Rev. Biol. Trop. 46(4): 1135-1139, 1998
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Interspecific competition between *Metagonystilum minense* (Diptera: Tachinidae) and *Cotesia flavipes* (Hymenotera: Braconidae) parasitoids of sugarcane borers (*Diatraea* spp., Lepidoptera:Pyralidae)

Enrique H. Weir L.[1] and Luis Sagarzazu[2]

1 Universidad del Zulia, Facultad Experimental de Ciencias, Departamento de Biología, Apartado 526, Maracaibo 4001A, Venezuela. Fax 5861-529432; email: eweir@solidos.ciens.luz.ve
2 Universidad Católica Andres Bello, Escuela de Educación, Departamento de Biología, Caracas, Venezuela.

Received 11-V-1998. Corrected 7-IX-1998. Accepted 2-X-1998.

Abstract: We evaluated the effect of interspecific competition between *M. minense* and *C. flavipes* larvae on survival in both species and on the growth of *M. minense*. Interspecific competition was evaluated by the inoculation of *M. minense* larvae (1 or 2 per host larvae: *D. sacharalis*) 1 to 5 days before or 3 to 8 days after the inoculation of *C. flavipes* eggs (one inoculation = 45 - 50 eggs). All experiments were done with ten replicas. We found a significant effect of interspecific competition on larval and pupal survival in both parasitoids and body weight in *M. minense*. *M. minense* dominated over *C. flavipes*, except when *M. minense* was inoculated 5 or more days after *C. flavipes*.

Key words: *Metagonystilum minense*, *Cotesia flavipes*, parasitoids, *Diatraea*, sugarcane

Parasitoid insects are the most effective facultative agents in the regulation of insect pests population in agroecosystems. This is attributable to the nature of the parasitoid, which has an obligatory lifeform association with a host insect, which is the only food source of the larval stage of the parasitoid (May and Hassell 1988, Begon *et al.* 1996).

This obligatory dependence can generate intra or interspecific competition when the number of parasitoids per host reduces the availability of food and thus affects the survival, fecundity, growth and development of one or both parasitoids as well as the host species (Vinson and Iwantsch 1980, Taylor 1988 a, b, Begon *et al.* 1996).

In this work we evaluate the effect of interspecific competition between the amazonian fly *Metagonystilum minense* Myers (*Diptera:Tachinidae*) and the wasp *Cotesia flavipes* Cameron (*Hymenoptera:Braconidae*), parasitoids of the sugarcane borer, *Diatraea saccharalis* Fabricius (*Lepidotera: Pyralidae*), and other species of *Diatraea* in sugarcane crops in Venezuela. Interspecific competition effects on larval weight and larval mortality has been studied by Pschorn-Walcher (1971) between the tachinid flies *M. minense, Paratheresia claripalpis and Lixophaga diatreae.*

In Venezuela, *M. minense* is the main biological control of some species of the genus *Diatraea.* This parasitoid has been produced under laboratory conditions since 1953 (Box 1956). The wasp *C. flavipes* is an alternative biological control agent of the amazonian fly of *Diatraea* in sugarcane (Ferrer *et al.* 1990). It has been produced under laboratory conditions in Venezuela since 1987, while its commercial production began in 1989 (Ferrer *et al.* 1990,

Micale 1995). *D. saccharalis* is the main pest of sugarcane crops in Venezuela; but since 1953 it has been controlled by *M. minense* (Box 1956).

MATERIALS AND METHODS

This study was done at the Entomology Laboratory of The Santa Teresa Farm, El Consejo, Aragua State, Venezuela, from 1992 to 1995 at 28 ∞C, 12 hours of illumination and 70-80 % RH. Population samples of the two parasitoid species and the host were selected from populations reared in the Entomology Laboratory.

One hundred larvae of *D. saccharalis* were reared on corn ears in 3.7 liter glass boxes. When they pupated were placed in groups of up to 50 in 30 x 50 cm. cylindrical cages covered with a plastic screen. The inner surface of the walls were covered with wax paper for oviposition and the bottom was covered with filter paper. After five days, the wax paper containing the eggs was removed. Sections of this wax paper were placed in petri plates and were sprayed with water. When the larvae emerged they were placed in a 3.7 liter glass box to continue the rearing. *Diatraea* larvae of ten to thirteen days old were inoculated with larvae of *Metagonystylum minense* or *Cotesia flavipes*.

For the inoculation with *M. minense*, a gravid female fly was placed under a dissecting microscope and dissected in a petri dish containing a physiological solution. With the help of a fine brush one or two parasitoid larvae were transferred to the dorsum of each *Diatraea*. The parasitized hosts were placed in vials with a corn diet, one per vial. For the inoculation with *C. flavipes,* a gravid female wasp was placed with the host in a 3.7 liter glass box until she oviposited in one larvae. Each oviposition contained 45 to 50 wasp eggs.

For the competition experiments, both inoculation processes were done. A set of experiments where eggs of wasps were oviposited one to five days after inoculation of the fly larvae. A set of experiments where fly larvae were inoculated three to eight days after oviposition by the wasp. Each experiment were done with ten replicas. After each inoculation, the host was placed in a vial with corn diet, one per vial. When the parasitoids emerged, changes in pupal weight, number of pupae and pupal survival in *M. minense*, and number of pupae and pupal survival in *C.flavipes*, were recorded.

We evaluated the normality of variance by Kolmogorov-Smirnov test, and the variance homogeneity by Scheffe-Box test. The effects of interspecific competition were evaluated by parametric variance analysis.

RESULTS

The results of the effects of interspecific competition were evaluated by parametric variance analysis with the following factors: inoculation time (days) of *C. flavipes* eggs after *M. minense* larvae or *M. minense* larvae after *C. flavipes* eggs, age of *Diatraea* host larvae, and number of larvae of *M. minense* inoculated per host.

A covariance analysis showed a significant relationship between changes in *M. minense* pupal emergence rate with changes in *C. flavipes* pupal emergence rate ($F=65.99$, $a= 0.0001$). When the inoculation time of *C. flavipes* increased from one to five days, a significant increase in the pupal emergence rate ($F=65.99$, $a= 0.0001$), pupal survival rate ($F=31.21$, $a= 0.0001$) and pupal weight ($F=89.67$, $a= 0.0001$) of *M. minense* is observed with a decrease in the pupal emergence rate and pupal survival rate ($F=65.99$, $a= 0.002$) of *C. flavipes* (Fig. 1). The intensity of all these effects was greater when we inoculated two larvae of the fly per host. A significant increase in the pupal emergence rate ($F=2.54$, $a= 0.038$) and pupal weight ($F=18.32$, $a= 0.0001$) of *M.minense* with an increase in age of the larval host, except in experiments with thirteen day old larvae is observed.

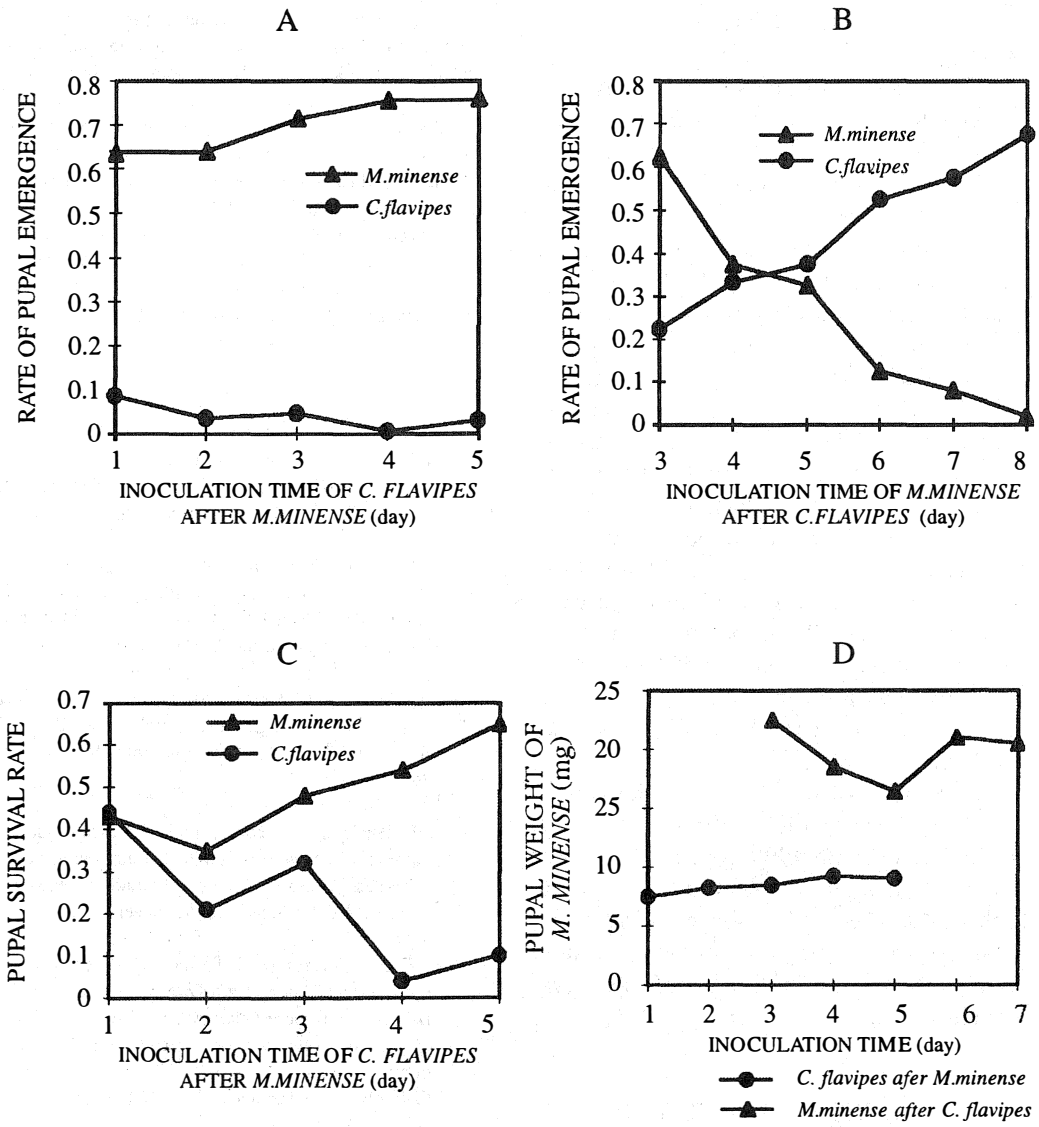

Fig. 1. Effect of changes in the inoculation time of: A. *C. flavipes* after *M. minense* over the rate of pupal emergence of *M. minense* and *C. flavipes*. B. *M. minense* after *C. flavipes* over the rate of pupal emergence of *M. minense* and *C. flavipes*. C. *C. flavipes* after *M. minense* over pupal survival rate of *M. minense* and *C. flavipes*. D. *M. minense* or *M. minense* after *C. flavipes* over the pupal weight of *M. minense*.

The wasp won only when fly larvae were inoculated five or more days later than the wasp (Fig.1). With this timing, there was a significant decrease in rate of pupal emergence of *M.minense* (F=19.895, a= 0.0001) but an increase for that of *C. flavipes* (F=3.218, a= 0.007). These effects are independent of the age of the larval host or number of *M. minense* larvae inoculated per host. The changes in pupal survival rate of *M. minense* are not significant. However, a decrease with respect to inoculation time is observed (Fig. 1)

Pupal weight in the fly (F=6.82, a= 0.005) and the pupal survival rate of the wasp (F=11.49, a= 0.0008) decreases with the number of *M. minense* larvae inoculated per host. With respect to the age of host larvae, no changes for any parameters were noted.

DISCUSSION

The existence of interspecific competition between the amazonian fly *M. minense* and the wasp *C. flavipes*, produced by the reduction in food availability is evident. This competition produces a decrease in larval and pupal survival rates, in both parasitoids, and in body weight in the amazonian fly. Generally the fly dominated over the wasp, except in cases when the larval inoculation time of *M. minense* was five or more days after oviposition by *C.flavipes*.

The fly might have had a competitive advantage over the wasp because of a shorter developmental time. Pschorn-Walcher (1971) observed this effect in competition experiments between *M. minense*, *Paratheresia claripalpis* and *Lixophaga diatreae*; where *P. claripalpis* and *L. diatreae* dominated over *M. minense* due to shorter developmental time. Gaviria (1974) reported that the Peruvian race of *Paratheresia claripalpis* had a competitive advantage over the colombian race because a shorter developmental time.

A litter of 40 to 60 eggs per host of *C. flavipes* (Brewer and King 1980, Ferrer 1987, Overholt and Smith 1990) versus one to four larvae per host in *M. minense* (Box 1956, Pschorn-Walcher 1979, Ferrer 1987) may constitute an advantage for the wasp in farm areas, although the higher egg and larval mortality reduced this advantage.

ACKNOWLEDGMENTS

This research was supported by the Entomology Laboratory of Santa Teresa Farm. We thank Roque Morejon and Williams Contreras for their assistance in this study and Clark Casler for reviewing and improving this manuscript.

RESUMEN

Evaluamos el efecto de la competencia interespecífica entre larvas de *M. minense* y *C. flavipes* en la supervivencia de la progenie de ambas especies y en el crecimiento de *M. minense*. La competencia interespecífica fue evaluada mediante la inoculación de larvas de *M. minense* (1 o 2 por larva del hospedador: *D. saccharalis*) 1 a 5 días antes o 3 a 8 días después de la inoculación de huevos de *C. flavipes* (una inoculación = 45 a 50 huevos). Se hicieron diez repeticiones de todos los experimentos. Encontramos un efecto significativo de competencia en la supervivencia larval y pupal en ambas especies parasitoides y en el peso corporal de *M. minense*. *M. minense* predominó sobre *C. flavipes*, excepto cuando *M. minense* fue inoculado 5 o mas días después de *C. flavipes*.

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