3M Sprayable Pheromone for Mating Disruption of Blackheaded Fireworm: Use in IPM Programs and Examples from Research Trials

by Sheila Fitzpatrick
Agriculture and Agri-Food Canada, Pacific Agri-Food Research Centre,
PO Box 1000, Agassiz, British Columbia, Canada VOM **1A0**

How 3M Sprayable Pheromone Works

3M Sprayable Pheromone releases tiny amounts of synthetic Z 11-tetradecenyl acetate -- the main component of fireworm pheromone -- into the air around cranberry plants. Male fireworm moths follow airborne trails of natural pheromone to locate receptive females. In areas treated with 3M Sprayable Pheromone, most male fireworm moths are unable to find females and the number of fireworm matings is reduced. The numbers of fertilized eggs and hatching larvae are also reduced, and there is less damage to the crop.

Sprayable pheromone works by interfering with moth communication and behaviour. This mechanism is very different from the rapid killing action of insecticides. When using Sprayable Pheromone, it is helpful to understand the following points.

1. ***Sprayable Pheromone best disrupts mating where there are few fireworm moths.***

   Where there are few moths, they are likely well-separated and males are relying mostly on trails of natural pheromone to lead them to females. Under these circumstances, Sprayable Pheromone interferes with the major method of female-to-male communication.

   Where there are many moths, the moth-to-moth distance is short. One moth taking flight disturbs others which, in turn, fly and disturb more moths. Moths may see and hear each other easily. They may be able to detect ("smell") odors from other moths' scales. Under these circumstances, males may see, hear, and smell females. Males may be close enough that the female's natural pheromone signal is too strong to be blocked or overpowered by Sprayable Pheromone.

2. ***Mated fireworm females can fly into an area treated with Sprayable Pheromone and lay fertile eggs from which larvae emerge. Crop damage can result.***

   Imagine two adjoining farms. One has been treated with Sprayable Pheromone and the other has not. Fireworm mating and egg-laying is greatly reduced on the treated farm. However, the untreated farm has many fireworm moths along the adjoining edge, and much mating and flight is occurring. Some mated female moths fly into the treated area and lay eggs. Three weeks later, the manager of the treated farm finds spots of unexpected fireworm damage.

We don't know how far fireworm females fly. They are seen flying in short hops, and moving with the prevailing wind rather than against it.

3. ***Sprayable Pheromone promotes a gradual, season-by-season reduction in fireworm populations. This is slower than the quick reduction caused by insecticide application.***

In spring, fireworms hatch from overwintering eggs. Sprayable Pheromone has no effect until the moth stage. If most mating is prevented during the first flight, the number of larvae and moths in the second flight will be reduced. If most mating is prevented during the second flight, the number of over-wintering eggs should be reduced, and the number of larvae that hatch the following spring should be reduced.

If Sprayable Pheromone is used to disrupt mating only in the first half of a flight, it is likely that mating will occur in the second half and there will be little reduction in eggs, larvae or the next flight of moths.

4. ***In a field treated with 3M Sprayable Pheromone, male moths can find IPM pheromone traps even though they can't find females.***

It's a question of signal strength. The pheromone lures used as bait in IPM pheromone traps emit a powerful signal -- perhaps as powerful as 1000 fireworm females.

In research trials, I found that males have trouble finding less-powerful lures. A lure loaded with 0.01 mg of the fireworm pheromone blend (100 times less powerful than the IPM lures) is a good approximator of males' ability to find a female. I suggest that several such "decoy-female" traps be used to assess mating disruption in areas treated with Sprayable Pheromone.

Using 3M Sprayable Pheromone in IPM Programs

Sprayable Pheromone will be most effective on farms with low to moderate fireworm populations, especially if the farm is isolated or surrounded by others that are also using IPM programs and Sprayable Pheromone.

It will be helpful to use several "decoy-female" pheromone traps in addition to IPM traps. "Decoy-female" lures can be purchased from PheroTech (British Columbia), Scentry (Montana) and probably from other suppliers of fireworm pheromone lures; request lures loaded with 0.01 mg instead of 1 mg of fireworm pheromone on gray septa. IPM and "decoy-female" traps should be at least 50 feet from each other.

In the first year of use, scout for fireworms as usual and apply pesticide as needed. Pay particular attention to reducing the number and size of "hot spots" -- areas with many

fireworm larvae. Apply 3M Sprayable Pheromone when the first fireworm moth is caught in IPM pheromone traps or, preferably, several days before first catch. Continue applications at intervals of 2.5-3 weeks during each flight of fireworms.

In the second year of use, scout for fireworms in spring and, if necessary, apply pesticide to kill hatching larvae. Apply 3M Sprayable Pheromone when the first fireworm moth is caught in IPM pheromone traps or, preferably, several days before first catch. Continue applications at intervals of 2.5-3 weeks during each flight of fireworms.

Scout for larvae in late June and early July to determine if the number of fireworm larvae warrants a pesticide application. If fireworm populations were low to moderate at the beginning of the first year, if there were few hot spots and if mating disruption has been effective, summer pesticide application against fireworm larvae should not be required.

In the third year of use, follow the protocol for the second year. The summer pesticide application against fireworm larvae should not be required. It may be possible to reduce the spring pesticide application to partial or spot treatments.

In subsequent years, follow the protocol for the third year. A small number of fireworm moths will continue to exist in areas treated with 3M Sprayable Pheromone. If Sprayable Pheromone use is discontinued, the population will likely increase.

What about other pests?

3M Sprayable Pheromone for Mating Disruption of Blackheaded Fireworm will not control other pests.

3M Sprayable Pheromone for Mating Disruption of Sparganothis Fruitworm should soon be registered for use in the United States. The two Sprayable Pheromone products will be tested together by other researchers in 1999 trials.

Research on biologically based management of other cranberry pests such as tipworm will be initiated by other researchers in 1999. Biorational insecticides that will be alternatives to organophosphates and carbamates are being investigated, and registrations are being pursued. Sprayable Pheromone products are compatible with biologically based management and biorational insecticides.

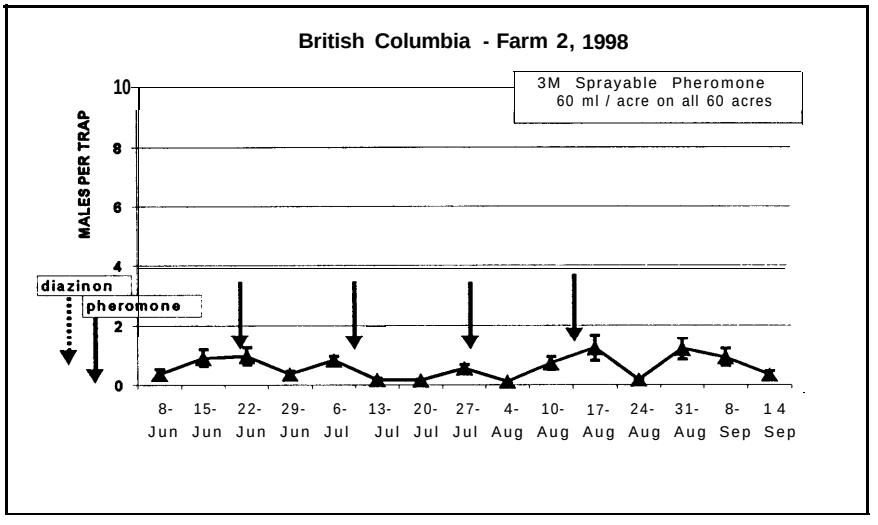
Examples from Research Trials of 3M Sprayable Pheromone

The four graphs on the following pages show the numbers of males caught in "decoy-female" pheromone traps in areas treated with 3M Sprayable Pheromone and in Control areas not treated with Sprayable Pheromone. Pesticides were applied to all or parts of these areas according to the recommendations of IPM scouts. Some pesticide applications targetted other pests, like flea beetle.

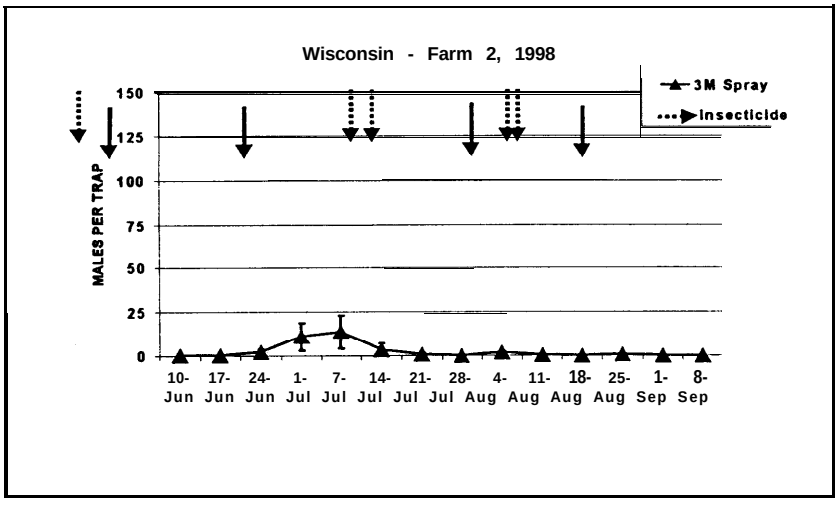
The "MSTRS®" mentioned in the following examples 2-4 are "Metered

Semiochemical Timed Release Systems" developed by Dr. Tom Baker of Iowa State University. These systems are plastic boxes containing battery-powered aerosol containers that spray small amounts of pheromone into the field at timed intervals. MSTRS are placed around field edges. In research trials, MSTRS have been shown to disrupt mating as effectively as 3M Sprayable Pheromone. Full details of research on MSTRS, 3M Sprayable Pheromone and the two systems used together may be found in Research Reports by Fitzpatrick and by Baker to Ocean Spray Cranberries and to the Wisconsin Cranberry Board.

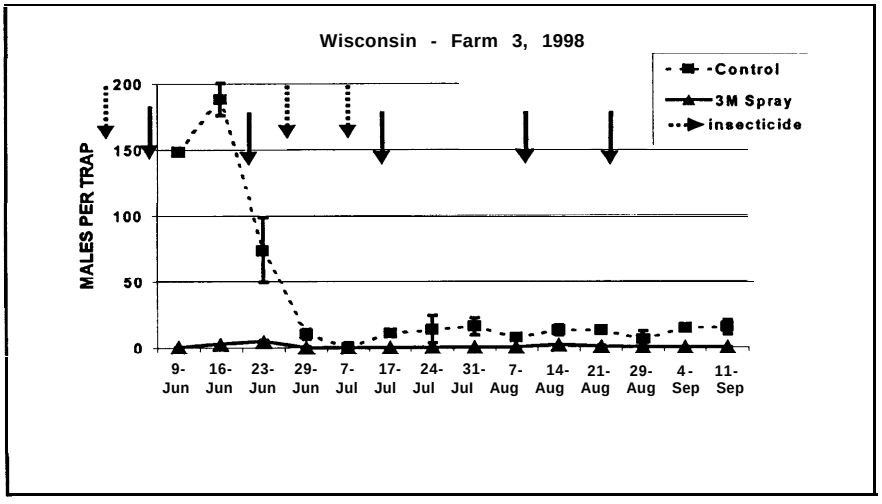
Example 1. This isolated farm has a history of low fireworm populations, and has never applied pesticide for the second flight. In 1997, two-thirds of the farm was treated with 3M Sprayable Pheromone; in 1998, the entire farm was treated (on dates shown by solid arrows). On May 15, 1998, 470 two-foot-square areas were sampled for fireworm; 77 contained fireworm larvae. On July 15, 1998, only 9 of 486 samples contained larvae.



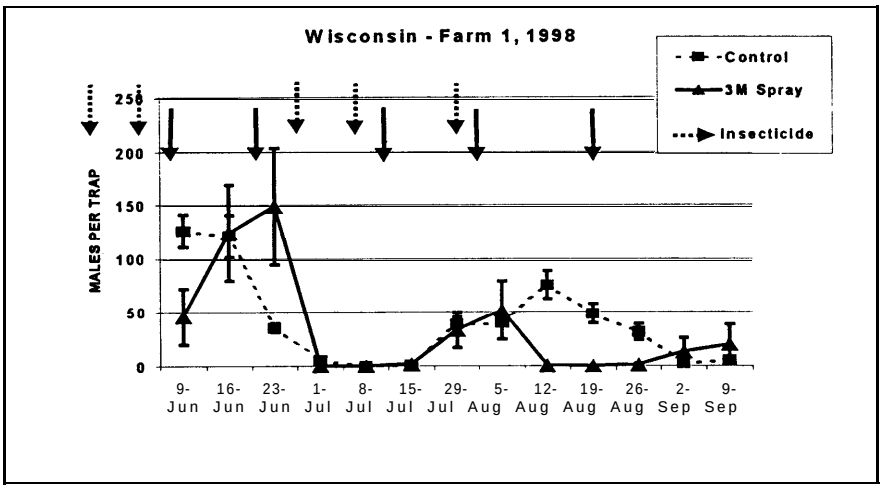
Example 2. This relatively isolated farm has a history of moderate fireworm populations. Two-thirds of the farm was treated with pheromone (3M Sprayable or MSTRS) in 1996 and 1997. In 1998, the entire farm was treated with pheromone (3M Sprayable, MSTRS, or Sprayable + MSTRS). Only the 3M Sprayable treatment (90 ml/acre; solid arrows) is shown here. Complete results can be obtained from Research Reports by Fitzpatrick and by Baker to Ocean Spray Cranberries and the Wisconsin Cranberry Board.



***Example* 3.** This large farm is bordered by others, and has a history of low to moderate fireworm populations. A small amount of the farm was treated with 3M Sprayable Pheromone or MSTRS in 1997. In 1998, approximately 60 acres was treated with pheromone ((3M Sprayable, MSTRS, or Sprayable + MSTRS). Only the 3M Sprayable treatment (90 ml/acre; solid arrows) and the Control (which had some "hot spots" of fireworm infestation early in the season) are shown here. Complete results can be obtained from Research Reports by Fitzpatrick and by Baker to Ocean Spray Cranberries and the Wisconsin Cranberry Board.



Example 4. Parts of this farm were used in research trials of 3M Sprayable Pheromone and MSTRS in 1996 and 1997. In 1998, trials were expanded to include areas not previously treated with Sprayable Pheromone or MSTRS . The area treated with Sprayable Pheromone had an infestation of fireworm larvae . Trap counts show that Sprayable Pheromone (90 ml/acre; solid arrows) was not effective until pesticide applications reduced the population. Complete results can be obtained from Research Reports by Fitzpatrick and by Baker to Ocean Spray Cranberries and the Wisconsin Cranberry Board.



Acknowledgements

I would like to thank all grower-cooperators in Wisconsin, British Columbia and Washington for hosting research trials in 1996, 1997 and 1998. Thanks to all research assistants in the three areas, particularly to Amy Blodgett and Merrilee Busch for their excellent handling of the work in Wisconsin in 1998 . I appreciate the cooperation and ideas of Tom Baker, Agenor Mafra-Neto and Henry Fadamiro, who have since 1996 tested MSTRS alongside 3M Sprayable Pheromone. Funding from Ocean Spray Cranberries, the Cranberry Institute, the Wisconsin Cranberry Board, 3M Canada Company, the Pacific Coast Cranberry Research Foundation, the British Columbia Cranberry Growers Association, and Agriculture and Agri-Food Canada is much appreciated. Finally, a special thank-you to Tim Dittl and Leroy Kummer of Ocean Spray Cranberries for so ably organizing and facilitating this project in Wisconsin.