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Source: Florida Entomologist, 91(3) : 498-500

Published By: Florida Entomological Society

URL: https://doi.org/10.1653/0015-4040(2008)91[498:LPATAD]2.0.CO;2

LARVAL PARASITOIDS ASSOCIATED TO *ANASTREPHA DISTINCTA* (DIPTERA: TEPHRITIDAE) IN TWO HOST FRUITS AT THE SOCONUSCO REGION, CHIAPAS, MEXICO

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Anastrepha distincta Greene (Diptera: Tephritidae) is considered a pest of secondary importance in Mexico because it is only associated with non-commercial fruits in the *Inga* genus (Fabaceae) (Norrbom & Kim 1988; Malo et al. 1987; Celedonio-Hurtado et al. 1995). However, there are reports of *A. distincta* infesting economically important fruits such as oranges (*Citrus sinensis* L.) and mangoes (*Mangifera indica* L.) (Norrbom & Kim 1988).

During the last few years biological control of fruit flies has emerged as an alternative to synthetic insecticides (Ovruski et al. 2000). Therefore, it is important to determine the potential of parasitoids in regulating populations of various species of fruit flies under field conditions (Figueroa 1998; Ovruski et al. 2000; Montoya et al. 2000). The first step in developing a biological control program is an inventory of native parasitoids. Practical issues, such as which species are most suitable for mass rearing, might eventually be taken into account (Ovruski et al. 2000; Montoya & Liedo 2000).

Native host plants in rainforest areas provide an important reservoir of native and introduced *Anastrepha* parasitoids (López et al. 1999; Aluja et al. 2003). Studies carried out in neotropical regions indicate that populations of fruit flies such as *A. ludens* (Loew), *A. obliqua* (Macquart), *A. serpentina* (Wiedemann), *A. striata* Schiner, *A. fraterculus* (Wiedemann), *A. leptozona* Hendel, and *Toxotrypana curvicauda* (Gerstaecker), are frequently associated with *Diachasmimorpha longicaudata* Ashmead, *Doryctobracon areolatus* Viereck, and *D. crawfordi* parasitoids (Aluja et al. 1990; Eskafi 1990; Figueroa 1998).

Inga spp. are native species of tropical America and are widely distributed (Sousa 1993). Usually, these tress are used to provide shade for coffee plants (*Coffea arabica* L.). They are also found naturally in the subdecidous forest, disturbed areas, and gardens (Miranda 1998).

There are no reports of parasitoids attacking *A. distincta* under field conditions. The goal of this study was to identify the parasitoid species associated with *A. distincta* infesting two natural hosts; "Cuajinicuil" (*Inga spuria* H. et B.), and "Caspirol" (*I. laurina* Wild), in the Soconusco region, in Chiapas, Mexico. The fruits of *I. spuria* are lengthener (~15 cm), flattener, green colored, and become greenish-yellow when they mature. In the case of *I. laurina* fruits are shorter (~10 cm), bulkier and stay green, even when ripe. *Inga spuria* has two fruiting seasons per year; the first from Jan to Mar and the second from Aug to Sep *Inga laurina* has only one fruiting season per year; from Feb to Apr (Miranda 1998).

The study site is at an altitude between 670 and 960 m above sea level, and geographical coordinates are 15°02'11"N latitude, and 92°05'64"W longitude. The area's climate is defined as Af (tropical wet) with a mean annual temperature of 25.4°C, and 4,720 mm rainfall. The rainy season is from May to Oct and the dry season lasts 5-6 months, from Nov to Apr (García 2004). *Anastrepha distincta* larvae were obtained from infested fruits that had fallen to the ground. The collected fruits were transported to the laboratory of El Colegio de la Frontera Sur (ECOSUR) in Tapachula, Chiapas. They were weighed, counted, and placed in plastic trays where they remained for 5 or 6 d until the larvae reached maturity (third instar), and began leaving the fruits. Subsequently, the fruits were dissected and the remaining third instar larvae were extracted and counted. All larvae were placed in plastic containers ($26 \times 12 \times 9$ cm) with humid vermiculite in order to promote pupation. We found few younger larvae (234 in total in the 12 samples of the 2 host fruits), and they were separated from third instar larvae. Pupae remained in the containers for 13 d and they were sieved from the medium (Mesh 18 sieve), placed in containers, and covered with fine mesh until fruit fly and parasitoid adults eclosed. Fruit fly adults were identified with the taxonomic key by Hernández-Ortiz (1992). Parasitoids were separated by sex, counted, and placed in vials containing 70% alcohol. Species were identified by descriptions in Wharton & Gilstrap (1983), Wharton & Marsh (1978), and Ovruski et al. (1996).

Twelve samples of fruits were taken from each plant; 37.5 kg of *I. spuria*, and 36.9 kg of *I. laurina*, which yielded 3,375 and 4,386 larvae, respectively (Table 1). However, parasitoids emerged only from 3 samples from each host. In the case of *I. spuria* 3 species of parasitoids (*Diachasmimorpha longicaudata*, *D. tryoni*, and *Doryctobracon crawfordi*) were obtained. All 3 species of parasitoids were found from a 9.1 kg sample of *I. spuria* fruits with an infestation rate of

TABLE 1. PARASITOIDS ASSOCIATED WITH LARVAE OF *ANASTREPHA DISTINCTA* (GREENE) IN 2 HOST FRUITS IN THE SOCONUSCO HIGHLANDS, CHIAPAS, MEXICO.

Host fruits								
Common name	Scientific name	Number of fruit	Kg of fruit	Number of *A. distincta* larvae	Parasitoid species	Males	Females	Total
Cuajinicuil	*Inga spuria*	337	9.1	793*	*Diachasmimorpha longicaudata*	16	11	27
					Diachasmimorpha tryoni	0	3	3
					Doryctobracon crawfordi	3	1	4
		1,044	28.4	2,582**		0	0	0
Sub-total		1,389	37.5	3,375		19	15	34
Caspirol	*Inga laurina*	355	8.5	1,807*	*Doryctobracon crawfordi*	10	5	15
		1,187	28.4	2,579**		0	0	0
Sub-total		1,542	36.9	4,386		10	5	15
Total		2,931	74.4	7,761		29	20	49

*Total of 3 samples. **Total of 9 samples.

86.7 larvae per kg of fruit (Table 1). The highest density of fruit fly larvae was recorded from *I. lauriana* samples (212.6 larvae/kg), but only *D. crawfordi* was obtained from all 3 samples (8.5 kg) which were collected during Mar. In general, parasitism rate was low (0.63%). Previous studies carried out in the Soconusco region indicate that in *Micropholis mexicana* L., a native host of *A. leptozona*, parasitism by *D. crawfordi* was 8.1%. In the same host fruit, the parasitism by *D. longicaudata* on *A. serpentina* was 6.1% (Figueroa 1998). The high infestation rate by *A. distincta* in both host fruits probably was due to the sampling being directed only towards infested fruits. The adult eclosion rate was 85.4%, and sex ratio was 1:1 (male: female).

Diachasmimorpha tryoni (Cameron) and *D. longicaudata* (Ashmead) are parasitoids of fruit flies that were introduced for first time to the Americas in 1935 and 1954, respectively. Both species attack a wide range of frugivorous tephritids (Ovruski et al. 2000). But in the case of *A. distincta*, the only parasitoid species that had been recorded previously were *Aganaspis pelleranoi* (Figitidae) (Brèthes) in Venezuela (Katiyar et al. 1995), *Doryctobracon areolatus* Szépligeti (Braconidae) in Costa Rica (Jiron & Mexzón 1989), and by *Opius* sp. (Braconidae) in 2 localities of the State of Amazon, Brazil (Canal-Daza et al. 1994). *Doryctobracon crawfordi* (Viereck) is a native species frequently found parasitizing larvae of several fruit fly species, sometimes with high parasitism rates. This is why this species has been considered as a feasible biological control agent of fruit flies (Aluja et al. 1990; Figueroa 1998; Ovruski et al. 2000). However, comparative studies have shown that *D. longicaudata* is a more effective and efficient biocontrol agent (Miranda 2002).

Due to the seasonal fluctuation of *A. distincta* and associated parasitoids, samples of different native hosts should be taken during the fruiting seasons (González-Hernández & Tejada 1979; Wharton et al. 2000). Parasitism of *A. ludens* by *D. crawfordi* increased as the fruit fly populations increased and the environmental conditions (relative humidity and temperature) were favorable for parasitoid development (González-Hernández & Tejada 1979). A relative humidity of 60 to 80% was optimal for *D. crawfordi*. However, <60% humidity and temperature of >30°C resulted in population decline. This might partially explain the lower degree of parasitism and reduced diversity observed in *I. laurina* fruit as the collections were made during a period when environmental conditions were not optimal (relative humidity <60%, and temperature >30°C). Since *I. spuria* has 2 fruiting seasons per year, it might be that fruits from the Aug to Sep season would show higher parasitism rates duo to environmental conditions at this time of the year.

In conclusion, we are reporting the first case of tritrophic relationships among the species of parasitoids associated with *A. distincta* and 2 natural host fruits in the Soconusco highlands, Chiapas, Mexico.

The authors are grateful to G. Rodas, and S. L. Rodriguez (ECOSUR) for technical assistance. We thank to E. Malo, and 2 anonymous referees for helpful comments on an earlier draft of this paper.

SUMMARY

In this research we report for the first time 2 exotic species of parasitoids, *Diachasmimorpha longicaudata* and *D. triony*, and 1 native species, *Doryctobracon crawfordi*, parasitizing larvae of *Anastrepha distincta* present in 2 natural host

fruits of the *Inga* genus, in the Soconusco region, in Chiapas, Mexico.

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