Biological Control

Rose plantings increase leafroller parasitism in orchards: A story for the Rose City

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Abstract: In 1999-2002 parasitism of leafrollers was measured in multiple orchards embedded in a 1000-hectare landscape mosaic in Wapato, Washington. Using field exposure of lab-reared larval *Pandemis pyrusana*, we found parasitism was very low in spring and modest in summer generations. Roughly half of the parasitism was caused by 2 tachinids and the remaining half by 3 wasp parasitoids. Parasitism by the exotic wasp, *Colpoclypeus florus,* was found most reliably in sites near riparian habitats and almost exclusively in summer. In late summer of 2000 we planted 4 gardens of wild rose, *Rosa woodsii*, next to orchards at sites distant from riparian habitats with no previous history of parasitism by *C. florus*. Gardens were infested with the strawberry leafroller, *Ancylis comptana*, which is an important overwintering host of *C. florus* in some riparian settings. *Ancylis* larvae subsequently became parasitized by *C. florus* in the fall of 2000. In the spring of 2001, sentinel *Pandemis* in both gardens and nearby apple orchards showed high parasitism by *C. florus* and much higher parasitism overall than observed in 1999-2000. Gardens acted as foci of *C. florus* parasitism in orchards through the 3 subsequent leafroller generations in 2001 and 2002. These manipulations demonstrate that the rose/strawberry leafroller community produces significant orchard leafroller parasitism in the spring when it is usually very low and that spring parasitism grows into even higher parasitism in the summer generation.

Introduction

In 1992 Jay Brunner at the Tree Fruit Research and Extension Center in Wenatchee found the parasite *Colpoclypeus florus* parasitizing leafrollers in an orchard near the station. This tiny wasp was collected in Italy and introduced by Agriculture Canada into the Ontario area to control red-banded leafroller in 1968. We believe it spread on its own to Washington. *C. florus* is found throughout Europe and is often the most important parasite of as many as 9 leafroller pests there. By 1996 Jay's lab including his postdoctoral associate, Bob Pfannenstiel, were mass rearing and releasing *C. florus* in an effort to increase its distribution in Washington and to determine the impact it could have on *Pandemis* and OBLR. They observed that it caused high parasitism of leafrollers in the summer generation in some orchards. They also observed that the wasp parasitized very few leafrollers in the spring generation of larvae, similar to its biology in Europe. Both of our pest leafrollers and most pest leafrollers in Europe spend the winter as tiny larvae hidden in bark crevices and bud scales or as egg masses. *C. florus* overwinters on its host and requires a large larvae on which to do this. The mystery in Europe and now in Washington was what were the overwintering hosts that allowed this species to persist. In the winter of 1998-99, Bob Pfannenstiel discovered 2 leafrollers in our native habitats that pass the winter as mature larvae and act as hosts for *C. florus* to do the same. These include *Syndemis* spp., an uncommon

native on dogwood, and the exotic species, *Ancylis comptana*, or strawberry leafroller, which is often abundant on wild rose species (*Rosa woodsii, R. canina,* and *R. nutkana*). Studies based on this background and designed to demonstrate the importance of riparian habitat elements in orchard parasitism are presented here.

Materials and Methods

Parasitism was assessed by exposing laboratory-reared, 4th instar, *Pandemis* leafrollers that we placed on potted apple trees in and near orchards, typically 20 leafrollers/tree and 5 trees per site. After 2 to 3 weeks of exposure, leafrollers were retrieved and individually reared to adulthood on apple foliage in the laboratory. Parasitism was estimated as the number of a given parasitoid emerging divided by the total of all parasitoids and moths emerging. Parasitism exposures occurred in the spring and summer generations of our pest leafrollers and also in mid to late September in some years. In 1999-2000 at one site and in 2001-2002 at a second, transects of leafrollers were deployed in orchards near naturally occurring patches of *Rosa woodsii*. In 1999-2000 over 100 deployment sites were used to characterize parasitism patterns across two nearby areas comprising over 1000 hectares near the Yakima River. In 2001 and 2002 fewer sites were used to estimate the effect of roses planted at 4 sites in this 1000-hectare area. Roses were planted in July and August of 2000 and consisted of 5 by 15 m plots containing 20 to 30 seedling rose plants (*Rosa woodsii*) collected from wild rose patches and 30 to 40 strawberry plants (var. Quinault). Gardens were 10 to 70 m from orchard edges and were irrigated regularly by drip or impact sprinklers. Gardens were situated at sites distant from the Yakima River near sage-grassland habitat where previous 1999 and spring 2000 studies of parasitism showed no parasitism by *C. florus*. In late August 2000 gardens were infested with mid-stage *Ancylis* larvae by transferring infested strawberry leaves from our laboratory colony.

Results and Discussion

In two locations where fairly large and heavily infested naturally occurring rose patches were adjacent to orchards, we found parasitism by *C. florus* was consistently higher than 50% in the summer generation of *Pandemis* and, at one of the sites, parasitism in the spring generation also exceeded 50%. Parasitism declined with distance from the rose patches but this effect was highly variable by date and year.

Also in 1999 and 2000, in landscape studies in over 1000 hectares of mixed apple, pear, cherry and stone fruit orchards along hillsides adjacent to the Yakima River near Parker, we found that parasitism by 3 wasps, *C. florus*, *Oncophanes americana*, and *Apanteles* spp., was higher in those orchards closest to the river while parasitism by wasps was very low or absent in orchards bordering the grass-sage habitats away from the river. These observations led us to the following fairly natural set of conclusions: 1) parasitism is enhanced by nearby riparian habitats; 2) rose infested with the strawberry leafroller seems to be the critical element of this "riparian habitat" effect. We tested these conclusions as hypotheses by planting the 4 gardens described above.

Collections in December 2000 and February 2001 showed that 3 of the 4 gardens were successfully infested with the strawberry leafroller and these leafrollers were also parasitized by

C. florus. In the spring of 2001 we observed parasitism of *Pandemis* by *C. florus* in orchards near each of these 3 garden sites. This significantly contrasts with our observations that 1) no parasitism by *C. florus* occurred in the same orchard sites the previous 2 seasons, 2) no parasitism by *C. florus* occurred near the garden that failed to become infested with strawberry leafroller, and 3) no parasitism by *C. florus* occurred in other orchard sites along the sage-grassland habitat. Parasitism at these gardens has persisted and increased through the summer generation of 2001 and the spring of 2002.

We are now taking these "proof of concept" experiments to a larger scale with 6 more gardens in Yakima, 3 in Wenatchee, and 2 each in Milton-Freewater, The Dalles and Brewster. Several of the new gardens will be larger (50 m by 50 m). It is our hope that these simple habitat modifications will prove to be an enduring low input method to provide biological control of leafrollers and eliminate this need for insecticides.

More beneficial insects in orchards near riparian habitats seem to be the rule, but studies of the details suggest that having more beneficial species may not be as important as having some of the right beneficial species. All elements of riparian habitats may not be important, and the significant beneficial effects may be associated with only a few key plants and the insects they harbor.

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