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TWO NEW NATIVE HOST PLANT RECORDS FOR *ANASTREPHA FRATERCULUS* (DIPTERA: TEPHRITIDAE) IN ARGENTINA

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Anastrepha fraterculus (Wiedemann) (South American fruit fly) is a polyphagous cryptic species complex (Steck 1991) distributed throughout continental America from USA (it has occasionally been trapped in extreme south Texas but does not seem to be established) and Mexico to Argentina (Aluja 1999; Norrbom et al. 1999b). It and *Ceratitis capitata* (Wiedemann) (Mediterranean fruit fly) are the only two economically important fruit fly species found in Argentina (Aruani et al. 1996). There are some genetic differences between *A. fraterculus* collected from *Psidium guajava* L. in the Buenos Aires (central-eastern region) and Tucumán (northwestern region) Provinces (Sonvico et al. 1996), but Alberti et al. (2002) concluded that Argentine populations of the complex are conspecific. Within Argentina, *A. fraterculus* is mainly restricted to the northern region between 22° and 31°S latitude where it breeds in native and wild exotic plant species (Ovruski et al. 2003), whereas *C. capitata* occurs from the northern region to as far south as 40°S latitude in Patagonia (southern region), mainly in the Río Negro Valley, commonly infesting commercial exotic fruits (Sanchez et al. 2001).

Of 29 fruit species recorded as hosts of *A. fraterculus* in Argentina, only seven are from plants known to be indigenous to the country (Rust 1918; Ogloblin 1937; Hayward 1960; Blanchard 1961; Putruele 1996; Nasca et al. 1996; Ovruski et al. 2003). Unfortunately, most of these host records did not include data on field infestation level, fruiting phenology, part of the fruit being used by larvae, nor taxonomists performing the plant and fly identifications (Ovruski et al. 2003). Many records excluded specimen or voucher data. All this information is needed to unequivocally consider a plant species as a natural host (Norrbom & Kim 1988; Aluja 1999). This work provides new host plant records for *A. fraterculus* and a more complete picture of the native host range of this economically important tephritid species in Argentina.

Fruit samples consisted of fallen ripe fruit of two native plants, *Chrysophyllum gonocarpum* (Mart. et Eich.) Engler (Sapotaceae) (locally known as "aguay") and *Inga marginata* Willd. (Fabaceae) locally known as "pacay" or "inga del cerro, which were collected in patches of disturbed wild vegetation. The fruit samples of *C. gonocarpum* were collected at El Oculto (Salta Province, NW Argentina) at 23°06'S latitude and 64°29'W longitude, and 530 m above sea level, whereas the fruit samples of *I. marginata* were collected at Horco Molle (Tucumán Province, NW Argentina) at 26°45'S latitude and 65°20'W longitude, and 500 m altitude.

Chrysophyllum gonocarpum is a tree that reaches 7-12 m in height with a trunk diameter of 20-50 cm when fully grown (Legname 1982). The fruit is a yellow subglobose berry with five longitudinal grooves, 2.9 ± 0.8 cm (mean ± SD) in diameter and 8.2 ± 1.3 g in weight (n = 100) when fully ripe. In NW Argentina, it is distributed in the Subtropical Montane Rainforest (locally known as "Yungas" or "tucumano-bolivian" forest), and is found at altitudes of 400-1200 m between the Premontane Forest and Montane Forest environmental units of the Yungas (Morales et al. 1995). The fruiting period occurs from October to December (L. Oroño and S. Ovruski, pers. obs.), although according to Legname (1982) it starts in September.

Inga marginata is a tree that reaches 4-12 m in height with a trunk diameter of 10-30 cm when fully grown (Legname 1982). The fruit is a yellow-brown indehiscent pod, 10.8 ± 2.2 cm long, 2.9 ± 2.3 cm wide, and 21.2 ± 6.3 g weight (n = 100) when fully ripe. In NW Argentina, *I. marginata* is found at altitudes of 300-700 m in the Premontane Forest and Montane Forest of the Yungas (Morales et al. 1995). The fruiting period lasts from January to March (Legname 1982).

Samples ranged from 45 to 130 fruits, depending on fruit availability. These samples were placed in individual cloth bags, and then put in-

side a plastic container (45 × 27 × 38 cm) for transport to the laboratory of the Centro de Investigaciones para la Regulación de Poblaciones de Organismos Nocivos (CIRPON), in San Miguel de Tucumán (26°50'S, 65°13'W, 426 m), Tucumán Province. In the laboratory, each fruit was counted, weighed, and placed individually in a plastic tray with damp sand in the bottom as a pupation substrate. All tephritid pupae from each fruit tray were removed every three days, and the *A. fraterculus* and *C. capitata* pupae were separated based on external pupal characters (White & Elson-Harris 1992). The pupae were then isolated in individual plastic container (220 cm^3) with moistened sterile sand at the bottom. A mesh-covered top was fitted over the glass. All trays containing pupae were kept inside a room at 25 ± 1°C, 75 ± 5% relative humidity and a photoperiod of 14:10 (L:D) h for two months. Emerged flies and parasitoids were captured alive. Parasitoids and *C. capitata* adults were placed in plastic vials containing 70% ethanol, while *A. fraterculus* adults were placed in transparent Plexiglas cages (30 × 30 × 30 cm) and provided with diet (sugar and hydrolysate enzymatic yeast) and distilled water. One week after emergence, *A. fraterculus* adults were killed in 70% ethanol. A. Norrbom and S. M. Ovruski identified the *Anastrepha* specimens, and S. M. Ovruski identified the *C. capitata* and parasitoid specimens. C.B. Martin identified the host plant species. Voucher specimens of the insects are placed in entomological collections of the National Museum of Natural History, Washington, DC, USA, and Fundación Miguel Lillo (FML), in San Miguel de Tucumán, Argentina. Voucher specimens of host plants are placed in the herbarium of FML. Terminology for native host plants follows Morales et al. (1995). Parasitism rates reported here are based on the number of emerged adult flies and parasitoids. Fruit infestation levels are expressed as the mean (±SD) number of *A. fraterculus* and *C. capitata* pupae per individual fruit and as the total number of *A. fraterculus* and *C. capitata* pupae per kg of fruit. These indices are given for all fruit samples (uninfested plus infested) and also for infested samples only. Spearman's coefficient of rank correlation was calculated to determine the relationship between individual fruit weight and the number of *A. fraterculus* pupae yielded per fruit.

A total of 168 (1,213.8 g) *C. gonocarpum* fruits were collected from six trees between October 12, 2001 and November 18, 2001, and 407 (8,964.9 g) *I. marginata* fruits were collected from five trees between February 25, 2002 and April 16, 2002. Of the fruit sampled, 50 (29.8%) *C. gonocarpum* and 25 (6.1%) *I. marginata* produced tephritids. *Anastrepha fraterculus* was reared from 47 (27.9%) aguay fruits and from all infested pacay fruits. *Ceratitis capitata* was reared only from 9 (5.4%) aguay fruits. Six (13%) of the *C. gonocarpum* fruit that produced *A. fraterculus*, also yielded *C. capitata*. *Anastrepha fraterculus* larvae were observed feeding in the pulp of both native plant species. Field infestation data for both host plant species are shown in Table 1.

The infestation level was 3.2 times higher in *C. gonocarpum* than in *I. marginata*, despite the greater number of pacay fruit collected (2.5-fold differences). A positive correlation between fruit size and number of *A. fraterculus* pupae per fruit was observed in both host plant species, but these associations were due to weak correlation coefficients in aguay ($R_s = 0.17$, $P = 0.03$, $n = 168$, minimum and maximum individual fruit weight: 4.5-10.5 g) and pacay ($R_s = 0.19$, $P < 0.001$, $n = 407$, minimum and maximum individual fruit weight: 8.3-39.4 g). In total, 87 *A. fraterculus* pupae and 9 *C. capitata* pupae were recovered from all infested aguay fruits. From *A. fraterculus* pupae, 32 adult flies (37% emergence rate) and one adult parasitoid [*Aganaspis pelleranoi* (Brèthes) (Hymenoptera: Figitidae, Eucoilinae)] were recovered, and from *C. capitata* pupae, 3 adult flies (33% emergence rate) were obtained. Of the 168 *A. fraterculus* pupae recovered from all infested pacay fruits, 64 adult flies (38% emergence rate) and nine adult parasitoids were obtained [8 *Doryctobracon brasiliensis* (Szépligeti) (Hymenoptera: Braconidae, Opiinae), and 1 *A. pelleranoi*]. Parasitism rates were 12.3% and 3% in *I. marginata* and *C. gonocarpum*, respectively.

Chrysophyllum gonocarpum is recorded for the first time from Argentina as a natural host plant for *A. fraterculus*, and it appears to be a good host based on infestation data and number of adult flies reared from fruit samples. As reported previously by Ovruski et al. (2003), high levels of infestation by *A. fraterculus* were also recorded in the Yungas Forest in fruit species weighing between 1 and 60 g, such as the natives *Eugenia uniflora* L., *Myrcianthes pungens* (Berg) Legrand (Myrtaceae), *Juglans australis* Grisebach (Juglandaceae), and the introduced *Prunus armeniaca* L., *P. domestica* L., *P. persica* (L.) Batsch (Rosaceae), and *Psidium guajava* L. (Myrtaceae). Similarly, Ovruski & Schliserman (2003a) found high infestation rates by *A. fraterculus* in the natives *Feijoa sellowiana* (O. Berg) O. Berg (Myrtaceae) and *E. uniflora* from samples collected in a subtropical rainforest in northeastern Argentina. Interestingly, *C. gonocarpum* was previously recorded as a primary host for *A. fraterculus* in southeastern Brazil (Salles 1995; Kovaleski et al. 2000). *Chrysophyllum cainito* L (star apple) was also recorded as a natural host for *A. fraterculus* in Perú (Korytkowski & Ojeda-Peña 1970), but this record was considered questionable (Norrbom & Kim 1988). Among 22 indigenous plant families from which *A. fraterculus* has been reared, the Sapotaceae includes the third highest number of genera and species of native hosts reported (4

TABLE 1. INFESTATION LEVELS FOR *ANASTREPHA FRATERCULUS* (*AF*) AND *CERATITIS CAPITATA* (*CC*) IN *CHRYSOPHYLLUM GONOCARPUM* AND *INGA MARGINATA* IN NORTHWESTERN ARGENTINA.

Plant species	Total no. of samples	Mean (±SD) no. fruit per sample	Mean (±SD) no. infested fruit per sample	Fruit fly pupae no./kg of fruit (infested samples only)		Mean (±SD) no. of fruit fly pupae per fruit (infested samples only)		Fruit fly pupae no./kg of fruit (all samples)		Mean (±SD) no. of fruit fly pupae per fruit (all samples)	
				Af	*Cc*	*Af*	*Cc*	*Af*	*Cc*	*Af*	*Cc*
Chrysophyllum gonocarpum	3	56.0 ± 32.9	16.7 ± 14.7	86.1	8.9	0.64 ± 1.17	0.07 ± 0.25	71.7	7.4	0.52 ± 1.08	0.05 ± 0.21
Inga marginata	3	135.7 ± 11.9	8.3 ± 7.2	27.0	0	0.61 ± 2.22	0	18.7	0	0.41 ± 1.86	0

genera and 6 species versus 8/26 in Myrtaceae and 4/7 in Rosaceae) (Norrbom et al. 1999a).

Inga marginata is a new host plant record for *A. fraterculus*, although it has been previously reported as a host of *A. distincta* Greene in Venezuela (Norrbom & Kim 1988). The low infestation level observed in the native *I. marginata* is similar to values recorded in exotic cultivated fruit growing in northwestern Argentina, such as *Diospyros kaki* L. (Ebenaceae), *Annona cherimola* Mill. (Annonaceae), *Citrus paradisi* Macfadyn (Rutaceae), and *Mangifera indica* L. (Anacardiaceae) (Ovruski et al. 2003). Although the Fabaceae are mainly infested by *A. distincta* (17 species of the genus *Inga* recorded as hosts), five species of this plant family have been reported as hosts for *A. fraterculus*) (Norrbom 2004).

As reported previously in northwestern Argentina by Ovruski et al. (2003), we found that *A. fraterculus* is much more abundant in native, wild fruit than *C. capitata*. These authors showed that *A. fraterculus* appears to prefer areas with patches of wild vegetation, whereas *C. capitata* seems to adapt well to highly perturbed environments where exotic plants are more common. A similar situation has been recorded in several regions of Brazil (Malavasi & Morgante 1981; Malavasi et al. 2000).

Doryctobracon brasiliensis and *A. pelleranoi*, both native parasitoid species collected in the study areas, were previously recorded from northwestern Argentina in association with *A. fraterculus* in *Prunus armeniaca*, *P. domestica*, *P. persica*, *Psidium guajava*, and in *J. australis* (Ovruski et al. 2004). These two wasp species are solitary, koinobiont endoparasitoids of larvae of the genus *Anastrepha*, belonging to the fruit fly parasitoid guild number "2" defined by Ovruski et al. (2000). In general, the degree of larval parasitism obtained in *I. marginata* and *C. gonocarpum* was similar to values found in other native fruit species such as *F. sellowiana*, *E. uniflora*, *M. pungens* and *J. australis*, and exotic "feral" species such as *P. guajava* and *Prunus* species, which form part of the wild vegetation in perturbed subtropical rainforest of northern Argentina (Ovruski & Schliserman 2003a, b; Ovruski et al. 2004).

Inga marginata and *C. gonocarpum* increase to nine the number of native host plant species of *A. fraterculus* recorded for Argentina. Previously, one species of Juglandaceae (*J. australis*) and six species of Myrtaceae (*Eugenia retusa* Berg, *E. uniflora*, *M. pungens*, *Hexachlamys edulis* (Berg.) Krausel et Legrand, *Campomanesia crenta* Berg, and *F. sellowiana*) were registered for Argentina (Ovruski et al. 2003; Ovruski & Schliserman, 2003a).

The discovery of these two new native host plants for *A. fraterculus* in northwestern Argentina underscores the importance of conducting fruit surveys in environments with vast areas of native vegetation and over long periods including

several fruiting seasons (Aluja 1996; Aluja et al. 2000). Thus, the information yielded by these types of studies can aid the Argentinean National Fruit Fly Control and Eradication Program to develop management strategies in the fruit-producing regions of northern Argentina, where *A. fraterculus* and *C. capitata* have numerous alternative host plants.

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Summary

Chrysophyllum gonocarpum (Sapotaceae) and *Inga marginata* (Fabaceae) are reported as host plants of *Anastrepha fraterculus* in Argentina for the first time. Infestation rates (number of *A. fraterculus* pupae/kg of fruit) were 86.1 and 27.0 for *C. gonocarpum* and *I. marginata*, respectively. In total, 32 *A. fraterculus*, 3 *Ceratitis capitata*, and 1 *Aganaspis pelleranoi* (parasitoid) adults were recovered from *C. gonocarpum*, while 64 *A. fraterculus*, 8 *Doryctobracon brasiliensis* (parasitoid), and 1 *A. pelleranoi* were obtained from *I. marginata*.

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