PROJECT NO:	8090
TITLE:	Mating disruption of leafrollers and codling moth.
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REPORTING PERIOD:	Termination report covering period from 1990-1991 to 1993-1994.

ACCOMPLISHMENTS:

Through studies conducted under this project we have developed use strategies for the two commercially available mating disruption products, Isomate-C (Biocontrol, Ltd.) and Checkmate-CM (Consep membranes), and evaluated several experimental dispensers. The intitial population density of CM has been identified as a major factor affecting the success of MD. Several applications at the full label rate were required when initial densities were moderate, but significantly fewer dispensers provided good suppression of CM when initial densites were low. A pheromone trap baited with 10 mg of codlemone was determined to be an effective system for monitoring CM in pheromone treated orchards. Monitoring populations of non-target species in several orchards over a three year period indicated substantial increases in predators and parasitoids in MD orchards could be expected. However, it also identified consistent increases in leafroller densities as a major impediment to the adoption of MD for control of CM. This work has contributed significantly to the development and implementation of mating disruption as a commercially viable control for codling moth in Washington.

RESULTS:

1. Effectiveness of MD as a control for codling moth in apple: Through large-scale field trials we have demonstrated the MD is a highly effective control for CM in Washington. The intitial density of CM within and adjacent to a block appeared to have the greatest effect on the degree of control by MD. In blocks with low pressure, suppression of CM with Isomate-C or Checkmate-CM applications at rates as low as 160-200 dispensers per acre (d/a) resulted in less than 1% injury to fruit and control generally equivalent to conventionally treated blocks. Levels of CM injury of 1% to 4% were recorded in pheromone treated blocks at sites with a history of moderate CM densities. At these sites, multiple treatments with Checkmate-CM at the label rate of 120-160 d/a was less effective than a single treatment of Isomate-C at the label rate of 400 d/a. High levels of CM injury to fruit (up to 80%) occurred in blocks where initial densities of this pest were high.

2. Monitoring codling moth in pheromone treated orchards: In MD orchards, moth catch in pheromone traps baited with the standard lure (1 mg of

codlemone in a red septa) is inhibited, thus interfering with the ability to monitor CM populations. During the past three years we have determined that a trap baited with a 10 mg lure is an effective tool for monitoring CM in MD orchards. This system can also be used to determine the need for supplemental treatments of pheromone or conventional insecticides where MD is failing to control CM. Cumulative moth catches of 5-9 during the first generation and 3-6 during the second generation have been proposed as thresholds triggering supplemental treatments. Research indicates that 10 mg baited traps placed at a standard height of 7- 8 feet may not adequately detect CM activity in pheromone treated orchards that have canopy heights of 15 feet or greater. Additional studies have suggested that placing traps at 12-13 feet in orchards with high canopies may improve their reliability.

3. Transition to pheromone-based management programs in apple: Population densities of leafrollers, aphids, mites, western tentiform leafminer (WTLM), white apple leafhopper (WALH), and their natural enemies were monitored in ten apple blocks over a three year period of transition to a pheromone-based CM control program. Increases in leafroller densities were usually recorded by the second year in MD orchards where supplemental OP sprays to control this pest were not applied. *Bacillus thuringiensis* was determined to be a good option for leafroller control in MD orchards. It provided control and did not affect beneficial insects. Aphid and mite predators, and the parasitoids of WTLM and WALH were frequently more abundant in pheromone treated blocks than in conventionally treated blocks. This was particularly evident by the third year for mite predators and the parasitoid of WALH.

4. Effectiveness of MD as a control for leafrollers in apple: MD has also showed promise as a control for pandemis leafroller (PLR) and obliquebanded leafroller (OBLR). In studies conducted from 1990 to 1992 we determined that treatment of young apple orchards with "rope-type" dispensers loaded with Z11-OAc (400 d/a), a major component of PLR pheromone, provided 98% trap-shutdown and good suppression of PLR where initial population densities of this pest were low. In contrast, less than a 90 % reduction in trap catch and highly significant increases in larval densities were recorded following the same pheromone treatment in young orchards with high initial densities of PLR (1990-1992 field tests) and in all mature orchards (1993 field tests).

In 1992 we also intiated tests to evaluate MD as a control for OBLR. Good suppression of the overwintering generation of OBLR by the single component "rope-type" dispenser was recorded in five of the seven blocks. Promising results in 1992 led to an increased effort in 1993 with more acreage involved. Both the "rope-type" dispenser (Pacific Biocontrol) and a new "packet-type" dispenser (Consep Membranes), also loaded with the single pheromone component, were tested. Neither dispenser provided adaquate suppression of OBLR populations in 1993. Further research on release rates, dispenser placement and movement of mated females is needed to begin to understand why mating disruption did not control leafrollers in 1993.

DISSEMINATION OF INFORMATION:

1. Publications:

Brunner, J. F. 1991. Mating disruption as a control for fruit pests pp. 89-100. *New Directions in Tree Fruit Pest Management* [ed.] K. Williams. Good Fruit Grower, Yakima, Washington.

2. Proceedings:

Gut, L.J. and J.F. Brunner. 1992. Mating disruption as a control for codling moth in Washington. Wash. Hort. Assoc. Proc. 199-201.

Gut, L.J. and J.F. Brunner. 1992. Mating disruption as a control for codling moth and leafrollers. Oregon Hort. Soc. Proc. 67-75.

Brunner, J. F., L. J. Gut, and A. Knight. 1993. Transition of apple and pear orchards to a pheromone-based pest management system Proc. Wash. St. Hort. Assoc. 88: 169-175.

Gut, L. J., J. F. Brunner. 1993. Mating disruption of codling moth and leafrollers. Proc. Wash. St. Hort. Assoc. 88: 281-284.

Gut, L. J., J. F. Brunner. 1993. Mating disruption 1992: revenge of the worm. Proc. Oregon St. Hort. Soc. 88: 94-102.

3. Technical reports:

Brunner, J.F. 1991. Mating disruption of leafrollers. 65th Annual Western Orchard Pest and Disease Management Conference, Portland, Oregon.

Gut, L.J., J.F. Brunner and A. Knight. 1992. Mating disruption: *Cydia pomonella* on apple. 66th Annual Western Orchard Pest and Disease Management Conference, Portland, Oregon.

Gut, L.J. and J.F. Brunner. 1992. Mating disruption: *Pandemis pyrusana* on apple. 66th Annual Western Orchard Pest and Disease Management Conference, Portland, Oregon.

Gut, L.J. & J.F. Brunner. 1992. Mating disruption: Effects on non-target populations. Pheromone workshop held in conjunction with Annual meeting ESA.

Brunner, J., L. Gut, L. Hull and A. Knight. 1992. Mating disruption as a potential control for codling moth and leafroller in Washington apple orchards. Implementing the LISA paradigm in orchards: "what are we doing for insect pest management" symposium. Pacific Branch ESA, Hawaii.

Gut, L., J. Brunner, A. Knight and T. Unruh. 1993. Pheromone-based pest management programs in apple and pear. Advances in pheromone-based management of insect pests symposium, Pacific Branch ESA, Portland.

Gut, L.J., J.F. Brunner and A. Knight. 1993. Mating disruption: *Cydia pomonella* on apple. 67th Annual Western Orchard Pest and Disease Management Conference, Portland, Oregon.

Gut, L.J. and J.F. Brunner. 1993. Mating disruption of leafrollers on apple. 67th Annual Western Orchard Pest and Disease Management Conference, Portland, Oregon.

Gut, L., J. Brunner, and T. Unruh. 1993. Pheromone-based pest management programs in pear. 67th Annual Western Orchard Pest and Disease Management Conference, Portland, Oregon.

Gut, L.J. & J.F. Brunner. 1994 (submitted). Mating disruption of codling moth in apple and pear. 68th Annual Western Orchard Pest and Disease Management Conference, Portland, Oregon.

Gut, L.J. & J.F. Brunner. 1994 (submitted). Mating disruption of pandemis and obliquebanded leafrollers. 68th Annual Western Orchard Pest and Disease Management Conference, Portland, Oregon.

Gut, L.J. & J.F. Brunner. 1994 (submitted). Monitoring codling moth with pheromone traps in conventional and pheromone treated orchards. 68th Annual Western Orchard Pest and Disease Management Conference, Portland, Oregon.

4. Popular articles:

Gut, L.J., J.F. Brunner and A.K. Knight. 1992. Mating disruption as a control for codling moth and leafrollers. Good Fruit Grower 43: 56-60.

5. Talks at grower meetings:

Legislative tour, Wenatchee - May, 1991.

Washington Horticulture Association, Wenatchee - December, 1991

North Central Washington Annual Pear Day, Wenatchee - December, 1991

Oregon Horticulture Society, Portland, Oregon - January, 1992.

Dovex growers meeting, Wenatchee - January, 1992

Columbia fruit packers growers meeting, Wenatchee - February, 1992

Horticultural & Traffic Association of Okanogan County, Omak - February, 1992.

Chamberlin distributors growers meeting, Chelan - February, 1992

Tilth (organic grower conference), Chlelan - February, 1992

Tonasket Pest Management Seminar, Tonasket - March, 1992.

Beebe orchards growers meeting, Chelan - March, 1992

North Central Washington Fieldmans Assoc. meeting, Wenatchee - April, 1992.

Washington Horticulture Association, Yakima - December, 1992.

Oregon Horticulture Society, Portland - January, 1993.

Tilth (organic grower conference), Yakima - February, 1993

Cherry Pest Shortcourse, The Dalles - February, 1993.

Blue Mountain Growers Association, Milton-Freewater, Oregon - February, 1993.

Dovex growers meeting, Wenatchee - March, 1993

North Central Washington Fieldmans Assoc. meeting, Wenatchee - June, 1993

Colorado High Density Apple Producers, Grand Junction, Colorado - June, 1993.