Biological Control

Landscape Effects on Leafroller Parasitism

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Several parasitoids have been identified attacking medium to large leafroller larvae in Washington orchards. Dominated by *Colpoclypeus florus* and two tachinids *(Nilea erecta* and *Nemorilla pyste),* parasitism of leafrollers in some orchards with limited or no use of hard insecticides can cause significant leafroller mortality. Additionally, several other parasitoids *(Oncophanes americanus, Sympiesis acrobasidis* and an *Apanteles* sp.) can cause high leafroller mortality. A common characteristic of most (if not all) of these parasitoids is that they depend at some point in the season on the availability of leafroller hosts in non-orchard habitats. Therefore, the availability of habitats containing these alternate hosts may have a dramatic impact on parasitism of leafrollers in orchards. Studies conducted in 1999 explored the importance of non-orchard areas on parasitism of leafrollers.

Impact of an *Ancylis comptana* population on parasitism of leafrollers in orchards by *C. florus: Ancylis comptana* is shown to be a key overwintering host of *C. florus* in central Washington. In 1999 we studied *A. comptana* feeding on wild roses and the subsequent movement of leafroller parasites into nearby orchards. A large patch of roses was found that supports a large population of *A. comptana* that are commonly parasitized by *C. florus.* A transect from this rose patch into nearby orchards was monitored using groups of 6 potted apple trees that we infested with ten 3rd-4th instar *Pandemis pyrusana* (PLR) each. Leafrollers were allowed to remain on the trees for two weeks before being collected and reared in the laboratory to determine parasitism. There was a group of potted trees in the roses, one in a windbreak between the roses and the orchards, 2 groups at different distances in the orchards and a site in the lupine-sage habitat above the orchards. These trees were infested 6 times in the 1999 season to measure leafroller parasitism and how it relates to the phenology and parasitism of *A. comptana* in the rose patch.

Parasitism of sentinel hosts by *C. florus* was low through most of the spring although it was consistently observed in PLR in the rose patch and to varying degrees in the orchard blocks. During June *A. comptana* became suitable and were parasitized by *C. florus.* Parasitism of the *A. comptana* peaked at ca. 20% and the very large number of *A. comptana* in the patch indicated that thousands of parasitized hosts occurred and many thousands of *C. florus* would emerge. In early July when these parasitoids began to emerge parasitism jumped from below 20% to near 100% of PLR in the rose patch and the windbreak, ca. 65% in the 1st apple site, but remained low in the more distant 2nd apple site. The subsequent sample showed parasitism declining in the roses as *C. florus* apparently abandoned the rose patch and moved into other habitats. Parasitism at this time was near 100% in the windbreak and both apple blocks. Parasitism remained high in the apple blocks through the middle of September.

Impact of Landscape Factors on Leafroller Parasitism

A study started in 1999 examined the influence of orchard type (apples, pears and in the 2nd generation, cherries), orchard management regime [from Mating Disruption (MD) to conventional] and non-orchard habitats on parasitism of leafrollers. Two large areas were selected for the initial year of this study: the original Parker CAMP site and another area adjacent to the Yakima USDA-ARS laboratory. Both areas included all orchards between the Yakima River and the grasslands to the north. One area is typified by MD and soft pesticide programs and the other by orchards using a variety of management regimes including MD and conventional. To measure parasitism, potted apple trees were placed in orchard blocks and nearby riparian areas and infested with PLR leafrollers. Two weeks after infestation, all leafrollers surviving on the trees were collected and brought to the laboratory to determine if they were parasitized and, if so, by which parasitoid. This was repeated once during each leafroller generation and a third time at the Parker site during the fall.

Parasitism was low at most locations in both areas during the first leafroller generation. Parasitism was 1.8 and 0% in the apples and pears, respectively, at the Parker site and 5.6 and 8.7% in the apples and pears at the Wapato site. No parasitism was detected in riparian areas. Parasitism during the second generation increased. Parasitism was very high in riparian areas (90.6%) and at the Parker site parasitism increased from very low (0-1.8%) to 25.2, 30.5 and 46.8% of leafrollers in apples pears and cherries, respectively. More significantly, parasitism was typically high near riparian habitats, particularly in the western end of the Parker area and decreased rapidly as the distance from these riparian habitats increased. *Colpoclypeus florus, Oncophanes americanus* and the tachinids were the dominant parasitoids. At the Wapato area, parasitism increased from 5.6 to 20.5% in apples and did not increase at all in pears. Parasitism in cherry blocks was low at 4.3%. Tachinids dominated parasitism in the Wapato area and there was no apparent pattern to parasitism in area. *C. florus* was rare near Wapato in the second generation despite four of five total 1st generation recoveries occurring there.

A third trial was conducted at the Parker site in September to determine how far the parasitoids had moved from the riparian areas. Parasitism was very high at all sites but one (mean parasitism of 94.5% in apples and 63.2% in pears) and both *C. florus* and *O. americanus* were very common and had dispersed into even the farthest blocks from the river.

The effect of orchard pesticide use on parasitism has not been evaluated as we are still obtaining pesticide application records. Several important observations were made in this study. Distance from alternate habitats appears to be critical for some parasitoids such as *C. florus* and *O. americanus*. In the fall these parasitoids actively search within the orchards for overwintering hosts. Because overwintering hosts are not available near the orchards that are distant from the riparian areas, these parasitoids most likely die without reproducing and must colonize again the following year from riparian habitats. At Parker, parasitism of leafrollers in even the most distant blocks was high by the middle of September, which suggests that if a habitat containing alternate hosts could be established, they would be colonized by leafroller parasitoids and parasitism in subsequent years could be increased. Therefore, we believe that provision of an overwintering habitat within or near certain parts of this area could increase parasitism during both leafroller generations and reduce the need for control applications. Additionally, there appear to be major differences in the distribution and change in parasitism between the Parker and Wapato areas. Tachinids were the dominant parasitoid in the Wapato area. We believe the dominance of tachinids in Wapato may be due to the differences in pesticide use in the two areas, particularly greater use of organophosphate insecticides in summer in Wapato. Tachinids are likely to be

more tolerant of pesticide residues than the much smaller *C. florus* and *O. americanus*. For parasitoids such as *C. florus* which must move from habitat to habitat in search of hosts during the year, a mosaic of neurotoxic insecticide use may reduce populations much more than predictions based on the proportion of the area sprayed. Blocks with pesticide residues may intercept moving parasitoids and kill them, reducing the benefits of having individual blocks managed under soft programs.

Future Objectives and Potential for Improved Leafroller Biological Control

These studies indicated both an effect of orchard proximity to non-orchard habitats and a potential inhibiting effect of areawide patterns of pesticide use. Further studies into the importance of habitats containing alternate hosts and areawide patterns of pesticide use are critical to designing cultural programs including habitat manipulation and augmentation which may potentially improve biological control of leafrollers in orchards.