Pome Fruits—Biological Control

Pandemis pyrusana Kearfott on Apple

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The Eulophid parasite discovered attacking pandemis leafroller (PLR) in 1992, *Colpoclypeus florus,* was reared in the laboratory under various conditions to determine factors that would affect fecundity, longevity, development rate and sex. The effect of a carbohydrate source on the longevity of *C. florus* was investigated by holding newly emerged females in small containers with water only or with water plus honey. *C. florus* females lived an average of 8.9 days when provided only water. When honey was provided as a carbohydrate food source, longevity was increased to 20.9 days.

Host size effects on *Colpoclypeus florus.* *C. florus* can use different stages of leafroller larvae as hosts. To determine the optimum age of PLR larvae to use as a host for C. *florus* in mass rearing efforts, different instars were presented to females and the number of progeny recorded. Table 1 shows the average number of *C. florus* progeny produced for each leafroller larva. Larvae near ecdysis are not suitable hosts for *C. florus.* Early fifth instar larvae should be acceptable as hosts according to literature, but in this test late 5th instars were not acceptable.

The average number of *C. florus* produced from a single parasitized PLR larva collected from the field in 1992 was 13.5. There were slightly more *C. florus* produced per field-collected leafroller larva in 1993, 17.4, compared to 1992 but a slightly lower percentage of females was found in 1993. The number of progeny produced and percentage of females per PLR larvae in the laboratory was similar to that observed in the field (Table 2).

Like other Hymenoptera, *C. florus* determines sex by fertilizing or not fertilizing the egg. The literature is a little confusing concerning whether males or females are produced from fertilized eggs (Table 3). Most Hymenoptera produce males from unfertilized eggs (haploid) and females from fertilized eggs (diploid). A study was conducted to determine the situation with *C. florus.* Mated *C. florus* produced both males and females while unmated *C. florus* produced only males. The production of offspring was lower than in some other studies, due in part to a fungal contamination problem. Longevity of female *C. florus* was also less than expected due to the same problem.

Parasite release studies. The number of parasites to release in an orchard will be dependent upon several factors including how many host larvae are present, how they are distributed in the orchard, the size of the trees, and the ability of *C. florus* to locate its host. Preliminary studies were undertaken in 1993 to better ascertain the potential of *C. florus* as a biological control for PLR and at what levels releases might be made. When PLR larvae were actively feeding in the shoots, August 11-13, *C. florus* females were released at different densities (10, 20, 30, 50, 100, and 150 per tree) and in different patterns. The percentage of

leafroller larvae parasitized by *C. florus* in the spring and summer is given in Table 4. In the spring, 20 parasites per tree were released during the bloom period. An average of 45.5% of the PLR larvae were attacked by *C. florus* on release trees. Within the same row on trees nearest the release tree, parasitism was 31.7%, and on the next tree (two trees from the release tree) the percent parasitism was 13.6. On trees in the row to the north and south of the release row, parasitism was 3.1% and 2.9%, respectively. In spring *C. florus* seemed to stay within the release row but did not cross readily to the adjacent row. This was less evident in summer, for example, where 100 *C. florus* were released per tree. Parasitism of PLR larvae was highest on release trees (88%), slightly less on adjacent trees within the same row (72%) and lower yet on trees in an adjacent row (66%).

Table 1. The production of *C. florus* from different ages of PLR larvae.

PLR larval age	Average no. *C. florus* ±SE[1]	% dead[2]	% LR adults[3]
3rd instar	3.8±	30	10
4th instar	7.3±	30	20
5th instar	0.1	26	66
No parasites	0.0	0	100

[1]Number of *C. florus* per leafroller larva was lower than expected, probably due to the age of *C. florus* adults used in the test and the presence of a fungus that affected survival of *C. florus*.
[2]Leafroller larvae that were stung and died without producing *C. florus* larvae.
[3]Percent of larvae that were not parasitized and emerged as adult PLR.

Table 2. The number of PLR larvae collected from the field in 1992 and 1993, the average number of *C. florus* produced compared with the number of *C. florus* produced in the laboratory.

			Colpoclypeus florus		
Year	Source	No. of leafroller larvae	% male	% female	Average no. adults ±SE
1992	field	85	28.2	71.8	13.5±1.02
1993	field	456	37.5	62.5	17.4±0.66
1993	lab	53	27.0	73.0	12.1±1.27

Table 3. The effect of mating status on the longevity, fecundity and percent female production of *C. florus*.

Mating status	Average female longevity (days)	Average no. *C. florus*	% *C. florus* females	% without *C. florus*[1]
Mated	10.9	8.8	73	46.9
Unmated	12.7	14.0	0	30.8

[1]Some leafroller larvae were stung but did not produce *C. florus* or were too old at the time of exposure and went on to produce leafroller adults.

Table 4. The percent of PLR escaping parasitism and the percent parasitized by different parasitic species on trees where *C. florus* was released at different levels.

Release no. per tree	N	% LR adults + pupae	Average percent parasitism of PLR larvae per tree			
			% *C. florus*	% Tachinidae	% Apanteles	% Other
Spring						
20	5	55.5	45.5	0.0	0.0	0.0
Summer						
10	12	12.5	54.2	28.1	0.0	3.0
20	12	6.8	63.3	11.5	1.6	8.3
30	20	13.7	50.6	27.0	0.6	3.0
50	10	10.5	64.1	16.1	0.0	5.5
100	10	0.5	87.6	6.3	0.0	5.5
150	5	12.4	47.1	15.7	15.0	4.8