Mating Disruption/SIR

Evaluation of new mating disruption formulations

David Epstein, Larry Gut, Peter McGhee and Mike Haas
Michigan State University, East Lansing, MI

Keywords: Codling moth (*Cydia pomonella*), oriental fruit moth (*Grapholitha molesta*), obliquebanded leafroller (*Choristoneura rosaceana*), apple, pheromone mating disruption

Abstract: Mating disruption is a novel technique that has been used successfully by many apple growers for control of one or more pest species. However, this approach has not been widely adopted in some apple production regions, including Michigan. Among the factors that contribute to the relatively low adoption of mating disruption in some areas are the high cost of the technique and the presence of several pests that growers may have to contend with, including oriental fruit moth and leafrollers. Sprayable disruption formulations, hand-applied delivery systems that target multiple pest species, or widely spaced devices may have a better fit under these conditions. Sprayable pheromones could be readily incorporated into current programs that include a number of sprays for diseases, insects and mites. A sprayable product could be used on an as-needed basis rather than as an expensive preventive control. Formulations targeting different pest species could be tank-mixed. Trials conducted in Michigan in 2002 demonstrated that frequent application of very low rates of sprayable pheromones was a highly economical and effective tactic for control of OFM and showed promise for other pests as well. The performance of OFM sprayable pheromone was significantly improved by adding Nu-Film 17. Under low to moderate pest pressure, hand-applied delivery systems that target multiple pest species also were found to be efficacious and may fit well in apple IPM programs in Michigan and elsewhere where several lepidopteran pests are a problem in apple.

Introduction

Mating disruption is a novel technique that has been used successfully by many apple growers for control of one or more pest species. However, this approach has not been widely adopted in some apple production regions, including Michigan. Among the factors that contribute to the relatively low adoption of mating disruption in some areas are the high cost of the technique and the presence of several pests that growers may have to contend with, including oriental fruit moth and leafrollers. Sprayable disruption formulations, hand-applied delivery systems that target multiple pest species, or widely spaced devices may have a better fit under these conditions.

Sprayable formulations. Research trials with sprayable mating disruption formulation for control of CM, OFM and OBLR were conducted on *ca.* 160 acres of commercial orchards. The overall experimental design was a direct comparison of three treatments: 1) a low rate of sprayable pheromone, 2) a high rate of the same formulation and 3) a non-pheromone control (insecticides only). Commercial orchards ranging in size from 15 to 30 acres were divided into 3 blocks. The low-rate pheromone treatment entailed applying 2.5-5.0 g ai/acre every 10-14 days throughout the flights of the targeted pest. This protocol was to simulate a program in which the

pheromone is tank-mixed with the regular fungicide or insecticide sprays often required for disease and insect control in Michigan apple. The high-rate pheromone treatment entailed one application of 20-30 g ai/acre per generation. Capture of males in pheromone traps baited with lures and levels of fruit injury were used to evaluate treatment effects in test plots.

Table 1. Fruit injury in blocks treated with high or low rates of sprayable pheromone (3M Corporation) plus companion insecticides or insecticides only

		Midseason		Preharvest	
Location	Treatment	CM/OFM	LRs	CM/OFM	LRs
Ridge 1	High rate	0.7	0	2.8	2.5
	Low rate	0	0.2	0.8	2.7
	Insecticides	1.3	1.0	14.5	4.8
Ridge 2	High rate	0	0.5	0	1.9
	Low rate	0	0	0.2	1.9
	Insecticides	0.2	0.3	0	1.1
Southwest	High rate	0	1.0	0	1.0
	Low rate	0	0	0	1.0
	Insecticides	0	1.0	3.0	3.0

The highest levels of trap shutdown were recorded for OFM in blocks treated frequently with low rates of sprayable pheromone (close to 100%). Inhibition of moth captures was less dramatic for OBLR and CM, but the addition of pheromone to the insecticide spray program did appear to improve control. At the two sites with higher CM and OBLR pressure (Ridge 1 and Southwest), sprayable pheromone plus companion insecticides provided better fruit protection than insecticides only (Table 1).

Addition of NuFilm-17. Our efforts to increase the longevity of sprayable formulations have focused on testing new formulations or the effects of adding various stickers. The overall experimental design in 2002 trials was a direct comparison of each formulation with and without Nu-Film 17 added as a sticker and UV protectant, and an untreated control. The tests were not set up to compare different formulations (Suterra, MEC and Thies) targeting the same pest. A randomized complete block design was used to test Suterra formulations, with treatments applied to three 1-acre blocks, replicated in three locations at the MSU Trevor Nichols Research Station. MEC treatments were applied to three 1-acre blocks in two locations, and Thies formulations were tested in unreplicated 1-acre blocks. Male captures in pheromone traps were used to evaluate the performance of pheromone treatments. Pheromone traps baited with standard lures (red septum loaded with 0.1 mg for OFM or 1 mg for CM and OBLR) were placed in orchards at a density of 2 per test block. The number of male moths captured was recorded weekly.

Under very high OFM pressure, sprayable pheromone generally provided 70-100% inhibition of moth captures in pheromone-baited traps, with up to 7 weeks of activity (Figs. 1-2). Adding Nu-Film 17 enhanced the performance of Suterra and 3M formulations of OFM

sprayable pheromone (Figs. 1 and 2). During the second and third generation OFM flights, significantly higher levels of inhibition of moth captures were recorded when the sticker was included with the pheromone. Addition of the sticker did not improve performance of the disruption formulation during the first generation flight. Interestingly, Nu-Film 17 also did not improve the performance of any of the codling moth or leafroller formulations tested (data not shown).

Multispecies 'rope' dispensers. The performance of two experimental mating disruption formulations for control of codling moth (CM), oriental fruit moth (OFM), obliquebanded leafroller (OBLR) and redbanded leafroller (RBLR) was evaluated in large block trials in apple. Isomate CD/LR/OFM is a rope dispenser containing the major pheromone components of all four species, and Isomate CM/OFM is a rope dispenser loaded with the major pheromone components of CM and OFM. A total of 18 blocks comprising *ca.* 180 acres of commercial orchards was involved in the trials. The overall experimental design was a direct comparison of an experimental multi-component disruption formulation, one or more registered Isomate dispensers as a positive control, and a no-pheromone control at multiple locations. Pheromone treatments were applied prior to the start of CM flight in the spring at rates of 280-300 dispensers per acre. Male captures in pheromone traps and terminal foliage and fruit injury caused by larval feeding were used to evaluate the performance of pheromone treatments.

Treatment with pheromone provided essentially 100% inhibition of RBLR moth captures in pheromone traps for the entire season. Isomate CD/LR/OFM or CM/OFM also consistently inhibited OFM moth captures during the first generation flight. Percent trap shutdown at all sites was nearly 100%. Second generation catches were also close to zero, but moth captures increased dramatically during the third flight, *ca.* 90 days post-treatment. After this period, OFM captures increased dramatically, peaking at levels higher than the untreated check. Treatment with pheromone inhibited OBLR captures through August but not to the same extent as for RBLR. The pheromone treatments had substantially weaker effects on CM orientation to traps, with consistently high numbers of moths captured during both the first and second flights. Overall, the pheromone treatments provided less than 75% trap shutdown during the second flight. Low levels of fruit injury were recorded in all of the experimental blocks at midseason, with similar values for pheromone or non-pheromone treatments. Higher levels of injury were recorded prior to harvest. The CD/LR/OFM treatment, plus reduced use of insecticide programs, provided levels of control similar to the no-mating disruption program. Internal fruit injury across all sites averaged 3.3 in the CD/LR/OFM plots and 3.6 in the no-pheromone plots. External (leafroller) fruit injury across all sites averaged 2.6 in the CD/LR/OFM plots and 2.1 in the no-pheromone plots. The Isomate CM/OFM, plus reduced use of insecticide program, provided levels of control of the first generation that were similar to those achieved in the insecticides-only program (no pheromone). However, pheromone plus companion insecticides was less effective against second generation CM. A mean of 3% internal worm injury was recorded in the four blocks treated with the CM/OFM formulation compared to 0.2% in the other two treatments.

Summary

Trials conducted in Michigan in 2002 demonstrated that frequent application of very low rates of sprayable pheromones was a highly economical and effective tactic for control of OFM

and showed promise for other pests as well. The performance of OFM sprayable pheromone was significantly improved by adding Nu-Film 17. Sprayable pheromones could be readily incorporated into current programs that include a number of sprays for diseases, insects and mites. A sprayable product could be targeted for specific flights as opposed to the usual season-long approach. Formulations targeting different pest species could be tank-mixed. Under low to moderate pest pressure, hand-applied delivery systems that target multiple pest species also were found to be efficacious and may fit well in apple IPM programs in Michigan and elsewhere where several lepidopteran pests are a problem in apple.

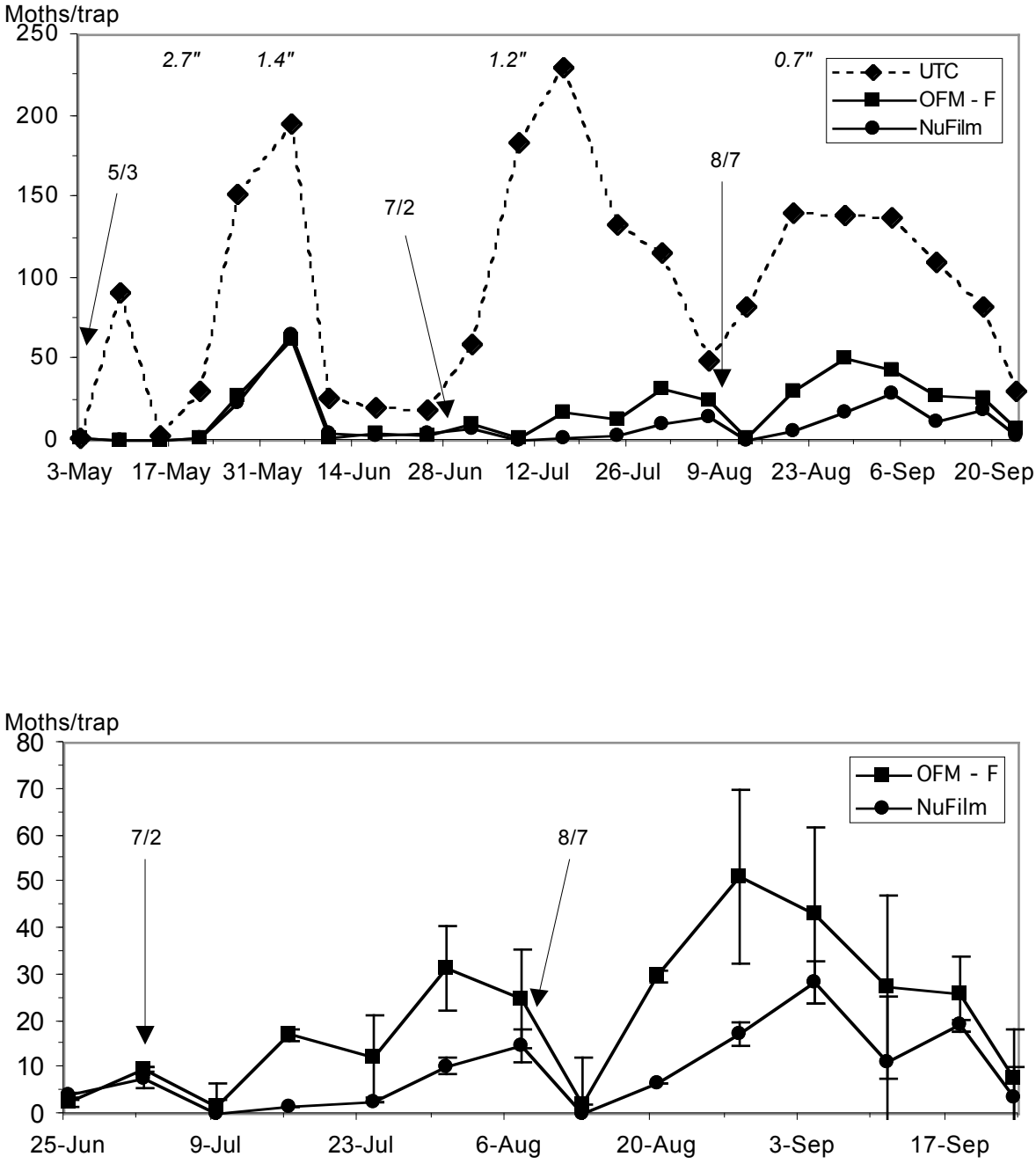

Figure 1. Mean oriental fruit moth captures per week in apple blocks treated with Suterra sprayable pheromone (OFM-F) with or without Nu-Film 17 (top and bottom graphs) and in non-pheromone treated blocks (top graph only).

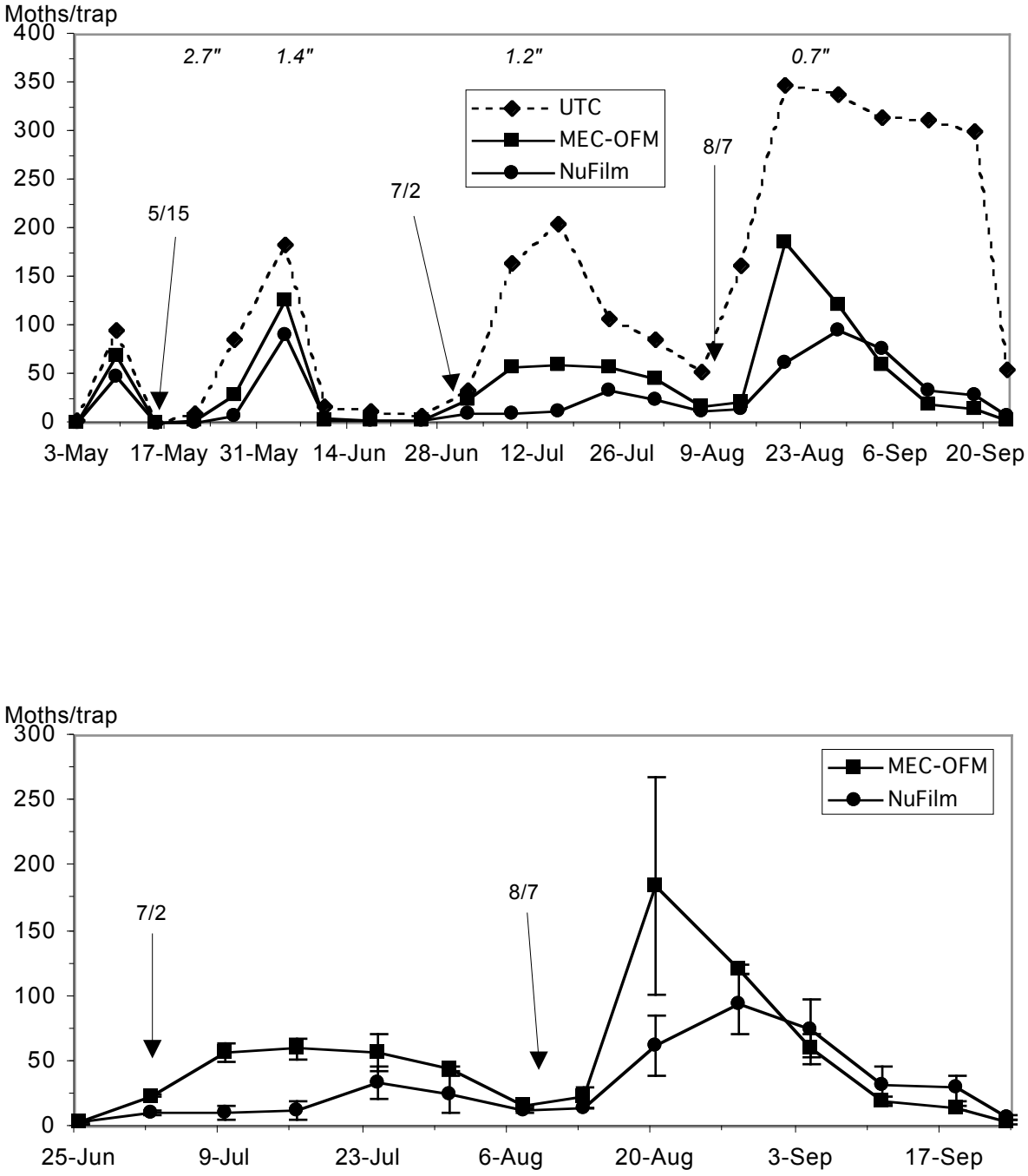

Figure 2. Mean oriental fruit moth captures per week in apple blocks treated with 3M sprayable pheromone (OFM-F) with or without Nu-Film 17 (top and bottom graphs) and in non-pheromone treated blocks (top graph only).