

**PARASITOID RELEASES IN THE CONTROL OF *CERATITIS CAPITATA*
(DIPTERA: TEPHRITIDAE) OUTBREAKS, IN COFFEE GROWING
ZONES OF CHIAPAS, MEXICO**

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ABSTRACT Augmentative releases of *Diachasmimorpha longicaudata* (Ashmead) were carried out as a new component in the control of *Ceratitis capitata* (Wied.) outbreaks in Chiapas, Mexico. Parasitoids were released during 2001 and 2002 on a weekly basis at densities of 900-1800 parasitoids/ha over ~9000 ha of growing coffee. Through extensive fruit sampling, we found high levels of parasitism on *C. capitata* larvae in both years (average parasitism: 2001=42.7%; 2002=37.7%), with peaks of 60.7 and 68.8% in 2001 and 2002, respectively. Our results indicate that augmentative releases of parasitoids could be an alternative control method for area wide suppression of fruit fly populations.

KEYWORDS: Fruit flies, augmentative biological control, *Diachasmimorpha longicaudata*, *Ceratitis capitata*.

RESUMEN Liberaciones aumentativas de *Diachasmimorpha longicaudata* se llevaron a cabo como un nuevo componente en el control de brotes de *Ceratitis capitata* (Wied.) en Chiapas, México. Los parasitoides se liberaron durante 2001 y 2002 a una densidad de 900-1800 parasitoides/ha/semana, sobre una superficie aproximada de 9000 ha de café. A través de un programa intensivo de muestreo de frutos, se determinaron niveles altos de parasitismo sobre larvas de *C. capitata* en ambos años (parasitismo promedio: 2001=42.7%; 2002=37.7%), con picos de 60.7 y 68.8% en 2001 y 2002, respectivamente. Estos resultados indican que las liberaciones aumentativas de parasitoides pueden ser un método alternativo de control para suprimir poblaciones de moscas de la fruta en áreas extensas.

PALABRAS CLAVE: Moscas de la fruta, control biológico aumentativo, *Diachasmimorpha longicaudata*, *Ceratitis capitata*.

**AUGMENTATIVE BIOLOGICAL
CONTROL OF MEDFLY**

The presence of the Medfly *Ceratitis capitata* (Wied.) (Diptera: Tephritidae) in the southern border of Mexico, represents a constant threat to the Mexican and United States fruit industries (Gutierrez 1976). For

this reason, the governments of both countries initiated a cooperative program to avoid the establishment and northward distribution of this pest (Schwartz et al. 1989). This program uses an area-wide approach in which the Sterile Insect Technique (SIT) and aerial chemical control are the fundamental strategies. The program has effectively

prevented the establishment of the pest in the Mexican territory. However, the recurrence of Medfly outbreaks in the Soconusco region of Chiapas, as well the continuous application of the control actions over the same geographical area, gave rise to various difficulties, resulting particularly from wide spread of aerial bait sprays. In this zone, there has been an increase in organic coffee growing, and public opposition to bait spraying has grown. This has generated the need to integrate new strategies of control that are environmental friendly, as is the case of biological control. The feasibility of augmentative biological control of fruit flies has been shown both theoretically (Barclay 1987; Knipling 1992) and empirically (Wong et al. 1991, 1992; Sivinski et al. 1996; Montoya et al. 2000a). Our aim here is to show the results of complementary augmentative releases of *Diachasmimorpha longicaudata* (Ashmead) (Hymenoptera: Braconidae), for control of *C. capitata* outbreaks under an integrated management approach, and to discuss the potential use of this strategy in control/eradication programs.

BIOLOGICAL MATERIAL AND STRATEGIES

Diachasmimorpha longicaudata parasitoids were obtained from the Moscafrut mass-rearing facility located in Metapa de Domínguez, Chiapas. The rearing process was described by Cancino (2000). Prior to releasing, the parasitized fly pupae were packed in paper bags as described by Montoya et al. (2000a). The parasitoid releases were made over ~9000 ha of a coffee growing area in the Soconusco region, which is located in Southern Chiapas, Mexico, near the Guatemalan border (Fig. 1), and is characterized by its great ecological diversity (Deinlen 1993). This zone has been under sterile fly releases for more than 20 years, as the main tool to avoid the northward movement of

Medfly. During 2001 and 2002, a sterile bisexual strain of *C. capitata* was released weekly at an average density of 2000–2500 insects/ha. Parasitoids were released at a density of 900–1800 wasps/ha, using aircraft Cessna 206 or Bell 206 helicopter depending on availability. Releases started at first detection of Medfly larvae in the zone, and continue through 12 weeks without detection of wild flies.

The dispersal of parasitoids was estimated using traps named “sausage bags” (yellow cloth bags, 5 x 20 cm, with 200 irradiated third instar *A. ludens* mixed with diet and a corn cob at the center). These traps were placed on coffee plants, with a distance among traps ~700 m. The traps remained in the field for seven days, and then transported to laboratory to estimate percentage parasitism. Coffee fruit samples were collected once per week to evaluate the action of the parasitoids on Medfly larvae. Samples of 40–60 coffee berries (~400 g), were collected and immediately dissected. Percent parasitism on *C. capitata* was determined by direct observation of the scars caused by parasitoid’s oviposition on Medfly larvae, according to Montoya et al. (2000b, 2003). Those larvae showing one or more scars were dissected to verify the presence of parasitoid eggs or larvae.

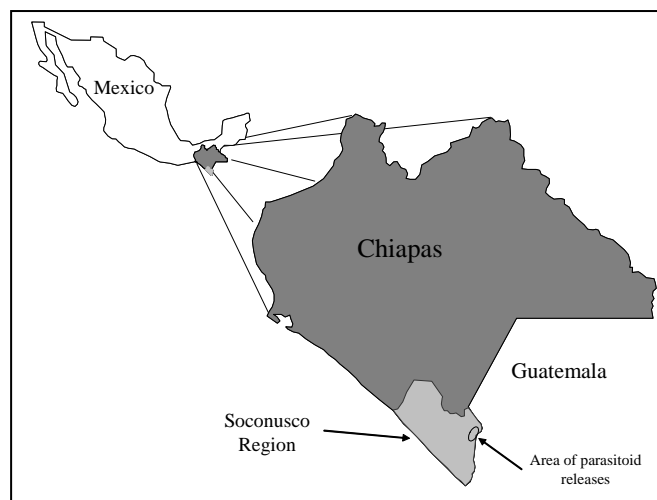


Fig. 1. Location of parasitoid release area in the Soconusco region, State of Chiapas, Mexico.

Additional to sterile insect and parasitoid releases, the general strategy to control outbreaks consisted in delimiting a 4.0 km² zone around each outbreak. The routine detection system consisting of two Jackson traps baited with Trimedlure/km², was increased with the addition of four traps baited with Biolure[®] per outbreak, distributed 100 m around according to cardinal points (N, S, E and W). Medfly fruit host located in the control area were removed and destroyed. Aerial or terrestrial bait sprays using a mix of 60% Success 0.02 CB[®], 40% water, was carried out during an eight week period. For aerial sprays 4.0 l/ha were applied, whereas in terrestrial applications 10 l/ha were used. These treatments were carried out weekly, three or four days after parasitoid releases.

SUPPRESSION OF MEDFLY OUTBREAKS

Ten larval outbreaks were detected during 2001. A total of 93 larvae were found in 2,851 kg of coffee berry obtained from 5,641 fruit samples. *D. longicaudata* parasitized 44 of 93 *C. capitata* larvae during the year, which represents 42.7±5.3 (mean±SE) (see Montoya et al. 2002). A higher number of Medfly outbreaks and larvae were detected in 2002 in relation to 2001. This was mainly attributed to abandonment of coffee crops because a decrease in coffee international price, leading to an increase in host fruits available to Medfly. In the parasitoid release zone, a total of 2,062 Medfly larvae were obtained from 3,630 samples of coffee berries (1,798 kg of fruit sampled). The percentages of parasitism reached by *D. longicaudata* during the time of releases are shown in Fig. 2, where a peak of 68.8% occurred in week 16, with an average percent of 37.7±5.4 (mean±SE). The average percent of "sausage bags" with parasitism was 74±3.8 (mean±SE, 2001) and 53.6±4.2 (2002), which showed that the spatial distribution of released parasitoids in the field was adequate.

The high level of parasitism on *C. capitata* larvae by *D. longicaudata* observed in both years is strong evidence of the potential of this control tool against fruit fly pests. Although the optimal rate of parasitoid releases in the field is still unknown, it is reasonably to expect that higher density of parasitoid releases will lead to better suppression of fruit fly populations, mainly in those host fruits (as coffee berries) offering little refuge to Medfly larvae. Fruit sampling removed an important number of first and second instar larvae that had not reached the third instar preferred by *D. longicaudata*. According to van Driesche (1983) and Wong et al. (1991), such sampling subestimates the real parasitism that could be reached if these larvae remained in the field. The parasitoids were able to find and parasitize an important percentage of those larvae that were not removed through mechanical control or fruit sampling, and with a high probability of reaching the adult stage. This is particularly relevant in situations where chemical control is an ineffective or an inadequate option controlling fruit fly populations, such as canyons, marginal and urban areas with non commercial hosts, zones with organic fruit culture, during the rainy season, etc. (Montoya & Cancino 2004). In all these cases augmentative biological control is a promising tactic for suppressing fruit fly populations, as suggested by Knippling (1992).

CONCLUSION

To be effective, parasitoid releases must be performed through an area-wide approach and under an integrated pest management framework (Wong et al. 1991; Knippling 1992; Sivinski et al. 1996; Montoya et al. 2000a). Data of this experience presented here support the hypothesis that augmentative releases of parasitoids can play an important role in fruit fly control/ eradication programs, if they are made in the adequate places, circumstances, periods, and densities.

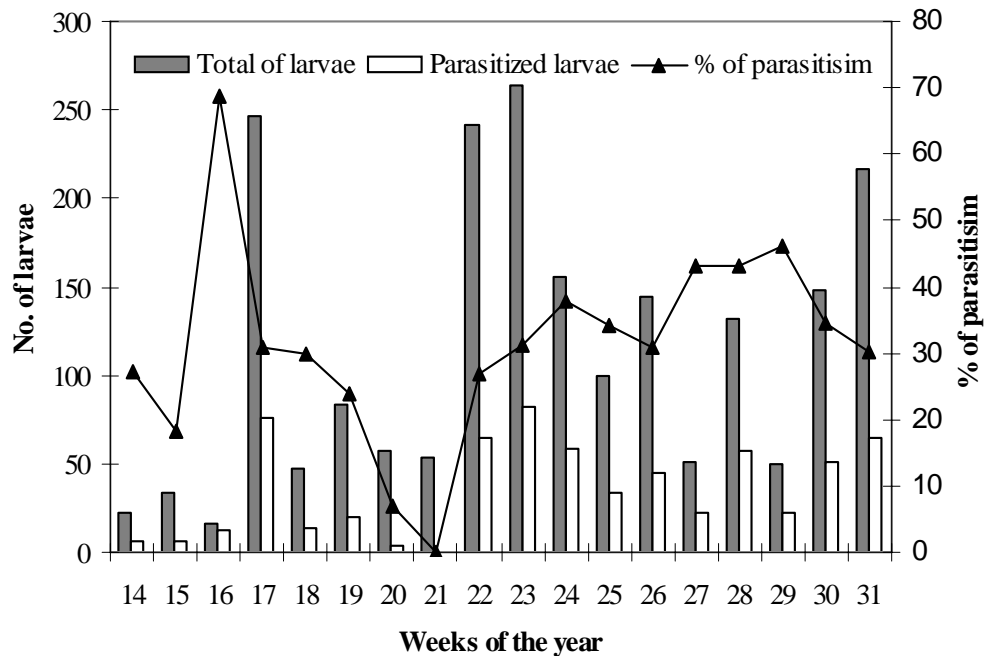


Fig. 2. Parasitism of *Diachsmimorpha longicaudata* on larvae of *Ceratitis capitata* found in coffee berries. 2002.

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