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Joop C. van Lenteren*

Laboratory of Entomology, Wageningen University, Wageningen, The Netherlands

* E-mail: joop.vanlenteren@wur.nl

 Biological Control in Latin America and the Caribbean: Its Rich History and Bright Future (eds J.C. van Lenteren *et al*.)

Abstract

Conservation biological control, implemented in the 1910s by erecting perches in rice fields for insectivorous birds, resulted in effective control of the fall armyworm. Guyana is supposed to be the first country where the tachinid parasitoid *Lydella minense*, which had been collected in 1932 in Brazil, was successfully introduced for sugarcane borer control in the same year. During this period, several native natural enemies of this borer, as well as of other pests, were also identified as a result of prospecting projects. Guyana provided some of these species to other countries in the region. Classical biocontrol projects during the period 1970–2000 were attempted and the pink hibiscus mealybug was brought under complete control in 1998 by a parasitoid and a predator. Current projects concern classical biocontrol of the carambola fruit fly by parasitoids, augmentative control of the red palm mite by predatory mites, augmentative control of the palm castniid by a native entomopathogenic bacterium and conservation biocontrol of pests in rice.

17.1 Introduction

Guyana has an estimated population of almost 740,000 (July, 2017) and its main agricultural products are sugarcane, rice, edible oils, beef, pork, poultry, shrimp and fish (CIA, 2017).

17.2 History of Biological Control in Guyana

17.2.1 Period 1875–1969

Conservation biological control of lepidopterans in rice

G.E. Bodkin, during the 1910s, found that *Spodoptera frugiperda* Smith was a serious defoliator of rice and suggested erecting perches in the fields for insectivorous birds. This appeared to be most effective, particularly in rice nurseries (Cock, 1985).

Classical biological control of sugarcane borer with the Amazon fly

In 1933, Myers reported that a tachinid parasitoid, which he had collected near Santarem in Brazil and called the Amazon fly *Lydella* (*Metagonistylum) minense* Tns, had established and become widespread in Guyana after he had introduced it in 1932. Thereafter, it was considered a valuable parasitoid of *Diatraea saccharalis* F. (Cock and Bennett, 2011). Cock (1985) referred to a number of papers related to sugarcane borer and its natural enemies in Guyana by J.F. Bates, H.E. Box and L.D. Cleare, who worked on mass rearing of the egg parasitoids *Trichogramma* sp. and *Telenomus* sp. (Myers, 1935), as well as the Amazon fly. As a result of introduction and releases of *L. minense*, populations of *D. saccharalis* went down, as well as the damage caused by the borer (Dasrat *et al*., 1997).

Guyana as provider of natural enemies

N. Vesey took the giant toad *Bufo marinus* (L.) from Guyana to introduce it into Bermuda in 1875 in the hope that it would control insects, particularly roaches. The toad became extremely abundant and undoubtedly had some value as a predator of insects, slugs and snails, according to Cock (1985).

H.E. Box, engaged by a Puerto Rican sugar company, successfully introduced a braconid, *Alabagrus stigma* Brullé, from Guyana to Puerto Rico (Cock and Bennett, 2011).

J.C. Meyers and his wife (stationed at the Trinidad CABI station) went for several natural enemy exploratory trips to Guyana. Cock and Bennett (2011) provided a very interesting story of the couple's rather spectacular journeys. When travelling privately in Guyana in 1930, Mrs Myers discovered that balisier *Heliconia bihai* (L.) is a wild food plant of the sugarcane giant moth borer *Telchin licus* (Drury). J.C. Myers found a tachinid subsequently identified as *Palpozenillia palpalis* (Aldrich) parasitizing larvae of this borer. Later, puparia of this species were sent to Trinidad but attempts to breed it in the laboratory failed.

In 1933, during a trip on the Brazilian frontier of Guyana, Meyers collected froghoppers and their natural enemies. He found *Tomaspis* aff. *pubescens* Fabr. and another, large red *Tomaspis* sp. On the large red *Tomaspis* no parasitoids were found, but two syrphid predators were common,

Salpingogaster nigra (Schiner) and a pale yellow one, apparently new to science (Cock and Bennett, 2011). Dissection of many hundreds of nymphs of *T.* aff. *pubescens*, did not result in finding any parasitoids, but one adult froghopper had an egg of a new parasitoid, a phasiine tachinid fly that specialized on insects of the order Hemiptera, to which froghoppers belong. Meyers went back in 1934 and found, dissected and observed many *T.* aff. *pubescens*, but could not detect parasitoids. He did find large numbers of nymphs and a few adults of another, small froghopper (*Clastoptera* sp.) infesting a shrub, but found neither parasitoids nor predators.

17.2.2 Period 1970–2000

Biological control of pests of coconut and oil palms

The palm castniid *Lapaeumides dedalus* (Cram.) is a pest of coconuts in Guyana. Its larvae are gregarious, living in communal webs, from which they emerge to feed at night and bore in the crown of the tree. They are able to totally defoliate coconuts and other palms and repeated defoliations will kill the palms. Several parasitoids have been recorded from Guyana that attack eggs, larvae and pupae, but they do not provide adequate control. Possibilities for biocontrol by introduction of exotic natural enemies are limited, since the family Castniidae is restricted to the Americas. According to Cock (1985), the best prospect for biocontrol might be the introduction of tachinid parasites known from this pest in Brazil. In Guyana, R. Bhim and colleagues (mentioned in Cock, 1985) have used a bacterium (species as yet undetermined) against *L. dedalus* attacking oil palms and reported that this castniid moth is no longer a major pest problem on that crop.

Biological control of sugarcane borers

The sugarcane borer *D. saccharalis* was brought under classical biocontrol by introducing *L. minense* in 1932, but another borer species, *D. centrella* (Möschler), was occasionally causing serious damage. The parasitoid *Allorhogas pyralophagus* (Marsh), initially found in Mexico in the early 1980s, was mass reared and released by the Guyana Sugar Industry from 1989 to 1994. The parasitoid easily attacked borers in the laboratory, but parasitism in the field was below 1% (Dasrat *et al.*, 1997).

Classical biological control of the pink hibiscus mealybug

The pink hibiscus mealybug *Maconellicoccus hirsutus* Green has been present in Guyana since 1997 and attacks many different plant species. A project with involvement of the UN's Food and Agriculture Organization (FAO), CABI and the Caribbean Agricultural Research and Development Institute (CARDI) developed biocontrol of the mealybug based on the introduction of the parasitoid *Anagyrus kamali* Moursi and the predator *Cryptolaemus montrouzieri* Mulsant in the Caribbean region. These two natural enemies were introduced and released in Guyana in 1997 and resulted in complete control of the pest (Kairo *et al.*, 2001).

17.3 Current situation of biological control in Guyana

17.3.1 Biological control of the carambola fruit fly

Much work was recently done on biocontrol and the male annihilation technique (MAT) of the carambola fruit fly (*Bactrocera carambolae* Drew and Hancock) in Suriname, Guyana, French Guiana and Brazil. The carambola fruit fly supposedly originates from South-east Asia. An eradication programme based on MAT was developed and funded by the International Fund for Agricultural Development (IFAD) (Netherlands, France and the USA); it began officially in 1998 and covered Guyana, Suriname, French Guiana and Brazil (Midgarden *et al.*, 2016). As a result of MAT the distribution of *B. carambolae* was reduced to limited areas of Suriname and French Guiana by 2001, and Guyana was declared free of this pest. However, in 2002 funding for the eradication programme was reduced and eventually terminated. This resulted in

expansion of the distribution of this fruit fly, with detections as far South-east as Curralinho, in the Para State of Brazil, and as far North as Orlando, Florida, and there was re-infestation of over 50% of the regions in Guyana. Currently, natural enemies of the pest are being evaluated, e.g. in Suriname (see Chapter 28: Suriname for more detail).

17.3.2 Augmentative biological control of red palm mite

Coconut palm is the third most important economic crop in Guyana. The red palm mite *Raoiella indica* Hirst was first found in Guyana in 2013 and is now one of the most serious pests of palm. Two predators, lacewings and the predatory mite *Amblyseius largoenesis* (Muma), are currently being studied for control of this pest. Also, the National Agricultural Research and Extension Institute (NAREI, 2016) is testing the effectiveness of the entomopathogenic fungi against red palm mite.

17.3.3 Conservation biological control of pests in rice

The Guyana Rice Development Board (GRDB, 2018) has several projects related to biocontrol. An example is conservation biocontrol of the paddy bug *Oebalus* sp. by ladybirds, spiders, damsel flies and dragon flies, *Telenomus* sp. egg parasitoids and entomopathogenic fungi.

Based on data presented in this chapter and areas harvested according to FAO (2016), an area of 44,000 ha might be under classical biocontrol and 12,000 ha under augmentative biocontrol (Table 17.1), but it was difficult to verify these data.

17.4 New Developments of Biological Control in Guyana

No information has been found about future developments of biocontrol in Guyana. However, in the light of the long history of the application of biocontrol in Guyana, new programmes might eventually be implemented.

Table 17.1. Overview of major biocontrol activities in Guyana.

Biocontrol agent / exotic (ex), native (na)	Pest / crop	Type of biocontrol[a] / since	Effect / area under biocontrol[b]	Reference
Insectivorous birds / na	Defoliating insects, rice	ConsBC, 1910	Control / ? ha	Cock, 1985
Trichogramma sp. / na	*Diatraea saccharalis*, sugarcane	ABC	Insufficient	Myers, 1935
Telenomus sp. / na	*D. saccharalis*, sugarcane	ABC	Insufficient	Myers, 1935
Lydella (Metagonistylum) minense / ex	*D. saccharalis* sugarcane	CBC, 1932	Control / 44,000 ha	Dasrat *et al*., 1997
Allorhogas pyralophagus / ex	*D. centrella*, sugarcane	CBC, 1989–1994	Insufficient control, established	Dasrat *et al*., 1997
Entomopathogenic bacterium / na	Palm castniid, coconut and oil palm	ABC	Control / 12,000 ha	Cock, 1985
Amblyseius largoenesis / ?	Red palm mite, coconut palm	ABC / 2015s	Testing phase	NAREI, 2016
Entomopathogenic fungi / ?	Red palm mite	ABC / 2015s	Testing phase	
Anagyrus kamali / ex	Pink hibiscus mealybug, various plants	CBC / 1997	Complete control / ? ha	Kairo *et al*., 2001
Cryptolaemus montrouzieri / ex	Pink hibiscus mealybug	CBC / 1997	Complete control / ? ha	Myers, 1935
Suite of natural enemies / na	Paddy bug, rice	ConsBC /	Partial control / ? ha	GRDB, 2018

[a]Type of biocontrol: ABC = augmentative, CBC = classical, ConsBC= conservation biological control; NC = natural control
[b]Area of crop harvested in 2016 according to FAO (http://www.fao.org/faostat/en/#data/qc)

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