ISSUE 76 / MAY 2016

LANDCARE RESEARCH
MANAAKI WHENUA

Weed Biocontrol

WHAT'S NEW?

Highlights

- TRADESCANTIA BEETLES ON THE UP
- OLD MAN'S BEARD SAWFLY FOUND
- EARLY PROMISE FOR PRIVET LACEBUG

Tradescantia leaf beetle
Justine Hall, Wellington City Council

Contents

Key contacts

EDITOR: Lynley Hayes
Any enquiries to Lynley Hayes
hayesl@landcareresearch.co.nz

THANKS TO: Leah Kearns
LAYOUT: Cissy Pan

CONTRIBUTIONS: Alison Evans

www.weedbusters.org.nz

ISSN 2463-2961 (Print) ISSN 2463-297X (Online)

www.landcareresearch.co.nz

Tradescantia Beetles on the Up

Beetles brought to New Zealand from Brazil to control tradescantia *(Tradescantia fluminensis)* have found a new home on Mt Victoria in Wellington, after being released there by Conservation Minister Maggie Barry and Wellington Mayor Celia Wade-Brown in March. Tradescantia is one of the 'dirty dozen' weeds that are the current focus of a new campaign called the "War on Weeds" to reduce the spread of unwanted plant pests. Tradescantia has been growing rampantly in native bush remnants and people's gardens for decades now. But the three beetle species introduced to help stop the spread of this weed, the tradescantia tip beetle (*Neolema abbreviata*), tradescantia leaf beetle (*Neolema ogloblini*) and tradescantia stem beetle (*Lema basicostata*), are establishing well and starting to knock back the plant at release sites.

"Tradescantia is a significant environmental weed that prevents natural regeneration of native plants and changes the processes on the forest floor that sustain biodiversity," said Quentin Paynter, who helped to discover these beetles.

Since the first release of the leaf beetle in 2011 at Mt Smart in Auckland, the beetles have been gradually increasing in number. "The leaf beetles got off to a slow start at Mt Smart, possibly due to the less than ideal weather conditions around the time of their release in late autumn," said Quentin, who has been following their progress. Despite their slow start at this site, the damage to the tradescantia is becoming obvious now, with large patches of dead plant material visible (see photo).

At other release sites the beetles have multiplied more quickly and the damage to the tradescantia has been more visible as a result. Northland and Taranaki Regional Councils have been able to begin harvesting beetles from initial release sites to spread around their regions. The beetles are also proving to be very popular, with some groups now rearing their own on potted plants to boost numbers available for release. The Wellington Botanic Gardens, for example, are breeding up all three species of the beetles with the intention of releasing them in Wellington's parks and reserves. The first such release was made by the Minister and Mayor at Mt Victoria, and it is hoped there will be many more to come.

Furthermore, a stem beetle site in Marlborough visited this autumn again showed that this insect alone can have a rapid impact on tradescantia. "At Waikakaho I estimate around 10 m^2 of the weed had collapsed and disappeared at the release point, after only 3 years, with heavy damage around the edge out for another 20 m," described Lindsay Smith. The beetles appeared to have not spread much beyond that though as yet.

Justine Hall, Wellington City Council

Minister Barry and Mayor Wade-Brown releasing tradescantia leaf beetles.

"Now that we are confident that the beetles will establish on tradescantia throughout New Zealand, we have started to ask more complex questions that will hopefully demonstrate the benefits of these biocontrol agents," Quentin said. This autumn a joint project has been set up on the Hikurangi floodplain (at the head of the Kaipara Harbour catchment) called 'Living Water'. Living Water is a 10-year partnership between Fonterra and the Department of Conservation working with farmers, iwi, conservation groups, schools and other agencies to improve the ecosystem health of five key catchments in significant dairying regions throughout the country. Bev Clarkson, a wetlands expert at Landcare Research involved in the Living Water project, is passionate about seeing biodiversity restored in the tōtara and kahikatea remnants that form part of the floodplain habitat. "The Hikurangi floodplain is considered a 'biodiversity hotspot' and although it is fragmented, it still supports important forest habitat and wetlands containing threatened plant species," said Bev. "The aim is to improve the biodiversity values of the forests found on the Hikurangi floodplain and to achieve this, we need to be able to control tradescantia, which has been identified as a fundamental problem," said Bev. "The ability of the forest to replace itself is severely compromised by the presence of tradescantia, which is widespread and forms dense 'mats' (up to 1 m deep in places) that prevent native seedling regeneration," she explained. "The Living Water project considers the biocontrol of tradescantia as a key restoration opportunity and is very supportive of the initiative," said Bev.

So Bev and Quentin have teamed up to establish a research trial at four of the forest remnants to determine how efficiently the beetles control tradescantia, how far they move into the forest fragments over time, and to assess habitat recovery in terms of biodiversity values such as native insect diversity. "We have collected baseline data on insect diversity using malaise and pitfall traps and will repeat the same methods in 2–3 years' time to see if there has been any change as a result of the tradescantia beetles being present," said Bev. They are also comparing the effectiveness of the beetles with more traditional control methods such as manual weeding. Weeding has been done in the past by volunteers in an attempt to reduce the spread of the weed, and to replicate the natural flooding that used to occur across the floodplain prior to man-made changes to the hydrology of the region. There are promising signs already that the beetles are settling in well and we will share results from this trial in future issues.

Biocontrol of tradescantia has been funded by the National Biocontrol Collective and the Ministry of Business, Innovation and Employment as part of Landcare Research's Beating Weeds programme. The Hikurangi biodiversity restoration project is funded by the Biological Heritage National Science Challenge, MBIE (Restoring Wetlands and Beating Weeds programmes) and the Fonterra/DOC Living Water Programme. Information about the War on Weeds is available at: http://www.doc.govt.nz/our-work/war-on-weeds/

CONTACT: Quentin Paynter
paynterq@landcareresearch.co.nz

Setting up the trial in the Hikurangi.

Leaf beetle damage at Mt Smart.

Stem beetle damage at Waikakaho.

What's Happening with Old Man's Beard?

Old man's beard (*Clematis vitalba*) has proven to be a challenging biocontrol target. Since we have many valued native *Clematis* species in New Zealand biocontrol agents need to be highly host-specific, and surveys in the native range did not yield a long list of candidates worthy of further study. Three agents have been released in New Zealand to date.

The first agent released, back in 1996, was a leaf-mining fly (*Phytomyza vitalbae*) that showed early promise, establishing readily and dispersing throughout New Zealand within a couple of years. But unfortunately it did not take long for its own natural enemies to catch up. While mining of leaves is now common on old man's beard, six native and two exotic parasitoids, generally keep the leaf miner populations lower than the threshold needed to impact on the growth of the plant. However, damaging outbreaks do sometimes occur. "We saw heavy mining this autumn at Ashburton and on Banks Peninsula," reports Hugh Gourlay.

The second agent, released around the same time as the leaf miner, was believed to be a superior strain of a fungus (*Phoma clematidina*). This fungus was already present New Zealand but only causing cosmetic damage to old man's beard in the autumn. Initially heavy damage was observed at release sites, but this did not persist. Subsequent studies could find no trace of the released strain, and it is possible that it was outcompeted by other fungi on old man's beard, some of which studies have shown occur as symptomless endophytes that may confer disease resistance to the plant.

The third agent, a sawfly (*Monophadnus spinolae*) was released with high hopes in 1998. Although a rare insect in its native range in Europe, each larva can consume several leaves, and it was hoped that it might be able to complete three generations a year here. Other sawfly species, such as the willow sawfly (*Nematus oligospilus*), which self-introduced to New Zealand in 1997, can be damaging pests. However, the old man's beard sawfly proved to be a difficult insect to mass rear. With much perseverance enough were produced to make 16 releases at 14 sites from the Bay of Plenty to Otago before the rearing colony died out. It is thought that the rearing colony probably became too male-dominated and too inbred. If conditions are not good for mating the females produce unfertilised male eggs. Six sites quickly succumbed to floods or human disturbance and, since no sign of the sawfly was ever seen in the field, it was thought to have failed to establish.

L Grueber

Lynley finds a sawfly in the field.

Recently the merits of having another attempt at establishing the sawfly have been considered, given the ongoing seriousness of the old man's beard problem in many regions. Before investing in such an undertaking, it was agreed that surviving release sites should be checked once more at the optimal time of the year. Lynley Hayes, along with Robin Van Zoelen and Lindsay Grueber (Tasman District Council) checked a site near Nelson in January. Nearly 3000 sawflies were released here in 2002, by far the largest release made, and the larvae were initially covered with mesh to protect them from being eaten by birds. The site has since been highly modified to provide better flood protection, and much of the old man's beard had been removed to make space for native plantings, so the trio's expectations were low. However, clumps of old man's beard remain at the site and Lynley discovered one of the distinctive white caterpillar-like larvae on the second clump examined. "However, 2 hours of searching only yielded another two larvae and one adult, so the sawflies remain rare at this site," confirmed Lynley. Reasons for the low population may be that it is inbred or taking a hit each year from wasps. "We hoped that we might find sawflies elsewhere, so we could have a go at creating a new rearing colony with increased genetic diversity, and then release the progeny in a wasp-free area, to see if that could yield better results. However, that hope was dashed when no sawflies were found at any of the other release sites. Given that wasps are likely to be a limiting factor for sawflies in New Zealand, we recommend focussing instead on two remaining options that are not likely to be affected in this way," said Lynley.

One of these is a bark beetle (*Xylocleptes bispinus*), known to regularly kill vines in Europe, which was investigated by colleagues at CABI in Switzerland early on, but proved difficult to test. Tests in confined spaces, and attempts to use cut stems of native *Clematis*, shipped from New Zealand, proved unsatisfactory, and the work was discontinued without resolution due to a lack of funding. When it became clear that the three agents released in New Zealand were unlikely to do the job required, the bark beetle option was revisited and a field trial in the native range deemed the way to go. Frustratingly, several attempts to set up such a field trial in the UK were unsuccessful as New Zealand native *Clematis* plants failed to thrive due to the cooler climate, severe storms and even rabbit browsing. So arrangements were made with a botanical garden on the Isle of Wight, which offers a milder climate and has native populations of the bark beetles. Even then, some plants were lost before they were planted out, due to a severe winter storm damaging the glasshouse they were being stored in! But finally in the last couple of years New Zealand native *Clematis* plants have been successfully established at the garden, allowing the field trial to get underway. More plants, recently shipped over to boost numbers, will be added this spring. "Results are still several years away," warned Hugh. In breaking news, some funds have been secured from councils seriously affected by old man's beard that will allow us to also import some bark beetles into containment in 2017 and undertake studies that will complement the field trials. The other option is a leaf and bud galling mite (*Aceria vitalbae*) not found during the original surveys that only came to light more recently. The mite stunts the new growth and is likely to be highly host-specific. However, again a range of unexpected setbacks to studying this agent occurred, which have only recently been overcome. Several attempts to establish a mite colony in containment at Lincoln were unsuccessful after shipments were delayed in transit or heavily diseased," explained Lindsay Smith. At that point, mite expert Dr Biljana Vidovic from the University of Belgrade, Serbia, hand-delivered a colony of mites but plant quality issues then emerged that could not be treated without harming the mites and the colony was lost. The narrow window in which mites can be collected in the field further complicated matters. At that point it seemed more feasible to attempt the host-testing in Europe. "The logistics of shipping all the test plants successfully to Serbia took some time to overcome," said Lindsay. However, testing is now well underway and is expected to be completed soon. With a bit of well overdue luck, an application to the Environmental Protection Authority to release a potentially useful new agent for old man's beard might well be possible later this year.

This project is funded by the National Biocontrol Collective.

CONTACT: Lindsay Smith
smithl@landcareresearch.co.nz
Hugh Gourlay
gourlayh@landcareresearch.co.nz

Privet Lace Bug Shows Early Promise

The Environmental Protection Authority (EPA) granted approval to release the privet lace bug *(Leptoypha hospita)* in May 2015. Waikato Regional Council was the applicant on behalf of the National Biocontrol Collective. This is the first agent to be used against Chinese privet (*Ligustrum sinense*) both in New Zealand and worldwide. The lace bug adults and nymphs pierce and suck the sap from the privet leaves, damaging the leaf tips and, if the attack is severe, causing defoliation, all of which reduces the vigour of the plant. The lace bugs have fortunately proven to be relatively easy to rear, which allowed 11 releases to be made last spring/early summer in the Auckland, Bay of Plenty, Waikato and Wellington regions.

Visits this autumn to an Auckland site have generated an early surge of excitement. It is not unusual when releasing weed biocontrol agents to not be able to find any sign of them, or only very subtle indications for the first few years following release. However, at Mt Richmond seedling plants in the shade were clearly showing signs of attack, with much bleaching of the leaves, after only a few months. "This early sign in the field, on top of damage observed to plants in our rearing colony, augers well that the lace bug will establish and be able to cause considerable damage to Chinese privet," said Quentin Paynter. In its native range (China) the lace bug is reported to attack a range of privet species in addition to Chinese privet. Host-range testing has indicated that other *Ligustrum* species present in New Zealand, such as the larger tree privet (*Ligustrum lucidum*) are also potential, but less-preferred hosts.

Small plant showing lace bug damage.

It is not certain how many generations of the lace bug will be produced per year in New Zealand, but at least two are likely. It is also not certain whether additional agents will be needed to provide sufficient control of weedy privet species in New Zealand. For now it is a matter of wait and see, but the project is off to a good start.

This project is funded by the National Biocontrol Collective.

CONTACT: Quentin Paynter
paynterq@landcareresearch.co.nz

Feasibility of Biocontrol for Evergreen Buckthorn

We were recently approached by Auckland Council (AC) to take a look at biocontrol options for evergreen buckthorn (*Rhamnus alaternus*), which is threatening coastal and offshore island native plant communities. This is another species that originates from North Africa, Asia, the Mediterranean and parts of Europe, but its weedy threat has been largely overlooked in the past because it has spread slowly relative to other plant pests. Evergreen buckthorn is an attractive ornamental plant with, as its name suggests, thorns, and small, green, fragrant flowers that are pollinated primarily by insects. Once pollinated, the plant produces poisonous red berries. When ripe, the berries become attractive to birds, which transport the seed to new places.

"*Rhamnus* is a major weed of the inner Hauraki Gulf and we have an active control programme on Waiheke and Rakino Islands but it is often difficult to access the plants unless you have abseiling equipment," said Holly Cox, who is a senior regional advisor for plant biosecurity at AC. "DOC is also managing the weed on Rangitoto and Motutapu Islands. But the problem is that it grows abundantly in people's gardens along the coast of the Waitemata Harbour on the North Shore and eastern suburbs, which means that the birds can easily bring the seeds over to the islands," Holly said. "We are looking at biocontrol as an option because in places it is really dense, dominating coastal cliff habitats, altering the ecology and limiting the opportunities for native plant recruitment," Holly added.

Evergreen buckthorn can also be found in a number of other places around New Zealand from Northland to Otago, so it is very adaptable, growing at a range of altitudes and latitudes. The plants are drought tolerant, with a persistent seed bank that germinates quickly following fire, and are also frost resistant. These are all characteristics of competitive, invasive plants," said Ronny Groenteman, who has been leading the feasiblity study.

"In northern Spain, which has a similar climate to New Zealand, evergreen buckthorn grows from sea level to altitudes of 1300 m," Ronny said. "There are several things that make evergreen buckthorn a good target for biocontrol, such as having no closely related indigenous species in New Zealand and not being a favoured ornamental plant. Also, it is a difficult plant to control using herbicide because it grows amongst native plants that are susceptible to the same chemicals. This is one of the main reasons that biocontrol is potentially the only cost-effective option for this plant in the longer term," Ronny confirmed.

Auckland Council

Evergreen buckthorn on Motukaha Island

Biocontrol has been explored overseas for two other closely related buckthorn species, *R. cathartica* and *Frangula alnus,* which have become invasive in North America. However, because that part of the world has closely related native plants, no insect agents could be found that were sufficiently host-specific to use as biocontrol agents. Plant pathogens may yet offer some hope down the track. Several fungal pathogens have been isolated from *Rhamnus* species that could be possible candidates.

With respect to evergreen buckthorn, fourteen species of host-specific insects and one rust fungus have been reported in the literature, and dedicated surveys may well reveal more natural enemies. The potential of the pathogen and at least eight of the insects (including five species of psyllids, two butterflies and a gall midge) appear to be worth examining further.

Ronny considers evergreen buckthorn to be an 'intermediate' target in terms of predicting biocontrol impact but warns that it would likely be a relatively expensive target, given that the project would have to start from scratch. For such projects the cost of developing biocontrol agents is historically on average $475,000 per agent, and generally 2–3 agents are needed.

Ronny has identified a number of useful next steps. These include undertaking a baseline survey of natural enemies already present in New Zealand on evergreen buckthorn, including organisms that might disrupt a biocontrol programme, and a molecular study to pinpoint the exact geographic location that the New Zealand material originated from in order to inform native range surveys for potential agents. Another useful step would be to conduct a cost-benefit analysis of how different control options compare, including a 'doing nothing' approach. Ideally, this would consider future weed spread scenarios and include the economic impact of controlling the weed on offshore islands in the Hauraki Gulf that are managed as wildlife refuges.

This feasibility study was funded by Auckland Council.

CONTACT: Ronny Groenteman
groentemanr@landcareresearch.co.nz

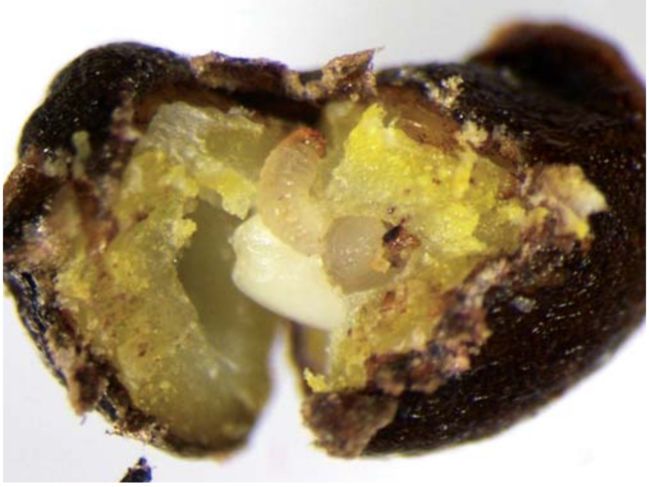
Barberry Weevil Breakthrough

Widespread releases of a seed-feeding weevil (*Berberidicola exaratus*) finally got underway last summer with batches of weevils sent off to new homes in Southland, Wellington and Manawatu-Wanganui. While Darwin's barberry (*Berberis darwinii*) is problematic currently in only a few regions of New Zealand, it has strong potential to become another 'gorse' of the future. A key challenge in managing this prickly plant is that birds readily feed on the abundantly-produced berries, which helps it to spread and re-infest cleared areas. Clearing infested areas is no small task. It has been estimated that 37 person days were required to cut and stump treat a 3.3 ha Darwin's barberry infestation in Wellington.

The female weevils lay eggs inside the developing fruits, and the resulting larvae damage or entirely consume the developing seeds. There is one larva per fruit. Host-testing has suggested that the weevil will also attack the seeds of the next weediest barberry species in New Zealand (*Berberis glaucocarpa*), and possibly some closely-related ornamental species (such as *Berberis thunbergii*) to a lesser extent. The latter might have the added bonus of helping to prevent more barberry species from becoming future weeds while not detracting from their appearance. Although the weevil was approved for release by the Environmental Protection Authority in 2012, some unexpected challenges cropped up that we have needed to overcome before widespread releases could begin. A flower-feeding weevil (*Anthonomus kuscheli*) was also approved for release, but efforts are being made to establish the seed weevil first. Neither weevil has been used as a biocontrol agent anywhere in the world before.

"The first challenge we ran into was that Darwin's barberry does not like being grown in pots, and especially not under artificial conditions, such as in our containment facility," said Hugh Gourlay. The plants would abort most of their flowers and fruit and produce little new growth, all of which we needed to rear the weevils. With mass rearing ruled out, we then explored direct field release options. Our Chilean collaborator, Hernan Norambuena, sent us a large shipment of over-wintered adult weevils in spring 2013, but hopes of direct field releases were dashed when we found they were infected with microsporidia and parasitic fungi, something we had not encountered with earlier shipments. Further research that spring showed that not all populations of the weevils in Chile were diseased, so material collected from 'disease-frees sites' was shipped to New Zealand in early spring 2014. "It was therefore a blow to discover infection in these shipments too," said Hugh.

We then hypothesised that perhaps the disease became prevalent during winter when the weevils hibernate closely together, but was not passed on via the eggs to offspring (which become infected later on). So we asked Hernan to send us larvae inside infested fruits later in spring 2014 and were relieved when they proved to be disease-free. "We originally planned to hold the subsequent new adults in cages over the winter and release them in spring. However, the new adults were not doing well, likely due to the lack of new growth on our sulky potted plants, so we decided to release them instead into a field cage where they had a better chance of finding what they need," said Hugh. So in April 2015, with the help of Randall Milne (Environment Southland), the first release of around 100 weevils was made in Southland.



Larva consuming Darwin's barberry seed.

We had proved that direct release of a small number of weevils was possible, but could we successfully bulk this up? We asked Hernan if he could collect a much larger shipment of infested fruit, which he did, and, to be on the safe side, hand carried them to New Zealand. This shipment produced 1260 healthy weevils. The plan now is to repeat the exercise again this spring to allow a similar number of releases to be made. "We will repeat this process until no further releases are needed," said Hugh.

As well as these efforts to shut down the reproductive ability of the plant, we are also seeking an agent that could damage the plants themselves. Surveys revealed the best likely candidate to be a rust fungus (*Puccinia berberidis-darwinii*). We have imported rust-infected plants from Chile into our pathogen containment facility in Auckland for further study. No-one has worked with this rust before, so there is a bit to learn, including some experimentation to work out infection processes so host-range testing can get underway.

This project is funded by the National Biocontrol Collective.

CONTACT: Hugh Gourlay
gourlayh@landcareresearch.co.nz

Farmer Grateful for Tiny Beetle

Ragwort's (*Jacobaea vulgaris*) distinctive bright yellow flowers used to be a familiar sight across New Zealand farmland. But thanks to a tiny flea beetle the weed, which is particularly toxic to cattle and horses, is now largely under control, saving farmers millions in control costs. Recently one North Island farmer has explained what this biocontrol project has meant for his farm.

Waikato dairy and beef farmer Steve Fagan was sceptical to say the least when tiny beetles were released on his farm about 25 years ago to control ragwort. "When Jim Laurenson, the local biosecurity officer, released flea beetles onto my property I said he was a fool to do so. I thought it was a big joke." But he would later eat his words. "Ten years on, I went back to shake his hand and say thanks," Steve said.

The ragwort flea beetle (*Longitarsus jacobaeae*), first introduced to New Zealand by Landcare Research in 1983, worked. In fact, a recent quantitative study by Landcare Research has found it is saving dairy farmers across the country $44 million in control costs alone every year. The Fagans, who say the weed nearly 'broke them', aren't surprised.

The weed has now almost disappeared from the Fagan's 1000-acre Hangatiki property, but the beetles are still there. His wife Maxine said the farm, which they purchased 42 years ago, used to be overrun with ragwort. Looking at the lush green pastures, now full of clover, it's hard to imagine. "We had what we would call a ragwort farm," she said. "We had to use a rotary crusher to cut tracks for the cows. That's how bad it used to be," Steve said. The family lost several cows to the weed. "No one wanted to buy the farm when we bought it because it had so much ragwort," Maxine said.

The couple used to spray the weed with chemicals daily to try and get it in check. But this not only killed the weed but also the grass. "We'd milk early, milk late, and spray all day. We'd spray 2500 litres most days to try and get it under control. We thought we'd never get rid of it. It cost thousands. We even tried running sheep but they only made it grow thicker. It nearly broke us," Steve said.

"These days it's more about milking the cows. We still have the odd ragwort plant, but we used to have paddocks of it." Maxine said news of the biocontrol's success spread fast in the community. "Cars lined up our road all coming to get the beetle."

Not all biocontrol agents work as quickly as the flea beetle. Some areas where the flea beetle had been released were almost clear of ragwort in as little as two years, and within about 10 years, in most drier climates around New Zealand where we had released

Hangatikei today, no longer a ragwort farm.

the beetle, ragwort had pretty much disappeared. But the flea beetle didn't prove a solution for every region, struggling in wet conditions.

"In areas where rainfall exceeded 1700 mm/year the flea beetles simply couldn't cope adequately with the conditions," said Hugh Gourlay. As a result, the weed continued to persist, particularly on the West Coast, as well as Southland, parts of Otago and the central North Island. The West Coast community rallied and with Hugh's help established the West Coast Ragwort Control Trust (WCRCT). The group was granted funding by the Ministry for Primary Industries Sustainable Farming Fund to search for another biocontrol agent. In 2005, a plume moth that was proving successful in controlling the weed in wet conditions in Australia was released after extensive testing.

"Three to five years later, we had the same result we had with the flea beetle, ragwort populations started disappearing," Hugh said. "Between the two agents almost throughout New Zealand ragwort has become relatively rare." Areas where ragwort continues to persist are those where the plume moth has yet to be established or where spraying, often by landowners who are not aware of the biocontrol agents, is preventing these insects from working. Sometimes all that is needed is for spraying to stop to allow these highly effective biocontrol agents to take over.

A video about this project is available at: https://www.youtube.com/watch?v=gZNje5Idu-g

The study to estimate the value of ragwort biocontrol in New Zealand was funded by the Ministry of Business, Innovation and Employment as part of Landcare Research's Beating Weeds Programme.

CONTACT: Hugh Gourlay
gourlayh@landcareresearch.co.nz