Predation of *Frankliniella occidentalis* by *Orius insidiosus* on plant hosts serving as sources of populations infesting fruit orchards

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Summary: Annual cycles of population abundance of thrips and natural enemies were determined in three agricultural areas in the Aconcagua valley in Central Chile. The most important plant species serving as hosts for reproducing populations of *Frankliniella occidentalis* are not native to Chile. Local populations of thrips developed year-round on *Medicago sativa, Raphanus sativus*, and *Sisymbrium officinale*. Numbers of the predator *Orius insidiosus* in *M. sativa* were sufficient by late spring to suppress thrips populations which persisted nearly extinct on this plant host until the winter when the predator entered diapause. No natural enemy species reached numbers sufficient to suppress local populations of *F. occidentalis* in *S. officinale* and *R. sativus*. Local populations of *F. occidentalis* on *Eschsholzia californica* developed unchecked by natural enemies during the spring and early summer. Each of the above-mentioned plant hosts is a source in the early spring for large numbers of *F. occidentalis* migrating into nearby fruit orchards.

Key words: *Frankliniella occidentalis*, *Orius,* natural enemies, alfalfa

Introduction

The western flower thrips, *Frankliniella occidentalis*, was first detected in Chile during 1995. The species is a serious pest of many crops grown for export and domestic markets including nectarines, peaches, grapes, peaches, peppers, lettuce, and ornamental flowering plants. The major agricultural areas are the valleys of central Chile. Mass flights of *F. occidentalis* adults occur in the spring when fruits and vegetables are flowering and most vulnerable to damage. Large plantings of alfalfa occur in the ecosystem and several invasive plants also are common along roadways, hedgerows, creeks, canals, and into the hills where the soil is disturbed by grazing animals. Alfalfa and many of the invasive plants serve as the sources for migrating adults. We conducted extensive surveys to determine the major plant hosts of *F. occidentalis*. Cycles of population abundance of thrips and their natural enemies on the major plant hosts were determined, and the importance of natural enemies was evaluated.

Material and Methods

An extensive plant survey comprising 65 plant species was carried out on hills and valleys of central Chile to determine the most important hosts of western flower thrips. Plant species were sampled in one liter glass jars partially filled with soapy water and the thrips retrieved by filtering the content using a set of sieves of decreasing mesh size and examined under the stereo microscope to determine the number of adult and larval *F. occidentalis*, *Thrips tabaci* and *Frankliniella australis* Morgan, and among natural enemies, adults and nymphs of *O. insidiosus*, adults and larvae of *Aeolothrips fasciatipennis* (Blanchard), and adults of the eulophid *Ceranisus menes*.

Weekly samples were taken in the following plant species: *Medicago sativa*, *Eschscholzia californica*, *Raphanus sativus*, *Sysimbrium officinale*, and *Brassica rapa.* Samples consisted of 5 to 7 jars of 5 shoots, inflorences, or flowers per jar with soapy water, replicated 4 times on each date. Larval parasitism in alfalfa was assessed by confining 20 larvae of *F. occidentalis* per 15 cm Petri dish plus a green bean pod as a food source until thrips pupation or parasitoid emergence. Larvae were obtained from a sample of alfalfa shoots and placed in one paper bag per plot. A separate set of alfalfa foliage samples was maintained in Petri dishes so as to observe possible thrips egg parasitoids. The importance of predators was evaluated by determining their number in relation to prey (Sabelis and Van Rijn 1997).

Results

Sampling showed that *F. occidentalis* was abundant in the valleys on five common invasive and cultivated plant species. It was not encountered on plants growing in the hills. The important plant species that are reproductive hosts for *F. occidentalis* identified in the extensive survey were:

Medicago sativa	Cultivated crop
Eschscholzia californica	Invasive species
Raphanus sativus	Invasive species
Sisymbrium officinale	Invasive species
Brassica rapa	Invasive species

Populations of *F. occidentalis* were low during the lower temperature period from April to October (Figs. 1 and 2). Populations increased in the spring reaching a peak in January. Larvae were abundant on *S. officinale* indicating that this plant species is a good reproductive host (Fig. 1). Numbers of the predator *O. insidiosus* in relation to prey were sufficient on many sample dates to suppress thrips. Both *E. californica* and *R. sativus* are poor reproductive hosts for *F. occidentalis* considering the number of larvae in relation to

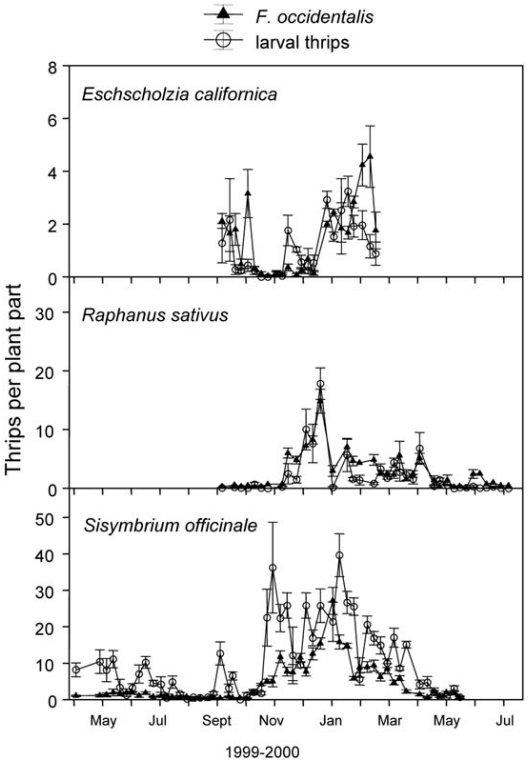

Figure 1. Abundance of adults and larvae of Frankliniella occidentalis in Eschscholzia californica, Sisymbrium officinale, and Raphanus sativus in the Aconcagua Valley of Central Chile.

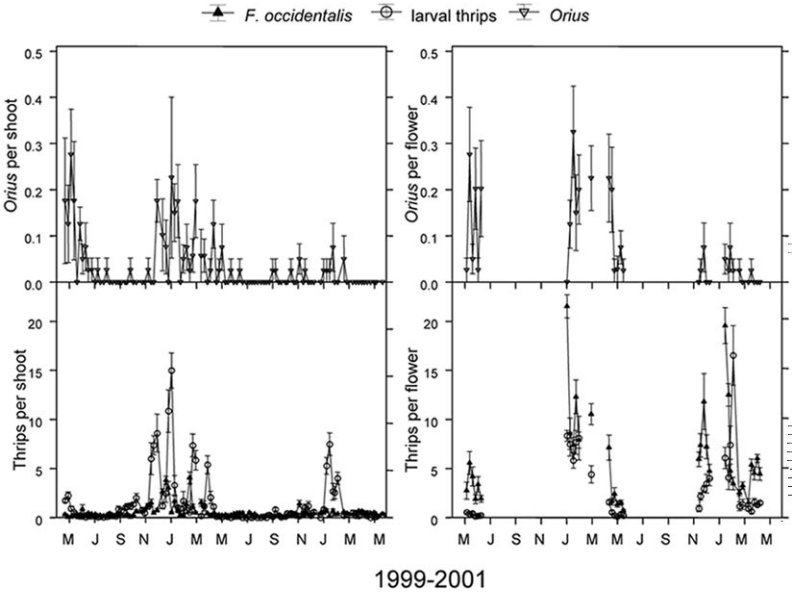

Figure 2. Annual cycle of population abundance of Frankliniella occidentalis and Orius insidiosus in the flowers and terminal buds of Medicago sativae in the Aconcagua Valley of Central Chile.

adults in the samples (Fig. 1). However, both plant species are very common, and the larvae are able to escape predation in the near absence of *Orius*. Populations of thrips in *M. sativa* built to large numbers in the spring until numbers of *O. insidiosus* in relation to prey were sufficient to cause near extinction of populations (Fig. 2). Populations of the predator in alfalfa persisted in the near absence of prey through the summer and fall.

Ceranisus menes was collected from thrips larvae. The parasitized larvae did not develop wings in the prepupal stage and acquired an orange color spot in the middle of the body. Near to pupation the integument of the larvae opens and the pupa of the parasitoid exits the host. The newly emerged pupa shows an orange spot inside the abdomen (Loomans and van Lenteren, 1995). Adults of *C. menes* were found on *M. sativa*, *Cestrum parqui* and weeds such as *S. officinale* and *R. sativus* in unmanaged ecosystems, free of pesticide application. Larval parasitism was very low reaching a peak near 5% during February to April and the lowest occured during August to January. Such levels are considerably lower than those reported by Loomans and van Lenteren (1995). *C. menes* has several generations a year. It completes a life cycle in about one month.

Sampling showed that *A. fasciatipennis* was about 5% of the total predators collected in alfalfa and about 15% of those in *S. officinale* flowers. The low numbers of these predators and its polyphagy suggests that it has little effect on thrips density. No males were observed, which suggests parthenogenetic reproduction. No egg parasitoids or nematodes were found.

Discussion

Sabelis and Van Rijn (1997) reported the intrinsic abilities of predators to suppress a coherent population of *F. occidentalis*. Suppression by *O. insidosus* was predicted at predator to prey ratio of 1 to 217. Funderburk et al. (2000) and Ramachandran et al. (2001) reported that field populations in pepper were suppressed at ratios of about 1 to 180 and that extinction occurred rapidly when the ratio was about 1 to 40. Numbers of *O. insidiosus* in relation to prey were sufficient in *M. sativae* and *S. officinale* on many dates during summer and fall to predict suppression of thrips (Figs. 1 and 2). Local extinction was evident in *M. sativa* and the persistence of the predator allowed only occasional buildup of populations.

Populations of thrips developed rapidly in a density independent fashion during the spring (Figs. 1 and 2). Both *M. sativa* and *S. officinale* undoubtedly serve as major sources of thrips invading nearby flowering crops. Although *E. californica* and *R. sativus* may not be good reproductive hosts for *F. occidentalis*, the plants are abundant in areas of disturbed soil near crop fields, and they may serve as important sources for migrating adults during the spring mass flight. Mass flights of flower thrips are typical in the spring in temperate regions (Lewis 1997). Funderburk et al. (2000) and Ramachandran et al. (2001) reported that *O. insidiosus* is important in the regulation of local populations and possibly global populations during summer and fall. We conclude that this predator is an important natural enemy of *F. occidentalis* in Chile.

The only plants identified as hosts of *F. occidentalis* in this study were crops and invasive plant species. The plant species native to Chile growing in the hills and mountains were not found to be hosts for *F. occidentalis*. Agriculture appears to be important in the persistence and abundance of *F. occidentalis* in Chile.

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