

Harnessing naturally occurring viruses

Navigating an environment where productivity, phytosanitary compliance, chemical regulation, and sustainability must co-exist. By **Rob Elfick**



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In the South African fruit industry, producers must contend with export markets that demand stricter control of phytosanitary pests, while simultaneously managing the risks of pesticide resistance, and the loss of registered active ingredients due to the perceived impact of pesticides on human health and the environment.

Microbial biological control

Therefore, producers require crop protection solutions that are both biologically justifiable and commercially viable. Biological control provides producers with the option to safely and effectively manage insect pests. Baculoviruses are among the most powerful microbial biological control solutions, and are naturally occurring and already commercially available.

Baculoviruses are host-specific viruses that only occur within insect populations. Although they are a very diverse group of viruses, most of the commercially developed baculovirus products are found in only two groups, the Alpha- and Betabaculovirus groups. These are lepidopteran (moth and butterfly) baculoviruses and they consist of the grauloviruses (GVs) and nucleopolyhedroviruses (NPVs), respectively. The viruses infect the larval stages of lepidopteran species, and several baculovirus products are used to manage important moth pests, such as those in the Tortricidae family. These pests are responsible for significant economic yield losses across multiple different export crops. Within a South African context, key species that impact export crops include the false codling moth, macadamia nut borer, codling moth, litchi moth and oriental fruit moth.

Main advantages

Targeted infection

A key advantage of baculovirus products is that they can be applied in tank mixes, much like other insecticide products. As microbial biological control agents, their effectiveness lies in their highly specialised and targeted infection process.

Once applied, virus particles (which are housed in protective protein lattices called occlusion bodies) are deposited on fruit and foliage surfaces. The occlusion bodies, which are composed of the viral proteins polyhedrin (NPVs) or granulin (GVs), shield

the virus particles from UV degradation and improve persistence in the field. Newly hatched larvae that feed on the surface of the crop, ingest the occlusion bodies. After ingestion the occlusion bodies enter the midgut of the larvae, where they dissolve in the alkaline environment, thus releasing the infectious virions.

They then bind to epithelial cells lining the midgut of susceptible larvae and initiate infection through replication within the cell nuclei. The infection spreads systemically throughout the tissues of impacted larvae. Larval feeding activity declines rapidly post infection, limiting further crop damage. Larvae then become sluggish and, eventually, they die within a few days of the initial infection. Once dead, the larvae liquify and rupture, releasing millions of new replicated occlusion bodies into the environment. This contributes to secondary infections within the pest population, and it is one of the defining strengths of virus-based pest control products.

Host specificity

This is another defining characteristic. Baculoviruses are highly specific and infect only their targeted insect pest species. Pollinators, parasitoids, predators, mammals, and birds remain unharmed after spraying baculovirus products. Therefore, the use of baculoviruses in integrated pest management (IPM) programmes can help conserve beneficial organisms within the agricultural habitat. This, in turn, promotes biological complexity and natural ecosystem services, which can improve crop production and overall pest management by reducing secondary pest outbreaks.

No harmful residues

Furthermore, baculoviruses degrade naturally under UV light and do not accumulate in soil or water. Thus, they do not leave harmful residues on plants. Fruits and other food crops that are treated with baculoviruses are perfectly safe for human

consumption. Viruses are not subject to strict maximum residue limit (MRL) requirements in export markets and can be used by producers up until harvest, without the risk of rejection due to the presence of harmful residues. Their use can also lessen the need for chemical interventions, which can help producers manage their MRLs and maintain responsible production practices. This is beneficial for managing phytosanitary pests, such as false codling moth. These pests require consistent management to a level below the economic threshold, to prevent infestation and rejection by international markets. Virus-based interventions provide producers with a biologically sound method of reducing larval populations before fruit penetration, thereby supporting export compliance and safeguarding market access without the risk of residue detection.

Unique mode of action

In addition to environmental compatibility, baculoviruses have a unique mode of action, which means they do not share cross-resistance with conventional insecticides. Their inclusion in spray programmes diversifies selection pressure and contributes towards resistance management. This is particularly important in export-driven industries where the long-term efficacy of available chemical products must be protected. Thus, the long-term benefits of virus applications extend beyond a single season. If integrated correctly, viruses contribute to resilient orchard systems that are capable of sustaining productivity under increasing regulatory and environmental pressures.

Preventative pest control

To achieve effective IPM in orchards, biological control options such as baculoviruses should be combined with good monitoring practices (pheromone trapping and scouting), orchard sanitation, mating disruption, and, where necessary, selective chemical interventions. Within this framework,

virus applications are positioned as a preventative pest control option, as well as a resistance management tool. If timed well and applied appropriately at egg hatch, or during early larval stages, viruses can reduce initial pest pressure and limit fruit infestation before economic thresholds are exceeded.

Meticulous application regimen

However, correct application is vital. Baculoviruses must be ingested by targeted larvae. Therefore, producers should use baculoviruses as full cover crop sprays and applications should be conducted in the evenings, or early mornings, to prevent unnecessary UV exposure. The pH of tank mixes should also be monitored carefully. Producers must ensure that the spray mixtures are not too alkaline, as this can damage the protective occlusion bodies. Buffers and wetters can be used with baculovirus products to maintain pH and improve coverage, but it is important to first read and adhere to product label instructions prior to application to ensure product compatibility.

Harnessing power

At River Bioscience, the focus is on harnessing naturally occurring biological pest management tools through rigorous scientific research and formulation technology. By integrating virus sprays into well-structured IPM programmes, producers can manage key economic pests effectively while strengthening the ecological balance of their orchards.

In doing so, they are not just controlling pests, they are building production systems designed for long-term sustainability, export readiness and environmental responsibility.

