

PROJECT: Final Report (1997)

TITLE: Development of Tactics for Area-wide Management of Codling Moth

PERSONNEL: Gary Judd and Joan Cossentine
Agriculture and Agri-Food Canada
Pacific Agri-Food Research Centre
Summerland, British Columbia
Canada V0H 1Z0

YEAR INITIATED:1995 **TERMINATING YEAR:**1997 **REPORTING PERIOD:**1997

OBJECTIVES:

1. To determine if SIR, MD and BC are compatible technologies for control of codling moth and if these combined tactics are either as, or more effective, than the individual components alone.
2. To further refine SIR, MD and BC technologies by evaluating the effects of ground *versus* aerial canopy releases of sterile moths on the dispersal and recapture of sterile males, oviposition by sterile females and parasitism rates by *Trichogramma*.
3. To assess the influence of infection by granulosis virus on the fecundity of mass-reared sterile female codling moths.

ACCOMPLISHMENTS:

1. a) Completed the third and final year of trials examining the efficacy of combining MD + SIR for control of codling moth in organic orchards. **No damage** from codling moth was detected at harvest in any of five organic orchards treated with a combination of MD + SIR in 1997, down from 0.015% in 1996, and 0.45% in 1995. Four orchards receiving SIR plus a reduced insecticide program also had no detectable damage from codling moth, down from 0.015% in 1996 and 0.38% in 1995. In spite of finding no damage, codling moth was not eradicated from these orchards, as banding samples detected a small residual population of overwintering codling moth in orchards receiving MD + SIR (3.8 larvae per ha) and in SIR orchards receiving supplementary insecticides (2.5 larvae per ha). One SIR orchard that received no supplementary sprays had overwintering populations of 584 larvae per ha in 1996 and 130 per ha in 1997, a 78% reduction but far from eradication.
- b) Completed a study assessing the frequency of mating with sterile males in pheromone-

treated SIR orchards to determine if apparent synergism between SIR and MD treatments was a result of mating with sterile males. During first brood one female out 154 tested (0.6%) became mated in a pheromone-treated SIR orchard, whereas 48% of the females in a SIR only orchards mated with sterile males. MD caused a 98.8% reduction in mating compared with the levels of mating in SIR only conventional orchards. These data suggest there is little synergism between these tactics although the control effort is improved.

2. a) Completed studies examining the dispersal and recapture of codling moths released in orchards either by uniform application on the ground or from nine point sources on the ground or in the canopy of one-ha test plots. Compared with ground release, the aerial release system produced a significant increase in recapture of male codling moths in pheromone traps, but there was little or no effect on recapture of females on pane traps. Dispersal of sterile males was just as effective when moths were released from point sources compared with uniform release. Point-source aerial releases resulted in a slight increase in the percentage of matings with sterile males among females deployed in mating tables, indicating that a less time consuming and potentially less expensive system for delivering sterile insects is possible.
 - b) Completed a comparison of oviposition by irradiated codling moths, released from nine point sources on the ground or in the canopy of one-ha plots. Up until 27 days after biofix, no difference was found in the number of codling moth eggs recovered in trees receiving moths by the two release techniques. However, after this point greater oviposition was documented in trees receiving canopy releases. Higher egg counts were not observed in trees adjacent to the canopy releases, supporting trapping data indicating that the released female codling moths did not migrate to adjacent trees from point source releases.
 - c) Completed a study to determine if there was a potential to increase parasitism of codling moth eggs by *Trichogramma platneri* through releases of *T. platneri* within trees receiving canopy- released sterile codling moths. Fifty percent of the eggs found in trees receiving canopy releases were parasitized, compared with only 30% in trees receiving ground releases. Higher parasitism rates combined with higher oviposition rates, leads to a significantly higher production of parasites resulting from release of codling moths in the canopy than release of codling moths on the ground.
3. a) Completed trials assessing the relationship between infection of codling moth females with granulosis virus (CpGv) and the number of eggs oviposited at four temperatures ranging from 15-30°C. No correlation was found between the presence of the virus in adult moths and fecundity.

- b) Completed a survey for the presence of CpGv within wild populations of codling moth and found the virus at all locations and in all populations screened.

RESULTS:

1. a) **Combining MD and SIR:** Five organic apple orchards receiving a full SIR program (1 May to 15 September) were divided in half and treated with 500 Isomate-C or Isomate-Special dispensers per ha on 1 May, to assess the effectiveness of combining these technologies. Moth populations were monitored from 1 May to 1 October using one, 10-mg-baited pheromone trap per ha. The sterile:wild ratios of male moths were calculated weekly in each orchard using catches from traps while the number and percentage of mated wild females were determined from matings among females placed on mating tables. In each orchard all trees were banded in June and the number of larvae caught after first and second broods were used to determine the change in population density between generations and previous years. All orchards were sampled for codling moth and leafroller damage at harvest by sampling 100 fruit from each of 20 trees (10 interior and 10 edge trees) within each half of each orchard.

For comparison, five conventional orchards receiving a full SIR program as above, and treated with 0 - 4 sprays of Guthion during first brood (SIR + INS), were also monitored and banded. Moth populations were monitored from 1 May to 1 October using one, 1-mg-baited pheromone trap per ha. Bands were placed on 50 trees in June and replaced after first and second broods to assess the change in population density relative to the MD + SIR orchards.

Very few wild moths were caught in any orchards and all of these moths were caught during first-brood flight. In the MD orchards seasonal S:W ratios ranged from 91:1 to 967:1, but in one orchard this ratio averaged only 14:1 for three weeks during peak first-brood flight, less than the 40:1 target ratio. In 4 conventional orchards, S:W ratios ranged from 407:1 to 1252:1, which is significantly better than 1996. As in previous years recapture of sterile males was lower during first-brood flight period than the second-brood flight.

In 1996, the mean level of damage at harvest was 0.015% in 5, MD + SIR orchards, but in 1997 no damage from codling moth was found in any MD orchard. This lack of damage represents a 100% **reduction** over the 1996 and 1995 (0.45%) levels. In spite of finding no damage, banding samples indicated that there was a small residual population of overwintering codling moth in three of five MD + SIR orchards and in one of four SIR orchards receiving insecticides. In 1997, the mean population density of 3.8 larvae per ha in MD + SIR orchards was not significantly different than the 2.5 larvae per ha seen in SIR + INS orchards. The 1997 overwintering populations levels were almost unchanged from 1996. These data indicate that population densities have stabilized at very low levels and it may take several years to reach eradication.