Mating Disruption/SIR

Studies with Checkmate OFM-F Sprayable Pheromone with Fluorescent Dye

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Abstract: Applications of CheckMate® OFM-F oriental fruit moth microencapsulated sprayable pheromone were made with an airblast sprayer in peach and apple orchards. A fluorescent dye was incorporated into the sprayable pheromone so microcapsules could be counted using ultraviolet light. The average number of microcapsules at 2-6 hours, 7 d, and 14 d after sprayable pheromone was applied was 0.082, 0.009, and 0.002 microcapsules per cm^2 on peach leaves, and 0.090, 0.004, and 0.002 microcapsules per cm^2 on apple leaves, respectively. Sunlight had the highest correlation to loss of microcapsules (r^2 = 0.90). Despite significant losses of microcapsules after 7 d, trap shut down in the central spray row was 96-99%. The number of microcapsules on leaves dipped in beakers of aqueous solutions of CheckMate® OFM-F was 25- to 69-fold greater than peach and apple leaves treated with the same concentration in the field using an airblast sprayer. The top leaf surfaces of 'Bluebell' plum leaves and 'Columbia' sweet cherries and the bottom surface of 'Shinko' Asian pears had the lowest number of microcapsules of the tree fruit leaves tested. The bottom surface of 'Gala' apple leaves had the highest number of microcapsules. There were significantly more microcapsules on the bottoms of 'Delicious' leaves than 'Gala' apple leaves.

Materials and Methods

Applications of CheckMate® OFM-F oriental fruit moth sprayable pheromone (Suterra LLC, Bend, OR) were made with an airblast sprayer at the maximum labeled rate of 2.93 fluid ounces/acre (20 grams active ingredient/acre) in peach and apple orchards at the Missouri State Fruit Experiment Station, SMSU-Mountain Grove. A fluorescent dye was incorporated into the sprayable pheromone by Suterra chemists so that microcapsules could be visualized using an ultraviolet light. The sprayable pheromone was applied in an aqueous solution with a total spray volume of 100 gallons/acre (154 liters/hectare). Fifteen applications were made in the 2003 field season and 11 in the 2004 season. Traps were placed in treatment, adjacent, and control rows and monitored 2-3 times per week. On-site weather data including precipitation and sunlight were collected using a model 900ET WatchDog™ weather station (Spectrum Technologies, Inc., Plainfield, IL).

Orchard block layout. In the peach block, the cultivars used for the study were 'Redhaven' and 'Encore'. The total size of the peach block is 3.8 acres. The section with 'Redhaven' and 'Encore' trees is 2.2 acres within this block. The peach trees are 14 to 15 years old with 20 feet between trees and 20 feet between rows. Four of the 14 rows in the peach block are 'Redhaven' and four are 'Encore'. In the apple block, 'Gala' was the primary cultivar used in the study. Some leaves from the 'Red Delicious' (Starkrimson) trees were sampled to compare

with 'Gala' leaves. The total size of the apple block is 2.6 acres, and the 'Gala' and 'Red Delicious' trees each comprise 0.5 acres of the total. The apple trees are 13 years old with 15 feet between trees and 20 feet between rows. There is a total of 24 rows in the apple block. 'Gala' and 'Red Delicious' trees each comprise one-fourth of the first 20 rows in this block.

Foliage collections. Peach and apple leaves were collected at 2-6 hours, 7 and 14 days after the sprayable pheromone was applied. Fifteen leaves per tree on a total of three to four randomly selected trees were removed at each collection period. For a portion of the study, prior to the applications of sprayable pheromone, leaves were collected and brought into the laboratory for leaf dip application of sprayable pheromone at the rate equivalent to the field-applied rate.

Checkmate OFM-F sprayable pheromone is registered on a variety of fruit crops including apples, pears, peaches, cherries, and other stone fruits. In addition to comparing leaf dip and airblast sprayer application methods, we compared the number of pheromone microcapsules on leaves from a European and Asian pear cultivar, a sweet and tart cherry cultivar, a peach and a plum cultivar, and two different apple cultivars ('Gala' and 'Delicious').

Microcapsule counts. Leaves were illuminated with an ultraviolet light (Spectroline Model BiB-150-P, 365 nm) to count the green fluorescing microcapsules on the tops and bottoms of leaves with the naked eye. Because leaf surface area is a variable, a leaf area meter (LI-COR Model LI-3000) was used so that counts could be standardized to a per square centimeter surface area.

Results and Discussion

The average number of microcapsules at 2-6 hours, 7 d, and 14 d after sprayable pheromone was applied was 0.082, 0.009, and 0.002 microcapsules per cm^2 on peach leaves, and 0.090, 0.004, and 0.002 microcapsules per cm^2 on apple leaves, respectively. Sunlight had the highest correlation to loss of microcapsules on peach ($P = 0.00$, $r^2 = 0.90$) and apple ($r^2 = 0.89$) leaves. Rain also caused losses of microcapsules ($P = 0.00$, $r^2 = 0.58$-0.80). Despite significant losses of microcapsules after 7 d, trap shut down in the central spray row was 96-99%. The responsiveness of male moths to extremely low concentrations of pheromone may explain this phenomenon.

The number of microcapsules on leaves dipped in beakers of aqueous solutions of CheckMate® OFM-F was 25- to 69-fold greater than peach and apple leaves treated with the same concentration in the field using an airblast sprayer. The top leaf surfaces of 'Bluebell' plum leaves and 'Columbia' sweet cherries and the bottom surface of 'Shinko' Asian pears had the lowest number of microcapsules of the tree fruit leaves tested (Table 1). The bottom surface of 'Gala' apple leaves had the highest number of microcapsules. There were significantly more microcapsules on the bottoms of 'Delicious' leaves than 'Gala' apple leaves. The number of microcapsules on the tops of 'Delicious' and 'Gala' was not statistically different.

Differences in trichome abundance and cuticle structure have been given as potential factors responsible for differences in the number of pheromone microcapsules on tops and bottoms of leaves and young and mature leaves (Waldstein and Gut 2003). Differences in

trichome abundance and cuticle structure may have also caused differences in the number of microcapsules among the different fruit leaves.

References

Waldstein, D. E. and L. J. Gut. 2003. Comparison of microcapsule density with various apple tissues and formulations of oriental fruit moth (Lepidoptera: Tortricidae) sprayable pheromone. J. Econ. Entomol. 96: 58-63.

Table 1. Mean number of microcapsules/cm^2 on tree fruit leaves treated by leaf dips in beakers with a solution of 2.93 fl oz/100 gallons CheckMate® OFM-F.

Tree	Cultivar	Top/bottom	Microcapsules/cm^2
Apple	Gala	T	0.28b
Apple	Gala	B	0.50a
Sweet cherry	Columbia	T	0.10gh
Sweet cherry	Columbia	B	0.17ef
Tart cherry	Montmorency	T	0.17def
Tart cherry	Montmorency	B	0.28b
Peach	Loring	T	0.13ef
Peach	Loring	B	0.17fg
Euro. pear	DDAB*	T	0.22cd
Euro. pear	DDAB*	B	0.19de
Asian pear	Shinko	T	0.16ef
Asian pear	Shinko	B	0.09h
Plum	Bluebell	T	0.09gh
Plum	Bluebell	B	0.23bc

Means in a given column followed by the same letter are not significantly different (Fisher's protected LSD, P = 0.05).
*Duchess de Angloeme Bronze.