Biological control of *Diatraea* spp. (Lepidoptera: Pyralidae) in sugarcane crops in Central Venezuela

Enrique H. Weir L.[1,3], Williams Contreras[2] & Karine Gil de Weir[1,3]

1 The Platte River Whooping Crane Trust Inc. 6611 W. Whooping Crane Dr. Wood River, NE-68883, Nebraska, USA; henryweirl@msn.com; EWeir@whoopingcrane.org. Fax +1-308-384-7209

2 Central El Palmar, Laboratorio de Entomología, Hacienda Santa Teresa, El Consejo, Edo. Aragua, Venezuela.

3 The Beijer International Institute, The Royal Swedish Academy of Sciences, Lillafrescativågen 4, SE 10405, Stockholm, Sweden.

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Abstract: In 1990-1996, we evaluated the relative importance of the Amazonian fly (*Metagonystilum minense*) and the wasp (*Cotesia flavipes*), in sugarcane crops, in Central Venezuela. We observed a significant decrease in relative abundance of *Diatraea* spp. when the Amazon fly abundance increased but not with the wasp abundance. *Diatraea* spp. abundance in presence of both parasitoids was similar to its abundance throughout the last 45 years, when only inundations of *M. minense* occurred. However a net effect by using both parasitoids was not evident. *M. minense* is probably the stronger pest control, because its more efficient in its host searching than *C. flavipes* and is better as competitor than the wasp. Rev. Biol. Trop. 55 (2): 655-658. Epub 2007 June, 29.

Key words: *Metagonystilum minense*, *Cotesia flavipes*, parasitoid, *Diatraea*, sugarcane.

Flooding agroecosystems with parasitoid insects is sometimes very effective in lowering the abundance of crop pest insects (Knipling and McGuire 1968, Knipling 1970, 1972, Knipling and Gilmore 1971). Thus, parasitoids are commonly reared in laboratories and periodically liberated in high-density populations as biological control agents of lepidopterous crop pests (Barclay *et al.* 1985). The effectiveness of this biological control technique may be improved by adjusting parasitic inundation rates, until the pest population reaches a very low level (Barclay *et al.* 1985), and by evaluating the stability of parasitic-host system after inundation stops.

The purpose of this study is to evaluate the role of two parasitic species, the Amazonian fly *Metagonystilum minense* Myers (Diptera: Tachinidae), and the wasp *Cotesia flavipes* Cameron (Hymenoptera: Braconidae), in regulating sugarcane borers *Diatraea saccharalis* Fabricius, and *Diatraea rosa* Heinr (Lepidoptera: Pyralidae) in sugarcane crops in Central Venezuela.

MATERIALS AND METHODS

To determine the relative abundance of *Diatraea* spp., *M. minense* and *C. flavipes,* we sampled sugarcane harvests yearly, from 1990 to 1996, in Carabobo and Aragua States, Central Venezuela. During each harvest, we counted the number of stem holes, larvae and pupae of *Diatraea* spp., and pupae of *M. minense* and *C. flavipes* on 100 randomly selected sugarcane stems from each of 100, one ha plots (total=10 000 sterns).

These methods employed to estimate population were similar enough to those used 1950-1989. Proportions of parasitized and non-parasitized *Diatraea* spp. were correlated with the abundance of *M. minense* and *C. flavipes* reared in the laboratory, and liberated on

the farms. Laboratory work was done at the Entomology Laboratory of Santa Teresa Farm, El Consejo, Aragua State.

Stems were dissected in the laboratory to extract *Diatraea* larvae or pupae, and *M. minense* and *C. flavipes* pupae. Each *Diatraea* larva was placed in a vial and given a corn diet. Food was replaced every two days. Larvae were maintained in vials to molting pupae or to emergence of the parasitoid pupae. *Diatraea* spp., *M. minense* and *C. flavipes* pupae were placed in a Petri dish with absorbent paper.

We performed Kolmogorov-Smirnov and Schefee-Box tests to evaluate normality and homogeneity of variance (Sokal and Rohlf 1995), a parametric analysis of variance when was homogeneous (Sokal and Rohlf 1995), and Kruskal-Wallis test when variance was not homogeneous (Conover 1980).

RESULTS

The relative abundance of *Diatraea* spp. in sugarcane crops and proportions/ha, of laboratory reared *M. minense* and *C. flavipes,* are shown in Figure 1. The impact of mass liberations of these parasitoids on the sugarcane borer population has been important, particularly for *M. minense*. *M. minense* has controlled the pests for 50 years with a mean relative abundance range of 0.9 to 4.2 %. Changes in *Diatraea* spp. population levels showed a significant relationship with *M. minense* released between 1950 to 1989 ($F=99.9$, $\alpha=0.0001$).

During the last six years of biological control (Fig. 2), changes in *Diatraea* spp. population density showed a significant relationship with *M. minese* in this period ($F=6.17$, $\alpha=0.05$), but the relationship with *C. flavipes* was unsignificant ($F=2.99$, ns). However, the parasitization frequency of *Diatraea* hosts by *C. flavipes* was similar to that of *M. minense,* suggesting that *C. flavipes* is less efficient than *M. minense* as a parasitoid, because ten times more *C. flavipes* must be liberated to equal the effect produced by *M. minense.*

DISCUSSION

For six years, biological control by both *M. minense* and *C. flavipes* has used to control *Diatraea* spp. populations in sugarcane crops in Venezuela. A net effect by using both parasitoids is not evident. The recent trend of *Diatraea*

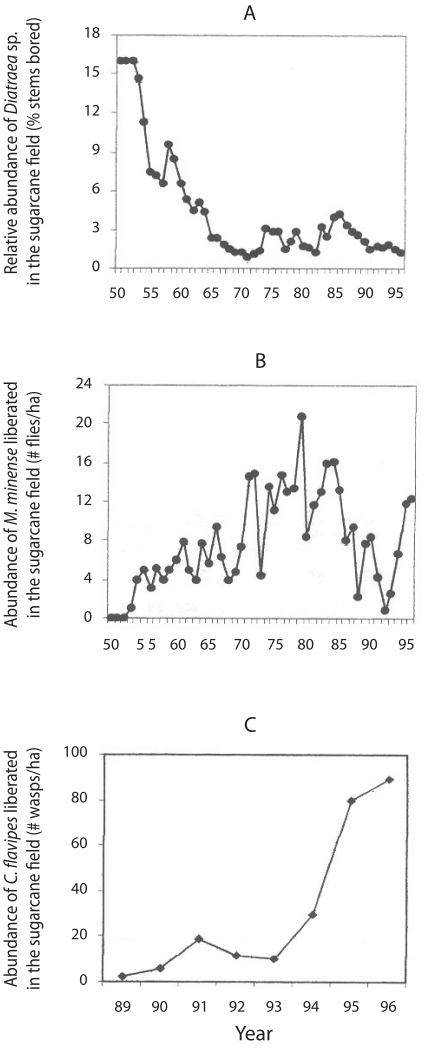

Fig. 1. Changes in host and parasitoid abundance in sugarcane field. A. Relative abundance of *Diatraea* sp. (estimated by the percent of stems bored). B y C. Shows the abundance of *M. minense* y *C. flavipes* respectively, liberated in sugarcane fields.

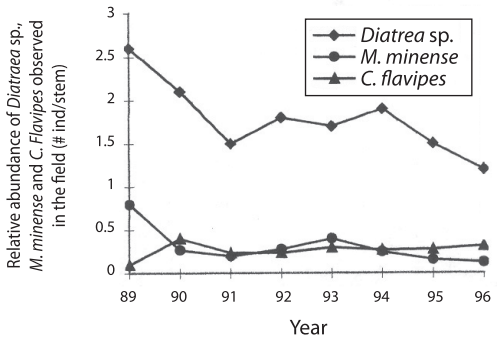

Fig. 2. Mean relative abundance of *Diatracea* sp. (% stems with *M. minense* y *C. flavipes* (porportion of hosts parasitized) obtained from sugarcane stem samples collected ramdomly during harvests.

abundance in presence of both parasitoids is similar to its abundance throughout the last 45 years, when only inundations of *M. minense* occurred (Fig. 1). However, *M. minense* probably has had a stronger effect as control agent because is more efficient as parasitoid (Data of Central El Palmar), and better competitor than *C. flavipes* (Weir and Sagarzazu 1998).

A reduction in *Diatraea* spp. abundance to lower levels by the parasitoids and partial or total parasitoid extinction may be a result of artificial inundation practices of both parasitoid species (Box 1956, this study). The final balance is an unstable interaction where parasitoid extinction occurs in many patches of sugarcane crops because of these low levels and to the intra and interspecific superparasitism caused by inundation practices (Ferrer *et al.* 1990, Weir 1991, Weir and Sagarzazu 1998). At present, recurrent inundation of parasitoids has avoided a population increase of *Diatraea* to epidemic levels in Venezuela (Ferrer *et al.* 1990, Micale 1995), Colombia (Gaviria 1990) and Brazil (Botelho *et al.* 1980). Regulation of artificial production of parasitoids, as well as parasitoid release in sugarcane crops, might avoid the intraspecific and interspecific superparasitism and stabilize parasitoid-host interactions. This action would allow a reduction of parasitoids released in sugarcane crops.

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RESUMEN

Entre los años 1990-1996, se evaluó la importancia de la mosca amazónica (*Melagonystilum minense*) y de la avispa (*Cotesia flavipes*) como controles biológicos de los perforadores de la caña de azúcar (*Diatraea saccharalis* y *Diatraea rosa*) en el centro de Venezuela. Durante el período de la zafra, seleccionamos aleatoriamente tallos de caña de azúcar que fueron abiertos para observar el número de perforaciones, hospedadores, proporción de hospedadores parasitados, proporción de hospedadores parasitados por la mosca amazónica o por la avispa. Como consecuencia de las periódicas liberaciones de las moscas y las avispas criadas en el laboratorio, observamos una disminución pronunciada de la abundancia relativa de *Diatraea* spp., pero no se obtuvo un efecto evidente de utilizar ambos parasitoides. La abundancia de *Diatraea* spp. en presencia de ambos parasitoides fue similar a la observada durante los 45 años en que se utilizó únicamente *M. minense* como control biológico. Sin embargo, *M. minense* probablemente sea el principal control biológico de esta plaga por ser más eficiente en la búsqueda de la misma y por ser un competidor más fuerte que *C. flavipes.*

Palabras clave: *Metagonystilum minense*, *Cotesia flavipes*, parasitoide, *Diatraea*, caña de azúcar.

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