Pome Fruits—Biological Control

# Mating Disruption as a Control for Pandemis Leafroller

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Mating disruption (MD) as a control for pandemis leafroller (PLR) in Washington was evaluated at two study sites in 1991. A total of seven non-bearing apple orchards (34.2 acres) was treated with Hamaki-con (Biocontrol Ltd.) dispensers (Table 1). These dispensers contained ca. 150 mg of Z11-14Ac, which is the main component of PLR pheromone. Application rates of 400d/a, 800 d/a, and two treatments of either 400 d/a or 800 d/a were evaluated.

**Trap catch and larval density.** Pherocon 1C traps baited with 5 mg of PLR pheromone (96%:Z11-14Ac, 4%:Z9-14Ac) in a red septa were used to evaluate the effectiveness of mating disruption through the season. Four traps were placed in each orchard in late May. Traps were monitored and maintained as described for CM. Trap catch was lower in the pheromone treated as compared to the non-pheromone treated orchards (Table 1). The major exception was in the 800 d/a orchard at W7 during the summer flight, where a relatively high trap catch was recorded. Similar levels of trap shutdown were observed in 1990 MD trials, suggesting that treatment with Hamaki-con dispensers successfully interferes with the ability of PLR males to orient to females.

Changes in leafroller densities from one generation to the next provided the most direct measure of MD success. Larval sampling was conducted toward the end of each generation when most were in the 4th or 5th instar, but before pupae were present. Sampling consisted of dividing each orchard into quadrants, examining an equal number of trees in each, and recording the total number of larvae present. The first application of pheromone was targeted at adults of the overwintering generation which were active from May to July. In all pheromone treated orchards at W6, PLR levels at the end of the summer generation did not differ significantly from levels at the end of the overwintering generation (Table 1). This was in contrast to the increase in PLR densities in the untreated orchard and in the orchard treated with Lorsban only. PLR population level appeared to have more effect on the MD success than the number of dispensers applied per acre. The two orchards treated with pheromone at the rate of 800 d/a had the highest pre-treatment (overwintering generation) larval counts, 2.32 and 1.46 larvae per tree, and showed the greatest increase in density the following generation. These data suggest that the initial density of PLR was too high for MD to operate effectively and data on egg mass distribution tend to confirm this conclusion.

Figure 1 shows the distribution of the total number of egg masses observed on each tree in a segment of four orchards at W6. As shown in Figure 1A high numbers of egg masses were found in the orchard (H) that was without any treatment while in the pheromone treated orchard (I) only 6 egg masses were found. In Fig. 1B both orchards had about the same number of egg masses. In one case the pheromone treatment (only 400 d/a) suppressed mating and thus oviposition while in the other it did not, even though the dispenser density was twice as high.

The best evidence for the success of leafroller mating disruption comes from orchards H and I at site W6. MD was begun in orchard I in 1990 with a single application at 400 d/a using the Hamaki-con dispenser and repeated in 1991 but with 2 applications. Orchard H was an untreated control in both years. Both orchards were planted in 1990 and thus PLR densities were zero prior to the first application of pheromone. In orchard H larval densities were 0.67, 1.02 and 3.58 per tree in three consecutive generations. During the same period larval densities in the pheromone treated orchard, I, were 0.35, 0.42, and 0.51 per tree. Starting with low populations of PLR the MD disruption tactic has slowed the increase in the leafroller population, even when the pheromone treated area was directly adjacent to an untreated area with a high leafroller population.

**Comparison of pheromone blends.** Some research in MD suggests that the best results will occur if the complete pheromone blend of the target species is used in a dispenser. Shin-Etsu provided dispensers loaded with the reported blend of PLR, a 96:4 mixture of Z11-14Ac and Z9-14Ac. The Hamaki-con dispenser used in mating disruption trials contains 100% of Z11-14Ac. To evaluate the effectiveness of single and two-component dispensers for MD of PLR small plot trials were conducted during the flight of the second generation in 1991. The test was conducted in an orchard at W6. It was divided into 18 35-tree blocks. Six blocks were treated with Hamaki-con dispensers at a rate equivalent to 400 d/a, six were treated with the PLR pheromone blend at the same rate, and six had no pheromone. Treatments were evaluated by comparing trap catch. Three pheromone traps, each employing a different attractant, were placed in each block. Traps were baited with either a red septa loaded with 5 mg of Shin-Etsu PLR pheromone blend, a pair of virgin PLR females, or a red septa loaded with 5 mg of the Trécé Inc. pheromone blend for the three-lined leafroller *(Pandemis limitata*), a 91:9 blend of Z11-14Ac and Z9-14Ac, as reported in the literature. Trécé has since indicated that the pheromone blend in the *P. limitata* septa was actually the 96:4 ratio of Z11-l4Ac and Z9-14Ac, the same as the Shin-Etsu PLR pheromone. To reduce position effects, the three traps were rotated within a block three times a week. Capture of males in traps baited with the Trécé pheromone or virgin females was significantly reduced by both pheromone treatments. Treatment with the Shin-Etsu pheromone reduced catch in traps baited with the same blend, while treatment with Hamaki-con dispensers did not significantly inhibit moth catch in traps baited with the Shin-Etsu PLR pheromone. In all treatments the Trécé pheromone was the most attractive lure (Figure 2).

**Table 1.** PLR trap catch and larval density in pheromone and non-pheromone treated orchards.

| Site | Treatment | Orchard size | Trees per acre | Mean moths/trap after the indicated application date | | Mean larvae/tree for the indicated generation[1] | |
|---|---|---|---|---|---|---|---|
| | | | | 1st | 2nd | Overwintering | Summer |
| W6 | Untreated | 2.9 | 389 | 6.5 | 17.0 | 1.02* | 3.58* |
| | Conventional | | | | | | |
| | Lorsban + Penncap-M | 4.9 | 201 | 11.0 | 32.0 | 0.67* | 0.19* |
| | Lorsban + Lorsban | 4.9 | 201 | 22.5 | 50.0 | 0.50 | 4.14 |
| | Pheromone | | | | | | |
| | 400 x 2 | 5.1 | 389 | 0.5 | 1.3 | 0.42 | 0.51 |
| | Fenoxycarb + 400 | 4.5 | 269 | 0.5 | 2.3 | 0.11 | 0.19 |
| | Fenoxycarb + (400 x 2) | 4.6 | 269 | 0.5 | 2.3 | 0.08 | 0.17 |
| | Lorsban + 800 | 4.7 | 201 | 2.5 | 8.8 | 2.32 | 4.61 |
| | (Lorsban x 2) + (800 x 2) | 4.7 | 201 | 7.0 | 7.0 | 1.46 | 2.97 |
| W7 | Conventional (Lorsban) | 5.3 | 242 | 5.5 | 9.0 | ND | ND |
| | Pheromone | | | | | | |
| | 400 | 5.3 | 242 | 1.5 | 7.0 | ND | ND |
| | 800 | 5.3 | 242 | 2.8 | 18.0 | ND | ND |

[1]Mean pairs followed by an asterisk are significantly different (paired *t*-test, P<0.05).

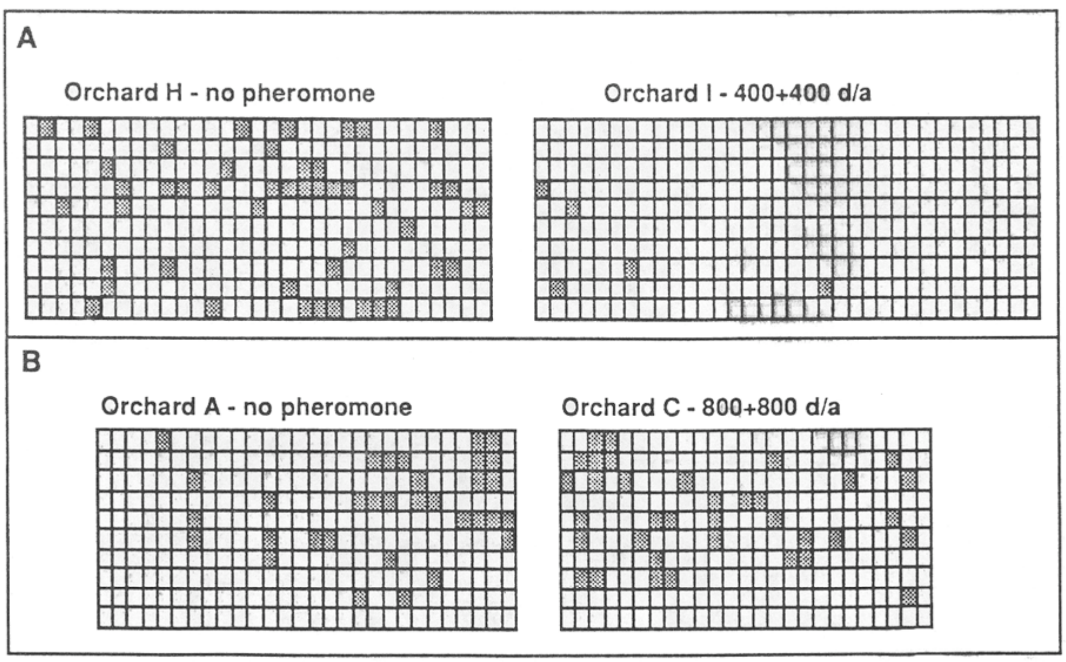


Figure 1. Distribution of summer generation PLR egg masses in the north ten rows of two pairs of adjacent orchards with or without a pheromone treatment at site W6 in 1991.

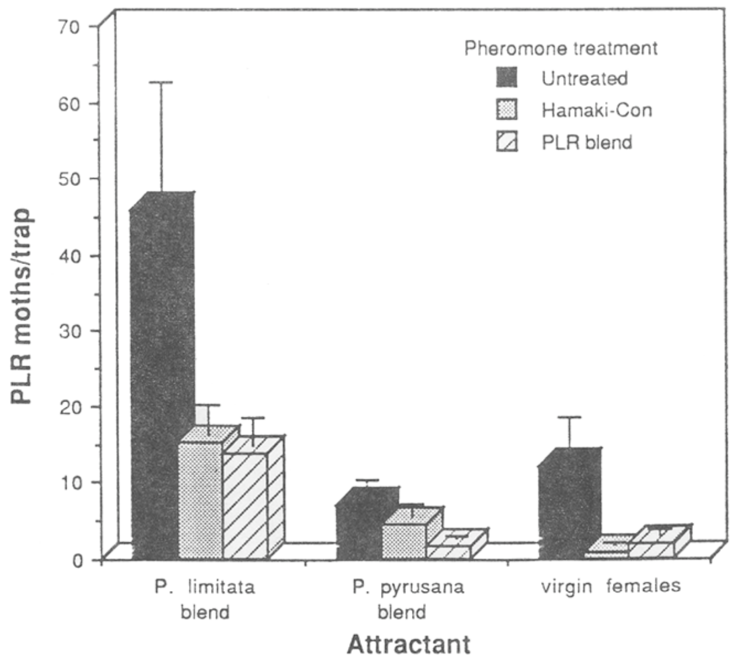


Figure 2. Comparative capture of PLR moths in orchards treated with: 1) Hamaki-Con dispensers (100% Z11-14Ac) at the rate of 400 d/a, 2) PLR dispensers (96%:Z11-14Ac, 4%:Z9-14Ac) at the same rate, or 3) no pheromone