

Trichogramma (Hymenoptera: Trichogrammatidae) species, egg parasitoids of *Diatraea saccharalis* (Lepidoptera: Crambidae) on sugarcane (Poales: Poaceae) in Argentina

Marcos Isas¹, Erica Luft Albarracin², María L. del P. Pérez¹, and Analía Salvatore¹

The sugarcane borer, *Diatraea saccharalis* F., sensu Guenée (Lepidoptera: Crambidae), is the most damaging pest of sugarcane (*Saccharum officinarum* L.; Poales: Poaceae) in Argentina and in almost all other sugarcane producing countries in the New World (James 2004). Effectiveness of chemical control against this pest is limited because larvae develop inside the sugarcane stalks, which diminishes efficacy of the insecticides (Pereira et al. 2015). Taking into account successful experiences in Brazil and other countries, biological control seems to be the most effective approach to regulate populations of this pest (Botelho & Macedo 2002). In this regard, identification of natural enemies associated with the pest in an agroecosystem is a fundamental step (Zucchi 2002). *Trichogramma* Westwood (Hymenoptera: Trichogrammatidae) species are mainly associated with economically important lepidopterans (Zucchi et al. 2010), with around 210 species known worldwide (Pinto 2006). This genus has been used widely in biological control programs because of its efficiency, wide geographical distribution, and ease of breeding in the laboratory (Zucchi & Monteiro 1997).

In Argentina, few studies on the natural enemies of *D. saccharalis* have been conducted, all more than 70 yr ago. Box (1927) reported *Telenomus alecto* Crawford (Hymenoptera: Scelionidae) and *Trichogramma* sp. parasitizing *D. saccharalis* in Tucumán, and supposed the latter was *T. minutum* Riley. Jaynes (1933) recorded *T. minutum* in sugarcane borer eggs in Tucumán and Salta. Hayward (1943) recorded *T. semifusca* Blanchard but that name is unavailable. Unfortunately, no voucher specimens of these studies could be found. However, care must be taken about such information, considering that consistent male genitalia characters for species identification were employed only from the beginning of the 1970s. Previous records generally were not the result of taxonomic identification, i.e., they were based on the use of an available name found in the literature, without appropriate species confirmation (Querino & Zucchi 2007). Therefore, the goal of this study was to identify egg parasitoids of *D. saccharalis* on sugarcane crops from Tucumán, Argentina, undertaken as a first step to develop a biological control program.

Sampling of *D. saccharalis* egg clusters was conducted during the summer of 2013 at sugarcane commercial plots in Fronterita (Famaillá, 26.8123056°S, 65.0480000°W; 461 m), Luisiana (Cruz Alta, 27.0340833°S, 65.4731944°W; 401 m), and La Cruz (Burrucyacu,

26.6561944°S, 64.8559444°W; 492 m) in Tucumán Province in Argentina. Sites were chosen attempting to include the diversity of climatic conditions prevailing in the region. The leaves and leaf sheaths with egg clusters were cut from the plant and taken in plastic cups to the Estación Experimental Agroindustrial Obispo Colombres laboratory, Tucumán, Argentina. Parasitized eggs were incubated in Petri dishes with wet absorbent paper and checked daily until adult parasitoid emergence.

Specimens obtained were kept in 70% ethanol until all were slide-mounted in Hoyer's medium, and later some were remounted in Canada balsam for permanent storage as vouchers. All emerging parasitoids were identified using specific keys (Pinto 1999; Querino & Zucchi 2011). Voucher specimens of *Trichogramma* species were deposited in the entomological collection of the Fundación e Instituto Miguel Lillo, San Miguel de Tucumán, Tucumán, Argentina (IMLA).

In total, 1,723 viable eggs of *D. saccharalis* (251 egg masses) were collected from the sugarcane fields in the course of this study, 44% of which were parasitized. The emerged specimens from La Cruz and Luisiana belonged to *Trichogramma galloi* Zucchi and *Trichogramma pretiosum* Riley, whereas all individuals from Fronterita were identified as *Trichogramma atopovirilia* Oatman & Platner.

Trichogramma galloi has not been recorded previously from Argentina. It was cited from many countries, mainly where sugarcane is cultivated (Zucchi et al. 2010). This species was first described by Zucchi (1988) from Brazil where it was obtained from *D. saccharalis*; all following records were from this host, except from Bolivia where it was identified parasitizing *Diatraea rufescens* Box eggs (Querino & Zucchi 2003). It is successfully used in augmentative biological control programs at São Paulo State in Brazil to control the sugarcane borer in 400,000 ha of sugarcane (Nava et al. 2009). During this study, *T. galloi* samples were obtained from 2 locations—16 males (IMLA) from eggs of *D. saccharalis* collected from Burrucyacu (La Cruz) on 22-III-2013, and 12 males (IMLA) from eggs of *D. saccharalis* collected from Cruz Alta (Luisiana) on 25-IV-2013.

This is the first reported host association of *T. atopovirilia* with *D. saccharalis* on sugarcane. This parasitoid has often been cited from several lepidopteran pests in corn and soybean (Cañete & Foerster 2003). In Argentina, it was recorded attacking *Spodoptera frugiperda* Smith & Abbot (Lepidoptera: Noctuidae) on corn (Murúa et al. 2003).

¹Instituto de Tecnología Agroindustrial del Noroeste Argentino (ITANO), Estación Experimental Agroindustrial Obispo Colombres (EEAOC), Consejo Nacional de Investigaciones Científicas y Técnicas (CONICET), Las Talitas, 4101, Tucumán, Argentina

²Planta Piloto de Procesos Industriales Microbiológicos (PROIMI) – Biotecnología - CONICET), San Miguel de Tucumán, 4001, Tucumán, Argentina

*Corresponding author; E-mail: marcosisas@hotmail.com

Currently, it is commercially reared in Brazil for biological control of *S. frugiperda* on corn (Pedrazzoli & Carvalho 2006). In the present study, *T. atopovirilia* samples (20 females, 31 males, IMLA) were obtained from *D. saccharalis* eggs collected from Famaillá (Fronterita) on 18-IV-2013.

Trichogramma pretiosum is the most widespread and important member of the genus in the New World and is present in all South American countries (Zucchi et al. 2010). This species is the most used parasitoid in biological control in many countries to control corn, cotton, sorghum, sugarcane, soybean, and tomato pests (Hassan 1994). *Trichogramma pretiosum* has been associated with about 240 hosts (Pinto 1999). During this study, we obtained *T. pretiosum* samples from 2 locations—7 males (IMLA) from *D. saccharalis* eggs collected from Burruyacú (La Cruz) on 22-III-2013, and 8 males (IMLA) from Cruz Alta (Luisiana) collected on 25-IV-2013.

All these species of *Trichogramma* are widely distributed on the American continent. In sugarcane, 8 *Trichogramma* species are associated with *D. saccharalis* in the Neotropical region, and 4 of them are known only from this host (Zucchi et al. 2010). It is important to note that *T. alecto*, which had previously been cited from Tucumán (Box 1927), was not found in the present study.

Knowledge of the natural presence of *T. galloi*, *T. atopovirilia*, and *T. pretiosum* in the sugarcane agroecosystem in Tucumán is an important finding for future prospective augmentative biological control programs in this state, because these species have shown a significant potential for use in many agricultural crops (Parra & Zucchi 2004). Studies about the bionomics of these species in Argentina are necessary.

Summary

The aim of this study was to identify egg parasitoids of *Diatrea saccharalis* F., sensu Guenée (Lepidoptera: Crambidae) in sugarcane in Tucumán, Argentina. We report a new host–parasitoid association of *Trichogramma atopovirilia* Oatman & Platner (Hymenoptera: Trichogrammatidae) attacking *D. saccharalis* and the first record of *Trichogramma galloi* Zucchi from Argentina. Additionally, *Trichogramma pretiosum* Riley was recorded in this survey.

Key Words: sugarcane borer; geographical distribution; new host association

Sumario

El objetivo de este estudio fue identificar los parasitoides de huevos de *Diatraea saccharalis* F., sensu Guenée (Lepidoptera: Crambidae) en caña de azúcar en Tucumán, Argentina. Se reporta una nueva asociación hospedero parasitoide de *Trichogramma atopovirilia* Oatman & Platner (Hymenoptera: Trichogrammatidae) sobre *D. saccharalis* y es el primer registro de *Trichogramma galloi* Zucchi para Argentina. Además, se registró la presencia *Trichogramma pretiosum* Riley en este relevamiento.

Palabras Clave: gusano perforador de la caña de azúcar; distribución geográfica; nueva asociación de hospedero

References Cited

- Botelho PSM, Macedo N. 2002. *Cotesia flavipes* para o controle de *Diatraea saccharalis*, pp. 409–425 In Parra JRP, Botelho PSM, Corrêa-Ferreira BS, Bento JMS [eds.], Controle biológico no Brasil: parasitoides e predadores. Manole, São Paulo, Brazil.
- Box HE. 1927. Apuntes preliminares respecto al descubrimiento de algunos parásitos de los huevos de "*Diatraea saccharalis*" en Tucumán. Revista Industrial y Agrícola de Tucumán 18: 5–8.
- Cañete CL, Foerster LA. 2003. Incidencia natural e biología de *Trichogramma atopovirilia* Oatman & Platner, 1983 (Hymenoptera, Trichogrammatidae) em ovos de *Anticarsia gemmatalis* Hübner, 1818 (Lepidoptera, Noctuidae). Revista Brasileira de Entomologia 47: 201–204.
- Hassan SA. 1994. Strategies to select *Trichogramma* species for use in biological control, pp. 55–71 In Wajnberg E, Hassan SA [eds.], Biological Control with Egg Parasitoids. CAB International, Wallingford, United Kingdom.
- Hayward KJ. 1943. El gusano chupador de la caña de azúcar *Diatraea saccharalis* (Fabricius) en Tucumán. Boletín Estación Experimental Agrícola de Tucumán 38: 25 pp.
- James G. 2004. Sugarcane. Blackwell Science, Oxford, United Kingdom.
- Jaynes HA. 1933. The parasites of the sugarcane borer in Argentina and Peru, and their introduction into the United States. Technical Bulletin USDA 363: 26 pp.
- Murúa MG, Fidalgo P, Virla E. 2003. First record of *Trichogramma atopovirilia* Oatman & Platner (Hymenoptera: Trichogrammatidae), for Argentina, attacking the eggs of *Spodoptera frugiperda* Smith (Lepidoptera: Noctuidae) on corn. Vedia 9: 25–26.
- Nava DEN, Pinto ADS, Silva DAS. 2009. Controle biológico da broca da cana-de-açúcar. Embrapa Clima Temperado, Pelotas, RS, Brazil.
- Parra JRP, Zucchi RA. 2004. A *Trichogramma* in Brazil: feasibility of use after twenty years of research. Neotropical Entomology 33: 271–281.
- Pedrazzoli DS, Carvalho DR. 2006. Comercialização de *Trichogramma* no Brasil, pp. 241–246 In Pinto A de S, Nava DE, Rossi MM, Malerbo-Souza DT [eds.], Controle biológico de pragas: na prática. ESALQ/USP, Piracicaba, Brazil.
- Pereira FF, Kassab SO, Calado VRF, Vargas EL, de Oliveira HN, Zanuncio JC. 2015. Parasitism and emergence of *Tetrastichus howardi* (Hymenoptera: Eulophidae) on *Diatraea saccharalis* (Lepidoptera: Crambidae) larvae, pupae and adults. Florida Entomologist 98: 377–380.
- Pinto JD. 1999. Systematics of the North American species of *Trichogramma* Westwood (Hymenoptera: Trichogrammatidae). Memoirs of the Entomological Society of Washington 22: 1–187.
- Pinto JD. 2006. A review of the New World genera of Trichogrammatidae (Hymenoptera). Journal of Hymenoptera Research 15: 38–163.
- Querino RB, Zucchi RA. 2003. Caracterização morfológica de dez espécies de *Trichogramma* (Hymenoptera: Trichogrammatidae) registradas na América do Sul. Neotropical Entomology 32: 597–613.
- Querino RB, Zucchi RA. 2007. Do *Trichogramma minutum* Riley and *Trichogramma bennetti* Nagaraja & Nagarkatti (Hymenoptera: Trichogrammatidae) occur in Brazil? Neotropical Entomology 36: 145–146.
- Querino RB, Zucchi RA. 2011. Guia de identificação de *Trichogramma* para o Brasil. Embrapa Informação Tecnológica, Brasília, Brazil.
- Zucchi RA. 1988. New species of *Trichogramma* (Hym., Trichogrammatidae) associated with the sugar cane borer *Diatraea saccharalis* (F.) (Lep., Pyralidae) in Brazil. Colloques de l'INRA 43: 133–140.
- Zucchi RA. 2002. A taxonomia e o controle biológico de pragas, pp. 17–27 In Parra JRP, Botelho PSM, Corrêa-Ferreira BS, Bento JMS [eds.], Controle biológico no Brasil: parasitoides e predadores. Manole, São Paulo, Brazil.
- Zucchi RA, Monteiro RC. 1997. O genero *Trichogramma* na America do Sul, pp. 41–66 In Parra JRP, Zucchi RA [eds.], *Trichogramma* e o controle biológico aplicado, FEALQ, Piracicaba, Brazil.
- Zucchi RA, Querino RB, Monteiro RC. 2010. Diversity and hosts of *Trichogramma* in the New World, with emphasis in South America, pp. 219–236 In Consoli FL, Parra JRP, Zucchi RA [eds.], Egg Parasitoids in Agroecosystems with Emphasis on *Trichogramma*. Springer, New York, New York.