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Authors: Ovruski, Sergio M., Schliserman, Pablo, De Coll, Olga R., Peñaloza, Claudia, Oroño, Luis E., et al.

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THE ESTABLISHMENT OF *ACERATONEUROMYIA INDICA* (HYMENOPTERA: EULOPHIDAE) IN THREE BIOGEOGRAPHICAL REGIONS OF ARGENTINA

SERGIO M. OVRUSKI[1], PABLO SCHLISERMAN[1], OLGA R. DE COLL[2], CLAUDIA PEÑALOZA[3], LUIS E. OROÑO[1] AND CAROLINA COLIN[1]

[1]PROIMI-*Biotecnología*, División Control Biológico de Plagas, Av. Belgrano y Pje. Caseros T4001MVB San Miguel de Tucumán, Tucumán, Argentina

[2]Instituto Nacional de Tecnología Agropecuaria, Estación Experimental Agropecuaria Montecarlo Av. El Libertador 2472, (3384) Montecarlo, Misiones, Argentina

[3]Universidad Nacional de Córdoba, Facultad de Ciencias Agropecuarias, Cátedra de Manejo Integrado de Plagas Av. Valparaíso s/n, (5000) Córdoba capital, Córdoba, Argentina

Aceratoneuromyia indica (Silvestri) is a gregarious eulophid parasitoid of tephritid larvae that was originally collected in India (Clausen 1978). Its natural range includes the Indo-Pacific region, but it has been introduced into Italy, South Africa, Australia, Mexico, Caribbean islands, and Central and South America as a biological control agent of various fruit fly species of economic importance (Graham 1991; LaSalle 1994). *Aceratoneuromyia indica* and the opiine *Diachasmimorpha longicaudata* (Ashmead) are the most widely employed exotic parasitoids for inundative releases against *Ceratitis capitata* (Wiedemann), the Mediterranean fruit fly, and *Anastrepha* species in the New World (Ovruski et al. 2000). *Aceratoneuromyia indica* was imported into Argentina from Mexico in 1961 and 800,000 were released between 1966 and 1977 in the northwestern provinces of Tucumán and Jujuy, in the northeastern provinces of Misiones and Entre Rios, and in the central province of Córdoba for control of both *Anastrepha fraterculus* (Wiedemann), the South American fruit fly, and *C. capitata* (Turica et al. 1971; Ovruski & Fidalgo 1994). This exotic parasitoid species was recovered immediately following releases in the following sites: Montecarlo (26°33' S, 54°47' W, 200 m) (Misiones province in northeastern Argentina), San Miguel de Tucumán (26°50' S, 65°13' W, 426 m), Quebrada de Lules (26°56' S, 65°21' W, 545 m), El Siambón (26°43' S, 65°27' W, 1,185 m) (Tucumán province), Calilegua (23°47' S, 64°46' W, 465 m) (Jujuy province in northwestern Argentina), Cruz del Eje (30°44' S, 64°49' W, 476 m), and Yacanto (32°03' S, 65°02' W, 1,208 m) (Córdoba province in Central Argentina) (Ovruski et al. 1999). A new introduction of *A. indica* into Argentina was made in 1986. Initial shipments originated in Hawaii, via Costa Rica. Although a laboratory colony was established in Tucumán's Research Center for Regulation of Noxious Organisms (CIRPON), no specimen was field-released (Ovruski et al. 1999). Even though Turica (1968), Nasca (1973), and Fischetti et al. (1978) considered it established, there was no evidence of permanent establishment in any release locality prior to our data presented here.

Studies on the fruit fly parasitoids of Argentina have been largely neglected. The first major works concentrating on the different biogeographical regions of Argentina were those of Turica (Turica & Mallo 1961; Turica 1968). Recently, intensive fruit fly parasitoid surveys focused in ten localities of Tucumán province, including San Miguel de Tucumán, Quebrada de Lules, and El Siambón (Ovruski et al. 2004), and in four localities of the northwestern province of Salta (Ovruski et al. 2005) only revealed the existence of a native larval-pupal parasitoid guild. However, recent parasitoid surveys made in the provinces of Jujuy, Córdoba, and Misiones recorded the presence of *A. indica*.

Between January and February 1998, and during February 2001, 382 (= 12 kg) and 314 (= 10.3 kg) peaches (*Prunus persica* (L.) Batsch, Rosaceae) were collected in an untreated semicommercial peach orchard administred by the National University of Córdoba located at 31°48' S, 64°22' W and 425 m in Córdoba city (Córdoba province); during February 1999, 408 (= 16.9 kg), 223 (= 14.4 kg), and 387 (= 17.2 kg) guavas (*Psidium guajava* L., Myrtaceae) were collected in patches of disturbed wild vegetation adjacent to citrus orchards throughout the localities of Yuto (23°38' S, 64°28' W, 349 m), Caimancito (23°44' S, 64°36' W, 367 m), and Calilegua (Jujuy province), respectively; during February 2000, 400 (= 16.7 kg) guavas were collected in areas covered with wild vegetation in the locality of Montecarlo (Misiones province). The fruit samples consisted of fallen ripe fruit (60-70%) and ripe fruit still on the tree (30-40%). Peach samples collected in Córdoba city were processed in the Integrated Pest Management Department of the National University of Córdoba. Guavas samples collected in Misiones were processed in the Montecarlo's National Institute of Agricultural Technology Laboratory. Guava samples collected in Jujuy were

transported to the CIRPON's laboratory located in San Miguel de Tucumán. All fruit samples were placed in plastic containers with sand in the bottom as a pupation substrate. All pupae were removed weekly and the *A. fraterculus* and *C. capitata* pupae were separated by external pupal characters (White & Elson-Harris 1992). The pupae were placed in plastic vials containing sterilized humid sand until either a fruit fly or a parasitoid emerged. Fruit fly species were identified by S. Ovruski based upon Zucchi's (2000) taxonomic key. Parasitoid specimens were identified as species by S. Ovruski with the key from Wharton and Marsh (1978) for Braconidae, Graham's (1991) key for Eulophidae, Boucek y Rasplus' (1991) key for Pteromalidae, and the taxonomic description by Wharton et al. (1998) for Figitidae, Eucoilinae. Voucher specimens were placed in the entomological collection of the Fundación Miguel Lillo (FML) (San Miguel de Tucumán, Argentina).

A total of 231 fruit fly parasitoids was found representing one cosmopolitan species (*Pachycrepoideus vindemiae* (Rondani), Pteromalidae), five Neotropical species (*Doryctobracon areolatus* (Szépligeti), *D. brasiliensis* (Szépligeti), *Utetes anastrephae* (Viereck), *Opius bellus* Gahan (all Braconidae, Opiinae), and *Aganaspis pelleranoi* (Brèthes) (Figitidae, Eucoilinae)), and one exotic species (*A. indica*, Eulophidae). Table 1 summarizes parasitoid and fruit fly species abundance based on fruit samples collected in the different Argentinian localities.

The pupal parasitoid *P. vindemiae* was only obtained from *C. capitata*. This pteromalid species was introduced into Argentina for biocontrol of *C. capitata* and *A. fraterculus* and released in Córdoba province in the 1960s. However, it had been recorded about 30 years before under different scientific names (Ovruski & Fidalgo 1994). All native parasitoid species recovered in this study were only found attacking *A. fraterculus* larvae. These five Neotropical species have previously been recorded from *A. fraterculus* in both Las Yungas (Ovruski et al. 2004) and Paranaense biogeographical regions (Ogloblin 1937, Turica & Mallo 1961). They are solitary, koinobiont endoparasitoids of larvae of the genus *Anastrepha* (Sivinski et al. 2000; Ovruski et al. 2000). Of all the native parasitoids recovered in Jujuy and Misiones provinces, almost 42% and 26% were *D. areolatus* and *A. pelleranoi*, respectively (Table 1). A similar pattern of abundance was reported previously by Ovruski et al (2004) from collecting exotic and native fruit infested with *C. capitata* and/or *A. fraterculus* larvae in the northwestern province of Tucumán.

Aceratoneuromyia indica was recovered from *C. capitata* pupae that were obtained from peaches collected in Córdoba city and from *A. fraterculus* pupae obtained from guavas collected in Yuto, Calilegua, and Montecarlo localities. Thus, *A. indica* was recovered approximately

TABLE 1. NUMBER AND RELATIVE ABUNDANCE OF PARASITOID SPECIES REARED FROM *ANASTREPHA FRATERCULUS* AND *CERATITIS CAPITATA* PUPAE IN TWO HOST PLANT SPECIES IN ARGENTINA, 1998-2001.

Fruit	Collection localities (province)	Month and year collected	No. samples	Recovered fruit fly species: *A. fraterculus* No. pupae	*A. fraterculus* No. adults	*C. capitata* No. pupae	*C. capitata* No. adults	Parasitoid species[1], No. specimens and relative abundance (%): A.i.	A.p.	D.a.	D.b.	O.b.	P.v.	U.a.
Peach	Córdoba city (Córdoba)	Jan-Feb 1998	6	—	—	1,285	1,055	4 (66.7)	—	—	—	—	2 (33.3)	—
		Feb 2001	3		—	456	375	7 (63.6)	2 (18.2)	—	—	—	2 (18.2)	—
Guava	Yuto (Jujuy)	Feb 1999	3	806	380	98	51	4 (8.9)	11 (24.4)	20 (44.4)	8 (17.8)	—	—	2 (4.5)
	Caimancito (Jujuy)	Feb 1999	2	754	329	136	71	—	2 (8.3)	14 (58.3)	7 (29.2)	—	—	1 (4.2)
	Calilegua (Jujuy)	Feb 1999	3	734	393	73	44	2 (2.4)	22 (26.5)	38 (45.8)	19 (22.9)	—	—	2 (2.4)
	Montecarlo (Misiones)	Feb 2000	4	1,100	529	—	—	4 (6.5)	24 (38.7)	26 (41.9)	6 (9.7)	1 (1.6)	—	1 (1.6)
	Total			3,394	1,631	2,048	1,596	21 (9.2)	61 (26.4)	98 (42.4)	40 (17.3)	1 (0.4)	4 (1.7)	6 (2.6)

[1]A.i., *Aceratoneuromyia indica*; A.p., *Aganaspis pelleranoi*; D.a., *Doryctobracon areolatus*; D.b., *D. brasiliensis*, O.b., *Opius bellus*; P.v., *Pachycrepoideus vindemmiae*; U.a., *Utetes anastrephae*.

38 years after its first release in both Calilegua and Montecarlo sites. Similarly, in Montecarlo the permanent establishment of *D. longicaudata* was recently confirmed 40 years after its first release in Argentina (Schliserman et al. 2003). The presence of *A. indica* in the Yuto locality could be explained because this collection site is about only 36 km north of Calilegua, so that *A. indica* could spread north of the Jujuy province. The closest *A. indica* release sites to Córdoba city were Cruz del Eje, which is about 140 km north, and Yacanto, which is about 160 km south. These are the only documented release sites of this exotic parasitoid in Córdoba province. Three possible explanations for the presence of *A. indica* in central Córdoba can be drawn: (1) fruit infested with *C. capitata* or *A. fraterculus* larvae parasitized by *A. indica* could have been moved from north or south Córdoba to central Córdoba; (2) *A. indica* became established in north and/or south Córdoba and has spread to central Córdoba; (3) *A. indica* could have been released in central Córdoba without official knoweledge. If its presence in central Córdoba was the result of first releases, it would appear that *A. indica* has resided in the Córdoba province over 38 years. Thus, *A. indica* has become established in at least three different Argentinian biogeographical regions: Las Yungas region (including Jujuy province), Paranaense (including Misiones province), and Chacoan region (Córdoba province). The original native vegetation in the two former regions is a subtropical rain forest, while the Chacoan region is a subtropical dry forest. The climate in Las Yungas region is temperate-humid with a cold and dry winter. In the Paranaense region the climate is temperate-humid with a warm and rainy winter. The Chacoan region is dry-steppe with a cold and dry winter. For a thorough description of the Argentinian biogeographical regions, see Cabrera (1976) and Cabrera & Willink (1980).

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Summary

Specimens of the eulophid *Aceratoneuromyia indica* (Silvestri) were recovered from fruit fly pupae collected in three Argentinian biogeographical regions. A total of 11 *A. indica* specimens was obtained from pupae of the tephritid *Anastrepha fraterculus* (Wiedemann) in Las Yungas and Paranaense subtropical rain forest regions, and 10 *A. indica* specimens were recovered from pupae of the tephritid *Ceratitis capitata* (Wiedemann) in Chacoan subtropical dry forest region. Thus, *A. indica* was recovered approximately 38 years after its first release in Argentina.

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