

Mating Disruption/SIR

Developing Mating Disruption for Leafrollers

Alan Knight¹, Steve Cockfield², Don Thomson³ and Dean Neff⁴

¹USDA, ARS, Yakima, WA

²Scientific Methods, Brewster, WA

³Pacific Biocontrol, Vancouver, WA

⁴Ecogen Inc., Pateros, WA

Keywords: leafroller, codling moth, Hamaki-con, Isomate, *Bacillus thuringiensis*, obliquebanded leafroller, apple

Leafrollers have become the big new problem for growers, especially after they have adopted softer spray programs and use sex pheromones to disrupt codling moth (MD). At present, growers have only a few chemical tools to manage leafrollers, but soon several new options will become available. I have been investigating the potential of using sex pheromones to disrupt leafroller populations since 1992. The first three years were devoted to determining the best sex pheromone blend, release rate and dispenser density. Since 1995 I have been testing the performance of several pheromone products in growers' orchards.

Three projects will be reviewed: a hand-tied dispenser (Hamaki-con) for leafrollers, a sprayable formulation (MEK) for leafrollers and a hand-tied dispenser for both leafroller and codling moth (DUAL). The Hamaki-con dispenser has been tested for control of several leafroller species around the world and is currently registered in Asia for pests of tea and apple. This dispenser has a good emission rate (1.1 mg per day for 150 days), but its use would add another application cost for growers already using MD for codling moth. MEK is a microbead formulation that can be applied by conventional sprayers. Similar products are used in tomatoes and cotton, but we know little about its emission characteristics of codlemone or its persistence in the tree canopy following application. The DUAL dispenser is a hand-tied rope product that has recently been widely used in Italy. Its use would reduce the application cost to combat both pests, but the earlier application timed for codling moth wastes the leafroller pheromone.

Hamaki-con, 1995-96

This study was conducted within a 1,200-acre contiguous planting situated near Brewster, WA. The entire orchard is treated with ISOMATE C+ for disruption of codling moth. The obliquebanded leafroller (OBLR) has been a major concern in this area for several years. During 1994, lure-baited traps averaged over 400 OBLR moths and, despite up to 8 applications of *Bacillus thuringiensis*, fruit injury exceeded 0.5% in over half the acreage. In 1995 we established three 40-acre plots treated with Hamaki-con at 400 dispensers per acre. Conventional check plots were also established. Each pheromone-treated block was subdivided into a central 5-acre and an outer 35-acre area. One lure-baited trap was placed in the center and 8 traps in the outer area. Seven female-baited traps were placed in each area and females were replaced weekly. During peak male flight 60-100 tethered females were placed in each area overnight. Females were dissected to determine if they had mated. Trees within each plot were inspected in the spring for 3.5 hours for overwintering larvae. One hundred trees (10 shoots per tree) were

sampled for larvae during August in each plot. Two thousand fruits were checked for injury prior to harvest from each plot.

Populations of OBLR were reduced in the MD versus the check plots: overwintering populations were 30% in the second year; both lure and female-baited trap moth catches were reduced >90%; summer larval populations were 10-20% lower; and fruit injury was 50% lower the first year but no difference occurred in the second year. Little difference in the level of disruption or population density of OBLR was found between the inside and outside areas within pheromone-treated blocks. Growers used \$80 less insecticide per acre to manage leafrollers in the disrupted orchards compared with the check blocks.

While the Hamaki-con dispenser is not likely to be registered in the US, our conclusions from this two-year study should relate to any product that may be used for disruption of OBLR. First, we found that disruption is poor in areas with a high population density of resident moths. Second, we found that disruption is poor in areas adjacent to high population density. Third, larval populations can develop in areas despite high levels of adult disruption. This is likely due to the immigration of mated females into these areas. Fourth, based on this grower's use of alternative, selective control measures for leafrollers, the cost of MD for leafrollers should be less than \$50 per acre.

MEK, 1996

The MEK product utilizes a technology developed by 3M to place the sex pheromone inside 20 micron beads that can be applied by conventional sprayers. Last year we evaluated this product on small, non-bearing apple trees and found that it was active for ca. three weeks. This year we conducted similar tests but with larger, bearing trees and we also evaluated it in a small orchard trial. Three rates of pheromone (6, 12, and 24 g per acre) were applied once to replicated 0.25 acre apple plots for disruption of OBLR. Performance of this product was best with the highest rate tested, however, disruption of lure-baited traps lasted only three weeks. Three applications of the 12 g per acre rate were made in a 10 acre block on the 13th of June, July, and August to evaluate its performance relative to a comparable untreated orchard. Results from this unreplicated trial showed a moderate level of trap disruption and ca. 50% lower fruit injury than the comparison block. Further evaluation of this product is needed, especially its emission characteristics and persistence in the canopy. Testing of the MEK formulation in larger, replicated blocks is planned for 1997.

DUAL, 1996

We have been evaluating a dual dispenser in small plots since 1994, and its characteristics have changed and been improved each year. Recently this product has been widely used in Italy (ISOMATE C-SPECIAL), and this year was the first testing in growers' orchards in the US. The DUAL dispenser was placed in three 20-acre plots and populations were compared with similar conventional blocks treated with *Bt*. During 1996 the overwintering OBLR populations were high in the three DUAL sites. Disruption as measured by lower moth catches in lure-baited traps looked good (99%), except downwind and adjacent to high pressure sites (ca. 65%). Codling moth populations appeared to be low in these blocks as catches of CM averaged only 1 moth per trap. Yet, fruit injury by codling moth was high in 2 of the 3 blocks and all the injury occurred late. Injury by leafrollers was much lower in 2 of the 3-block

comparisons.

An apparent explanation for these significant levels of fruit injury can be drawn from the dispenser's performance late in the season. The DUAL dispenser had a good, linear release rate during the summer and had a higher daily release rate of codlemone than the ISOMATE C+ dispenser but a lower release rate of the leafroller pheromone than the Hamaki-con dispenser. Nevertheless, the DUAL dispenser ran out of codlemone by the first of September and the leafroller pheromone by mid-September.

Modifications of the DUAL dispenser have been made and will be evaluated this winter in the southern hemisphere. Next year we hope to initiate a larger project in the Brewster area with a new ISOMATE C-SPECIAL dispenser.