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Predation of *Bradysia* sp. (Diptera: Sciaridae), *Liriomyza trifolii* (Diptera: Agromyzidae) and *Bemisia tabaci* (Hemiptera: Aleyrodidae) by *Coenosia attenuata* (Diptera: Muscidae) in greenhouse crops

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Abstract. We studied the predation behaviour of the "hunter fly" (*Coenosia attenuata* Stein) in the laboratory and greenhouse. In the laboratory, which was conducted at 25°C at 60–80% RH, with a 16L : 8D photoperiod, we examined the functional response of this species to three different pests, namely the sciarid fly (*Bradysia* sp.), the tobacco whitefly (*Bemisia tabaci*) and the leaf miner *Liriomyza trifolii*. In the greenhouse, we studied the population dynamics of the predator and its prey on pepper and water melon crops grown in southern Spain. Adult hunter flies were found to exhibit a type I functional response to adult sciarid flies and whiteflies, but a type II response to adult leaf miners. The type II response was a result of the greater difficulty in capturing and handling leaf miners compared to the other two species. The dynamics of the predator-prey interaction in the greenhouse revealed that the predator specializes mainly on adult sciarids and that the presence of the other prey can be supplemental, but is never essential for survival of the predator; this, however, is crop-dependent. The results on the dynamics of the predator-prey systems were obtained through a known population dynamics model with modifications.

INTRODUCTION

Coenosia attenuata Stein is a polyphagous predator occurring in the Palaearctic region (Henning, 1964). In the last decade this species, which is commonly known as the hunter fly, has been reported to have spontaneously colonized a number of crops outdoors and in greenhouses in Germany (Kühne, 1998), Spain (Rodriguez & Aguilera, 2002), Italy (Colombo & Eördegh, 1991), Portugal (Prieto et al., 2003), France (Martinez & Cocquempot, 2000), Turkey (Polh et al., 2003) and Egypt (Henning, 1964). The hunter fly has also been reported from the USA, where it was probably introduced accidentally (Hoebeke et al., 2003; Sensebach et al., 2004).

C. attenuata adults can feed on a wide variety of insects of their own or smaller size, including adults of the sciarid *Bradysia* sp., whiteflies [*Bemisia tabaci* (Gennadius) and *Trialeurodes vaporariorum* (Westwood)] and adult leaf miners (*Liriomyza* spp.). The larvae attack immature arthropods in the soil, particularly sciarid larvae (Kühne, 2000). The hunter fly exhibits a unique behaviour as regards capturing other insects. In greenhouses, it can be found standing on a framework tube, wire or plant until it detects a prey flying nearby. It takes flight, using its front legs to capture the prey in the air, and then returns to the starting point to handling and feed on the prey (Kühne, 1998).

This predator has been widely detected in greenhouses in southern Spain. Its abundance depends on the soil type and the type and frequency of pesticide treatments; thus the hunter fly is more commonly found on crops grown in sand than semi-hydroponically, and on crops grown using biological or integrated control rather than on conventionally controlled crops (Téllez & Tapia, 2005). *C. attenuata* is a potentially effective biological control agent for sciarids and whiteflies in greenhouses; however, the optimum conditions for mass rearing this species remain to be established (Kühne, 1998; Morechi & Colombo, 1999). This may restrict the potential of the predator for periodic releases, whether inundative or inoculative, though not for conservation biological control.

Tests to identify functional responses have been widely used to assess the potential of natural enemies for controlling pest species (Cabello & Vargas, 1988; Jervis & Kidd, 1996; Hawkins & Cornell, 1999; García-Martín et al., 2006) and for an overview of the biological significance of Holling' response curves see Cabello et al. (2007). The calculated estimates of the parameters of the curves can be used in combination with how feasible it is to mass rear the species concerned to assess whether it is possible to develop effective biological control strategy for greenhouse crops. The aims of this work were to elucidate, via laboratory tests, the functional responses of the predator to the density of most frequent pests present in the green-

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