PROJECT NO.: ARS (Final Report)

TITLE: The Amount and Type of Pheromone Needed to Control Codling Moth by Mating Disruption

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REPORTING PERIOD: January 1991 - December 31, 1996

ACCOMPLISHMENTS:

During this study I conducted a very large number of experiments aimed at optimizing the use of sex pheromones by growers to control codling moth. Specific issues that I evaluated included: the importance of pheromone blend, dispenser placement, point source density, and dispenser emission rate. Trials were run to compare various commercial products. A number of dispenser's emission rates were measured. A more complete review of this project can be obtained by reading the yearly progress reports.

RESULTS:

1) No difference was found in the effectiveness of the three versus one component pheromone blend in disrupting codling moth.

2) Placement of dispensers higher in the tree versus lower increased the amount of disruption especially for female moths positioned higher in the canopy.

3) A predictive model was developed for estimating the emission of pheromone from ISOMATE-C dispensers as a function of temperature and accumulated degree days.

4) Changes in the residual content of ISOMATE, CHECKMATE, TNO, ECOPOM, and Herocon dispensers were measured over several years.

5) Various studies were conducted that evaluated the level of disruption obtained with different number of point sources per area. Over several years I found that disruption was always better with more point sources per area. For example, in 1995 I reported that disruption of female-baited traps was significantly higher with 400 than either 100 or 200 point sources per acre. No significant differences were seen between point sources releasing 1 or 2 mg per d at these dispenser densities. However, the effect of point source density and release rate on moth catch by traps baited with either 1 mg or 10 mg lures was not significant.

6) Evaluated the effectiveness of the isomer blend versus the standard codlemone pheromone for disruption. The isomer blend outperformed the standard in 1994. No difference was found in smaller trials conducted in 1996.

7) In 1995 four 10 acre plots of ISOMATE C++, CHECKMATE, CIDETRAK, and Ecogen's black spiral were each tested in grower's orchards near Mattawa, Wapato, Brewster, and Tonasket. Orchards were mature Red Delicious trees. Orchards were monitored with both 1 mg-baited and 10 mg-baited lures. Fruit injury was assessed at mid-season and prior to harvest. The data are presented in Table 1. Population pressures were low in each block. The data suggest that in the Wapato orchard the Checkmate dispenser provided poor control and the grower applied one cover spray late in the season, all dispensers' performances were similar in Mattawa, and the Isomate product performed the best among dispensers in Tonasket. The orchard in Brewster was unexpectively sprayed out.

8) **Results from 1996.** Plots (0.5 acre) treated with ISOMATE-C+, CHECKMATE, or left untreated (n=3) were established in an apple orchard near Moxee. Pheromone dispensers were applied on 25 April. ISOMATE and CHECKMATE were applied at 400 and 120 dispensers per acre, respectively. CHECKMATE was reapplied on 9 July at the same rate. A single trap baited with a 1 mg lure and twenty

virgin-female-baited traps were placed in each plot. Each test ran for two weeks. Lures and moths are replaced weekly. Each week 200 laboratory-reared male moths are released in each plot. The data are presented as summaries of the number of moths caught in the four 1 mg-baited traps and the number of female traps catching at least one moth (out of the 120 traps) and the total number of males caught by these traps.

Date	Check			ISOMATE-C+			CHECKMATE C		
	1mg caught	# F-traps	# males	1mg caught	# F-traps	# males	1mg caught	# F-traps	# males
2-22 May	64	16	16	5 3 **92** **81**	3 **81**		12 3 **81** **81**	3 **81**	
12-24 June	163	44	79	27 8 **83** **90**	8 **82**		37 3 **77**	3 **93**	**96**
29 July - 13 Aug	298	44	75	54 9 **82** **88**	9 **80**		212 21 **19** **72**	14 **68**	
3-17 Sept.	175	19	30	20 6 **88** **80**	6 **68**		98 11 **44** **63**	10 **47**	

The **bold number** is the percentage reduction versus the check plot.

PUBLICATIONS:

Results from these various studies have been published and presented through many mediums. The following is a list of published articles.

Williamson, E. R., R. J. Folwell, F. Howell, and A. Knight. 1996. Economics of mating disruption of codling moth in Washington apple orchards. Crop Protection. 15: 473-477.

Gut, L., J. Brunner and A. Knight. 1995. Implementation of pheromone-based pest management programs in Washington. Proc. Wash Hort Assoc. 91:

Knight, A. L. 1995. The impact of codling moth (Lepidoptera: Tortricidae) mating disruption on apple pest management in Yakima Valley, Washington. J. Entomol. Soc. Brit. Columbia 92: 29-38.

Knight, A. L. 1995. Evaluating pheromone emission rate and blend in disrupting sexual communication of codling moth, *Cydia pomonella* (Lepidoptera: Tortricidae). Environ. Entomol. 24: 1396-1403.

Knight, A. L., J. F. Howell, L. M. McDonough & M. Weiss. 1995. Experimental studies of mating disruption of codling moth, *Cydia pomonella* (Lepidoptera: Tortricidae). J. Agric. Entomol. 12: 85-100.

Knight, A. L. 1995. What do we know about the use of sex pheromones. The Good Fruit Grower 46: 37-54.