Biological Control

Alternate Hosts of the Gregarious Eulophid Ectoparasitoid *Colpoclypeus florus*

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Leafrollers have become major pests to tree fruits in Washington State. They have risen from secondary to primary pest status in those orchards that have begun to use soft pesticides and mating disruption for the control of codling moth. Leafroller larvae not only defoliate trees, but destroy fruit when populations are high enough. There are two main tortricid pest species in the State of Washington, pandemis and obliquebanded leafrollers.

Colpoclypeus florus is a gregarious eulophid ectoparasitoid that was first identified in the State of Washington in 1992, where it parasitized 80% of the leafroller larvae in an unsprayed orchard. It is common in Europe and attacks a number of leafroller species there. The finding of *C. florus* initiated research in its implementation in orchard systems as a biological control means for pandemis and obliquebanded leafrollers throughout the state. *C. florus* females sting fourth or fifth instar larvae and deposit eggs on the silk of the leafroller's retreat. When the eggs hatch, the larvae find their way to the host where they feed externally on its body. Up to 50 or more *C. florus* can develop on one host and development time is approximately 15 days at 75°C. *C. florus* overwinters as a mature larvae on a fourth to fifth instar leafroller larva. Obliquebanded and pandemis overwinter as second instar larvae. This is where the problem lies. *C. florus* do not have leafrollers of the suitable size to overwinter on in orchard situations. They could also use a summer host for greater populations throughout the growing season. This led to the idea of finding an alternate host that would better coincide with the life cycle of *C. florus.*

There is beginning to be a lot of work done on different types of ground cover in orchard systems. Ground covers could harbor beneficial insect populations that may, in some cases, help in pest control programs. We began to look and see if we could find any leafrollers associated with particular ground covers to see if we could locate a non-pestiferous alternate host for *C. florus.* We found a number of leafrollers associated with alfalfa, so we began trying to rear and identify them.

Clepsis pallorana was among the tortricid leafrollers we found on alfalfa. The literature suggested that it might be a suitable host for *C. florus* as it overwinters as a later instar larvae. *Clepsis* is a common leafroller found on the Columbia Basin in Washington State. Its primary hosts are alfalfa and white clover. Both of these plants were introduced to the United States, so *Clepsis* must have been associated with some other native legume before that time. It has been found on apple, but the literature suggests that it uses apple only as a site for pupation and when ground cover is depleted.

After we established a colony, we designed a number of experiments testing host plant

choice and parasitism by *C. florus.* The first experiment was to expose *Clepsis* to apple, pear, and cherry to see if they would feed on them. Feeding arenas were set up with fourth instar larvae and a leaf of one of the plants mentioned earlier. Feeding arenas were checked daily and monitored for feeding and construction of retreats. Feeding did take place in all three trials.

Next, we set up bigger arenas, again using fourth instar *Clepsis* larvae and the choice of alfalfa or a disk of either apple, pear, or cherry. The arenas were checked at 48 hr to see which *Clepsis* chose to feed on. Feeding once again took place in all three trials on both choices.

One of the initial and most important things we wanted to see is if *Colpoclypeus florus* would parasitize and develop on *Clepsis*. Fifty 9 x 50 ml petri dishes of both *Clepsis* and obliquebanded leafrollers were set up and compared. Each petri contained a piece of diet, a fourth instar larvae of either leafroller type, and one mated female *C. florus.* Petri dishes were checked daily to determine percent parasitism, development time, number of progeny, and the sex ratio of progeny. Results are as follows:

	Clepsis	OBLR
Percent parasitism	60%	58%
Average development time (days)	16.61	16.68
Average No. progeny	8.5	6.5
Sex ratio	13:1	10:1

Parasitism and development rates were found to have no significant difference using a 95% CI. The progeny of *C. florus* were then set up on obliquebanded leafrollers to determine fitness of the F1 generation. We found that the numbers were once again similar and there seemed to be no problem with either the F1 generation or host switch. This suggests that *C. florus* did recognize *Clepsis* as a suitable host and numbers would indicate that they do very well on them. Preliminary caged experiments were then set up using apple trees and alfalfa in the field. This was a preliminary experiment and more caged experiments will have to be done to better look at these interactions.

In conclusion, we have established a colony of *Clepsis pallorana* and found it to be a suitable host for *Colpoclypeus florus.* We did see *Clepsis* feed on apple, pear, and cherry, but we do not know, given normal circumstances, that this is truly the case. More experimentation needs to be done on this aspect.

Comparative parasitism rates, number of progeny, and development time for *C. florus* using *Clepsis* and obliquebanded leafroller as hosts have been shown to have no significant difference. Lastly, preliminary caged experiments suggests that *C. florus* will locate and parasitize leafrollers in trees as well as in ground cover.

Leafrollers have become major pests of tree fruits in Washington. As we adopt new methods to control primary pests in orchard systems, we will need to take into consideration problems with secondary pest outbreaks. *Colpoclypeus florus* could be a viable biological control method for leafrollers, given the right circumstances, and *Clepsis pallorana* could play a key role in its establishment.