Thresholds/Monitoring

Progress in Developing More IPM Compatible Techniques for Controlling Oriental Fruit Moths Infesting Apple Orchards in Western New York

Harvey Reissig, Art Agnello, and Jan Nyrop
Entomology Department, NYSAES, Geneva, NY

Keywords: oriental fruit moth, *Grapholita molesta*, apple, mating disruption, insecticides, trap catch thresholds, fruit sampling, DD models, risk classification

Abstract: Studies were conducted in 2004 to evaluate multi-tactic management programs integrating mating disruption and improved timing of IPM-compatible insecticides in large-scale plots in grower orchards. Three different OFM control programs were tested in 10 grower orchards in western NY: 1) seasonal mating disruption, 2) optimum chemical control, and 3) a monitoring program based on fruit sampling and pheromone trap catches. All three programs provided excellent control of fruit damage except in one "high risk" orchard. No late season damage was observed in any of the test plots from OFM during the 2004 growing season. OFM development was later than normal in NY apple orchards during the 2004 growing season, and the Pennsylvania DD model did not predict OFM activity accurately. Mating disruption may eliminate a need for special chemical control sprays against OFM except in very "high risk" orchards. Pheromone monitoring traps can be useful in determining the need and timing for control sprays but additional work is needed to test this concept. Monitoring fruit on trees during the season can accurately detect low levels of damage in time to apply appropriate control sprays, but the technique may be too laborious for consultants or growers to use.

NY apple growers have experienced difficulty in controlling internal lepidoptera, primarily oriental fruit moth (OFM), since the 2001 growing season. In 2003, most apple growers in western NY who had experienced unacceptable damage in the past began to intensify chemical control programs for control of internal lepidoptera and, consequently, fewer loads were rejected (13) from only about 11 growers. Even though western NY apple growers achieved temporary success in reducing internal lepidoptera damage in 2003, many applied frequent sprays and used materials such as synthetic pyrethroids that are incompatible with IPM programs. Although such intensive control programs may be necessary to achieve acceptable control in orchards with high levels of internal lepidoptera infestation, more cost-effective, IPM-compatible management programs for this pest complex need to be developed in the future. The objective of this study was to evaluate a multi-tactic management program that integrates mating disruption, monitoring, and improved timing of IPM-compatible insecticides in large-scale plots in grower orchards with various histories of infestation from internal lepidoptera in western NY.

Methods

Three management systems were compared in 10 commercial orchards in western NY. Plots were set up in both "high risk" orchards that had experienced severe damage from OFM in the past and in "low risk" blocks without a previous history of infestation. All research plots were 5-10 acres, and growers applied their own sprays. Two pheromone traps for OFM, codling

moth (CM), and lesser appleworm (LAW) were placed in the center of each plot (4 OFM traps were deployed in the mating disruption plots) and checked weekly. Fruit was sampled on July 19, after the end of the activity of the first brood of OFM, and on August 2 and August 17 (1000 apples/plot, 20 apples on 50 trees).

Positive chemical control treatment. One special OFM spray was timed at the estimated first hatch of OFM eggs for each of the three generations. A pink spray was applied to control egg hatch of the first generation, although subsequent trap catch patterns showed that this flight did not start until bloom. Originally, the Pennsylvania OFM DD model (base temp=45°F) was to be used to time sprays for first hatch of the other generations, but initial, early season observations showed that the model predictions were not accurate. Therefore, sprays for the second and third broods were recommended after the accumulation of 175-200 DD after biofix in pheromone traps. Sprays were recommended during the third week of July to coincide with egg hatch of the second brood and during the last week in August for control of the third brood. Growers were advised to apply normal control sprays against other insect pests when needed throughout the season.

Seasonal mating disruption. Isomate M-Rosso ties (200/acre) were deployed in April prior to the first OFM flight. Growers were advised not to apply special control sprays for OFM unless damaged fruit was observed during the July and August fruit samples or moths were captured in the pheromone monitoring traps deployed in the blocks. Growers were advised to apply normal control sprays against other insect pests when needed throughout the season.

Monitoring treatment. A prophylactic control spray was applied at pink to coincide with the initially predicted OFM egg hatch of the first generation. No other special OFM sprays were recommended unless moth catches averaged more than 10/trap/week or fruit damage was found in monitoring bouts during late July and August. Growers were advised to apply control sprays against other insects when needed.

Growers participating in the project used a wide variety of insecticides including chlorpyrifos at the pink bud stage, phosmet, azinphosmethyl, fenpropathrin, lambda cyhalaothrin, indoxacarb, and methoxyfenozide. Damage in each plot was compared at harvest during the first week of October. One thousand apples were evaluated from each plot, and samples were stratified by examining 100 apples (20/tree) along each of the edges and 400 (100/tree) in the center of each plot.

Results

OFM seasonal phenology. The development of OFM was later in NY apple orchards during the 2004 growing season than normal, probably because of generally cool, wet conditions throughout the summer. The initial flight began during early bloom on May 13, and peak flight of the first generation was observed during the week of May 18-25. The second flight began on July 13 and peaked around July 26. The third flight did not start until the last week in August and continued during September and October.

OFM monitoring treatments. OFM catches never exceeded recommended treatment threshold levels throughout the season in 4 of the research orchards (Table 1). Trap catches exceeding thresholds were most common during the first flight of OFM (5 orchards), and only 2 and 1 of the monitoring plots exceeded the threshold levels, respectively, during the second and third flights.

Table 1. Orchards exceeding the provisional OFM trap catch thresholds in monitoring treatments.

Orchard	Risk classification	1st flight	2nd flight	3rd flight
Bartleson	High	X		
Datthyn	High	X	X	X
Debadts	High	X	X	
Verbridge	High	X		
Beckons	Low	X		
Buhr	Low			
Fox	Low			
Kalir	Low			
Pettit	Low			

X=Weekly catches exceeded 10 moths/trap.

Seasonal OFM mating disruption. The Rosso ties completely shut down OFM trap catches throughout the season, although codling moth catches were high in two of the orchards in the disrupted plots. A trace of fruit damage was observed in one of the disrupted plots (0.1%), but since codling moth catches were high in that block, this summer fruit damage was attributed to that species. In one of the high risk blocks, a low percentage of fruit damage was observed during summer sampling, and chemical sprays were recommended. No fruit damage at harvest was observed in the other mating disruption plots**.**

Summer fruit monitoring in different research treatments. No damaged fruit was observed in any treatments in 8 out of the 10 research orchards in fruit sampled during July and August. Damage was observed in all treatments during each sampling bout in one of the "high risk" orchards (Table 2). A trace of damage (0.1%) was observed in treatments in one of the low risk orchards, but since codling moth catches were high in this orchard this damage was attributed to this species.

Table 2. Comparison of summer fruit damage in OFM plots in the Datthyn orchard, 2004.

	% Damaged fruit		
Treatment	7/19	8/2	8/17
Mating disruption	0.8	0.8	0.0
Positive chemical control	2.3	3.2	1.7
Monitoring	0.5	1.1	0.3

Harvest fruit damage. The percentages of damaged fruit observed at harvest in all of the treatments in all orchards was not significantly different among treatments and was very low (Fig. 1). The Datthyn orchard was the only site in which consistent levels of fruit damage were

detected at harvest, and overall damage in this orchard was similar among the different treatments (Fig. 2). Damage in the mating disruption treatment was higher in fruit sampled from the edges of the plot than in the middle, which suggests gravid females may have immigrated into the edges of this relatively small plot from sources outside of the orchard.

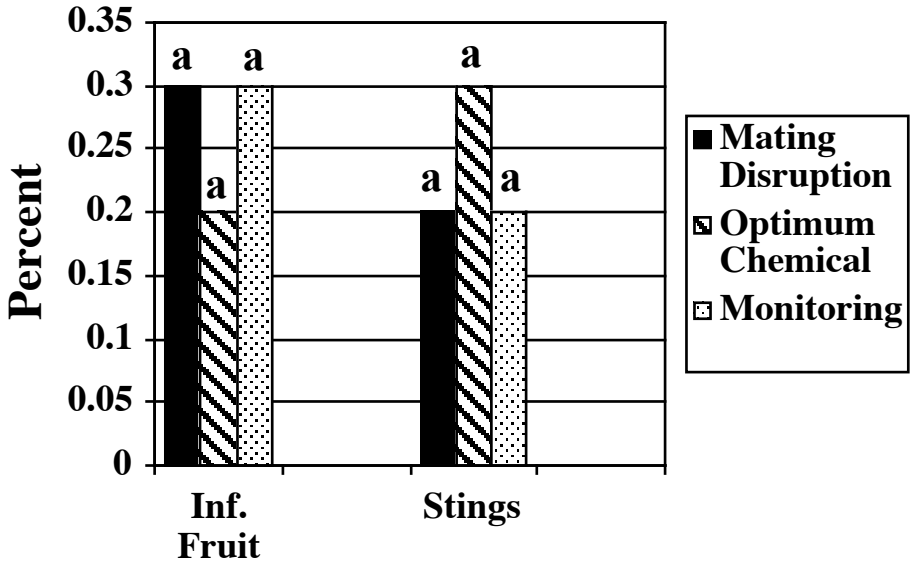

Fig. 1. Comparison of average fruit damage at harvest in different treatments in all research orchards in western NY, 2004.

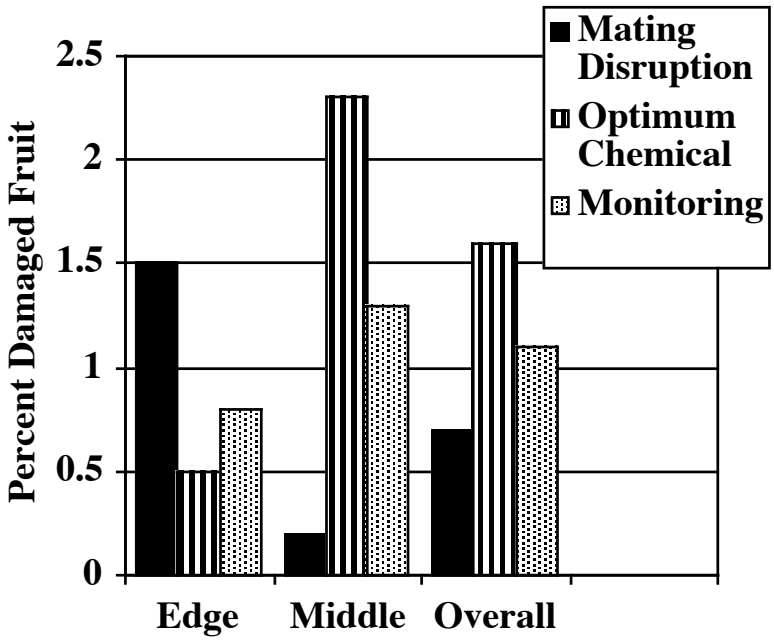

Fig. 2. Comparison of fruit damage at harvest in different OFM treatments in the Datthyn orchard, 2004.

Discussion

The Pennsylvania DD model did not accurately predict seasonal development of OFM in western NY apple orchards during the 2004 growing season, possibly because the spring and summer were unusually cool and wet. For example, the last flight started considerably earlier than predicted by this model. Because of the abnormalities of the season, it was difficult to determine when to time sprays for OFM in the proposed 3-spray optimum insecticide program. For example, the hatch of eggs from the first brood of OFM was originally predicted during bloom and, consequently, the first spray for this brood was recommended at the pink bud stage. However, since pheromone trap catches showed that the first flight did not start until bloom, petal fall would have been a better timing. The spray applied against the second brood based on estimated hatch predicted at 175-200 DD after the pheromone trap biofix, which was recommended during the third week in July, appeared to be timed correctly according to seasonal patterns of flight. However, the third flight did not start until the last week in August, and we estimated that the first hatch of third brood eggs would not occur until about the middle of September. Therefore, we advised growers to apply their last spray for OFM during the last week in August just before the Labor Day holiday in September. The flight of this last generation continued during September and October. However, based on comparisons of damage in the plots during late August and at harvest in October, it did not appear that fruit damage increased in most of the plots as a result of this late third brood activity.

The trap catches were highly variable in the monitoring plots set up in the research orchards and generally correlated with estimated risk. These initial results suggested that trap catch thresholds can be used in commercial orchards to determine when and if sprays for OFM

are necessary, although additional work may have to be done to more thoroughly test this concept.

Mating disruption was very effective in preventing OFM damage except in one high risk orchard, and observed patterns of damage suggested that injury in this block may have been due to immigration from outside sources into this relatively small plot. Therefore, it appears that mating disruption can eliminate the need for special chemical control sprays against OFM except in extremely high-risk orchards.

Monitoring fruit on trees during the season can accurately detect low levels of fruit damage in time to apply appropriate control sprays. However, this technology may not be practical for growers or consultants because it requires about 30 minutes to sample 1000 apples in a single orchard block for internal lepidoptera damage. Perhaps, in the future, this technique can be refined to require less time to monitor fruit during the season by optimizing timing so that only one session is required and reducing numbers of sampling apples so that only higher unacceptable infestation levels will be detected.