

VII. Mating Disruption/SIR

d. Chemical control

1. Codling moth mating disruption on apple

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Project area description and participation: Howard Flat represents a pome fruit production area that models many sites typical of northcentral Washington. It encompasses approximately 1,200 acres and is relatively isolated from other fruit growing areas in the region. The terrain is primarily flat, the orchards are contiguous although the border is irregular with a large rock outcropping on the western edge, and there is an abrupt slope to the east and south. Apple is the primary pome fruit produced on Howard Flat, but a few acres of pear and cherry are also grown. Delicious or mixed Delicious and Golden Delicious orchards dominate the varieties of apple produced (75%), while a few acres of Fuji and Gala are also present.

In 1994 a grassroots movement initiated by fieldmen from several of the fruit packing houses was organized into an areawide pheromone-based codling moth management project. It was from this interest and level of dedication that Howard Flat became part of a federally funded areawide codling moth pilot management project in 1995. There are 36 growers on Howard Flat served by 16 fieldmen. After a series of informational meetings in the fall of 1994 and spring of 1995, growers were asked to sign up for participation in the project. Initially, only three growers, representing a total of 88 acres, decided not to participate in the project. One of those growers eventually treated a majority of his acreage (25 of 30 acres) with pheromone. The total pome fruit production represented by the 34 growers participating in the project was 1,135 acres.

Organization and operation: The Howard Flat project was organized by growers and industry fieldmen interested in the implementation of new pest management technology. A Howard Flat Management Board (HFMB) was established to oversee the details of operating the project and to secure and manage funding from the USDA. The Management Board consists of five fruit industry fieldmen and three growers from Howard Flat. A Technical Advisory Committee was also established to provide scientific and technical input to the project.

A coordinator was hired to oversee the day-to-day activities of the project and to facilitate the collection and dissemination of information and communication between project participants. A meeting of the Howard Flat Management Board and members of the Technical Advisory Committee was held every Monday morning to review the previous week's activities and make plans for the coming week. A Howard Flat icon was placed on the WSU Tree Fruit Research and Extension Center Electronic Bulletin Board as a means of facilitating the transfer of data and information. A display bulletin board was built and placed at a central location. This display board was used to post weekly data on pheromone trap captures and maps summarizing the accumulated captures of codling moth and leafrollers, along with general updates. Two field days were held for growers and fieldmen to review the results of the project and answer questions.

Pheromone application: Mating disruption formed the basis of codling moth control in all areawide projects and, based on recommendations from the Advisory Committee, the HFMB chose to recommend the use of one pheromone dispenser, Isomate-C plus (Pacific Biocontrol, Inc.). Pheromone dispensers were purchased by the project through businesses servicing growers. Following the recommendation of the HFMB, the growers agreed to apply 400 dispensers per acre, the full recommended rate. The project coordinator visited each grower to determine the number of acres per orchard block, along with data on tree spacing, variety and trees

per acre. These data were used to calculate the number of dispensers required per block and the number of dispensers to be applied per tree in each block.

The HFMB decided to pay for the attachment of all dispensers to clips as a service for growers participating in the project. Growers were given the option to place dispensers in their orchards using their own personnel or to have project crews place the dispensers at a charge of \$20 per acre. About half of the growers chose to place dispensers in their own orchards. Three crews were used to place dispensers in orchards of growers who opted to have the project conduct this activity. An educational field day was held prior to the placement of dispensers for growers and crews involved in the placement of dispensers to demonstrate the correct method of dispenser placement. A group of students from Chelan High School's agricultural class became involved in the project through the field day education event and placement of dispensers on 60 acres of orchard. Dispenser placement was begun on April 13 and completed by April 23, prior to the capture of first codling moth in pheromone traps. Approximately 440,000 dispensers were placed in the orchards on Howard Flat in a 10-day period.

Codling moth activity was monitored using pheromone traps with 10 mg lures placed at an average density of one trap for every 2.5 acres. A total of 448 traps were placed in orchards within the Howard Flat project, including 12 traps baited with a standard 1 mg lure used to monitor codling moth in orchards not treated with pheromone dispensers. Traps were placed in the upper part of the tree canopy and monitored weekly. Lures were changed every third week in the first generation and every other week in the second generation.

More than 3,000 moths were captured in 270 of the 448 traps (60%) during the first 3 weeks of monitoring. The high level of codling moth pressure in many orchards was anticipated based on fruit injury reports from 1994 and histories of pest problems in certain areas on Howard Flat. All growers were advised by crop consultants to apply a well-timed first cover spray for codling moth control; this was in addition to suppression expected by the pheromone. Following the beginning of the first cover applications, codling moth captures in traps dropped dramatically.

The dramatic drop in moth captures on Howard Flat following the initiation of codling moth cover sprays suggested that moths in the region were not resistant to organophosphate insecticides. Bioassays were conducted to determine the level of resistance in codling moth adults at four separate locations within Howard Flat and at the Tree Fruit Research and Extension Center in Wenatchee. Dose-mortality curves generated from the bioassays indicated that only a low level of resistance was present within codling moth populations at Howard Flat.

Bin samples were taken from as many blocks as possible during the harvest period. In these samples, a minimum of 25 bins per variety were monitored and 100 fruits examined per bin. An attempt was made to examine bins from four areas of a block (NW, NE, SW, SE) and to examine approximately an equal number from each area. During this examination, fruit injured by other insects was also recorded. A total of 1,726 bins (172,600 fruits) were sampled from 46 blocks. The overall average fruit injury in blocks from Howard Flat sampled was 0.55%. There was more damage in Golden Delicious (0.9%) compared to Delicious (0.4%). No codling moth-injured fruit was detected in 71% of the bins sampled, and in an additional 12% of the bins fruit injury was 1% or less. Most fruit injury was isolated to certain sections within a block, often associated with a border. Only 2.4% of the bins sampled had extreme levels of fruit injury, greater than 5%, and these samples represented only seven blocks from which bin samples were taken.

Other arthropods: Other arthropod pests and their natural enemies, including mites, aphids, leafhoppers, leafrollers, *Campylomma* and leafminer, were monitored in 15 selected blocks throughout Howard Flat to provide details on pest densities and phenology. In general no pests were detected in unusual levels except leafrollers in certain blocks.