

## Trapping *Dasineura mali* (Diptera: Cecidomyiidae) in Apples

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**ABSTRACT** The midge *Dasineura mali* (Kieffer) (Diptera: Cecidomyiidae) is a significant pest of apples (*Malus* spp.), and the recent identification of the female sex pheromone is enabling new direct control tactics to be considered. Direct control using male suppression will require knowledge of the frequency of multiple mating, dispersal and colonization rates, and the efficiency of male removal. Males were able to mate up to five times, with a mean of 2.7 times when presented in a 10 female-to-1 male group, designed to simulate male suppression. Male catch in response to the pheromone loading was curvilinear over 4 orders of magnitude from 3  $\mu$ g to 30 mg on rubber septa. Trapping using a high-dose pheromone lure was combined with oil-based traps similar to the inexpensive New Zealand “Lynfield trap” used for tephritid surveillance, to test male suppression in young orchard blocks at 500 traps per ha. Monitoring traps indicated 96% lower catch in the treated plots compared with control plots, over 137 d. However, a lack of shoot tip infestation in both treated and untreated plots indicated limited colonization and prevented an assessment of potential population suppression. Furthermore, a contribution to these results from communication disruption cannot be ruled out. Replicated transects of frequency of infested shoots from a mature orchard across the adjacent young block confirmed that colonization by ovipositing females was essentially limited to the first 30 m.

**KEY WORDS** pheromone, multiple mating, mass trapping, dispersal, suppression

The midge *Dasineura mali* (Kieffer) (Diptera: Cecidomyiidae) is a significant pest of apples (*Malus* spp.) in several countries, especially in New Zealand. Its pest status is due to the effect of larval damage visible as tightly rolled leaves, on the shape and potential productivity of young trees (Allison et al. 1995) as well as to the impact the presence of cocoons on fruit can have on restricting market access (Tomkins et al. 2000). Biological control by using *Platygaster demades* Walker (Hymenoptera: Platygasteridae) and other agents is not currently adequate in New Zealand (Shaw et al. 2005), and there is some use of diazinon for insecticidal control (Burnip et al. 1998).

The existence of a powerful female sex pheromone in *D. mali* was demonstrated previously (Harris et al. 1996, Heath et al. 1998) and this has recently been identified (D.R.H., unpublished data). Research is underway in the United Kingdom and several other European countries as well as in New Zealand on approaches to using the pheromone in management of *D. mali*.

In pest management, mass trapping is a well researched technique for direct control by using attractants, with  $\approx 100$  reports in the literature (El-Sayed et al. 2006). Any direct control tactic, such as male suppression through mass trapping, will require knowledge of the frequency of multiple mating and rates of dispersal and colonization to estimate the efficiency of male removal required to achieve economic control. Diptera have been targets of mass trapping previously, although the majority of orchard pest management examples in this order have targeted tephritid fruit flies (El-Sayed et al. 2006). Mating behavior and female dispersal are important factors governing the success of mass trapping and related tactics. Mating behavior can have significant implications for direct control tactics based on odorants (Suckling 2000), and multiple mating represents a special risk to this approach, because the benefit of male suppression is diluted when males are capable of fertilizing more than one female. Female dispersal is important to consider, because it determines the extent and rate of colonization of orchards, including reinfestation risk after a successful control operation.

This work set out to examine the biological and operational potential for male suppression of this species. Here, we report developments toward a prototype mass trapping system, to test the concept against this family of Diptera as well as to provide an exam-

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