Managing whitefly resistance in NZ greenhouse tomatoes

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The resistance problem

From 2006 when tomato potato psyllid (TPP) was detected in NZ and on tomatoes, the industry resorted back to agrichemicals to control this pest. A consequence of this was the disruption to existing Integrated Pest Management (IPM) programmes in the greenhouse and subsequent problems with other pests.

> Chemical applications to control TPP causing disruption to biological control agents used to control whitefly.

Not only were the chemical applications to control TPP causing disruption to biological control agents used to control whitefly, but the heavy use of non-selective chemistry was resulting in reduced efficacy and resistance issues for whitefly. The tomato industry was also aware that many of the chemical modes of action being used were at risk of regulatory review and removal.

The current regulatory environment was not enabling the registration of IPM compatible replacement chemistry so control options for growers were reducing. The sector needed to look for a new way to control whitefly and move away from chemical tools back to an IPM approach.

What is whitefly?

Whitefly (*Trialeurodes vaporariorum*) or Greenhouse Whitefly) is a significant pest of greenhouse crops including tomatoes and cucumbers.

Whitefly adults are tiny white insects about 1mm long. They are often described as moth-like in appearance, but they have piercing, sucking mouthparts.

Their whole body, including wings, has a bright white powdery appearance.

Adult whiteflies are usually found on the underside of tomato plant leaves where they feed and lay eggs. Large numbers are obvious to the naked eye.

Whitefly feeding reduces plant vigour and suppresses productivity. The honeydew they excrete impairs light capture and facilitates the growth of sooty mould, leading to a decline in fruit quality.

Greenhouse whitefly (Credit: Whitney Cranshaw, Colorado State University, Bugwood.org)

Biological control is a potential solution

New Zealand's regulatory environment does not allow access to many of the generalist biological control agents (BCAs) that overseas tomato growers regularly use in their IPM programmes. In the absence of commercially available alternatives, the NZ sector looked at the potential of using BCAs that are native or endemic to NZ. There were a few potentially promising BCAs that had previously been identified in laboratory-based studies that could help control both TPP and other pests common in tomato crops. The tomato sector with the support of the A Lighter Touch programme initiated a research project to see if these BCAs could be identified, tested, and ultimately become part of an IPM programme.

Development of an IPM programme

The aim of the tomatoes IPM project was to **shift the sector from chemical dependence to a preventative, biologically driven integrated approach**. Consequently, the IPM programme was built from the 'ground up' with growers participating in trials of the BCAs. Using a grower-centric approach meant that many of the learnings that have been incorporated into the tomatoes IPM programme were generated by the growers themselves, tested and validated in commercial greenhouses. The final IPM programme recognises that every grower is different and has different levels of tolerance for various pests.

The tomato IPM programme was built on four key pillars

1. Early introduction of BCAs
Instead of waiting for infestations, BCAs are introduced immediately after planting; this ensures predators establish before whitefly populations grow. The BCAs available to use on tomato pests including whitefly are listed in table 1 (on the next page).

2. Maintaining a predator:pest balance
Pest thresholds are updated reflecting the BCAs need for host and prey which is critical to their establishment on the crop. The objective is to achieve a biological balance between the pest and the BCAs, rather than having zero tolerance for any pest population.

3. Reduction in chemistry and selective chemical use
Chemical sprays are still recommended but used strategically and as a last resort. Soft or physical mode of action insecticides are recommended along with any products that are compatible with biological systems.

The reduction in agrichemicals used has been a critical component for resistance management to mitigate the risk for whitefly resistance to occur.

4. Monitoring and rapid response
Regular pest scouting enables early detection of whitefly infestation and early intervention with targeted releases of BCAs or application of soft sprays.

Table 1. BCAs used in the tomato IPM programme

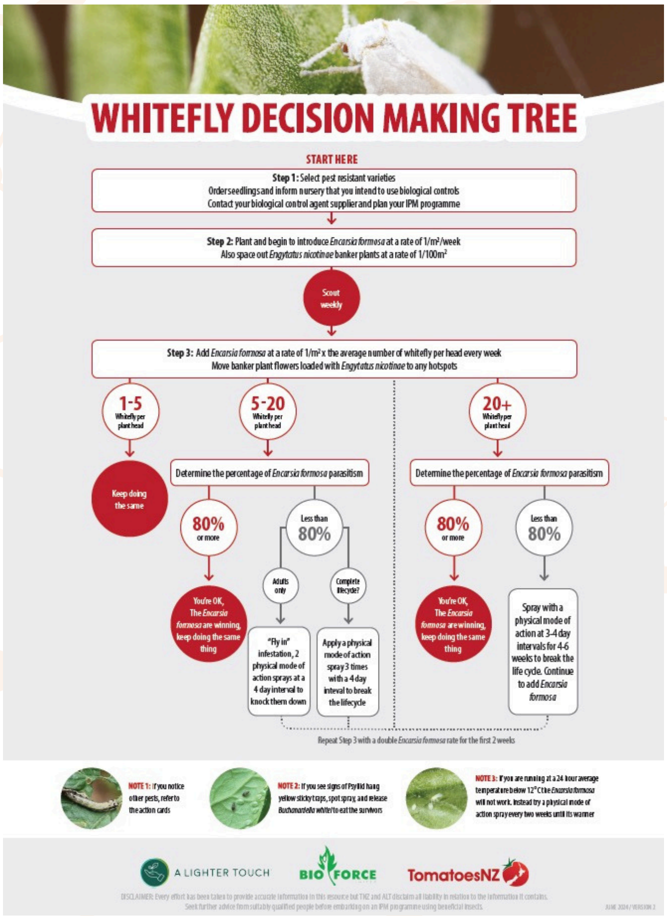
BCA	Description	Pest	Commercial product
Aphidius colemani	A parasitic wasp used to control aphids.	Aphids	Aphidius
Buchananiella whitei	A predatory, minute pirate bug native to Australia and New Zealand.	Psyllid	
Encarsia formosa	A parasitic wasp used to control greenhouse whitefly.	Whitefly	Enforce™
Engytatus nicotianae	A native predatory mirid bug that has shown success in feeding on both the tomato-potato psyllid (TPP) and greenhouse whitefly.	Whitefly, Psyllid	
Mallada basalis	Green Lacewing. Predate on a large variety of prey including aphids, mealybugs, spider mites, moth eggs, caterpillars, passion vine hoppers, whitefly, thrips, scale insects and psyllids.	Aphids. Generalist predator	Lacewing-Force
Scymnus loewii	Ladybird. Primarily and aphid predator, will predate alternative prey including psyllid and whitefly eggs.	Aphids	Dusky ladybird
Stratiolaelaps scimitus	A predatory mite. Will predate thrips pupae in the growing media or on the ground. Predator of Sciarid flies - eggs, larvae and pupae life stages.	Thrips, Sciarid flies	Hyper-mite™
Tamarixia triozae	A parasitic wasp that specialises in parasitising tomato potato psyllid, feeds on small TPP larvae and parasitises large larvae.	TPP	*Tamarixia*
Other BCAs			
Micromus tasmaniae	Tasmanian Brown Lacewing. Generalist predator observed to preferentially feed on psyllid, Greenhouse whitefly, Two spotted mites and aphids.	TPP, whitefly, two spotted mites, aphids	Tasman Lacewing
Neoseiulus cucumeris also called Amblyseius cucumeris	A predatory mites used against thrips.	Thrips	Mite-A™ Thripex
Orius vicinus	A pirate bug. Small predatory bug that predates on a large variety of prey, including thrips, aphids, whiteflies, mites (incl. spider mites), mealybugs, psyllids and the eggs of larger insects such as butterflies and moths	Generalist predator	Orius

Integrated pest management for whitefly

The IPM programme for whitefly centres around a decision-tree. The emphasis is on early BCA releases, weekly scouting for levels of BCA control (parasitism), and use of physical mode of action or soft chemistry.

For whitefly control two BCAs are recommended *Encarsia formosa* and *Engytatus nicotianae*. The combination of a parasitoid and predator BCA means that different life stages of whitefly are attacked, providing improved control.

Soft chemical or physical mode of action spray control options are only recommended when *Encarsia* parasitism rates drop below 80% and whitefly levels are greater than five per plant head to break the whitefly lifecycle.



The whitefly decision tree

Outcomes

- Over the course of the three-year IPM project Tomatoes NZ reported that was an increase in growers using BCAs, from 12% of growers to 35% of growers (by area).
- Many growers were able to complete an entire planting season without resorting to chemical inputs.
- Growers reported improved crop performance, having increased yield and improved fruit quality

Key lessons learnt

- Adopting an IPM approach has enabled tomato growers to control whitefly without using broad spectrum, residual and non-IPM friendly chemistry.
- Transitioning a crop to IPM is a significant shift that requires ongoing learning, evaluation, and refinement over several years. It is not something that can be achieved within a single cropping season. Growers involved in the project experienced setbacks initially, but success came through incremental improvements and continual adjustment.
- Most BCAs can be introduced to the crop soon after planting to support even distribution and successful establishment of the BCA population. Supplementary feeding can be required to prevent plant damage and give biological control the greatest chance of success.
- The IPM programme encourages growers to scout regularly, whether that's following an established protocol of observing a set number of rows per week or observing the full crop more regularly. Regular scouting activity is important, not how it is carried out.
- Physical mode of action sprays and soft chemistry are recommended where compatible with an IPM approach. Chemical options are recommended as a last resort to use when whitefly populations exceed a threshold. Tomatoes NZ has provided guidance to help growers set a threshold that is suitable for their local growing conditions.
- The tomato sector now relies less on chemical applications. Reduced spray frequency and overall use (up to 61% decrease in agrichemical use was measured in the IPM project) has resulted in improved resistance management outcomes, with less selection pressure on whitefly.

Reports and resources

Tomatoes NZ. Integrated Pest Management. https://www.tomatoesnz.co.nz/ipm/, accessed May 2026.

Tomatoes NZ - IPM greenhouse video series https://www.youtube.com/playlist?list=PLyWjTzcyS3kuOPeQlIQIIqgubEoBbvVAG, accessed May 2026.

Tomatoes NZ (2024) Whitefly decision tree. https://www.tomatoesnz.co.nz/dmsdocument/386-whitefly-decision-tree-a4, accessed May 2026.

Tomatoes NZ (2025) IPM programme for glasshouse tomatoes incorporating arthropod BCAs. Final report. https://www.tomatoesnz.co.nz/dmsdocument/417-final-report-alt-tnz-bca-project-pdf, accessed May 2025.