Codling moth control using granulosis virus

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Among the new options available for control of codling moth (CM) is a naturally occurring virus that goes by the scientific name of Cydia pomonella granulovirus (CpGV). It is commonly referred to as the codling moth granulosis virus. CpGV is highly specific to the codling moth. It may infect the larvae of a few very closely related species, but it is noninfectious toward beneficial insects, fish, wildlife, livestock, or humans.

Each CpGV particle is contained within a protein occlusion body (OB). Preparing a concentrated suspension of OB's using mass-reared CM larvae infected with CpGV produces commercial formulations of the virus. Viral OB's are very small. Indeed, over a trillion OB's are present in an ounce of formulated product. These tiny particles must be ingested by the CM larva to be effective, but it only takes a few to cause death. Upon ingestion, OB's are dissolved by the insect's alkaline gut lining, releasing the viral particles. The virus replicates itself within the gut cells and rapidly spreads to other organs. Within a few days the larva stops feeding, becomes discolored and swollen, and melts into a mass of billions of viral OB's.

Products

Two CpGV-based biological insecticides are available for use by Michigan apple growers, Cyd-X® (Certis USA, L.L.C.) and VirosoftCP4 (BioTEPP Inc.). The label recommended application rate for Cyd-X is 1 to 6 fluid ounces per acre. The labeled application rate for Virosoft is 3.2 fluid ounces per acre. Both are organically approved products. They can be applied up until harvest and have a re-entry interval of only four hours. Stored material should be kept refrigerated to ensure stability and potency.

Rate and timing of application

There are many options for incorporating virus into your CM management program. Deciding how much, when, and how often to apply product can be
quite confusing. Keep in mind the following factors when trying to sort things out: 1) CpGV must be ingested by the CM larva and may not kill it immediately, 2) the virus breaks down in the environment, thus a spray may only be effective for a week or so, and 3) the virus is highly lethal, a few OB's are all that are required to cause death.

Optimal use of the virus is against young larvae before they penetrate the fruit. The best way to target young larvae is to have the virus present on the surface of the eggs when they begin to hatch. Hatching CM larvae will ingest the virus as they consume their eggshells. If the virus is intended as a primary CM control, the first application should be made at about 250 GDD50 after biofix. At least four applications will be required to cover the egg hatch period. Weekly applications at a low rate are a better approach than high dose sprays applied at wider intervals. In orchards with high CM pressure, this sequence of sprays will need to be repeated beginning at about 1250 GDD post-biofix or 250 GDD after the start of the second-generation flight.

Growers can opt to use the virus as part of a multi-tactic CM control program. Rotating it with chemical insecticides is a good means of combating resistance. We suggest the following approaches to incorporating CM virus into a management program. If you want to restrict your use to a single generation, target the first generation. Some virus-infected larvae will not die immediately, allowing them to cause fruit damage and even complete larval development. Fortunately, stings or deeper entries in small fruits attacked by first generation larvae often fall off the tree or are removed by thinning. Additionally, research conducted in 2003 revealed that less than 4 percent of the individuals that managed to complete larval development survived to pupate and emerge as summer generation adults. Thus, applications against the first generation can greatly reduce the size of the summer generation that will need to be controlled.

Regardless of the generation targeted, it is best to make at least two applications. If you want to rotate a CpGV product with other controls, I favor applying a chemical insecticide as the first spray at the start of egg hatch (250 GDD) and the virus as the second spray. This is because more eggs will be present and covered by the virus spray at the later timing. The insecticide and virus could then be rotated again, or the virus could be applied weekly at a low rate for the remainder of the egg hatch period.
Tank mixing

Codling moth granulosis virus products are compatible with most fungicides and insecticides sprayed in apple orchards. However, they should not be mixed with lime sulfur, Bt products, or copper fungicides. Use of a buffer to neutralize the spray mix is recommended if the pH is above 9 or below 5. Also, I am concerned about tank mixing them with the neonicotinoids, Assail and Calypso. This is because bioassays conducted at the MSU Trevor Nichols Research Complex have indicated that the compounds have anti-feeding properties.

Use of spray adjuvants

A number of adjuvants have been recommended and tried as a means of increasing the longevity or improving the effectiveness of CpGV products. The virus is sensitive to the UV rays in sunlight, thus powdered milk and other adjuvants have been added to limit this effect. Since the virus must be ingested to be effective, feeding stimulants such as molasses are often used in an attempt to increase larval feeding on the spray droplets. Although these options may prove useful, my experience is that applying more virus, rather than adding a spray adjuvant, is the best means of increasing efficacy.