

Pheromone Mating Disruption for Conventional & Organic Orchards

by David Biddinger & Greg Krawczyk (5/15/09)

Many of the most economically important pests are moths. For these pests, synthetic chemicals have been developed based on the specific sex pheromone that the female of each species uses to lure males for mating. The direct management of insect pests using these synthetic pheromones to disrupt mating has given excellent suppression of populations. In tree fruit, the most important successes commercially have been in codling moth, Oriental fruit moth, several species of leafrollers, lesser peachtree borer and peachtree borer. Large-scale implementation trials have yielded significant reductions in pesticide use while managing crop damage levels at acceptably low levels. Because of difficulties in managing high populations of pests, these programs should not be viewed as stand-alone strategies, but rather as one tactic within the toolbox of pest management options.

The advantages of pheromone-based pest management systems include:

- **Compatible with organic production, except for sprayable pheromone products.**
- Negligible health risks to applicator and consumer.
- Virtually no detectible residues for some types of dispensing systems.
- No accumulation in groundwater or wildlife.
- Reduced worker re-entry in orchards after application and shorter pre-harvest intervals.
- Strong tool for managing insecticide resistance to other pesticides and no documented cases of resistance to the pheromone itself.
- Highly selective to the pest species being targeted for disruption without causing secondary pest outbreaks due to the elimination of biological control agents. This selectivity creates opportunities for the biological control of other pest species. Nontarget effects are generally not seen within or outside of the treated orchard.
- Improved control of the targeted pest if overlaid onto the standard insecticide program.

The disadvantages of pheromone-based pest management include:

- The high degree of selectivity can also be a disadvantage when other pests are able to move into orchards because insecticide targeted for the primary pest is eliminated and often unrealized collateral control of these other pests is released. In apple, disruption of codling moth often releases leafrollers from pesticide control and in peaches, disruption of the Oriental fruit moth has led to an increase of stinkbug injury for the same reasons.
- High development and production costs which often make these products significantly more expensive than the synthetic pesticides they may be replacing.
- Requirements for specialized application techniques or equipment with some types of pheromone products and possible increases in labor costs.
- The need to supplement expensive pheromone programs in high pest pressure situations with other pesticides for the same target pest.
- Effectiveness is often directly related to the size of the orchards being disrupted, and may be ineffective in orchards less than 10 acres in size. Effectiveness may be reduced along borders with other orchards/crops that are not being disrupted as well.
- Monitoring the target pest in a disrupted orchard can be a problem because the pheromones used to disrupt mating will prevent moths from locating pheromone traps. The use of high dose lures that still attract some moths even under mating disruption is useful for tracking the flights of pests like codling moth and to assess

- effectiveness. Other moths like Oriental fruit moth do not exhibit this response to high dose lures and other means for assessing effectiveness are needed.
- Treatment thresholds may have been developed using these high dose lures, but in most cases are dependent on levels of injury from previous seasons or on the trap catches of pest generations previous to disruption.

Special considerations are necessary for type of mating disruption product, rate and application method being used. Borders of disrupted blocks are often at higher risk because of pest mating outside the disrupted area and therefore efficacy increased with the size of the block treated. Peach and apple orchards adjacent to each other benefit from disruption in both crops for pests like the Oriental fruit moth. The residual activities of many of these products vary greatly. Below are some of the type of pheromones and special considerations in use.

Sprayable Pheromones – Microencapsulated pheromones are enclosed in a polymer capsule which controls the pheromone release rate. These capsules are small enough and durable enough to be applied in water through normal airblast sprays in the same manner as conventional pesticides. This makes them very attractive to use by many fruit growers. Residual activity is generally 4-6 weeks which gives them some flexibility in pest management programs but also means they may need to be re-applied several times in a season for a target pest. Residual activity may be reduced by rainfall soon after application and a sticker type spray adjuvant is often recommended. Currently the only effective materials are for Oriental fruit moth, peachtree and lesser peachtree borers. Several formulations for codling moth and several species of leafrollers have been tested and even sold commercially, but have not given reliable control.

Hand Applied Dispensers – include systems with an impermeable reservoir fitted with an impermeable membrane for regulating pheromone release. Pheromone impregnated polymer spirals, ropes or tubes are most commonly used products currently. Wires, clips or circular twin tubes allow these dispensers to be twist-tied, clipped or draped directly onto the plant. The larger reservoirs of these products allows for longer residual activity ranging from 60 to 140 days. This may allow early season applications to suppress mating for most or all of the growing season depending type of dispenser and pest species. Application rates vary from one to several dispensers per tree and can be labor intensive. Costs for these products tend to be significantly higher than the chemical control programs they are replacing, especially in high pest pressure situations where supplemental insecticides would be needed for acceptable control.

Puffers – automatic metered dispensers that release a puff of pheromone every 15 minutes for a 12 hour period during normal mating (at night). Battery powered and with a recommended rate of only 2 pear acre. There is a considerable savings in labor over the hand-applied dispensers, but depending on pest pressure and surrounding landscape, may require border applications of hand-applied dispensers.

Other Methods – Many other methods are being developed in the eastern fruit regions but have not been proven commercially yet. These include: pheromone impregnated flakes applied aerially or with specialized ground equipment; “attract and kill” methods of applying droplets of pheromone to foliage by hand that also contain pyrethroids to kill attracted males; and high emission dispensers such aerosol “puffers” or polymer bags loaded with large doses of pheromone. Some of these products may become commercially viable within the next couple of years.

Advanced Pest Management – Tree fruit area-wide mating disruption for 1 species

MD against one species of common fruit pest (Oriental fruit moth, codling moth, lesser peach tree borer, peach tree borer, obliquebanded leafroller or other pest with available MD materials).

- Mating disruption (MD) materials (i.e., hand applied, sprayable pheromone) applied to a minimum of 10 acres.
- For all species, the MD materials should be applied before the first flight of the targeted pest generation(s) to prevent mating. Full season MD of a specific pest generally produces the best results, but shorter residual products like the sprayable pheromones and some types of hand-applied pheromone dispensers may be targeted to only certain generations and then rely on conventional pesticides for during the rest of the season.
Example: OFM injury from the first generation is mostly confined to shoots and not the apple and peach fruit and can be controlled with pesticides targeting other early season pests. It may not, therefore, be necessary to control this first generation of OFM.

If sprayable pheromones will be used, at least one application of MD materials should be applied per generation for two or more generations to shut down trap captures in monitoring traps.

- Seasonal monitoring of pest populations in treated block with a minimum of 2 pheromone traps baited with the sex pheromone. Codling moth disrupted blocks should be monitored with 2 traps each of the normal commercial monitoring 1X monitoring lures and the 10X monitoring lures specifically for monitoring in disrupted blocks.

(MD and trapping recommendations from the current issue of the PSU Tree Fruit Production Guide; available on the web at: <http://tfpg.cas.psu.edu/>)

Advanced Pest Management – Tree fruit area-wide mating disruption 2 species

MD against two species of common fruit pest (Oriental fruit moth, codling moth, obliquebanded leafroller or other pest with available MD materials. Lesser peach tree borer and peach tree borers count as a single pest, because the same pheromone tie or sprayable pheromone disrupts both species. Lesser appleworm doesn't not count as a significant pests and because it is also disrupted by OFM disruption products).

- Mating disruption (MD) materials (i.e., hand applied, sprayable pheromone) applied to a minimum of 10 acres.
- For all species, the MD materials should be applied before the first flight of the targeted pest generation(s) to prevent mating. Full season MD of a specific pest generally produces the best results, but shorter residual products like the sprayable pheromones and some types of hand-applied pheromone dispensers may be targeted to only certain generations and then rely on conventional pesticides for during the rest of the season.
Example: OFM injury from the first generation is mostly confined to shoots and not the apple and peach fruit and can be controlled with pesticides targeting other early season pests. It may not, therefore, be necessary to control this first generation of OFM.

Isomate OFM/CM combination ties should be placed before flight of first generation CM and not OFM or residual activity for the pest may not be sufficient for seasonal control.

If sprayable pheromones will be used, at least one application of MD materials should be applied per generation for two or more generations to shut down trap captures in monitoring traps.

- Seasonal monitoring of pest populations in treated block with a minimum of 2 pheromone traps baited with the sex pheromone. Codling moth disrupted blocks should be monitored with 2 traps each of the normal commercial monitoring 1X monitoring lures and the 10X monitoring lures specifically for monitoring in disrupted blocks.

(MD and trapping recommendation from the current issue of the PSU Tree Fruit Production Guide; available on the web at: <http://tfpg.cas.psu.edu/>)

Checklist

Which crop? Apple or peach

Target pest(s):

Product Type:

Size of disrupted area in acres:

Weekly pheromone trap records (through Sept. 15) for the species disrupted:

Application rates and date(s) applied:

Method of application: (hand or airblast; if airblast, applied complete or alternate row-middle)

Was control of the target pest successful?

Was shut down of monitoring traps achieved?

Explain using pheromone trap data and observations at harvest.



BRIEF OVERVIEW OF MATING DISRUPTION MATERIALS AVAILABLE TO PENNSYLVANIA FRUIT GROWERS

Information/recommendation based on product labels and field trials.

Prepared by Greg Krawczyk, Ph.D. PSU, Dep. of Entomology, FREC. (April 2009)

CheckMate CM XL – *Targeted pest:* CM. *Longevity:* 150 days. *Crops:* Apples and pears. *Application type:* hand applied dispensers. *Rate per acre:* 150-170 dispensers/A. *Application timing:* prior to moth emergence. *Where to place:* upper ¼ of tree or higher. *Net contents/package:* 1,000 dispensers. *Produced by:* Suterra LLC.

CheckMate OFM SL– *Targeted pest:* OFM. *Longevity:* 150 days. *Crops:* Apples, pears, peaches, cherries. *Application type:* hand applied dispensers. *Rate per acre:* 100-150 dispensers/A. *Application timing:* prior to moth emergence in the spring. *Where to place:* upper ¼ of tree or higher. *Net contents/package:* 1,000 dispensers. *Produced by:* Suterra LLC.

CheckMate OFM F – *Targeted pest:* OFM. *Longevity:* based on weather, up to 21 days. *Crops:* Apples, pear, peaches, cherries. *Application type:* liquid form to spray directly onto tree. *Rate per acre:* 1.32 – 2.93 fl oz product/A. *Application timing:* prior to moth emergence and repeat as the season progress. *Where to place:* apply directly to foliage with uniform coverage. *Net contents/package:* 13.2 fl oz. *Produced by:* Suterra LLC.

CheckMate CM/OFM Duel - *Targeted pests:* CM and OFM. *Longevity:* Season. *Crops:* Apples, pears, peaches. *Application type:* hand applied dispensers. *Rate per acre:* 175-200 dispensers/A. *Application timing:* prior to moth emergence (usually beginning of the apple bloom). *Where to place:* upper ¼ of the top of tree. *Net contents/package:* 1,000 dispensers. *Produced by:* Suterra LLC.

CheckMate CM/OFM Puffer – *Targeted pests:* CM and/or OFM. *Longevity:* up to 160 days. *Crops:* Apples, pears, peaches. *Application type:* use with CheckMate Puffer Aerosol Cabinet, an automatic metered dispenser; one puff of pheromone is delivered every 15 minutes for a period of 12 hours, starting at 5pm. *Rate per acre:* 2 puffers/A (effective on orchards sized 40 acres and more). May require an additional border treatment of hand applied MD dispensers. *Application timing:* spring, prior to moth emergence. *Where to place:* on a tree limb close to center of the tree, 2/3 of tree height. *Net contents/package:* 1 canister (10.8 fl oz). *Produced by:* Suterra LLC.

CideTrak CM - *Targeted pest:* CM. *Longevity:* 120-140 days. *Crops:* Apples, pears. *Application type:* dispenser applied using pole applicator. *Rate per acre:* 400 dispensers/A. *Application timing:* prior to moth emergence. *Where to place:* lateral branches in upper ¼ of tree canopy. *Net contents/package:* 400 units. *Produced by:* Trece, Inc.

CideTrak OFM-L – *Targeted pest:* OFM. *Longevity:* up to 150 days. *Crops:* Apples, pears, peaches, cherries. *Application type:* dispenser applied using pole applicator. *Rate per acre:* 100-200 dispensers/A. *Application timing:* prior to moth emergence. *Where to place:* in upper ¼ of the tree canopy. *Net contents/package:* 360 units. *Produced by:* Trece, Inc.

Disrupt OFM – *Targeted pest:* OFM. *Longevity:* 90-120 days. *Crops:* Apples, pears, peaches. *Application type:* hand applied dispensers. *Rate per acre:* 108 dispensers/A. *Application timing:* prior to moth emergence or 100 days prior to fruit harvest. *Where to place:* upper ¼ of tree canopy. *Net contents/package:* 108 units. *Produced by:* Hercon Environmental.

Disrupt OFM mats – *Targeted pest:* OFM. *Longevity:* 90-120 days. *Crops:* Apples, pears, peaches. *Application type:* hand applied 6” x 10.5” mat dispenser. *Rate per acre:* 10 mats/A. *Application timing:* prior to moth emergence or 100 days prior to fruit harvest. *Where to place:* attach securely to upper ¼ of tree canopy. *Net contents/package:* 10 mats. *Produced by:* Hercon Environmental.

Isomate CM/OFM TT – *Targeted pests:* CM and OFM. *Longevity:* CM seasonal, OFM 100 days. *Crops:* Apples, pears, peaches, cherries. *Application type:* hand applied dispensers. *Rate per acre:* 200 dispenser/A. *Application timing:* prior to CM adult emergence (usually at pink or during the bloom on apples). *Where to place:* upper ¼ of tree canopy. *Net contents/package:* 400 dispensers. *Produced by:* Pacific BioControl.

Isomate M-100 – *Targeted pest:* OFM. *Longevity:* 90-100 days. *Crops:* Apples, pears, peaches, cherries. *Application type:* hand applied dispensers. *Rate per acre:* 100 dispensers/A. *Application timing:* spring, prior to moth emergence or about 100 days before fruit harvest. *Where to place:* upper ¼ of the tree canopy. *Net contents/package:* 400 dispensers. *Produced by:* Pacific BioControl.

Isomate -M Rosso – *Targeted pest:* OFM. *Longevity:* 150 plus days. *Crops:* Apples, pears, peaches, cherries. *Application type:* hand applied dispensers. *Rate per acre:* 150 - 200 dispensers/A. *Application timing:* prior to moth emergence in the spring. *Where to place:* upper ¼ of tree canopy. *Net contents/package:* 400 dispensers. *Produced by:* Pacific BioControl.

Isomate PTB Dual – *Targeted pest:* LPTB and GPTB. *Longevity:* season. *Crops:* Peaches, cherries. *Application type:* hand applied dispensers. *Rate per acre:* 150 dispensers/A. *Application timing:* spring, prior to LPTB moths emergence. *Where to place:* upper part of the tree canopy. *Net contents/package:* 500 dispensers. *Produced by:* Pacific BioControl



A



B



C



D

Various styles of mating disruption dispensers: A. CheckMate dispenser, B. Disrupt dispenser, C. Isomate dispenser and D. CideTrak dispenser. Photos: Greg Krawczyk.