

## Predatory Gall Midge (unofficial common name), *Feltiella acarisuga* (Vallot) (Insecta: Diptera: Cecidomyiidae)<sup>1</sup>

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### Introduction

The predatory gall midge, *Feltiella acarisuga* (Vallot), is one of the most effective and widespread natural enemies of spider mites (Tetranychidae) (Gagne 1995). It is a particularly important natural enemy of the twospotted spider mite, *Tetranychus urticae* Koch, in a number of cropping systems (Opit et al. 1997). *F. acarisuga* could be particularly useful for integrated pest management of spider mites that attack greenhouse crops (Gillespie et al. 1998).

### Synonymy

*Cecidomyia acarisuga*

*Mycodiplosis minuta*

*Therodiplosis persicae*

*T. beglarovi*

*Arthrocnodax rutherfordi*

*Feltiella tetranychii*

*F. davisi*,

*F. americana*

*F. ithacae*

*F. quadrata* (Gagne 1995)

### Distribution

The genus *Feltiella* is virtually cosmopolitan and contains eight species: *F. acarisuga* (worldwide, except for the Neotropical Region), *F. pini* (Felt) (North and Central America and West Indies), *F. curtistylus* Gagne (Brazil), *F. occidentalis* (Felt) (U.S.- California), *F. acarivora* (Zehnter) (Indonesia- Java), *F. insularis* (Felt) (eastern U.S., West Indies and Colombia), *F. reducta* Felt (northeastern U.S. - New York), and *F. ligulata* Gagne (Cape Verde Is.) (Gagne 1995). *F. acarisuga* is the most widely distributed species in the genus and is listed from the U.S., Canada, Finland, Germany, U.K., Switzerland, Italy, Morocco, Greece, Israel, India, Sri Lanka, Taiwan, Japan and New

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Zealand. It is the only species of *Feltiella* found throughout most of Europe and Asia.

## Description

### Egg

The shiny, translucent oblong eggs are deposited individually near prey mites on leaves. They are 0.1 x 0.25 mm in size (Koppert 1997). The eggs hatch within two days after oviposition and the larvae immediately begin to feed.



**Figure 1.** Eggs of the predatory gall-midge, *Feltiella acarisuga* (Vallot). Credits: David R. Gillespie, Agassiz

### Larva

The orange-brown larvae vary in length from 0.2 to 2 mm during their four developmental instars (Koppert 1997). They forage for mites on leaves and feed for four to six days, depending on temperature, RH and the abundance of prey mites (Gillespie and Raworth 1999). They feed exclusively on all developmental stages of several species of spider mites. *F. acarisuga* larvae occur in populations as large as 160 per cm<sup>2</sup> of eggplant leaf.

### Pupa

The fluffy white, 1 to 1.5 mm long pupa requires four to six days to complete development and produce an adult (Koppert 1997). Pupation occurs mainly on the underside of a leaf next to a vein.

### Adult

The adult *F. acarisuga* is a delicate pink-brown fly about 2 mm in length with long legs (Koppert



**Figure 2.** Larva of the predatory gall-midge, *Feltiella acarisuga* (Vallot). Credits: Lance S. Osborne, University of Florida



**Figure 3.** Pupa of the predatory gall-midge, *Feltiella acarisuga* (Vallot). Credits: Lance S. Osborne, University of Florida

1997). Females have a five day life span and produce about 30 eggs. Males do not live as long as females. The sex ratio is about 1:1. Adult *F. acarisuga* are not predaceous but drink water and nectar.

## Life Cycle

In climates without extremely dry or cold seasons, every stage of *F. acarisuga* is present year-round. *Feltiella* spp. apparently develop from egg to egg in 26 to 33 days, averaging around 29 days (Sharaf 1984); however, *F. acarisuga* requires about 15 days (Gillespie *et al.* 1998). Reproduction and development occur at 15-25°C. Eggs and larvae do not survive above 30°C or below 30% RH. At least 50% RH is required for a normal rate of development.



**Figure 4.** Adult of the predatory gall-midge, *Feltiella acarisuga* (Vallot). Credits: David R. Gillespie, Agassiz

The optimum temperature and RH combination is about 20°C and 90% RH. However, with an abundance of prey, the level of predation remains constant over the developmental range of temperature and RH (Gillespie *et al.* 1998). If prey populations are sub-optimal, larvae can survive by pupating at a smaller size. Larvae also can survive for several days without prey.

### Effectiveness

*Feltiella acarisuga* can be used to manage spider mite populations in a variety of greenhouse and field crops, especially when incorporated into a bio-intensive IPM program. In eggplant, for example, *F. acarisuga* has appeared naturally and reduced spider mite numbers by more than 40% (Sharaf 1984). Each midge larva can consume an average of at least 15 adult mites, 30 mixed developmental stages, or 80 eggs per day. Weekly releases of 1000 individuals per ha have been extremely effective for controlling spider mites on tomato, pepper and cucumber (Gillespie *et al.* 1998). In addition, *F. acarisuga* (sold as *Therodiplosis persicae*) is being used to manage spider mites on strawberries and various ornamental crops. It is recommended that 200-1000 individuals per ha be released weekly as a trial rate for growers. The weekly release rate is approximately doubled for heavy infestations, 2,500 adults per ha for six successive weeks (Biobest 1999).

It is highly advised that *F. acarisuga* be released in combination with the predaceous mite, *Phytoseulus persimilis*, a well-established natural enemy used to control spider mites. *F. acarisuga* is

more mobile as an adult than is the predatory mite and, once established, eats at least five times as many spider mites (Biobest 1999). However, *P. persimilis* should not be released where *F. acarisuga* is becoming established because they are known to eat midge eggs if prey is limited (Gillespie 1998).

### Commercial Availability and Use

*F. acarisuga* pupae are commercially available from several producers and suppliers of natural enemies (<http://www.anbp.org/> and [http://www.cdpr.ca.gov/docs/ipminov/ben\\_supp/contents.htm](http://www.cdpr.ca.gov/docs/ipminov/ben_supp/contents.htm)). Pupae are shipped on leaves or an inert substance in various containers, such as 1-liter pots. Pots are placed in the crop on the ground at the beginning of rows and their lids are pierced to release the adult midges. It is best if the midges are released near concentrations of spider mites. To establish, *F. acarisuga* requires fairly large prey populations (Gillespie and Raworth 1999). The pots should be stored in the dark for no more than two days at 10-15°C (Koppert 1997). Adults should be released from containers every 24 hours, late at night or early in the morning because of the cooler and more humid conditions. The RH should be kept above 80%, if possible (Gillespie and Raworth 1999).

It is essential to avoid non-target side effects of chemical pesticides, such as Thiodan, Diazinon, and Kelthane; however, most fungicides are safe to use with *F. acarisuga* (Gillespie and Raworth 1999). Sulfur products used as dusts or sprays do not cause mortality in larvae but females avoid laying eggs on treated plants. Another concern is parasitization of *F. acarisuga* larvae by *Aphanogmus floridanus*, potentially a very abundant parasitoid during warmer months. However, if necessary, releases can be timed to avoid the parasitoid because unlike the parasitoid *F. acarisuga* does not diapause during the cooler months. *F. acarisuga* parasitized by *A. floridanus* have pupal cases with characteristic round emergence holes.

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