The Invasion of Internal Fruit Feeders: Efforts by Rutgers and Penn State Universities to Face the Challenge

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Presented at the 46th Annual IDFTA Conference, February 17-19, 2003, Syracuse, New York

There are two topics to be covered here including oriental fruit moth (OFM) insecticide resistance monitoring and ways to increase success of OFM mating disruption in peaches. We will start with insecticide resistance monitoring.

In 1995, internal lepidoptera larvae were reported infesting apple fruit in several New Jersey, USA, orchards. Originally these "worms" were thought to be codling moth larvae. However, after examination of numerous larvae under the microscope, they were determined to be almost exclusively OFM. We suspected that OFM may have developed insecticide resistance to commonly used organophosporus (OP) insecticides, thus we initiated a study to investigate this.

We used a pheromone trap assay that allowed us to collect adult male OFM in problem orchards, test their susceptibility to insecticides in the laboratory and have results 24 hours later. We found out that male OFM from several New Jersey apple orchards expressed levels of azinphosmethyl resistance that were 3-4 times higher than in OFM populations from unsprayed orchards (Usmani and Shearer, 2001). In other words, it took 3-4 times more azinphosmethyl to kill 50% of the collected moths than those from a susceptible population.

Usmani and Shearer also demonstrated that moths became more resistant to azinphosmethyl if this insecticide was used continuously during the growing season. They also found that esterase enzymes were involved in OP resistance and that OP resistance was unstable and fluctuated from one generation to another.

These findings were important because they allowed us to develop insecticide resistance management programs for this problem pest. Essentially we recommended that growers rotate OP insecticides with other classes of insecticides to manage resistance. However, at that time, some OP sprays were needed for other pests so we found that a short-term solution was to raise OP rates. While this raised the potential to increase the rate of resistance development, it provided control until other insecticides and tactics could be rotated into the pest management program.

New Jersey was the first state to report OFM problems in apples but soon apple growers in other eastern USA states had problems with this pest. Entomologists from Pennsylvania, West Virginia, Virginia, Michigan and North Carolina have reported problems with OFM infesting apples. During the 1998-2000 seasons in Pennsylvania alone more than 1000 fruit loads were rejected by local fruit processors because of the presence of "live worms" in the delivered fruit. In 2000, cooperative work was initiated with several other states to determine the extent of OFM-OP resistance.

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Michigan, New York and Pennsylvania used the same sort of topical assay and results revealed that some OFM populations exhibited varying levels of OP resistance. The New York population tested susceptible that year. However, 2 years later, OFM control failures were reported in New York apples. It may be that resistance monitoring in 2003 will reveal that OP resistance is a problem in New York OFM as well.

Recent OFM resistance research conducted in Pennsylvania highlights some alarming trends (Krawczyk, unpublished). OFM are now exhibiting azinphosmethyl resistance that is almost 7 times as high as in a susceptible population. OFM have also developed resistance to the pyrethroid esfenvalerate (9 fold) and the carbamate methomyl (4.3 fold). This means growers should be careful when rotating these insecticides with OPs in a resistance management program because OFM are developing resistance to them as well. It may be that we need new tactics and/or insecticides to control this major apple pest.

In anticipation of new insecticides getting registered for use against OFM, laboratory studies are being conducted to generate information on susceptibility of OFM to these products (Krawczyk and Shearer, unpublished). This baseline data will be used to determine if future OFM generations are developing resistance to these new insecticides. In the meantime, apple growers can minimize their OFM problems by timing insecticide spray applications with a degree-day model, using complete sprays with adequate water volume when using both new and old insecticides, and monitoring diligently to make sure that OFM and other internal feeders are not getting out of control. Additionally, growers should consider using mating disruption (MD) for managing OFM in apple orchards. This tactic has the potential to alleviate OFM problems in many instances.

Mating disruption has been used to control OFM in peaches for many years. OFM mating disruption products come in many forms including hand-applied dispensers, aerosol emitters and microencapsulated sprayable formulations. These dispensers put out large amounts of pheromone into the air and somehow interfere with the mating process, thus preventing damage.

Product labels say that these materials should be put in the orchard before the flight of the first generation. However, in New Jersey we generally start our OFM mating disruption programs before the start of the second OFM flight. This usually occurs sometime in late May-early June. There are several reasons why we wait to deploy OFM mating disruption. This strategy evolved based on our experience with hand-applied dispensers. First, our peach orchards are sprayed every year starting around petalfall for OFM. These early OP sprays also control other early season insects such as plum curculio and catfacing insects (tarnished plant bug and stink bugs, collectively). If growers stop early season sprays for OFM, they still have to spray to prevent plum curculio and catfacing insect damage. The best insecticides for these

pests, the OPs, still work well for OFM in peach so it makes sense to apply OPs for this early season pest complex and implement mating disruption later. Secondly, by delaying application of MD dispensers, we are extending their period of effectiveness later into the season. In addition, it is very common that growers are still pruning when the first OFM generation starts to fly, thus the delay in dispenser deployment decreases the chances of pruning them out of the trees.

The substitution of broad-spectrum insecticide sprays with mating disruption often results in the loss of some benefits those sprays provided. Tarnished plant bugs and stinkbugs are normally controlled with the OP insecticides targeted against OFM. As the number of those broad-spectrum insecticide sprays against OFM is reduced, there is a greater chance of getting fruit damage by other insects, especially catfacing insects. In New Jersey, the Reduced Risk peach arthropod management program recommends combining OFM mating disruption with orchard floor weed management to reduce catfacing insect damage. This makes mating disruption programs more attractive to use by growers.

Our Reduced Risk peach program combines OFM mating disruption and ground cover practices for tarnished plant bug management and has allowed growers to reduce OP insecticide use between 50-70%. In orchards with the Reduced Risk program that includes well-managed established sod in the drive rows and weed-free tree rows, we found that the first spring appearance of tarnished plant bug can be delayed by a month.

We also observed that fruit from the orchards with the Reduced Risk program often had significantly less tarnished plant bug injury than fruit collected from adjacent conventionally managed orchards. Levels of OFM fruit damage were negligible in both Reduced Risk and conventional orchards and OFM mating disruption provided approximately 5 months of insecticide-free control of this major pest.

The reduction in OP and carbamate insecticide sprays in Reduced Risk orchards allowed the build-up of beneficial insects to levels almost twice as high as observed in conventional orchards. This reduction in insecticide use also plays an important role in diminishing the health risks to farmworkers, growers, consumers and the environment.

LITERATURE CITED

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