

Thresholds/Monitoring/Sampling

Two New Developments in Monitoring Codling Moth: Better Long-Lived Lures and a Novel Bisexual Attractant

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The sex pheromone of codling moth has been used to monitor populations for nearly 30 years. Captures of male moths in traps have been used effectively to establish action thresholds and to time control actions. Lures with higher loads are used to monitor populations in pheromone-treated orchards. Historically, red rubber septa have been used as the substrate for both the regular and high load lures, but sulphur-cured rubber is a poor substrate for codling moth's pheromone and lures must be replaced every 2-3 weeks. Fortunately, new, long-lived lures have been developed and were tested this summer. Our data showed that the new Super Lure (Pherotech) and Mega Lure (Trécé) are both effective for 10 weeks during the first moth flight. During the second flight, however, the attractiveness of the Superlure dropped after 4 weeks while the Megalure was effective for 10 weeks.

A second problem with the current monitoring program with codling moth is that we are forced to make assumptions about the timing and magnitude of the emergence, mating, and oviposition of female moths based on captures of the opposite sex. Efforts to monitor female moths with interception, light, or bait traps have been made but none of these methods is as easy, specific, and inexpensive as the use of sex pheromone-baited traps. Thus these sampling methods are generally not used.

Dr. Doug Light at the USDA, ARS Laboratory in Albany, CA, has recently discovered the first highly selective and sensitive chemical (DA2313) that attracts both male and female codling moth. This compound can be loaded into regular dry lure formulations such as red or gray septa and is less expensive than the sex pheromone of codling moth. This lure is not attractive to any other moth species found in orchards. Lures loaded with this compound were used to monitor codling moth in 12 apple and pear blocks during 1999. DA2313 lures were effective in establishing the first male moth flight (BIOFIX) and detected the first female emergence (BIOFIX-F) and first mated female moths when compared with captures in passive interception traps. DA2313 lures were also effective in detecting the beginning and the peak emergence of both sexes as well as the mating status of females during the second flight. Lures remained attractive all season, but in these studies they were replaced once at mid-season.

We believe that the use of the DA2313 lure can provide several improvements in monitoring codling moth in Washington apple and pear orchards. First, information is needed on the emergence and density of female moths in the orchard because they are responsible for the number of eggs and larvae produced. Sex pheromone traps catch only male moths. Male moths are known to fly much farther than females and the effect of male immigration into an orchard

due to the attractiveness of the sex pheromone-baited lure can create false positive trap catches and lead to unnecessary spraying of orchards.

Second, male captures of codling moth in sex pheromone-baited traps during the first generation typically exhibit two peaks. The relative heights of these two peaks vary among orchards and from year to year. Timing decisions based on the first and/or second moth peak are currently not based on good knowledge of how these male captures relate to female activity and resulting egg laying and egg hatch. Use of the DA2313 lure will allow us to follow the flight of female moths and their mating status in the orchard.

Third, the use of sex pheromone-baited traps in orchards treated with sex pheromone dispensers for mating disruption of codling moth has a number of problems, e.g., male moth catch is suppressed. Our studies in 1999 showed that the DA2313 lure is equally effective in monitoring females in MD or conventional orchards, and it actually catches a higher percentage of female moths in MD-treated orchards.

Fourth, action thresholds are currently based on the number of male moths caught per trap per time interval. As previously mentioned, problems in trap interpretation due to male moth immigration and the use of mating disruption have complicated the interpretation of moth catches and reduced the correlation of moth catch with egg and larval population densities. The ability to establish a threshold based on the number of female moths within an orchard may allow us to further refine our use of insecticides.

Fifth, the current male BIOFIX-based model has a number of problems inherent in its use. This model uses accumulated degree days after first male capture to predict egg hatch. Yet, the first males emerge before the first females. Mating and oviposition occur over a narrow time period around dusk and the lower threshold for these activities is 12°F higher than the threshold for larval and egg development. Thus degree days are accumulated on days not suitable for moth sexual activity or egg laying. Studies conducted over the past three years have shown that this model is not highly accurate in predicting the initiation and especially the shape of the egg-laying curve over time. In some years the model is 1-2 weeks off in predicting peak egg hatch. This level of error was not usually significant when growers used the nerve poison insecticides such as azinphosmethyl that provide a blanket protection from larvae searching for fruit. However, the current model's insensitivity to factors influencing female-based activities may become important as growers switch to more selective compounds, such as insect growth regulators. Thus, a monitoring tool that can validate an alternative model of female emergence and mating would likely improve our management of codling moth.