Field Host Range of Apanteles opuntiarum (Hymenoptera: Braconidae) in Argentina, a Potential Biocontrol Agent of Cactoblastis cactorum (Lepidoptera: Pyralidae) in North America

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Field host range of *Apanteles opuntiarum* (Hymenoptera: Braconidae) in Argentina, a potential biocontrol agent of *Cactoblastis cactorum* (Lepidoptera: Pyralidae) in North America

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Cactoblastis cactorum (Berg) (Lepidoptera: Pyralidae) was successfully used for biological control of *Opuntia* spp. (Caryophyllales: Cactaceae) in Australia and South Africa, where no native cacti occur (Dodd 1940; Pettey 1948). Larvae feed gregariously inside the cladodes of many species of *Opuntia*, often causing death of the plants (Starmer et al. 1988). Since 1989, this South American moth (Mann 1969) has been invading the southeastern United States, threatening the unique cactus diversity and industry in the western United States and Mexico (Hight & Carpenter 2009). *Cactoblastis cactorum* also was detected on 2 Mexican islands, but was eradicated during 2007–2009 by several control measures, including plant removal and sanitation to lower the population density, followed by the sterile insect technique (SIT) (Carpenter et al. 2008; Hight et al. 2008). In the United States, these control measures also were adopted. However, these action programs targeting *C. cactorum* outbreaks were not adequately funded and did not prevent the moth from spreading further to the west (USDA APHIS 2009). Although chemical control can be effective in some cases (Bloem et al. 2005), it has not been recommended because the *Opuntia* species often are associated with sensitive ecological areas (Habeck & Bennet 1990). In addition, aerial insecticide applications would probably not be effective because the damaging stage of the insect is endophagous (Vigueras & Portillo 2001). Currently, efforts are underway to develop sustainable control tactics, including the evaluation of biological control agents.

A literature review of natural enemies of *Cactoblastis* spp. (Pemberton & Cordo 2001) revealed the occurrence of at least 8 or 9 parasitoids, among which the braconid *Apanteles alexanderi* Brèthes (Hymenoptera: Braconidae) was the most frequent, with parasitism rates as high as 30%. However, because of its broad host range (De Santis 1967), this parasitoid was dropped from further consideration as a potential biological control agent in North America (Pemberton & Cordo 2001). After Parker et al. (1950) first reported *A. alexanderi* from *C. cactorum*, all braconids subsequently associated with this moth have been identified arbitrarily as this species. However, recent molecular and taxonomic studies confirmed the presence of 2 congeneric species, *A. alexanderi* and the recently described *Apanteles opuntiarum* Martínez & Berta (Martínez et al. 2012). Both *Apanteles* spp. have gregariously feeding larvae, attack the larval stage of their host, and are koinobiont endoparasitoids. Preliminary field observations revealed *A. opuntiarum* to have a more restricted host range than *A. alexanderi,* and to show the highest parasitism rates among 7 other parasitoids that attack *C. cactorum* in Argentina (Mengoni Goñalons et al. 2014). Consequently, *A. opuntiarum* is a candidate for biological control of *C. cactorum*. The parasitoid was first exported from Argentina in Mar 2013 to the quarantine facility of the Florida Department of Agriculture and Consumer Services, Division of Plant Industry, Gainesville, Florida, USA. A culture is being established in quarantine to perform host specificity tests with cactophagous moths native to the United States. Export permits were issued by Argentine regulatory agencies (Gestión de Uso Sustentable de los Recursos Naturales, Ministerio de Producción, Gobierno de Entre Ríos; Dirección de Fauna Silvestre and Dirección Nacional de Ordenamiento Ambiental y Conservación de la Biodiversidad Permit # 4612/13; Servicio Nacional de Sanidad y Calidad Agroalimentaria; DNPV Permit # 87). The importation permit (P526P-Permit # 13-00380) was issued by the United States Department of Agriculture–Animal and Plant Health Inspection Service.

The native range of *C. cactorum* in Argentina (roughly 23°53'S to 40°48'S; 58°38'W to 66°10'W) was surveyed from Aug 2007 to Mar 2014 for the presence of cactus-feeding moth larvae to determine the field host range of *A. opuntiarum*. Sites were selected by the occurrence of plant patches in the Cactaceae family. In patches containing more than 50 plants of the same species, at least 50 plants were visually inspected for the presence of larval damage. In smaller patches, all plants of the same species were inspected. Damaged plants were dissected and examined for the presence of cactus-feeding larvae, and all larvae and their host plants were returned to the laboratory. Once in the laboratory, larvae were reared on the host plant from which they were collected and checked every 2–3 d for the presence of parasitoid cocoons. In total, 394 sites containing 495 cactus patches were surveyed.

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At least 8 species of pyralids in the genera *Cactoblastis*, *Sigelgaita*, *Tucumania*, *Salambona*, and *Ozamia* were found attacking 17 species of Cactaceae in the genera *Opuntia*, *Trichocereus*, *Cleistocactus*, *Monvillea*, and *Harrisia* at 133 sites in Argentina (Table 1). Collection of *Sigelgaita* nr. *chilensis* was the second for this genus known to occur east of the Andes Mountains (Monteiro & Becker 2002) and the first for Argentina. Of the 3 species of *Cactoblastis* collected from Argentine Cactaceae, *C. cactorum* was, by far, the most frequently observed pyralid. *Cactoblastis cactorum* larvae attacked 10 *Opuntia* spp. at 95 sites; *C. doddi* Heinrich was found at 9 sites on 2 *Opuntia* spp.; and *C. bucyrus* Dyar was found at only 3 sites on 1 species of Cactaceae. Among the non-*Cactoblastis* moths, *Ozamia* spp. were found most frequently, occurring at 13 sites on at least 4 species of Cactaceae. The other pyralids were found at 1 to 8 sites (Table 1). *Apanteles* parasitoids were found at a total of 54 sites; *A. opuntiarum* and *A. alexanderi* occurred at 44 and 10 sites, respectively. *Apanteles opuntiarum* parasitized only *C. cactorum* and *C. doddi,* whereas *A. alexanderi* parasitized the other pyralid species except *Ozamia* (only non-parasitized larvae were found). Both *Apanteles* species were sympatric at 7 sites and shared similar geographical ranges (Fig. 1). Although these 2 *Apanteles* species parasitized different host species, the host larvae attacked often shared the same *Opuntia* host species. For example, *A. opuntiarum* attacked *C. cactorum* and *A. alexanderi* parasitized *Tucumania* sp., both were collected on *O. elata* var. *cardiosperma* and *O. megapotamica* (Table 1), and both were found in the same habitat. Furthermore, over 100 individuals of *Tucumania tapiacola* Dyar were collected at 2 sites cohabiting and feeding on the same plants and cladodes with *C. cactorum*, but only *A. alexanderi* emerged from *T. tapiacola* larvae (n = 11), whereas *A. opuntiarum* emerged from the larvae of *C. cactorum*. To date, all collections of parasitized *C. cactorum* larvae were attacked only by *A. opuntiarum*. *Cactoblastis doddi*, whose primary host plant was *O. sulphurea* Gillies ex Salm-Dyck, also was parasitized by *A. opuntiarum*. *Cactoblastis bucyrus*, whose host plant was the tree-like cactus *Trichocereus atacamensis* var. *pasacana* (F.A.C. Weber ex Rümpler) F. Ritter, was parasitized by *A. alexanderi*. Host plants of *C. doddi* and *C. bucyrus* occurred in the same habitat and insects were collected in close proximity to one another. *Apanteles alexanderi* was reported to attack other cactophagous Lepidoptera such as *Plutella* sp., *Argyrotaenia* sp., and *Eulia* sp. (De Santis 1967). However, these host records may be dubious given the discovery that historical identifications of "*A. alexanderi"* were composed of 2 species, *A. alexanderi* and *A. opuntiarum* (Martínez et al. 2012).

Table 1. Occurrence of *Apanteles* species found attacking cactus-feeding Pyralidae on associated host plant species in Argentina.

Pyralid species			
Cactus host	# sites	*Apanteles* spp.	# sites
Cactoblastis cactorum (Berg)			
Opuntia ficus-indica L.	43	*A. opuntiarum*	26
Opuntia elata var. *cardiosperma* (K. Schum.) R. Kiesling	21	*A. opuntiarum*	6
Opuntia megapotamica Arechav.	9	*A. opuntiarum*	5
Opuntia elata var. *elata* Link & Otto ex Salm-Dyck	5	*A. opuntiarum*	3
Opuntia anacantha Speg.	7	*A. opuntiarum*	1
Opuntia quimilo K. Schum.	4	*A. opuntiarum*	1
Opuntia robusta H. L. Wendl. ex Pfeiff.	2	—	
Opuntia leucotricha DC.	2	—	
Opuntia auriantiaca Gilles ex Lindley	1	—	
Opuntia penicilligera Speg.	1	—	
Cactoblastis doddi Heinrich			
Opuntia sulphurea	8	*A. opuntiarum*	1
Opuntia penicilligera	1	*A. opuntiarum*	1
Cactoblastis bucyrus Dyar			
Trichocereus atacamensis var. *pasacana*	3	*A. alexanderi*	2
(F. A. C. Weber ex Rumpler) Britton & Rose			
Sigelgaita nr. *chilensis*			
Opuntia elata var. *cardiosperma*	2	*A. alexanderi*	1
Tucumania tapiacola Dyar			
Opuntia ficus-indica	2	*A. alexanderi*	2
Tucumania sp.			
Opuntia megapotamica	5	*A. alexanderi*	2
Opuntia elata var. *cardiosperma*	2	*A. alexanderi*	2
Opuntia sulphurea	1	—	
Salambona sp.			
Trichocereus terscheckii (Parm. ex Pfeiff.) Britton & Rose	1	*A. alexanderi*	1
Ozamia spp.			
Cleistocactus spp.	4	—	
Opuntia spp.	4	—	
Monvillea cavendishii (Monv.) Britton & Rose	3	—	
Harrisia bonplandii (J.Parm. ex Pfeiff.) Britton & Rose	2	—	
Total	133		54

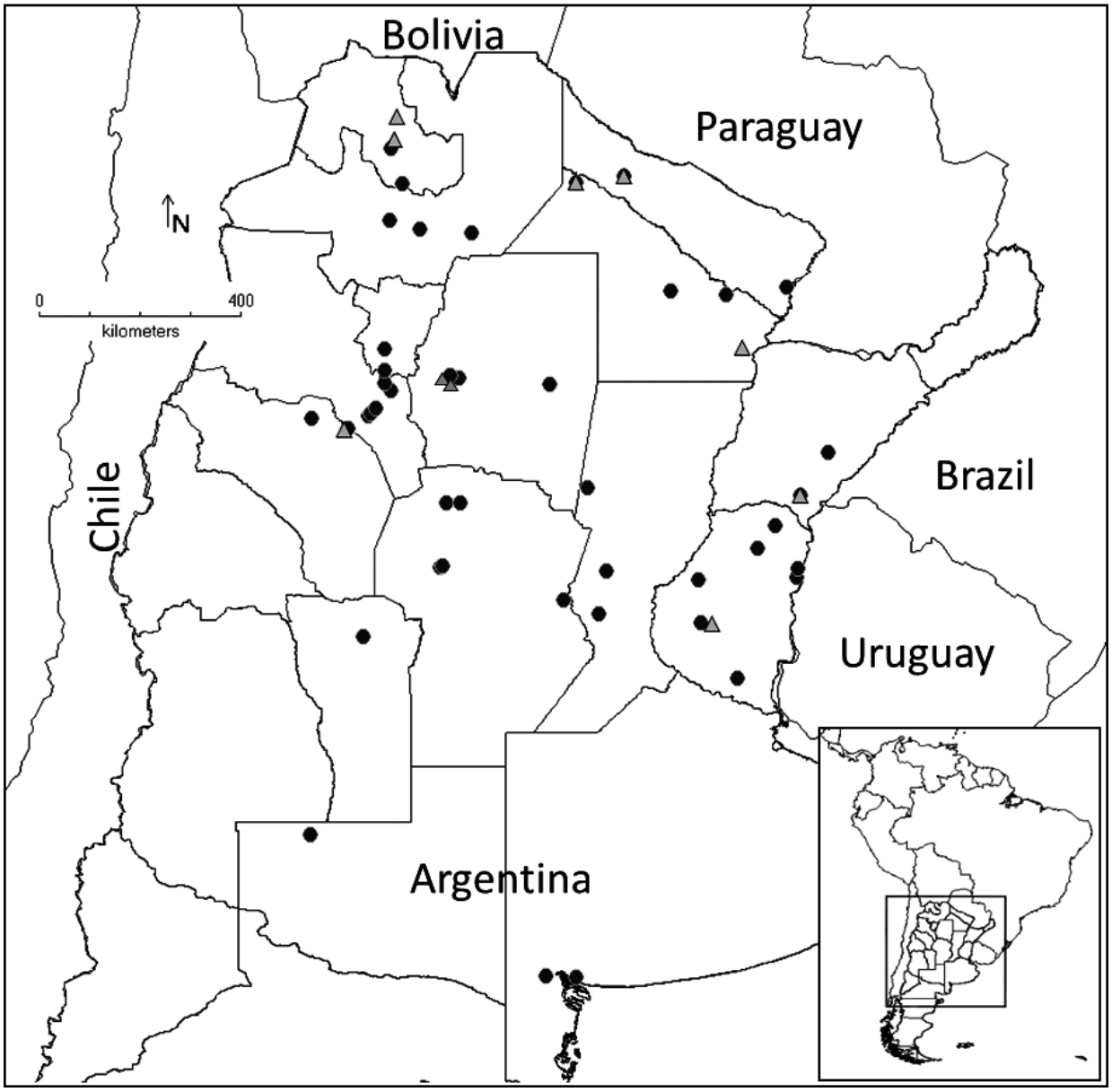

Fig. 1. Distribution of *Apanteles opuntiarum* (circles) and *Apanteles alexanderi* (triangles) that emerged from species of Pyralidae collected in Argentina, Aug 2007–Mar 2014.

Our findings revealed that the host range of *A. opuntiarum* was restricted to 2 *Cactoblastis* species, enhancing the potential of this parasitoid as a biological control agent of the invasive cactus moth, *C. cactorum*, in North America. Finding *C. cactorum* larvae parasitized by *A. opuntiarum* and non-target larvae parasitized by *A. alexanderi* on the same *Opuntia* spp. plants (often the same cladodes), provided strong evidence that the limited host range observed was due to host specificity and not due to geographical or host plant isolation of the pyralid larvae. If a narrow host range is confirmed in quarantine with North American cactus-feeding species, then *A. opuntiarum* will likely be released for biological control of *C. cactorum* in the United States, with little or no risk to non-target species.

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Summary

Field exploration in Argentina for cactophagous lepidopteran hosts parasitized by the recently described braconid parasitoid *Apanteles opuntiarum* Martínez & Berta (Hymenoptera: Braconidae) revealed a host range restricted to *Cactoblastis cactorum* (Berg) (Lepidoptera: Pyralidae) and *C. doddi.* Field collections of cactophagous larvae parasitized by the congeneric and sympatric parasitoid *A. alexanderi* included the host species *C. bucyrus*, *Sigelgaita* nr. *chilensis*, *Tucumania* sp., *Tucumania tapiacola* and *Salambona* sp. If a narrow host range for *A.*

opuntiarum is confirmed in quarantine with North American cactus-feeding species, then this parasitoid could be released as a biological control agent for *C. cactorum* with little or no risk to non-target species.

Key Words: parasitoid; host range; cactus moth; *Apanteles alexanderi*; *Apanteles opuntiarum*; biological control

Sumario

Las exploraciones de campo en Argentina de larvas hospedadoras cactófagas parasitadas por *Apanteles opuntiarum* Martínez & Berta (Hymenoptera: Braconidae), un bracónido recientemente descripto, revelaron un espectro de hospedadores restringido a *Cactoblastis cactorum* (Berg) (Lepidoptera: Pyralidae) y *C. doddi*. Las colecciones de campo de larvas cactófagas parasitadas por la especie congenérica y simpátrica *A. alexanderi* identificaron a *C. bucyrus, Sigelgaita* nr. *chilensis, Tucumania* sp., *Tucumania tapiacola* y *Salambona* sp. como especies hospedadoras. Si se confirma en cuarentena el estrecho rango de hospedadores de *A. opuntiarum* sobre especies norteamericanas que se alimentan de cactus, podría ser liberado como agente de control biológico de *C. cactorum,* con bajo riesgo o ninguno a especies no blanco.

Palabras Clave: parasitoide; espectro de hospedadores; polilla de la tuna; *Apanteles alexanderi; Apanteles opuntiarum*; control biológico

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