



Pauesia, the beneficial parasitic wasp that kills giant willow aphids (3-4 mm in length).

Tiny wasp set to help bees and beekeepers

A beneficial parasitic wasp from California could help to combat the giant willow aphid in New Zealand.



Mature giant willow aphids (~6 mm in length) feeding on a willow stem.

The giant willow aphid (*Tuberolachnus salignus*) is an exotic pest affecting many in New Zealand, but bees and beekeepers are particularly hard hit. The aphid affects them primarily in three ways:

1. Giant willow aphids secrete honeydew which provides an abundant food resource for pest wasps, causing their populations to increase. These pest wasps, such as the common wasp and German wasp, kill bees and rob them of their honey, and also sting humans and animals.
2. Bees also harvest the giant willow aphid honeydew, but the honeydew contains a particular kind of sugar that can cause honey to be sour and granular. If enough of this distasteful sugar is present, the honey solidifies in the comb and can't be extracted. Beekeepers have reported up to 30% of honey affected in this way.
3. Giant willow aphids damage willows as they feed, by depleting the trees of nutrients and water. This affects bees which rely on willows for pollen and nectar, especially in spring when not much else is available.

The good news is that a parasitic wasp, *Pauesia* sp., has promising potential to help beekeepers.

What is biological control?

Biological control is the use of natural enemies to reduce pest numbers. Insects often leave their natural enemies behind when they invade a new part of the world. This is one of the main reasons why they can become pests in other countries, despite not being known to cause harm in their native environment.






Parasitoids make ideal biological control agents. They tend to be highly specific, attacking only one species or a small group of closely related species. Parasitoids are also self-perpetuating and independently seek out their host insects, reducing the need for costly long-term control efforts.

Effective control of the pest insect can take time, but ultimately biological control is a sustainable and chemical-free pest control method.



Crystallised honey caused by giant willow aphid honeydew.

Pauesia host specificity testing results

Aphid species	Subfamily/Tribe	Host plants	Results	Conclusion	
Most closely related (same subfamily)					
<i>Cinara fresai</i> Exotic pest	Lachninae	Various Cupressaceae, <i>Cryptomeria japonica</i> (Taxodiaceae)	No interest* shown by <i>Pauesia</i> and no evidence of parasitism (no aphid mummies)	Not a host	
Less closely related (different subfamily, same family)					
<i>Aphis cottieri</i> Native	Aphidinae: Aphidini	<i>Muehlenbeckia</i> spp.	No interest* shown by <i>Pauesia</i> and no evidence of parasitism (no aphid mummies)	Not a host	
<i>Brachycaudus persicae</i> Exotic pest	Aphidinae: Macrosiphini	<i>Prunus</i> spp.	No interest* shown by <i>Pauesia</i> and no evidence of parasitism (no aphid mummies) to date. Host testing not yet completed	Unknown	
<i>Neophyllaphis totarae</i> Native	Neophyllaphidinae	<i>Podocarpus</i> spp.	No interest* shown by <i>Pauesia</i> and no evidence of parasitism (no aphid mummies)	Not a host	
<i>Sensoriaphis nothofagi</i> Native	Taiwanaphidinae	<i>Fuscospora</i> spp.	Yet to be tested	Unknown	

*Interest is defined as the parasitoid approaching the aphid and attempting to lay an egg inside the body of the living aphid. See www.giantwillowaphid.co.nz/publications for a video of *Pauesia* attacking a giant willow aphid.

Evaluating the safety of the parasitoid

Introducing a pest's natural enemies into the pest's new habitat can be risky. Rigorous testing must be done to ensure that the biological control agent only targets the pest, before it can be released.

A parasitoid wasp has been observed attacking giant willow aphid (GWA) in eastern Asia and the United States. *Pauesia* sp., hereafter referred to as *Pauesia*, is known only from GWA. In fact, all species in the genus *Pauesia* attack only aphids closely related to GWA. This highly specific nature makes *Pauesia* a good candidate for biological control.

None of New Zealand's native aphids are closely related to GWA. The only close relatives of GWA present in New Zealand are other exotic pests. If *Pauesia* attacked them, it would not be a concern.

Despite this, host specificity testing on a range of non-target aphids is still needed to ensure *Pauesia* is safe to release in New Zealand. This testing is underway in a containment facility at Scion in Rotorua. We are testing representatives of all aphid groups present in New Zealand, as well as one of the closely related pest species.

The tests look for wasps attacking non-target aphids, the formation of aphid mummies (dead aphids with parasitoids inside them), and live wasps emerging from mummies. Testing has been completed for three species, is underway for a fourth and will commence shortly for the fifth (see table). There has been no indication of parasitism, even on the closely related aphid species as of the end of October 2018.

Impact on host trees and the search for resistant willows

In addition to our biological control efforts, researchers at Plant & Food Research and Massey University established a nursery field trial to look at the effect of GWA on the survival, growth, and flowering of young willow trees. The willows showed varying degrees of susceptibility to GWA. The most resistant willows were *Salix eriocephala* and *S. lasiolepis* x *viminalis*. The former was previously identified by Trees for Bees as a very long flowering willow, and a valuable resource for bees. Two clones of the latter willow have been released to regional council nurseries and beekeepers for planting in the New Zealand landscape.

Parasitoid wasps like *Pauesia* are ideal biological control agents. Their ability to target and destroy their hosts reduces pest numbers without chemical control, and without putting other organisms at risk.



The *Pauesia* larva develops inside the giant willow aphid (dissected above), eventually killing it.



Honey bees harvesting giant willow aphid honeydew.

What's ahead

Preliminary host specificity testing results suggest that *Pauesia* only attacks GWA and will not attack any other aphids present in New Zealand.

Once testing is completed in early 2019, the next step is to apply to the Environmental Protection Authority for permission to release the parasitoid in New Zealand. This includes public consultation, allowing everyone to have a say.

If released, the parasitoid wasp is expected to spread on its own and provide a safe and sustainable method of keeping GWA numbers in check. In the meantime, beekeepers should ensure they remove their honey before it has a chance to become contaminated with GWA honeydew when GWA populations build up in autumn.

Resistant willows identified in the nursery field trial are already being planted to replace some of the more susceptible willows in the New Zealand landscape. This will ensure willows will continue to be available to protect river banks and erosion-prone land, and to provide food for bees. Over time, this is also expected to help reduce GWA numbers and minimise the impact of this pest.

Key links and references

<https://www.giantwillowaphid.co.nz>

https://www.giantwillowaphid.co.nz/_data/assets/pdf_file/0017/64124/GWA_article-Connections28.pdf

https://inaturalist.nz/observations?place_id=6803&taxon_id=354036



GWA team member Roanne Sutherland checking for parasitism of the native tōtara aphid, *Neophyllaphis totarae*.

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About Scion

Scion is the Crown research institute that specialises in research, science and technology development for forestry, wood and wood-derived materials, and other bio-material sectors.

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