

MANAGEMENT OF ORIENTAL FRUIT MOTH IN APPLES USING
DIFFERENT PHEROMONE DISPENSER TECHNOLOGIES AND
IN-SEASON FRUIT DAMAGE INSPECTION
2005

Arthur M. Agnello and Harvey Reissig
Dept. of Entomology
New York State Agricultural Experiment Station, Geneva

This trial was conducted in mixed plantings of fresh and processing apples on five commercial farms in Wayne, Orleans and Niagara Counties, NY. A low-density pheromone "packet" dispenser, a sprayable plastic micro-flake, and a standard "twist-tie" dispenser were compared for efficacy in managing the internal-feeding Lepidoptera species, oriental fruit moth (OFM), *Grapholita molesta*, when applied against the 2nd and 3rd generations of this pest. Apple varieties included Gala, Rome, Golden Delicious, Red Delicious, Ida Red, Mutsu, Ben Davis, 20-Ounce and McIntosh.

Materials & Methods

In 2005, OFM management programs were tested in five "moderate-risk" commercial orchards, using three different pheromone dispensing technologies, as well as a modified fruit sampling procedure to assess the need and timing for special pesticide sprays directed against the 2nd and subsequent generation of this species. The pheromone treatments used were: 1) Isomate-M plastic ties; 2) MSTRS OFM high-yield, low-density pheromone packets; 3) Hercon Disrupt Micro-Flake OFM, a sprayable plastic laminate, all applied against the 2nd and subsequent generations of OFM. In five additional "moderate-risk" commercial orchards, growers applied their conventional pest management programs (including one orchard where pheromones were used), and the fruit sampling procedure was used to determine the need for specific additional internal worm treatments based on the occurrence of new fruit feeding. In all cases, growers managed the first generation of OFM with their conventional pesticide applications that were directed primarily against plum curculio and obliquebanded leafroller occurring at and immediately following petal fall.

The Isomate-M 100 (CBC America Corp., Commack, NY) was a polyethylene rope (or "tie") containing 232.1 mg of OFM pheromone blend (88.5 : 5.7 : 1.0% of Z:E8-12:OAc : Z8-12:OH), deployed at a rate of 250 ties per ha (100 per acre).

A pheromone packet treatment, using "MSTRS" technology (Metered Semiochemical Timed Release System, AgBio Inc., Westminster, CO) consisted of food-grade plastic enclosing a 6.4 x 6.4 cm natural fiber pad containing 65.8 g of OFM pheromone (85.4 : 5.5 : 0.9% of Z:E8-12:OAc : Z8-12:OH), which was deployed in a grid pattern at a spacing of 27.4 m (90 ft) between dispensers, resulting in densities between 12.4–20 per ha (5.0–8.0 per acre). A pole+hoop applicator was used to position the dispensers in the top one-third of the tree canopy. Deployment of both of the above dispensers took place from 17–21 June. At one orchard, however—Knapp, an organic block—the MSTRS treatment was deployed in a second plot on 10 July, in place of the Disrupt Micro-Flake treatment, which was not organically certified.

The Disrupt Micro-Flake OFM (Hercon Environmental, Emigsville, PA) was a 3 x 3 mm solid matrix laminate chip impregnated with 7.83 : 0.51 : 0.08% Z:E8-12:OAc : Z8-12:OH,

applied at a rate of 70.8 g a.i. per ha (28.67 g a.i. per acre), or 852 g of flakes per ha (12.2 oz of flakes per acre) using a modified leaf blower mounted on an ATV travelling at 8–10 mph down the rows. The flakes were stuck to the tree foliage using a mixture (9.35 liters per ha; 1 gal per acre) of acrylic sticker and guar gum thickener applied as they were blown from the machine. All the Micro-Flake treatments were applied on 7–8 July.

Pheromone treatment efficacy in depressing adult male trap catch was monitored by using 4 Pherocon IIB traps per plot (2 at the row ends and 2 in the plot interior), each baited with a standard Scentry oriental fruit moth lure, and checked weekly from 9 May to 29 August. In addition, 2 traps each for codling moth (CM), *Cydia pomonella*, and lesser appleworm (LAW), *Grapholita prunivora*, were placed in the interior of each plot and also monitored weekly, to maintain information on background levels of these other potentially damaging pests in the event that unanticipated fruit injury was detected at harvest. Lures in all traps were changed in mid-July.

The fruit sampling protocol consisted of weekly on-tree fruit inspections conducted from mid-July through August, comprising 300 fruits per plot (20 on each of 15 trees) during the first week and 100 fruits per plot (10 on each of 10 trees) on subsequent weeks, for each of the 2nd and 3rd generations, to detect the initial occurrence of any OFM larval fruit damage in time to curtail further infestation. Whenever an inspection session resulted in detection of at least one damaged fruit, the grower or his consultant was notified so that they could determine whether a special spray of a selective pesticide was needed for control of internal Lepidoptera.

Results

Trap catches of OFM were generally suppressed to low levels in all pheromone treatment plots during the mid- and late summer, although some breakthrough captures did occur, so trap shutdown was not absolute in all cases (Fig. 1). Two plots with notable OFM catches were the Isomate and Micro-Flake treatments at the Bittner site. These plots were located near a non-disrupted organic apple planting with a high OFM population, so it is possible that immigration from that block was too severe to be completely disrupted by the pheromone treatments in our plots. The Bittner site also recorded a relatively high CM catch during the first flight in June. Trap catches in the insecticide-treated plots differed among the sites, with some farms at or near zero for both species all season, and others catching relatively large moth numbers (Fig. 2). The highest numbers of OFM and CM were caught at DeBadts and Kast, respectively, but the Russell site had relatively large catches of both species. Interestingly, if the proposed trap catch thresholds of 10 OFM and 5 CM/trap/week had been used as a basis for making control sprays, our management recommendations would have been much more conservative than they were using the evidence of fruit-feeding damage.

The fruit sampling procedure was convenient to implement, requiring 10–15 min per plot, and seemed to effectively allow detection of low-level infestations at a very early stage, so that the growers could be notified of any extra needed control measures in a timely fashion. Incidence of fruit injury was extremely low except for the Knapp (organic) site, which was the only pheromone plot location where more than 1 damaged fruit was detected per sampling bout (Table 1). No damaged fruits were found during the 8 weekly samples in any of the Isomate plots; damage was detected 3 times each in any MSTRS and Hercon flake plots. In the insecticide-treated plots, damaged fruit was found during only one of these sessions, near the end

of August. The high incidence of in-season fruit damage seen at the Knapp site was a result of high endemic pressure, of mostly OFM, plus the organic management regimen, which consisted of kaolin clay and B.t. for the 1st generation, and Cyd-X (codling moth granulosis virus) applied 4 times against the summer generations (20 July, at 5 oz/A; and 4, 20, 31 Aug, at 3 oz/A).

Our notifications to the growers of finding fruit damage during the season did not always result in a decision to apply an extra spray for internal worm control. The 2 such occasions at the Oakes site happened to correspond with the grower's scheduled applications of materials (i.e., Spintor and Assail) against other pests that also had some activity against OFM. Because of the farm's pest history, the Knapp orchard was on a preventive Cyd-X schedule, which was anticipated to have some effectiveness against OFM, so the grower was not relying on our reports for his spray decisions. At the Bittner site, a spray was applied for internal worms in all the pheromone plots, even though damage was found in only one treatment on 1 Aug, because of the grower's concern about the orchard's proximity to undisrupted moth populations.

Fruit damage caused by internal-feeding Lepidoptera at harvest was very low in all treatments at 3 of the 5 pheromone disruption sites (Table 2). At the Bittner site, the Isomate plot sustained approximately 10% fruit damage, although its proximity to a nondisrupted organic planting with a high population could have been a contributing factor. Additionally, the 1st generation CM we detected was not being disrupted, and damage from this species was likely included in the harvest evaluation, as no effort was made to distinguish between OFM and CM damage. The Knapp organic site had previously suffered relatively high fruit damage the previous season. Damage in all the treatments here ranged from 7–17% damage, which the grower indicated was acceptable for the organic processing market, and a measurable improvement over the previous season. No appreciable internal Lepidoptera feeding damage occurred in any of the 5 insecticide-treated plots.

Although the pheromone treatments tested were generally a useful component of the OFM management programs in these orchards, some factors can be identified as potentially contributing to less than perfect fruit quality: Plot size was not large enough to overcome the possibility of immigration by mated females; OFM population pressure was sometimes too high to be effectively disrupted by the pheromone treatments; the pheromones were applied only against 2nd and subsequent generations, leaving the potential for the 1st generation to contribute to fruit damage. More research should be done in future seasons and more locations to continue to test the effectiveness and reliability of the fruit damage inspection system. Nevertheless, it may be difficult to convince growers that any level of damage from internal Lepidoptera is acceptable in their orchards.

Acknowledgments

Thanks are due to J. Bittner, D. Bartleson, R. DeBadts, T. Kast, S. Knapp, D. Oakes, C. Pettit, and P. Russell for allowing these trials to be conducted on their farms; to M. Burlee, J. Eve, J. Misiti, and R. Paddock for coordinating the setup and maintenance of the plots and communications with the growers; to Dorothy and Dianne Mitchell, Rachel Mussack and Rachel Falkey for field assistance in plot establishment and data collection, and for T. Baker and J. Meneley (AgBio, Inc.), P. MacLean (Hercon Environmental), and G. Stamm (CBC America) for their cooperation in providing and helping to apply the pheromone products; and M. Dimock (Certis USA) for donating the Cyd-X used in this study. This work was partially funded by a grant from the NY Apple Research and Development Program and Motts (Cadbury Schweppes).

Table 2. Percent deep (internal) and sting (surface) fruit injury¹ at harvest in pheromone- and insecticide-treated plots, 2005.

Site	Treatment	Deep	Sting	Clean
Bittner	Isomate	9.3 b	0.3 b	90.4 b
	MSTRS	2.0 a	0.1 ab	97.9 a
	Hercon Flake	1.0 a	0.0 a	99.0 a
Oakes	Isomate	0.1 a	0.1 a	99.8 b
	MSTRS	1.6 b	0.2 a	98.2 ab
	Hercon Flake	0.6 a	0.1 a	99.3 b
	Insecticide Std	1.6 b	0.2 a	98.2 a
DeBadts	Isomate	0.0 a	0.0 a	100.0 a
	MSTRS	0.0 a	0.0 a	100.0 a
	Hercon Flake	0.0 a	0.0 a	100.0 a
	Insecticide Std	0.0 a	0.0 a	100.0 a
Bartleson	Isomate	0.1 a	0.0 a	99.9 a
	MSTRS	0.1 a	0.1 a	99.8 a
	Hercon Flake	0.0 a	0.0 a	100.0 a
Knapp	Isomate	7.2 a	0.6 a	92.2 a
	MSTRS-1	15.6 b	2.1 a	82.3 b
	MSTRS-2	6.0 a	0.9 a	93.1 a
Russell	Insecticide Std	0.2	0.0	99.8
Pettit	Insecticide Std	0.0	0.0	100.0
Kast	Insecticide Std	0.2	0.1	99.7

¹Within a site, values in the same column followed by the same letter are not significantly different at $P=0.05$ level (Fisher's protected lsd test).

Fig. 1. Pheromone trap catches (lines), in-season fruit infestation detection (asterisks) and harvest fruit damage (bars) in five WNY orchards receiving pheromone treatments against 2nd-3rd generation OFM, 2005

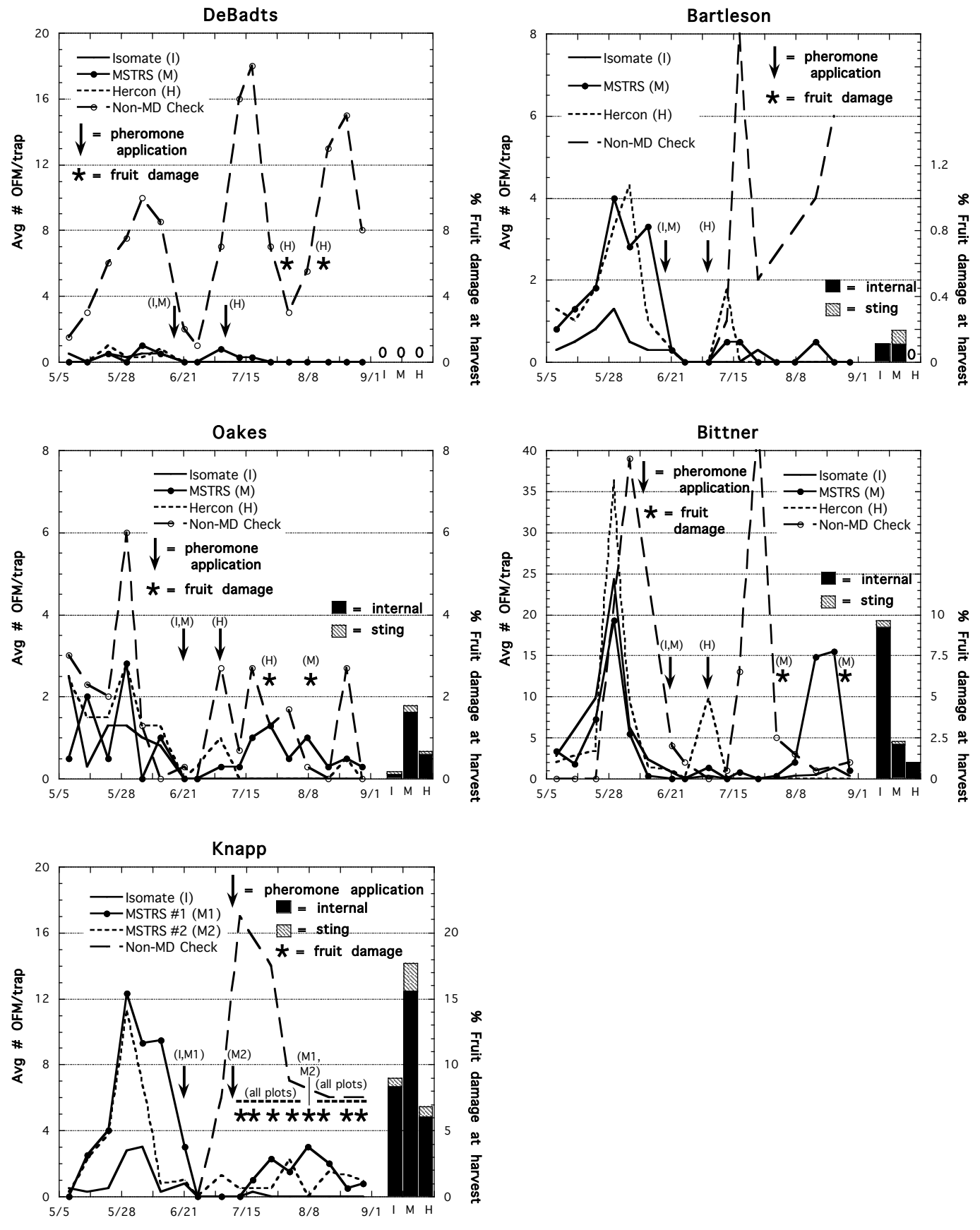


Fig. 2. Pheromone trap catches of oriental fruit moth and codling moth in standard insecticide-treated plots, WNY 2005.

