

#92
MAY 2020



Manaaki Whenua
Landcare Research

Weed Biocontrol

WHAT'S NEW?



Contents

A MESSAGE FROM THE EDITOR	2
MOTHS AWAY ON HOREHOUND!	3
LESSER CALAMINT PROJECT STEAMS AHEAD	4
COULD AN AGENT FOR BROME TELL FRIEND FROM FOE	5
CLEARING A HURDLE FOR FIELD HORSETAIL WEEVILS	6
A PHD AND NEW PASTURES FOR HESTER WILLIAMS	7
WELCOME SIMONE CUNHA	8

Key contacts

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

THANKS TO: Ray Prebble, Angela Bownes
LAYOUT: Cissy Pan

CONTRIBUTIONS:
Ronny Groenteman,
Paul Peterson, Jane Barton
Hester Williams, Simone Cunha

COVER IMAGE:
Horehound, Mackenzie Basin



www.weedbusters.org.nz

This information may be copied and distributed to others without limitations, provided Landcare Research New Zealand Ltd 2015 and the source of the information is acknowledged. Under no circumstances may a charge be made for this information without the express permission of Landcare Research New Zealand Ltd 2014

ISSN 2463-2961 [Print] ISSN 2463-297X [Online]

www.landcareresearch.co.nz



A Message from the Editor

The *Weed Biocontrol* team at Manaaki Whenua is fortunate to have been able to continue its work during the Covid-19 pandemic. For readers outside of New Zealand, we went into very strict Level 4 lockdown on 26 March for nearly 5 weeks and at the time of writing are in Level 3. At Level 4 we were required to stay at home in “our bubbles” with only essential workers allowed to attend workplaces as normal. Our team was relatively well set up to work from home at short notice as our organisation has recently been actively moving towards its staff being able to work anywhere, anytime.

Our major early concern was what would happen to our biocontrol agent cultures and plants, both inside and outside of containment, during Level 4. We were relieved to discover that this met the definition of essential work, since regular checks that containment facilities were secure were required. A skeleton staff of Arnaud Cartier, Zane McGrath and Chantal Probst were therefore able to go into work for short periods of time during lockdown to check that all was well and take care of our precious charges. Bob Brown was also able to look after his wasp biocontrol agents. It was a huge relief not to be faced with the prospect of losing all these cultures on top of the other many disappointments caused by Covid-19. With international travel likely to remain restricted, or difficult, for a long period of time, it might have been years before we could replace cultures if they had been lost.

At Level 3 people who were unable to work from home were allowed to return to work where it is safe to do so, but this was very strictly managed. This means some work in the molecular, and other, labs is restarting and some essential field work is being undertaken. With New Zealand’s move to Alert Level 2 in mid-May, physical distancing will still be critical and many of our staff will be continuing to work from home under Level 2. Please continue to contact us as normal via email or phone.

Planning very far ahead is obviously quite challenging. Even if New Zealand can, in the coming months, largely get back to business as usual within our own border, international aspects of our work are likely to be constrained for much longer. We are exploring innovative ways to allow project work to continue.

We have taken the opportunity while some work is on pause to begin a major refresh of the information sheets we collectively refer to as “The Biological Control of Weeds Book”. More on this in due course.

Finally, after 28 years of masterminding the production of quarterly issues of this newsletter I am handing over the reins to Angela Bownes so that I can focus on other things. A huge thanks to all the readers for their support and enthusiasm for this newsletter over the decades, without which it would have surely lapsed long ago. I have really appreciated all the feedback received after each issue. Angela will continue to ensure that you are kept abreast of all key developments in the world of weed biocontrol in New Zealand and will be happy to receive feedback, suggestions and offers of contributions.

Many thanks and stay safe everyone!

Lynley

CONTACT

Lynley Hayes – Hayesl@landcareresearch.co.nz

Angela Bownes - Bownesa@landcareresearch.co.nz

Moths Away on Horehound!

A little more than a year after the release of the clearwing moth (*Chamaesphecia mysiniiformis*) and the plume moth (*Wheeleria spilodactylus*) for the biocontrol of horehound (*Marrubium vulgare*), it was time to return to the release sites to look for early signs of establishment. “We were especially encouraged by reports that horehound at the North Canterbury sites was looking very sickly. This is exactly the kind of news we want to hear!” said Ronny Groenteman, who leads the project. So, at the height of summer, with the assistance of our trusted advisor on the project, research scientist Dr John Weiss (Agriculture Victoria, Australia), we visited six of the eight release sites to see what we could find.

The clearwing moth and the plume moth are classical biocontrol agents for horehound, which were tested and released in Australia 20 years prior to their introduction into New Zealand. Horehound is a small to medium perennial shrub that displaces important forage plants, reducing pasture productivity. In New Zealand, horehound is abundant in Canterbury and Otago, but it has become increasingly problematic on dryland farms throughout the country. It is now recognised as one of the worst weeds in lucerne pastures, and the negative economic impacts to farmers may be as high as \$29–39 million annually. With support from the Horehound Biocontrol Group, a collective of private landowners led by Gavin Loxton, the process to introduce biocontrol agents for horehound was started in 2017.

Since both the plume moth and the clearwing moth were already tested for host specificity in Australia and released as far back as 1994, the project moved swiftly to the stage of gaining approval for their release, which was granted by the Environmental Protection Authority (EPA) in May 2018. Just after Christmas 2018, field releases of the moths took place over a 2-week period in Marlborough, North Canterbury and the Mackenzie District. There were five releases of the clearwing moth and eight releases of the plume moth. These moths attack different plant parts and are expected to be complementary in their damage: larvae of the plume moth attack the above-ground vegetation, and larvae of the clearwing moth attack the roots. The plume moth is easy to rear and release, and established readily in Australia wherever rainfall is higher than 450 mm per annum (a requirement met in most horehound-infested regions in New Zealand). The clearwing moth was regarded as the more challenging agent to work with due to its specific environmental requirements, such as high temperatures for mating and reproduction.

Both moth species defied our expectations. “We were perplexed that at six of the eight plume moth release sites we barely found any evidence of moth activity, and this was supposed to be the easy one!” said Ronny. Our initial



Dead horehound plant (left) at clearwing moth release site.

disappointment was replaced with hope when John explained that it is possible that we were searching too soon. “We did not go back to the release sites for 2–3 years after the first releases,” said John. “But we should be encouraged that there is evidence of the presence of the moth and that the plants are in perfect condition to support their growth and development,” he added. On the other hand, the clearwing moth showed very promising early signs. “At one of the clearwing moth release sites we can even report that larvae were found in the root-crowns of some of those miserable-looking plants we were told about,” enthused Ronny. “And even better, at a visit to our very first release site, we found a number of dead horehound plants, some still displaying a label indicating they had received a moth egg. It was a delightful sight!” Even the large, tough horehound plants were visibly weakened by moth attack. Although it is too early to confirm establishment, the first, most crucial hurdle has been successfully crossed.

It will be another 2–3 years before we can officially confirm establishment of both biocontrol agents, but early signs are very promising. Once the moths have established stable, permanent populations at the release sites, we will be able to start the process of field collections and redistribution of infested plant material to increase their distribution and impact.

This project is funded by Environment Canterbury via the Horehound Biocontrol Group.

CONTACT

Ronny Groenteman – GroentemanR@landcareresearch.co.nz

Lesser Calamint Project Steams Ahead

Since our last update on prospects for the biocontrol of lesser calamint (*Calaminta nepeta*) in New Zealand, much progress has been made with the identification of several promising candidate agents in Europe for prioritisation and further study.

Preliminary work on lesser calamint included important baseline research to assess the feasibility of initiating a biocontrol programme. “We conducted surveys of lesser calamint in New Zealand to identify arthropods or pathogens that are already damaging the weed, and to identify any predators or parasitoids that may interfere with the establishment and spread of new biocontrol agents,” said Paul Peterson, who is leading the project. The next crucial steps in the project were to identify the region of origin of the lesser calamint populations invading New Zealand, and to conduct surveys in the native range in search of promising candidate biocontrol agents. Swiss and Italian collaborators embarked on a series of surveys in southern Switzerland, southern France, Italy (including Sardinia and Sicily), Greece and southern Spain. All of the natural enemies that were found on above- and below-ground plant parts at the collection sites were collected for identification using morphological diagnostics and, in some cases, molecular techniques. At each collection site lesser calamint leaf samples were preserved for DNA analysis, which has indicated that the invasive populations in New Zealand originated in Italy, France and Switzerland.

A total of 32 insect species, one mite and one fungal pathogen were found on lesser calamint plants, five of which are considered to be promising candidates for biocontrol. A leaf beetle (*Chrysolina suffriani*) that is endemic to Corsica and Sardinia was collected at six of the 12 sampling sites in Sardinia, with particularly high numbers found at one site. Although lesser calamint is the only reported host plant of the beetle in the literature, it was found feeding on another plant species in the mint family, Lamiaceae (presumed to be a European endemic known as *Mentha suaveolens subsp. insularis*). A flower gall midge (*Asphondylia nepetae*), which was identified as a promising candidate early on in the surveys, was found at the majority of the collection sites in Switzerland, France and Italy. Larval feeding on lesser calamint flowers induces gall formation, which reduces reproductive capacity. A leaf- and stem-mining moth (*Trifurcula saturejae*) was collected in France and Italy. Larvae of this moth species mine the leaves and the outer parts of the stems of lesser calamint, and it, too, has been recorded from a few closely related plant species. An eriophyid mite belonging to the genus *Anthocoptes*, not previously described, was found in central Italy. It is believed to be a leaf vagrant (a mite that feeds on the leaves of plants but does not form galls), as no galls were found. A rust fungus (*Puccinia menthae*) was found at three sites in southern France and at one site in central Italy. This species is reported from a wide range of plants within the Lamiaceae, including

peppermint, but there are likely to be several strains of the pathogen, including one that is specific to lesser calamint.

All five of the candidate biocontrol agents were collected on lesser calamint plants that are closely related to New Zealand populations, suggesting they will be well adapted for feeding and development on plants here. Although early indications are that some of the candidate agents are not entirely host specific to lesser calamint, they may be sufficiently host specific for New Zealand, as we do not have many native, close relatives of lesser calamint. “Our next steps in the project will involve discussions around prioritisation of the candidate agents for further study, and which combination of the agents is likely to be the most effective,” explained Paul. “The host ranges and impacts of these agents will then be studied in our containment facility at Tamaki, in Auckland, once funding permits”.

This project is funded by the Sustainable Farming Fund, which is administered by the Ministry for Primary Industries. Additional sponsors include Manaaki Whenua – Landcare Research (MWLR), Waikato Regional Council, Horizons Regional Council (Manawatu–Wanganui region), Hawke’s Bay Regional Council, and the Hawke’s Bay Lesser Calamint Control Group. Surveys for biocontrol agents were conducted by the Centre for Agriculture and Bioscience International (CABI) in Switzerland, and the Biotechnology and Biological Control Agency in Italy. DNA analysis of plant material was conducted by MWLR.

CONTACT

Paul Peterson – PetersonP@landcareresearch.co.nz



Rust fungus on lesser calamint.

CABI

Could an agent for brome tell friend from foe?

There are over 150 grass species in the genus *Bromus*. Despite some *Bromus* species being useful pasture grasses, many are unwanted weeds. Two of the most weedy and problematic *Bromus* species in New Zealand are downy brome (*B. tectorum*) and ripgut brome (*B. diandrus*). Ripgut brome gets its name from the injuries it causes to the intestines of sheep due to its sharp, rigid seeds. Downy brome seeds are not quite as hard on the gut, but are produced in abundance (more than 300 per plant) and germinate quickly. One small clump of downy brome easily expands into a large population, reducing soil moisture and rapidly outcompeting more palatable grasses.

Downy brome is mostly problematic in the South Island, whereas ripgut brome occurs in many locations throughout New Zealand. Downy brome readily grows in disturbed sites such as waste areas, while ripgut brome grows in both disturbed and undisturbed vegetation.

A recent study has explored the potential of using plant pathogens for the biocontrol of downy and ripgut brome in New Zealand. Weedy brome species are a challenging target for biocontrol since there are desirable grasses in the same genus as well as in closely related genera. This means that any biocontrol agents for weedy brome grasses would need to be highly host specific. The study found that there are 40 fungi and one bacterium associated with downy brome alone, five fungi and one bacterium that use ripgut brome alone, and seven fungi that are associated with both species. While this sounds like a lot, only a few are sufficiently host specific and damaging to the weeds to be potentially useful.

Downy brome is a very problematic weed in both Canada and the US, and so US scientists have already been investigating some of these fungi as the basis for bioherbicides. The two microbes that have received the most attention are a seed pathogen (*Pyrenophora semeniperda*) and a smut (*Ustilago bullata*). "However, after more than a decade of research, it has been concluded that neither pathogen is an ideal candidate, and unless there is an unexpected breakthrough, we would probably be wasting our money pursuing them," stated Jane Barton, who conducted the feasibility study.

Another fungus with potential as an inundative biocontrol agent, which has not been studied, is a stem smut (*Tranzscheliella hypodytes*) that is present in New Zealand. Hosts of this smut fungus are not limited to the genus *Bromus*, but an inundative agent does not need to be as host specific as a classical one, because it is not expected to cause significant disease outside the area where it is applied. "While this smut has been reported from downy, but not rip-gut brome in the field, it would probably damage several weedy *Bromus* species," speculated Jane. However, given the cost of developing a bioherbicide, and a lack of evidence that it causes devastating disease outbreaks, it is unlikely to be a commercially viable option.



Downy brome (green) invasion near Lake Tekapo

Gravin Loxton

The fungus with the most potential as a classical biocontrol agent is a rust (*Puccinia tsinlingensis*) that has not been recorded as present in New Zealand. "The reported host range is broader than I would like," said Jane, "but taxonomic studies give us reason to hope that there might be more specific subspecies or strains within this species." While this rust has been reported in the field from downy brome but not ripgut brome, its hosts include several *Bromus* species and it would not be surprising if tests revealed it could damage both weedy brome species.

So, while the feasibility study did identify some pathogens with potential as biocontrol agents, there remain two large obstacles. Firstly, we need to know more about which *Bromus* species are valued as pasture grasses in New Zealand, and what the negative financial impact would be if these were damaged by a biocontrol agent. Secondly, brome grasses tend to invade pastures in fairly marginal areas, where profit levels per hectare are low. Farmers in such areas may not be able to afford an expensive bioherbicide, and there is anecdotal evidence that weedy brome grasses can be successfully controlled with appropriate (and more affordable) land management practices, such as the application of fertiliser. So before going any further it would be prudent to assess all the costs and benefits of a biocontrol approach. "We know farmers see ripgut brome as the enemy while valuing other *Bromus* species, but we don't know if they would be willing to sacrifice the 'good guys' in order to get rid of the 'bad guys', or how much they can afford to pay to get rid of the latter," concluded Jane.

This feasibility study was funded by the Agricultural and Marketing Research and Development Trust (AgMardt) (Brome Grass Biocontrol Group; Grant no. A19023). Jane Barton is a contractor to Manaaki Whenua – Landcare Research.

CONTACT

Jane Barton – Jane.Barton14@gmail.com

Clearing a Hurdle for Field Horsetail Weevils

Field horsetail [*Equisetum arvense*] is an ancient, fern-like vascular plant that is an increasingly important agricultural weed in New Zealand. Field horsetail is native to Eurasia and is believed to have been accidentally introduced with iris root stock from Japan in the early 1900s. It was first recorded as established in New Zealand in 1922 and subsequently spread throughout the North and South Islands, although it is more prolific in wetter regions such as Wanganui, Rangitikei, Taranaki, Wellington, and the west coast of the South Island. Field horsetail thrives in riparian areas, blocking waterways, which causes flooding and prevents the recruitment of native seedlings. It is toxic to livestock, causing acute thiamine deficiency (equisetosis) in cattle and horses if consumed in large amounts. Despite attempts at management using chemical control, its spread continues with its invasion of the Wanganui River described as “phenomenal and unstoppable” by Craig Davey from Horizons Regional Council. Craig, together with AgResearch, has tested various herbicides for field horsetail, but the plant’s persistent underground root system makes high dosages and repeat applications necessary. According to Alistair Robertson, chair of the Rangitikei Horsetail Group, field horsetail can root down to 2 metres in river silts and sands, and it is extremely difficult to get herbicides to penetrate that deep.

With the demand for a more effective and sustainable solution for field horsetail management, biocontrol options were

investigated. The field horsetail weevil (*Grypus equiseti*) was first imported into containment for host specificity testing in 2013, and permission for its release was granted by the Environmental Protection Authority (EPA) in mid-2016. This weevil has not been used as a biocontrol agent anywhere else in the world, and it was hoped it would be the only agent needed to suppress the growth and spread of field horsetail, but the project has had some challenges. The weevil colony was initiated with a fairly small number of adult weevils received in multiple shipments from the United Kingdom. The weevils were difficult to locate in their native range, so some shipments consisted of only a few individuals, which yielded few offspring, attributed to tapering fecundity of aging females. From the low numbers of progeny produced by the imported weevils only small numbers of weevils have been mass-reared for release.

As a result, only 545 weevils have been released since 2017 and establishment has yet to be confirmed. “To date, no weevils have been recovered from the field, and this year’s visits to the release sites were prevented by the Covid-19 lockdown restrictions,” said Paul Peterson, who is managing the project. “More releases of the weevil are planned, but after another disappointing rearing season, with low numbers of adults produced in 2019, we realised we needed a change in rearing tactic to boost colony numbers. When first reared in the laboratory, 10 L potted plants produced enough weevils for host range testing, but using this same method for mass-rearing in outdoor greenhouses has not produced enough adults to make large releases. This could substantially hamper the chances of successful establishment”, explained Paul.

As a start, the team have focused on improving the quantity and quality of field horsetail stem and root/rhizome material for larval feeding. Under natural conditions field horsetail stems grow up to 80 cm tall and 3–5 mm thick, with roots and rhizomes extending up to 2 m underground in ideal conditions. To try to closely mimic the stature and form of these field horsetail plants, the 10 L pots have been upsized to 20 L, 70 L and even two 1,000 L containers for cultivating stock plants for rearing the weevil. “Early indications suggest that pot size does matter, and that the visibly larger stems and root systems are providing enough food for a higher proportion of larvae to complete their development,” said Arnaud Cartier, who is rearing the weevils. “Our next hope is that we can successfully overwinter high numbers of larvae and pupae to make large releases of adult weevils this coming spring,” he added.

This project is funded by the Sustainable Farming Fund, which is administered by the Ministry for Primary Industries.



Field horsetail weevil rearing containers.
Inset: Adult weevil

CONTACT

Paul Peterson – PetersonP@landcareresearch.co.nz

A PhD and New Pastures for Hester Williams

We are delighted to report that Hester Williams has passed her PhD and that her degree is to be conferred in June 2020. Hester joined us at the Lincoln campus in late 2016, where she was based full time until she submitted her dissertation in October last year. Hester's research focused on investigating factors influencing the establishment and persistence of small populations in order to gain a better understanding of the early stages of species invasions. She used a classical biocontrol agent as a case study. "In any biocontrol programme the establishment of agent populations is a critical step towards achieving success," explained Hester. "Understanding and identifying the ecological processes that underpin successful establishment is not only important in weed biological control, but also for preventing invasions of unwanted species." Biocontrol agent introductions are essentially "planned invasions" of exotic species and are subject to the same factors operating during unwanted invasions. They therefore offer a unique opportunity to experimentally study the processes involved in establishment, serving as a proxy for invasive species.

More specifically, Hester's research aimed to investigate the role of the Allee effect in the establishment success of species. The Allee effect is a biological concept defined as a positive relationship between population size and fitness, which is important when population densities are low, such as those that are typical in the early stages of invasions. The Allee effect may be caused by factors such as mate-finding failure or too few individuals in a population to saturate natural enemies. Her research also examined how spatial management at the point of introduction could render populations more vulnerable to the Allee effect, thereby facilitating their eradication. Hester explained that both aims were important. "Despite strong theoretical findings that the Allee effect can prevent small founder populations from establishing, there was limited scientific data. Further, there is mounting social pressure to find alternative, 'greener' tools to eradicate new incursions of invasive species," she said.

The tradescantia leaf beetle [*Neolema obliqua*] served as Hester's model insect. She investigated the impact of release size on establishment success of the beetles, finding that releases of larger numbers of individuals increased the probability of a population establishing. Increased aggregation of individuals through releases of large numbers facilitates necessary interactions such as mating and predator dilution, minimising the Allee effect. She also observed heavy predation on the immature stages of the beetle by generalist predators, which would potentially severely affect establishment success. In addition, Hester's study showed that adults of the leaf beetle respond to, and potentially utilise, feeding-induced plant volatiles as a cue to find their host, which would increase dispersal success among host plant patches in diverse



Hester and her family in Canada

landscapes and increase aggregation on those host patches. Hester's PhD research offers some valuable insights into managing new incursions. Since the Allee effect plays an important role in the dynamics of newly established small populations by driving them to extinction, it could be critical in guiding eradication efforts. The Allee effect, together with other processes that occur when species have small population sizes, eliminates the need for the removal of every single individual of a new invasive population during management actions. Hester recommends the strategic removal of host plant patches to limit and isolate resources at the point of introduction (or areas of high population densities) of a new species as an effective tool to achieve eradication. By targeting and removing heavily infested host plants there is an immediate reduction in population size (potentially below the Allee threshold). Further, by limiting and isolating remaining host patches, dispersal propensity in larger populations is increased because of competition, but dispersal success between patches is reduced, resulting in reduced population sizes. These populations could then be subjected to an Allee effect, or to tactics that exploit an Allee effect, thereby achieving eradication.

Shortly after submitting her dissertation, Hester moved to Peachland in British Columbia, Canada, with her husband and 12-year old son, where she is hoping to find research-related work. Hester says she is so grateful for the opportunities and experiences she had in New Zealand. "I met so many knowledgeable and helpful colleagues and was generously provided ample lab and greenhouse space to support my research," said Hester. "I hope to continue to foster the friendships and relationships I was privileged to have made during my time in New Zealand," she added.

Hester Williams was registered at Auckland University and her PhD research project was part of the 'Urban Eradication' programme funded by the Ministry of Business, Innovation and Employment (MBIE). She was supervised by Darren Ward (MWLR, Auckland University), Mandy Barron (MWLR) and Ecki

Brockhoff (Scion), with Andrew Liebhold (USDA) acting in an advisory capacity.

CONTACT

Hester Williams – hester.williams@yahoo.ca

Welcome Simone Cunha

We are very pleased to introduce a PhD student from Brazil, Simone Cunha, who has been registered at the University of Canterbury since early 2019. The main aim of Simone's PhD research is to investigate the impact of the four biocontrol agents that have been released against tradescantia (*Tradescantia fluminensis*) in New Zealand. She will also measure the interactions among the biocontrol agents in order to understand whether the four agents are complementary. "I have always been interested in studying botany and interactions between plants and animals, especially in the conservation field," said Simone.

Tradescantia is a trailing, perennial groundcover with soft, creeping stems that is native to the forests of south and southeastern Brazil and the north-east of Argentina. Tradescantia was introduced to New Zealand as an ornamental in 1910, but quickly escaped garden cultivation to invade a variety of damp, shaded habitats such as forests, shrublands, riparian zones, fernlands and wetlands. Dense mats of the weed inhibit the growth of seedlings of native plants, even smothering and suppressing small plants. Tradescantia is widespread throughout New Zealand, but in areas prone to frost it is restricted to sheltered habitats. Although tradescantia does not produce seeds in New Zealand, a plant fragment with a node has a high probability of survival and regrowth, giving rise to new plants.

Three species of beetle and one plant pathogen have been released as biocontrol agents for tradescantia in New Zealand, and all four agents have established to varying degrees in different parts of the country. Adult beetles of all three species feed on the leaves of tradescantia, while the larvae of each species attack different plant parts, and they are therefore expected to be complementary overall. Larvae of the tradescantia leaf beetle (*Neolema ogloblini*) damage the foliage, larvae of the stem beetle (*Lema basicostata*) bore into the stems, and larvae of the tradescantia tip beetle (*Neolema abbreviata*) feed on the growing shoot tips. The yellow leaf spot fungus (*Kordyana brasiliensis*), which is the most recent agent to be released, infects the leaves of tradescantia, sometimes leading to defoliation.

Simone will set up controlled glasshouse experiments at the university to investigate interactions between the four biocontrol agents. "I will be testing different combinations and densities of the agents to assess synergistic or antagonistic interactions between them" explained Simone. "For example,

while the damage of some of the agents is expected to be complementary, leading to greater impacts on the weed, the tradescantia tip beetle reduces leaf production, which could reduce local densities of the leaf beetle, altering damage levels to the weed". Simone also plans to run experiments outdoors, where natural weather conditions may limit the growth of tradescantia and the performance of the biocontrol agents. Lastly, Simone will study population densities and the impact of the agents where they have established or are soon to be released in Canterbury. "I hope my research will contribute to an understanding of how best to manage releases of the tradescantia biocontrol agents, and to a broader understanding of how to improve the efficiency of biocontrol programmes in New Zealand," said Simone.

Simone's PhD project is self-funded. She is being supervised by Prof. Dave Kelly (University of Canterbury) and Simon Fowler (MWLR).

CONTACT

Simon Fowler – FowlerS@landcareresearch.co.nz



Simone Cunha