biocontrol projects taking place in the 1990s. This author wrote that pest control in Guatemala had been based mainly on chemical pesticides and that high costs of chemical control caused a drastic decrease in cotton production in the 1970s and 1980s. Later, tomato production faced similar problems after *Bemisia tabaci* (Gennadius) appeared. In the 1990s, the major biocontrol projects concerned pests in coffee, cotton, vegetables, basic grains, pastures and sugarcane. An overview of biocontrol agents studied and/or applied in this period is given in Table 16.1.

Biever (1996) mentioned that a parasitoid release programme utilizing *Cotesia plutellae* (Kurdjumov) for control of the diamondback moth *Plutella xylostella* (L.) in broccoli and cabbage had been in operation in Guatemala for 3 years, since October 1993, on about 250 ha. Releases were limited in 1996 because the logistics of transporting the parasitoids from the USA to the other countries became difficult.

## 16.3 Current Situation of Biological Control in Guatemala

### 16.3.1 Natural and augmentative biological control of pests in coffee

The National Coffee Association (Asociación Nacional del Café) provides information about biological and integrated pest management (IPM) on its website (Anacafé, 2018). The website first presents an overview of IPM and then lists control measures for the most important coffee pests. The major pest of coffee in Guatemala is the coffee berry borer *Hypthonemus hampei* (Ferrari) and the parasitoid *Cephalonomia stephanoderis* Betrem is used for its control, for which on-farm production technology is available for coffee farmers. Two genera of nematodes are problematic in coffee plantations: *Pratylenchus* spp. and *Meloidogyne* spp. Experiments have been done with the pathogenic fungus *Paecilomyces lilacinus* (Thom) Samson, but it seems not be used at the moment. Several scale species cause problems in coffee, including *Dysmicoccus cryptus* Williams (= *bispinosus*) Beardsley, *Geococcus coffeae* Green, *Planacoccus citri* (Risso), *Coccus viridis* (Green.), *Coccus hesperidum* L., *Saissetia oleae* Olivier and *Saissetia nigra* (Nietner), but currently no natural enemies are used for their control. The coffee leaf miner *Leucoptera coffeella* (Guérin-Meneville) is often kept under natural control by ten species of hymenopteran parasitoids, including *Bracon* spp. and *Zagrammosoma* spp.

**Table 16.1.** Biological control agents studied and/or used in Guatemala since the 1990s, with their target pests and crops (retrieved from Estrada Hurtarte, 1996, with updates from other sources).

| Natural enemy, exotic (ex), native (na) | Pest / crop | Type of biocontrol[a] | Effect / area under biocontrol[b] |
|---|---|---|---|
| *Bacillus thuringiensis*[c] / ex | Lepidopterans in cotton and vegetables | ABC / 1990s | Control / > 50,000 ha |
| Baculovirus VPN 80 & 82 / na | Lepidopterans in cotton and vegetables | ABC / 1990s | Control / 3,600 ha |
| *Trichogramma pretiosum* / ex | Cotton leafworm in cotton | ABC / 1990s | Control / 14,000 ha |
| *Chrysopa* sp. / ex | | ABC / 1990s | Control |
| *Cephalonomia stephanoderis* / ex | Coffee berry borer in coffee | ABC / 1990s | Control / 100 ha |
| *Metarhizium anisopliae* / na | | ABC / 1990s | Testing / < 5 ha |
| *Paecilomyces lilacinus* / na | Nematodes in coffee | ABC / 1990s | Testing / < 5 ha |
| *Cotesia flavipes* / ex | Sugarcane borer in sugarcane | ABC / 1990s | Control / 156 ha |
| *Metarhizium anisopliae* / na | | ABC / 1990s | Control / 156 ha |
| *Cotesia plutellae* / ex | Diamondback moth in crucifers | ABC / 1990s | / 250 ha, terminated in 1996 |
| *Plutella xylostella* / ex | | ABC / 1990s | Control / 100 ha |
| Diplogasterid nematodes / na | White grub in corn | ABC / 1990s | Control / < 20 ha |
| *Encarsia opulenta* / ex | Citrus blackfly in citrus | CBC / 1990s | Control / 1,500 ha |
| *Metarhizium anisopliae* / na | Spittlebugs in pastures | ABC / 1990s–2006 | Testing |

[a]Type of biocontrol: ABC = augmentative biocontrol, CBC = classical biocontrol
[b]Area of crop harvested in 2016 according to FAO (http://www.fao.org/faostat/en/#data/qc)
[c]Strictly speaking, use of the biopesticide *B. thuringiensis* is not considered biocontrol

Biocontrol of the coffee tree root-attacking *Phyllophaga* spp., as well as the coffee berry borer, has been tested with *Metarhizium anisopliae* (Metchnikoff) Sorokin, resulting in larval infection of up to 65%.

### 16.3.2 Augmentative biological control of spittlebugs in grasslands

Cattle production is an important economic activity in some parts of Guatemala. Spittlebugs reduce biomass, protein content and digestibility of grass (in this case *Brachiaria decumbens* Stapf.). Zeno (2006) evaluated three commercial strains of *M. anisopliae* with regard to their effect on the mortality of two species of spittlebugs: *Aeneolamia albofasciata* (Lallemand) and *Prosapia simulans* (Walker). The results were disappointing, as treatments with *M. anisopliae* did not reduce spittlebug populations. However, near the study location, a native entomopathogenic fungus of the genus *Batkoa* was found, which caused epizootics in adult spittlebugs.

### 16.3.3 Classical biological control of the Mediterranean fruit fly

In a project of the US Department of Agriculture (USDA) Center for Plant Health Science and Technology (CPHST, 2009), experiments were conducted in Guatemala for control of the Mediterranean fruit fly *Ceratitis capitata* (Wied.) by releases of the exotic parasitoid *Fopius ceratitivorus* Wharton. Parasitoids were reared at USDA's Animal and Plant Health Inspection Service

(APHIS)/Moscamed (*mosca de la fruta del Mediterráneo*, or 'medfly', *C. capitata*) quarantine facility in San Miguel Petapa in Guatemala. During 2009, field releases of *F. ceratitivorus* in combination with releases of sterile fruit fly males were initiated in several areas in South-west Guatemala. According to CPHST (2009): 'circumstantial evidence obtained was that no recurrent infestation has been present in the area where releases were conducted'.

### 16.3.4 Classical biological control of Asian citrus psyllid

The Asian citrus psyllid *Diaphorina citri* Kuwayama, which is a vector of huanglongbing disease (caused by *Candidatus* Liberibacter *asiaticus*), is present in Guatemala. The country collaborates in several regional programmes to develop biocontrol of the psyllid (FAO, 2013).

### 16.3.5 Augmentative biological control of malaria vectors

*Bacillus sphaericus* Meyer and Neide was tested in1998 in 46 localities with the highest epidemiological malaria risk to reduce population of *Anopheles albimanus* Wiedemann. Larval mortality was high (> 90%) and the rate of malaria prevalence went down by 50% (Blanco *et al*., 2000). Based on the positive results, use of *B. sphaericus* was recommended for control of this malaria-transmitting mosquito in Central America.

### 16.3.6 Areas under biological control in Guatemala

Based on the information provided above and in Table 16.1, it is estimated that Guatemala has at least 18,000 ha under augmentative and 1,500 ha under classical biocontrol.

## 16.4 New Developments of Biological Control in Guatemala

Estrada Hurtarte (1996) mentioned that the use of biocontrol in Guatemala was promising, because of: (i) demands for residue-free food or by prohibiting the use of certain pesticides by countries to which Guatemala exports; (ii) resistance development to pesticides; (iii) growing resistance by the public and farm labourers to the use of pesticides that may cause health risks and have a negative effect on the environment; and (iv) positive experiences of farmers using biocontrol, the availability of biocontrol agents and local production of some beneficial organisms. However, he also reported that there were a number of factors that frustrate application of biocontrol in Guatemala, including: (i) the very limited number of professionals to teach and apply biocontrol and to rear and sell natural enemies; (ii) lack of support for research staff and limited financial support of biocontrol programmes; (iii) strong pressure to use chemical control by those who sold pesticides; (iv) difficult and expensive registration procedures for biocontrol agents; and (v) lack of extension personnel in the field of biocontrol.

## References

Anacafé (2018) Asociación Nacional del Café [National Coffee Association]. Available at: https://www.anacafe.org/caficultura/manuales/ (accessed 28 October 2019).

Biever, K.D. (1996) Development and use of a biological control – IPM system for insect pests of crucifers. *Proceedings of the 3rd International Workshop on the Management of Diamondback Moth and Other Crucifer Pests*, 29 October – 1 November 1996, 257–261.

Blanco, C.S.D., Martinez, A.A., Cano, V.O.R., Tello, G.R. and Mendoza, I. (2000) Introduction of *Bacillus spaericus* strain-2362 (GRISELESF) for biological control of malaria vectors in Guatemala [in Spanish]. *Revista Cubana de Medicina Tropical* 52, 37–43.

CIA (2017) The World Factbook: Guatemala. Available at: https://www.cia.gov/library/publications/the-world-factbook/geos/gt.html (accessed 18 April 2019).

CPHST (2009) Annual Report. Biological Control Unit, Center for Plant Health Science and Technology, APHIS, USDA, pp. 39–40. Available at: https://www.aphis.usda.gov/plant_health/cphst/downloads/2009BiologicalControlUnitAnnualReport.pdf (accessed 19 April 2019).

Estrada Hurtarte, R.E. (1996) Situación del control biológico de plagas en Guatemala [Biological control of pests in Guatemala]. In: Zapater, M.C. (ed.) *El Control Biológico en América Latina*. IOBC/NTRS, Buenos Aires, Argentina, pp. 43–53.

FAO (2013) *Managing huanglongbing/citrus greening disease in the Caribbean*. Issue Brief No. 4, Subregional Office for the Caribbean. FAO, Christchurch, Barbados. Available at: http://www.fao.org/3/a-ax739e.pdf (accessed 18 January 2019).

Zeno, S.C. (2006) Uso de *Metarhizium anisopliae* para el control biológico del salivazo (*Aeneolamia* spp. y *Prosapia* spp.) en pastizales de *Brachiaria decumbens* en El Petén, Guatemala [Use of *Metarhizium anisopliae* for control of spittlebugs (*Aeneolamia* spp. and *Prosapia* spp.) in pastures of *Brachiaria decumbens* in El Petén, Guatemala]. MSc thesis, Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), Turrialba, Costa Rica. Available at: http://repositorio.bibliotecaorton.catie.ac.cr/handle/11554/4543 (accessed 18 January 2019).