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# Parasitoids from Azores (Hymenoptera: Encyrtidae, Pteromalidae, Braconidae): potential use in integrated pest management against *Ceratitis capitata* (Diptera: Tephritidae)

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## SHORT COMMUNICATION

# Parasitoids from Azores (Hymenoptera: Encyrtidae, Pteromalidae, Braconidae): potential use in integrated pest management against *Ceratitis capitata* (Diptera: Tephritidae)

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Two hymenopterous parasitoids, *Halticoptera patellana* and *Toxeumorpha nigricola,* were recovered from Mediterranean fruit fly pupae on São Miguel Island, Azores. Both are new records for the Azores, and as Medfly parasitoids. Field-collected *Tachinaephagus zealandicus* was maintained on Medfly for 10 generations, but if it has potential as a biocontrol agent remains an open question.

**Keywords:** *Ceratitis capitata*; native parasitoids; Braconidae; Encyrtidae; Pteromalidae; new host

The Mediterranean fruit fly, *Ceratitis capitata* (Weidemann) originated in Africa (White and Elson-Harris 1992) but is now one of the most important fruit pests on a global scale (Liquido, Shinoda, and Cunningham 1991). It was first reported in the Azores (Portugal) in 1829 (MacLeay 1829) and is now a pest of many fruit crops throughout the archipelago (Medeiros 2004). Pesticides are currently the principal means of control but our objective is to develop a more ecologically acceptable integrated management program, including biological control. Headrick and Goeden (1996) consider that the parasitic Hymenoptera are the most promising candidates for Medfly biological control, and a number of candidate species have been identified. Nothing is known about Medfly parasitoids in the Azores so we decided to carry out a survey to see if there were possible candidates for innundative releases before considering the introduction of exotic species.

A survey, using the approach of Falcó et al. (2006), was carried on the Island of São Miguel from September to December 2005, and from August to December 2006. We selected different orchards that harboured Medfly populations, and included the most important host plants of the Medfly in the Azores (Table 1). In each orchard, fruit with signs of Medfly attack were selected and placed beneath the host tree on a plastic tray ($32 \times 47 \times 9$ cm) containing 1 cm of sand. The entire surface of each tray was covered with fruits of one species. After 2 weeks, the traps were replaced and the old ones brought back to the laboratory where all larvae and pupae found in the sand were counted, and placed in

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Table 1. Host fruit traps placed in São Gonçalo (37° 45′ 14″N; 25° 39′ 56″W), Rabo de Peixe (37° 48′ 25″N; 25° 35′ 23″W) and Vila Franca (37° 43′ 02″N; 25° 26′ 11″W), São Miguel Island, to collect larvae and pupae of *C. capitata* and their parasitoids.

| Local | Host plant | Traps per orchard | Survey period |
|---|---|---|---|
| 2005 | | | |
| Rabo de Peixe | Fig (*Ficus carica*, Moraceae) | 2 | September |
| | Cattley guava (*Psidium littorale*, Myrtaceae) | 3 | September–November |
| São Gonçalo | Feijoa (*Feijoa sellowiana*, Myrtaceae) | 3 | October–December |
| 2006 | | | |
| Rabo de Peixe | Cattley guava (*Psidium littorale*, Myrtaceae) | 3 | September–November |
| | Sweet orange (*Citrus sinensis*, Rutaceae) | 1 | March–April |
| | Fig (*Ficus carica*, Moraceae) | 2 | August–September |
| Vila Franca | Cattley guava (*Psidium littorale*, Myrtaceae) | 2 | September–November |
| | Hot pepper (*Capsicum annuum*, Solanaceae) | 1 | September |
| São Gonçalo | Feijoa (*Feijoa sellowiana*, Myrtaceae) | 3 | October–December |

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plastic containers with moist filter paper until Medfly or parasitoid adults emerged. In addition, all fruits were dissected to collect any Medfly that had remained within the host.

At the time each trap was collected in the field, we captured the adults of all parasitic Hymenoptera present on the fruits. These were brought back to the laboratory ($21 \pm 1$°C, $70 \pm 10$% RH, under natural photoperiodic conditions) and placed in individual screen cages, each with a source of diluted honey (10%) and an open vial containing 100 different sized Medfly larvae in artificial diet. Each female parasitoid was left with the Medfly until all potential hosts had pupated. The pupae were then collected and kept to monitor the incidence of parasitism.

The number of Medfly pupae recovered varied among host plants, both within and between years (Table 2). Four individual parasitoids were recovered in 2005 (in pupae from figs) but none in 2006. There was one male specimen of *Halticoptera patellana* (Dalman) (Pteromalidae identified by M.J. Verdú) a species with a wide geographic distribution (Noyes 2004). This species has previously been recorded in the Canary Islands but not in the Azores (Koponen and Askew 2002). Furthermore, while members of this genus have been reported from different Diptera (Bouček and Rasplus 1991), it is the first mention of *C. capitata* as a host.

Table 2. Number of pupae of *C. capitata* and their parasitoids collected in the host fruit traps during 2005 and 2006 placed in different sites on the island of São Miguel, Azores.

| | 2005 | | 2006 | |
|---|---|---|---|---|
| Host fruit | *Ceratitis capitata* | Parasitoids | *Ceratitis capitata* | Parasitoids |
| Fig | 202 | 4 | 96 | 0 |
| Cattley guava | 21 | 0 | 24 | 0 |
| Feijoa | 246 | 0 | 261 | 0 |
| Hot pepper | 1 | 0 | 7 | 0 |
| Sweet orange | 4 | 0 | 0 | 0 |
| Total | 474 | 4 | 388 | 0 |

We also recovered one male and two female *Toxeumorpha nigricola* (Ferrière) (Pteromalidae identified by M.J. Verdu). This species has been recorded in a number of African countries from Morocco to South Africa, as a parasitoid of several leaf mining Lepidoptera and Diptera (Ferrière 1936; Bouček 1976; Bouček and Rasplus 1991). Koponen and Askew (2002) found this species in the Canary Islands and Madeira, but not in the Azores.

Of all parasitoids foraging on fruits in the field (at least eight species) only two, *Asobara rufescens* (Förster) (European Braconidae) and *Tachinaephagus zealandicus* Ashmead (Encyrtidae, introduced into USA from Australasia), successfully parasitised Medfly larvae and completed a generation under laboratory conditions. These parasitoids were identified by K. van Achterberg and M.J. Verdú, respectively.

Many *Asobara* species have been recorded as larval parasitoids of drosophilids; however, some species attack *Anastrepha* spp and *C. capitata* in Brazil (Fernandes and Zucchi 1990). *Asobara rufescens* has been found in Germany and The Netherlands (Achterberg 2004). In our rearing *A. rufescens* only produced males and no additional experiments could be carried out. Whether this was the result of virgin females laying unfertilised eggs or a male biased allocation by mated females in response to hosts of poor quality is not known.

*Tachinaephagus zealandicus*, a parasitoid of many species of muscoid flies (Geden, Ferreira de Almeida, and Prado 2003), is endemic in Australia and New Zealand (Gold and Dahlsten 1981). However, it was introduced into many countries as USA and is now distributed throughout much of the Southern Hemisphere (Olton 1971), in Italy and in the European Atlantic islands (Koponen and Askew 2002). Neuenschwander (1982) recorded *T. zealandicus* attacking the olive-fly tephritid *Bactrocera oleae* Gmelin but thought that it did not regularly attack fruit-infesting Tephritidae. Under laboratory conditions, the culture of *T. zealandicus* was maintained for more than 10 generations on Medfly larvae, indicating this host is acceptable in a no-choice situation. Given that *T. zealandicus* females have the ability to attack $>25$ larvae per day (Almeida, Geden, and Prado 2002; Almeida, Prado, and Geden 2002), this species might have some potential in a biological control program using inundative releases. However, it should be noted that no Medfly pupae collected during the survey were parasitised by *T. zealandicus* (Table 2), suggesting that other preferred hosts exist in the field. Before any attempts of inundative releases against *C. capitata*, it would be necessary to obtain information about alternative hosts available in the habitat and their abundance relative to Medfly densities.

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**References**

Achterberg, K van (2004), 'Fauna Europaea: Hymenoptera: Apocrita'. Fauna Europaea version 1.1. http://www.faunaeur.org.

Almeida, M.A.F., Geden, C.J., and Prado, A.P. (2002), 'Influence of Feeding Treatment, Host Density, Temperature, and Cool Storage on Attack Rates of *Tachinaephagus zealandicus* (Hymenoptera: Encyrtidae)', *Environmental Entomology*, 31, 732–738.

Almeida, M.A.F., Prado, A.P., and Geden, C.J. (2002), 'Influence of Temperature on Development Time and Longevity of *Tachinaephagus zealandicus* (Hymenoptera: Encyrtidae), and Effects of Nutrition and Emergence Order on Longevity', *Environmental Entomology*, 31, 375–380.

Bouček, Z. (1976), 'African Pteromalidae (Hymenoptera): New Taxa, Synonymies and Combinations', *Journal of the Entomological Society of South Africa*, 39, 9–31.

Bouček, Z., and Rasplus, J.Y. (1991), *Illustrated key to the West Palearctic genera of Pteromalidae,* Paris: Institut National de la Recherche Agronomique.

Falcó, J.V., Tarazona, I., Pérez-Hinarejos, M., Garzón-Luque, E., Malagón, J., and Beitia, F. (2006), 'Two Native Pupal Parasitoids of *Ceratitis capitata* (Diptera, Tephritidae) Found in Spain', *Bulletin IOBC/WPRS*, 29, 71–74.

Fernandes, M.A.U., and Zucchi, R.A. (1990), 'Metodología de colecta de Tephritidae y Lonchaeidae frugívoros (Diptera: Tephritoidae) y sus parasitoides (Hymenoptera)', *Anais da Sociedade Entomológica do Brasil*, 28, 601–610.

Ferrière, C. (1936), 'The Parasites of the Coffee Leaf-Miners (*Leucoptera* spp.) in Africa', *Bulletin of Entomological Research*, 27, 477–491.

Geden, C.J., Ferreira de Almeida, M.A., and Prado, A.P. (2003), 'Effects of *Nosema* Disease on Fitness of the Parasitoid *Tachinaephagus zealandicus* (Hymenoptera: Encyrtidae)', *Environmental Entomology*, 32, 1139–1145.

Gold, C.S., and Dahlsten, D.L. (1981), 'A New Host Record for *Tachinaephagus zealandicus* (Hym.: Encyrtidae)', *Entomophaga*, 26, 459–460.

Headrick, D.H., and Goeden, R.D. (1996), 'Commentary: Issues Concerning the Eradication or Establishment and Biological Control of the Mediterranean Fruit Fly, *Ceratitis capitata* (Widemann) (Diptera: Tephritidae), in California', *Biological Control*, 6, 412–421.

Koponen, M., and Askew, R.R. (2002), 'Chalcids from Madeira, Canary Islands and Azores (Hymenoptera, Chalcidoidea)', *VIERAEA*, 30, 115–145.

Liquido, N.J., Shinoda, L.A., and Cunningham, R.T. (1991), 'Host Plants of Mediterranean Fruit Fly (Diptera: Tephritidae): An Annotated World Review', *Miscellaneous Publications of the Entomological Society of America*, 77, 1–52.

MacLeay, W.S. (1829), 'Notice of *Ceratitis citriperda*, an Insect Very Destructive to Orange', *Zoological Journal*, 4, 475–482.

Medeiros, A.M.C. (2004), 'Bioecologia e controlo com nematodes entomopatogénicos de Ceratitis capitata (Diptera: Tephritidae) em S. Miguel', M.S. thesis, Universidade dos Açores, Açores.

Neuenschwander, P. (1982), 'Searching Parasitoids of *Dacus oleae* (Gmel.) (Dipt., Tephritidae) in South Africa', *Zeitschrift fuer Angewandte Entomologie*, 94, 509–522.

Noyes, J. (2004), 'Fauna Europaea: Hymenoptera: Apocrita. Fauna Europaea', version 1.1, http://www.faunaeur.org.

Olton, G.S. (1971), 'Bioecological studies of Tachinaephagus zealandicus Ashmead (Hymenoptera: Encyrtidae), parasitoid of synanthropic Diptera', Ph.D. thesis, University of California, Riverside.

White, I.M., and Elson-Harris, M.M. (1992), *Fruit Flies of Economic Significance: Their Identification and Bionomics*, Wallingford, UK: CAB International.

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