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Manaaki Whenua
Landcare Research

Weed Biocontrol

WHAT'S NEW?

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COVER IMAGE:
Chilean needle grass

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Farewell to Hugh Gourlay

In June, Hugh Gourlay, Senior Technician in our Biocontrol and Molecular Ecology team, retired after a remarkable 49 years.

Hugh in his younger years, trimming gorse

Hugh's career began at the Ministry of Agriculture and Fisheries back in 1975. He moved to Levin the following year and worked at the Levin Horticultural Research Centre, before relocating to Canterbury for roles at Lincoln University and the University of Canterbury's School of Forestry. He joined the Entomology Division of DSIR in 1982, which morphed into Landcare Research in 1992.

Among his achievements at MWLR, the successful biocontrol of broom (*Cytisus scoparius*), ragwort (*Jacobaea vulgaris*), Californian thistle (*Cirsium arvense*), and scotch thistle (*Cirsium vulgare*) stand out. "These were all projects that I was involved in successfully seeking funding for and managed to achieve some level of control in New Zealand using insects that I imported and released as biocontrol agents," said Hugh.

Other notable highlights include his role as the Containment Facility Manager for 38 years (which involved writing the operating manual for the facility), being a keynote speaker at the International Plant Propagators conference in Tasmania, a speaking engagement with the local branch of the Royal Society, as well as being instrumental in developing the application forms and processes for the release of new biocontrol agents.

Hugh at his farewell, with his wife, Robyn

"Hugh was a great advocate for weed biocontrol, assisting many people who wanted to get involved, or needed advice and information, from farmers to biosecurity officers as well as many students," said Lynley Hayes, who worked with Hugh for more than 30 years. "He was also not afraid to take on field work in some quite tricky countries, always coming back with interesting stories to tell and many different insects to study for their potential to control weeds such as banana passionfruit (*Passiflora* spp.), Japanese honeysuckle (*Lonicera japonica*), moth plant (*Araujia hortoum*), and woolly nightshade (*Solanum mauritianum*). We thank Hugh for his many years of service."

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First ever release of Chilean needle grass rust for biocontrol

We are excited to report that we have completed the world's first release of a fungal pathogen biocontrol agent for an invasive grass: the Chilean needle grass rust (*Uromyces pencanus*). Chilean needle grass (*Nassella neesiana*) is a perennial, tufted grass native to South America. It forms dense clumps, outcompeting pasture species, and the seeds have sharp tips capable of penetrating the eyelids and pelts of animals, causing significant animal welfare concerns. Infestations are currently found in Marlborough, Hawke's Bay and Canterbury. The seeds are spread through human activity (vehicles, machinery, equipment) and animals, as well as through soil, plant material, and water.

The Environmental Protection Authority approved the release of the rust fungus in early July, and we've since been culturing it in containment to get ready for the first release. In October the Chilean needle grass rust was released at three sites near Blenheim in Marlborough and one site near Spotswood in Canterbury. We selected sites with high densities of Chilean needle grass plants, which were sheltered to retain moisture. These sites will be left undisturbed for years to come, without spraying, grazing, or mowing, which would hinder establishment.

Luise Schulte, who led the rust release, explained that spores produced by the rust will disperse by wind to spread and infect other Chilean needle grass plants. "The rust infects and grows inside Chilean needle grass leaves and then bursts through the leaf surface, producing dark brown powdery rust pustules. The rust drains energy from infected plants and is most damaging in dry weather since the broken leaf surfaces cause increased water loss. When the wind-dispersed spores land on a Chilean needle grass leaf and are combined with some moisture, they germinate and infect again."

The release site in Marlborough

Rust spores for release on a Chilean needle grass leaf

Brent Holmes (Marlborough District Council) assisted us in the field, helping to scope potential release sites and gather baseline data. Warwick Lissaman, from the Chilean Needle Grass Action Group, and Tim Struthers, one of the site landowners, were also present on the day. For the North Canterbury release we had assistance from Morgan Shields (Environment Canterbury).

But the hard work isn't over yet. Luise will go back to Marlborough in autumn to check for establishment of the rust at the release sites. Also, the strain of rust we released only infects South Island populations of Chilean needle grass, so we will still need to find effective strains for the Hawke's Bay populations.

The journey to approval for release of the Chilean needle grass rust took about 30 years, involving collaborations with Argentina and Australia and multiple rounds of host range testing. We are very grateful to our international collaborators and everyone who supported this project over the decades.

This work is funded by the National Biocontrol Collective and the Ministry for Primary Industries' Sustainable Food and Fibre Futures Fund (Grant #20095) on multi-weed biocontrol.

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Accidental introduction of cleavers mite

Increased global trade and international travel have facilitated the accidental introduction of numerous exotic species into New Zealand, and that number is growing every year. Introduced pest species such as varroa mites (*Varroa destructor*), *Polistes* spp and *Vespula* spp wasps, Argentine ants (*Linepithema humile*), and the fall armyworm (*Spodoptera frugiperda*) tend to dominate the news, but it isn't all doom and gloom. Accidentally introduced herbivorous insects and plant pathogens that attack invasive weeds have also become established.

For example, a European migrant, the hemlock moth (*Agonopterix alstromeriana*), was first recorded in New Zealand in 1986 and now often completely defoliates invasive and poisonous hemlock, an introduced weed. Similarly, the tutsan rust fungus (*Melampsora hypericorum*), has major impacts on populations of tutsan (*Hypericum androsaemum*), an introduced invasive shrub, in the South Island. Neither have been reported to attack any other plant species in New Zealand and appear to be highly beneficial accidental introductions.

Nevertheless, senior researcher Quentin Paynter cautioned against the indiscriminate use of accidentally introduced organisms in New Zealand. "Although these examples appear to be wholly beneficial additions to New Zealand's fauna, accidentally introduced species are unlikely to have undergone the level of scrutiny that deliberately introduced biocontrol agents are subject to, and we would want to be absolutely certain that an organism is host specific before considering redistributing it."

Quentin also noted that there is a regulatory process that needs to be followed to change the status of a new organism that has become established in New Zealand. Attempts to redistribute an organism that has not had its status as 'new' removed will contravene the Hazardous Substances and New Organisms (HSNO) Act, even if its impacts appear to be beneficial.

In June 2017 cleavers plants (*Galium aparine*, also known as goose grass) that were displaying extensively curled leaves were discovered in Auckland. These symptoms were found to be the result of attack by an eriophyid mite *Cecidophyes rouhollahi* (henceforth 'cleavers mite'). Since then, symptomatic plants have been found throughout New Zealand, from the Bay of Islands to Fiordland and Otago. The cleavers mite is still classified as a new organism in New Zealand, but it is already so widespread that any question about whether we should augment or slow its dispersal is moot. But is it likely to be a beneficial addition to New Zealand's fauna?

Globally, the cleavers mite was first recognised in the 1990s as a separate species, distinct from the very similar, closely related mite, *Cecidophyes galii*. Confusion between the cleavers mite, *C. rouhollahi*, and *C. galii* has occurred in the past; for example, pictures of specimens identified as *C. galii* collected from *Gallium* species from Finland and England in the 1950s appear to be of cleavers mites (*C. rouhollahi*). Subsequent investigations indicate that the cleavers mite is widespread in western Europe.

Damage from the cleavers mite

"It's interesting to speculate how the mite got here," said senior researcher Simon Fowler, adding that "the stems of cleavers are covered with hooked hairs and feel quite sticky and attach to clothes like Velcro, so it seems quite likely that some infested foliage arrived inadvertently attached to someone's clothing or belongings."

The damaging symptoms caused by the cleavers mite in Europe attracted the attention of weed biocontrol researchers, who were interested in its potential to control false cleavers (*Galium spurium*), a close relative of *G. aparine*, which is invasive in North America. Specificity testing conducted at the USDA Agricultural Research Service's European Biological Control Laboratory in Montpellier, France, indicated that the cleavers mite could only survive and reproduce on three closely related annual species in a section, *Kolgyda*, of the genus *Galium*, including *G. spurium*. The cleavers mite is therefore unlikely to be capable of attacking the *Galium* species that are native to New Zealand, because these belong to *Galium* sections other than *Kolgyda*. (Note that a recent phylogenetic study included *G. aparine* and *G. spurium* in section *Aparine*, which is adjacent to section *Kolgyda*, and so the conclusion that New Zealand species are unlikely to be hosts is unchanged.) The image (right) of the phylogenetic tree of Rubieae shows the *Galium* sections that are hosts of the cleavers mite in the red box, and the New Zealand native *Galium* species in the blue box.

Following approval, cleavers mites were released in Vegreville, Alberta, Canada, in 2004 and evaluations indicated that they reduced false cleavers (*G. spurium*) biomass and seed production by c. 30% over the 2004 field season. However, mites failed to reappear during the following field season in Vegreville, or at other release sites in Alberta, and subsequent experiments demonstrated that the mites are not sufficiently cold hardy to survive the bitterly cold Alberta winters. It was concluded that the cleavers mite wasn't suitable for use as a classical biocontrol agent in Alberta, but that that it might be effective in regions with warmer winters.

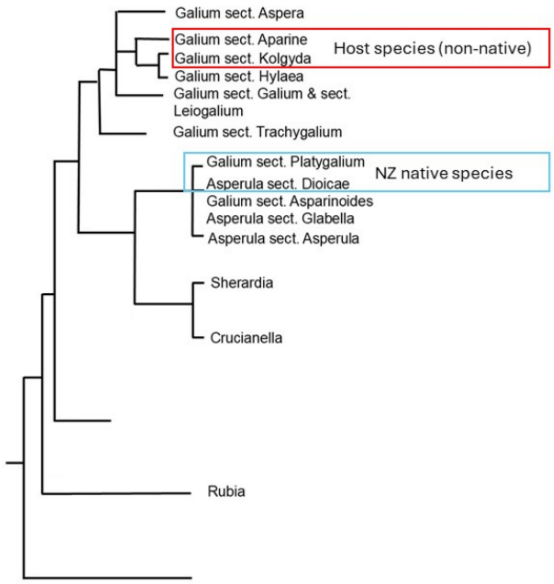
"We assume that the cleavers mite is having a big impact on cleavers here in New Zealand," said Quentin, who noted that most cleavers plants in the Auckland region appear to be galled and are often heavily damaged. "Because mite numbers have built up over several years, they may well be having a bigger impact than observed by the Canadian study, which was conducted over just one field season." Simon agrees, noting that the mite is also very common around Christchurch, where it appears to frequently kill plants completely before they set seed.

MWLR principal scientist Zhi-Qiang Zhang and colleagues Min Ma (Shanxi Agriculture University, China) and Qing-Hai Fan (Ministry for Primary Industries, Auckland) have documented the presence of several predatory phytoseiid mite species in association with the cleaver mite in New Zealand, notably *Amblydromalus limonicus*, which has previously been shown to be capable of surviving and reproducing on a diet of eriophyid mites.

"We know from this study that predatory mites have taken advantage of the abundant new food source that the cleavers mite provides in New Zealand", noted Quentin, "but they don't seem to have much impact on the ability of cleavers mites to gall cleavers plants."

Quentin also noted that this appears to mirror the situation regarding the broom gall mite (*Aceria genistae*), which is also attacked by phytoseiid mites but is nevertheless a successful biocontrol agent in New Zealand. "This is probably because the galls they induce are densely hairy and highly convoluted. Small eriophyid mites consequently find refuge from the bigger, predatory phytoseiid mites."

He continued, "This potential escape from predation bodes well for another eriophyid mite, the old man's beard gall mite



Simplified phylogenetic tree of the Rubieae showing the *Galium* sections

(*Aceria vitalbae*), which was first released in New Zealand following approval from the Environmental Protection Authority in 2021 and which also induces hairy, convoluted leaf curls."

Further reading

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Honolulu rose: a potential new target for weed biocontrol in the Pacific

Honolulu rose (*Clerodendrum chinense*) is a subtropical perennial shrub native to China, Taiwan, and Vietnam. Its attractive and fragrant flowers have seen it favoured as a garden ornamental throughout subtropical regions, but it has gone on to become invasive, particularly in the Pacific. Honolulu rose is now considered a major weed in Hawai'i, Fiji, Samoa, and American Samoa, and a weed to keep an eye on in the Cook Islands, Niue, and Tonga.

Honolulu rose has two forms: one that reproduces sexually and one that reproduces vegetatively, with the latter form being invasive. Due to its ability to self-propagate via underground root suckers, Honolulu rose can rapidly expand and form dense thickets. Its use as an ornamental plant, careless disposal of waste material, and transportation of soil and gravel containing root suckers are other means through which the weed is dispersed.

The formation of dense thickets can exclude native vegetation and reduce biodiversity, and can also outcompete commercially important crop species, such as banana, taro, and coconut, which leads to reduced crop yields and detrimental economic impacts. In Samoa, stems have been reported to number as many as 11 per square metre in shaded areas and 30 per square metre in newly infested open areas. Honolulu rose also has the potential to damage infrastructure, with reports that it can penetrate the bitumen of roads. These detrimental impacts of Honolulu rose are likely to be exacerbated in the wake of climate change, meaning effective management will be crucial.

Current mechanical and chemical control methods are difficult and labour intensive, and at best provide only temporary relief. Biological control is likely to be the only sustainable and safe management tool for effectively controlling Honolulu rose. At a workshop in Apia in November 2023 the Pacific Invasives Learning Network determined the top 10 weeds in the Pacific region for which biocontrol needs to be developed. "Honolulu rose ranked number seven, and so a feasibility study was deemed a priority to undertake under the new Restoring Island Resilience Programme, which is supporting such work in the Pacific," said Lynley Hayes, who facilitated the workshop.

Chris McGrannachan, with input from Luise Schulte and Murray Dawson, conducted the feasibility study. "Honolulu rose has been targeted for biocontrol in Thailand, with a leaf beetle (*Phyllocharis undulata*) released there to control it. However, the beetle attacks *Volkameria inermis*, a plant in the Lamiaceae family which is native to the Pacific, so it is not sufficiently host specific for consideration as a biocontrol agent for this region," said Chris. A total of 163 arthropods and 20 fungal pathogens were found to be associated with Honolulu rose, predominantly based on surveys conducted in China, Thailand, and Vietnam. "However, the majority of these species, particularly the arthropods, were unidentified and their host specificity is also unknown, meaning further surveys in the native range are needed to determine whether any have potential as biocontrol agent candidates," said Chris. Of the fungal pathogens, three species in the Mycosphaerellaceae, which cause leaf spots (*Cercospora*

Close-up of leaves and flower buds of Honolulu rose

Close-up of flowers of Honolulu rose

bakeri, *Cercospora volkameriae* and *Passalora clerodendri*), are of interest and three rust fungi (*Aecidium clerodendri*, *Hemileia solaninum* and *Coleosporium clerodendri*) are also worth investigating.

Although the invasive form of Honolulu rose reproduces vegetatively and is therefore unlikely to have a high level of genetic variability among introduced populations, a recommendation from the feasibility study is that it would still be prudent to conduct genetic analyses for this species. "Such a study would help to determine how genetically different populations are within the Pacific region and the native range and indicate which areas of the native range most closely match introduced populations. This would help guide where native range survey efforts would be best focused," said Chris.

Although Honolulu rose is used in traditional medicine in Asia and the Caribbean, this does not appear to be the case in the Pacific, although the flowers are used to make necklaces (ula) in places such as American Samoa. In conclusion, Honolulu rose looks to be a promising target to further explore for biocontrol when funds permit.

The Restoring Island Resilience programme is funded by New Zealand's Ministry of Foreign Affairs and Trade and administered by the Secretariat of the Pacific Regional Environment Programme as part of the Pacific Regional Invasive Species Management Support Service.

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Infestation of Honolulu rose in Niue

Summer Activities

Summer is a busy time for many biocontrol agents, so you might need to schedule the following activities.

Broom gall mites *(Aceria genistae)*

- Check for galls, which look like deformed lumps and range in size from 5 to 30 mm across. Very heavy galling, leading to the death of bushes, has been observed at some sites.
- Harvesting of galls is best undertaken from late spring to early summer, when predatory mites are less abundant. Aim to shift at least 50 galls to each site and tie them on to plants so the tiny mites can move across.

Giant reed gall wasp *(Tetramesa romana)*

- Check release sites for swellings on the stems caused by the gall wasps. These look like small corn cobs on large, vigorous stems, or like broadened, deformed shoot tips when side shoots are attacked. The galls often have small, circular exit holes made by emerging wasps.
- It will probably be too soon to consider harvesting and redistribution if you do see evidence of the gall wasp establishing.

Green thistle beetles *(Cassida rubiginosa)*

- December is often when green thistle beetle activity is at its peak. Look for adult beetles, which are 6–7.5 mm long and green, so they are well camouflaged. Both the adults and the larvae make windows in the leaves. Larvae have a protective covering of old moulted skins and excrement. You may also see brownish clusters of eggs on the undersides of leaves.
- If you find good numbers, use a garden leaf vacuum machine to shift at least 100 adults to new sites. Be careful to separate the beetles from other material collected, which may include pasture pests. Please let us know if you discover an outbreak of these beetles.

Honshu white admiral *(Limenitis glorifica)*

- Look for the adult butterflies from late spring. Look also for pale yellow eggs laid singly on the upper and lower surfaces of the leaves, and for the caterpillars. When small, the caterpillars are brown and found at the tips of leaves, where they construct pontoon-like extensions to the mid-rib. As they grow, the caterpillars turn green, with spiky, brown, horn-like protrusions.
- Unless you find lots of caterpillars, don't consider harvesting and redistribution activities. You will need to aim to shift at least 1,000 caterpillars to start new sites. The butterflies are strong fliers and are likely to disperse quite rapidly without any assistance.

Moth plant beetle *(Freudeita cupripennis)*

- This beetle has established in the Bay of Plenty, Waikato, and Northland. Look for adult beetles on the foliage and stems of moth plant. The adults are about 10mm long with metallic orangey-red elytra (wings) and a black head, thorax and legs. The larvae feed on the roots of moth plant so you won't find them easily.
- It will probably be too soon to consider harvesting and redistribution if you do find the beetles.

Tradescantia yellow leaf spot *(Kordyana brasiliensis)*

- Look for the distinctive yellow spots on the upper surface of the leaves with corresponding white spots underneath, especially after wet, humid weather.
- The fungus is likely to disperse readily via spores on air currents. If human-assisted distribution is necessary, you will need permission from MPI to propagate and transport tradescantia plants. These plants can then be put out at sites where the fungus is present until they show signs of infection, and then planted out at new sites.

Tutsan beetle *(Chrysolina abchasica)*

- The best time to look for this agent is spring through to mid-summer. Look for leaves with notched edges or whole leaves that have been eaten away. The iridescent purple adults are around 10–15 mm in size, but they spend most of the day hiding away so the damage may be easier to spot. Look also for the creamy-coloured larvae, which are often on the undersides of the leaves. They turn bright green just before they pupate.
- It will be too soon to consider harvesting and redistribution if you do find the beetles.

Tutsan moth *(Lathronympha strigana)*

- Look for the small, orange adults flying about flowering tutsan plants. They have a similar look and corkscrew flight pattern to the gorse pod moth (*Cydia succedana*). Look also for fruits infested with the larvae.
- It will be too soon to consider harvesting and redistribution if you do find the moths.

National Assessment Protocol

For those taking part in the National Assessment Protocol, summer is the appropriate time to check for establishment and/or assess population damage levels for the species listed in the table below. You can find out more information about the protocol and instructions for each agent at: www.landcareresearch.co.nz/discover-our-research/biodiversity-biosecurity/weed-biocontrol/

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Target	When	Agents
Broom	Dec–April	Gall mite *(Aceria genistae)*
Privet	Feb–April	Lace bug *(Leptoypha hospita)*
Tradescantia	Nov–April Anytime	Leaf beetle *(Neolema ogloblini)* Stem beetle *(Lema basicostata)* Tip beetle *(Neolema abbreviata)* Yellow leaf spot fungus *(Kordyana brasiliensis)*
Woolly nightshade	Feb–April	Lace bug *(Gargaphia decoris)*