BIOCONTROL PROJECT IN TOMATOES SHOWS SUCCESS

Contributed

An adult tomato-potato psyllid. Photo courtesy of Bioforce

A card carrying E. Formosa *scale is attached to the tomato plant, ready to hatch and hunt greenhouse whitefly*

A TomatoesNZ project in conjunction with A Lighter Touch is aiming to change the face of pest management of greenhouse tomatoes, moving the industry back to integrated pest management (IPM) centred on the biocontrol of insect pests. For the *NZGrower*, the project team shares findings so far.

First season results from a project demonstrating the biological control of two major greenhouse pests show greater suppression of the pest population using natural predators than with a full chemical approach.

The New Zealand native predatory mirid bug *Engytatus nicotianae* has been identified as having the potential to be a useful biological control agent (BCA) in the battle against greenhouse whitefly (GHW) and the tomato-potato psyllid (TPP).

Laboratory feed trial data published in 2022 by Emiliano Veronesi (of Lincoln University) indicated that *E. nicotianae* is a generalist predator that completes its entire life cycle on various prey species, including GHW and TPP. The Lincoln laboratory trials demonstrated *E. nicotianae's* feeding preference for juvenile TPP.

Across four of seven replicate cage studies, TPP establishment was prevented.

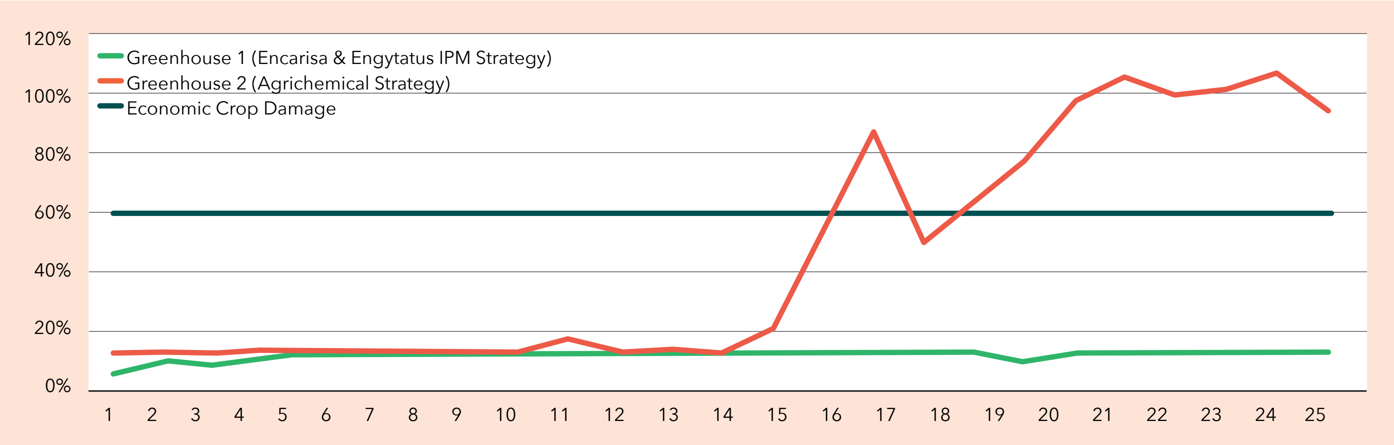
The biocontrol project took the knowledge gained through the Lincoln University trials and applied it to the biological control agent trials conducted as part of the TomatoesNZ / A Lighter Touch project. It aimed to determine:

- If *E. nicotianae* was introduced together with another BCA *Encasia formosa*, would they be able to successfully establish in the greenhouse through predating on GHW and TPP, and
- suppress these pest species to an economically acceptable level.

Method

Two greenhouse sites were selected for the BCA demonstration project. Site 1 consisted of an older style low-roofed plastic structure totalling around 3000 sq metres. Site 2 was a Venlo style high-stud of about three hectares, separated by a glass wall into approximately a one-hectare trial house and a two-hectare control.

Site 1 was completely dedicated to the use of BCAs. At Site 2, one hectare was solely based on BCA control while the two-hectare house was treated with standard chemical spray protocols.



The graph demonstrates the efficacy of the combination of E. nicotianae *and* E. formosa *for control of greenhouse whitefly in the BCA house, versus the control house*

Soon after planting, the predator *E. formosa* was introduced at a rate of three per metre^2. The rate was modified throughout the season based upon the GHW population observations of the crop scouts. Introduction of *E. formosa* continued weekly.

E. nicotianae, whilst predatory in nature, can also survive on certain plants, and for the demonstration was introduced in the greenhouse on tobacco 'banker' plants at the rate of nine plants per 1000m^2. (Banker plants consist of a non-crop host plant harbouring a natural enemy,)

Scouting was undertaken on a weekly basis using the scouting protocol developed for the project and available on the TomatoesNZ website. The scout moved through the rows looking for anything unusual, including any plant damage, residue, bugs on sticky traps, or bugs present on leaves.

If no signs of bugs were observed, the scout would stop randomly every six to ten metres and examine the underside of five to ten leaves for bugs, larvae or eggs. This approach is based on a Lincoln University statistical analysis of GHW populations which indicated that as long as 50 sites within a greenhouse were examined, an accurate average measure of the GHW population can be established (site size was not relevant).

Once scouting was completed, any areas of higher than acceptable pest population were identified and additional BCAs distributed accordingly.

Results and Observations

Site 1

Shortly after planting, the greenhouse had a GHW population ranging from low (zero per plant) to high (maximum of 100 per plant) with an average of 27. The *E. nicotianae* banker plants were placed on the centre path at row ends. *E. formosa* was introduced in the form of standard cards, each containing 150 parasitised GHW scale.

After three weeks *E. nicotianae* had not been observed more than five metres from their release point. A decision was made to break parts of the leaves off the banker plants and distribute them down the rows. This led to rapid establishment of *E. nicotianae* around the site. At this stage GHW numbers were static.

In the two to four weeks following leaf fragment distribution, the GHW population was visibly reduced. One month after distributing leaves through the house, GHW became difficult to find. From this time onwards, GHW were of no economic issue.

No insecticides were applied on this crop.

Site 1 is in what would be considered a medium TPP pressure location, and at no time did scouts observe a single TPP or signs of their presence (sugars or TPP yellows, adults on yellow sticky traps). This was unusual, as historically the site would have experienced multiple TPP incursions in a season.

Site 2

E. formosa was introduced the week after planting and the rate was increased from three per metre^2 to ten per metre^2 at the request of the grower, who was concerned at potential carry over pests from the previous season and elsewhere on the site. A month later the rate was decreased to three per metre^2 and remained there for the rest of the season.

E. nicotianae banker plants were also introduced a week after planting at the planned rate of nine plants per 1000 per metre^2, with plants being placed on row ends. Following the success of the plant leaf fragment distribution at Site 1, the same strategy was employed here.

A TPP incursion occurred in February and *E. nicotianae* was observed predating on all of the developmental stages of TPP but not the adults. Observations were made that the TPP population appeared to be somewhat suppressed, however the presence of 'hot' TPP meant that the infestation required hasty action. (Hot TPP refers to TPP that are carrying *Candidatus Liberibacter*, which kills the plant.)

A single spray of Spiromesifen was applied late in February and this was enough to eliminate the 'hot' TPP population. After the initial hot TPP incursion, scouts encountered no further TPP in the BCA area.

A positive aspect of this crop was that GHW remained at acceptable levels until week 32 of the season. Over the next seven to eight weeks, it then climbed to approximately ten per head at week 39.

In the BCA house, the grower wished to start his new crop with very clean houses, and so ten weeks out from the end of the crop cycle made the decision to clean up using a chemical intervention to assist with this.

Conclusions

Site 1 Conclusions

This site demonstrated that an entire season of GHW control can be achieved through the use of *E. formosa* and *E. nicotianae*. While there were some GHW present, they were not at levels to economically impact upon crop production.

As this trial operated without a control house, the project team was not able to definitively say that *E. nicotianae* was responsible for the absence of TPP. However, this was a promising observation and this site plans to manage its next season with the same biological controls.

Site 2 Conclusions

This site also demonstrated good GHW control for the majority of the crop. The decision to use chemical control at the end of the crop (the last ten weeks) was driven by a desire to go into the next new crop with totally clean houses.

The scouts found no additional TPP (after the initial hot psyllids issue) for the rest of the crop.

One significant difference between successful IPM systems and conventional chemical spraying is that with IPM, growers need to tolerate some levels of pest population. Different growers will have different tolerances of what level of pest population is economically viable, but the trials have shown that GHW can be managed to levels that do not significantly affect production.

Where to from here

These trials are ongoing in the 2023–2024 production seasons. Both of the trial sites are continuing to use *E. formosa* and *E. nicotianae* as their primary controls against insect pests.

At Site 1, the trial will be exactly the same.

At Site 2, the efficacy of *E. formosa* and *E. nicotianae* was such that the grower has chosen to run with *E. formosa* in both the trial and control houses. *E. nicotianae* has also been introduced on banker plants in the trial house. It has also been noted that some *E. nicotianae* has migrated into the control.

In addition to the above sites, a number of other trials are also taking place. All of these trials are using *E. formosa* as the base BCA, with other beneficials being trialled to try and add to the pool of tools available to tomato growers.

The TomatoesNZ / A Lighter Touch trials are also about learning how and when to apply the BCAs and at what volumes. The project team is building its knowledge base and seeking the most effective way to communicate this among tomato growers.

The project team has identified that as well as gaining an understanding of how beneficial insects work, it also needs to develop resources that explain what to do, and not to do, at a practical level.

Workshops were held in 2023, for which a video and decision tree on GHW control were created. These can found on the Tomatoes NZ website. Further workshops are planned for 2024.

One of the largest hurdles for growers to overcome is the focus on 100 percent clean crops, i.e. zero pests. More work needs to be done on developing grower understanding of the equilibrium that is needed between BCAs and pests.

Shifting to sustainable pest management options

A Lighter Touch projects are all based around researching options that allow growers to have more sustainable production futures.

The tomato industry is currently showing a significant shift towards BCA-based pest management programmes.

A survey when the TomatoesNZ / A Lighter Touch project began found only 50 percent of large commercial growers were actively involved in BCA use. With success demonstrated in the trials, all large growers are now participating in IPM programmes. Many smaller growers are also successfully using biological controls for GHW control and TomatoesNZ is looking forward to further uptake.

SUCCESS FROM E. FORMOSA MANAGEMENT STRATEGY OF GHW

In a third trial site where only part of the glasshouse area was subject to trial, a bay within the glasshouse had regular introductions of *E. formosa* from the time the crop was planted. Greenhouse whitefly (GHW) built up rapidly in the balance of the crop and the pest began to overwhelm the total property (but to a lesser extent in the trial area). Conventional spraying was having little effect upon GHW.

A decision was made to cease conventional spraying and to introduce large volumes of *E. formosa*, in conjunction with soap sprays and vacuum trolleys.

It took some time for the *E. formosa* to build in numbers but as it did so, *E. formosa* reduced the GHW population to manageable levels, and regained the viability of the crop.

This site plans to use *E. formosa* for the whole site (in its new crop), with gradual introduction from the week the crop is planted.

The graph illustrates the impact on GHW of *E. formosa* when it began to gain control in week 49. By week four, the whitefly levels are at an equilibrium, i.e. they are reduced to a level where the pest is not impacting the viability of the crop, but there are sufficient numbers to feed and maintain the *E. formosa* population.