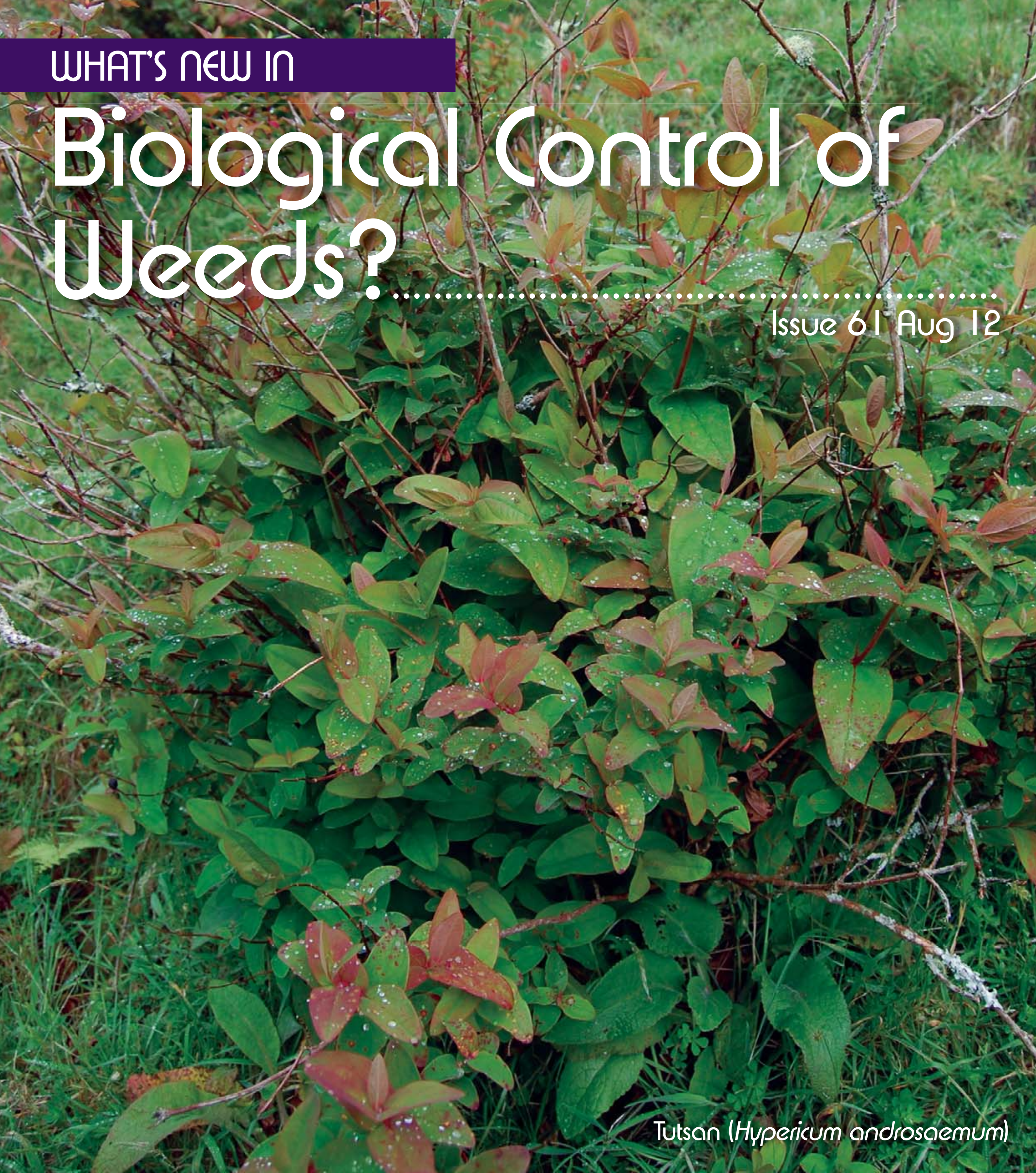
WHAT'S NEW IN

Biological Control of Weeds?

Issue 61 Aug 12



Tutsan (*Hypericum androsaemum*)

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Landcare Research
Manaaki Whenua

How Cost-Effective Is Successful Weed Biocontrol in New Zealand? Lessons from Three Programmes

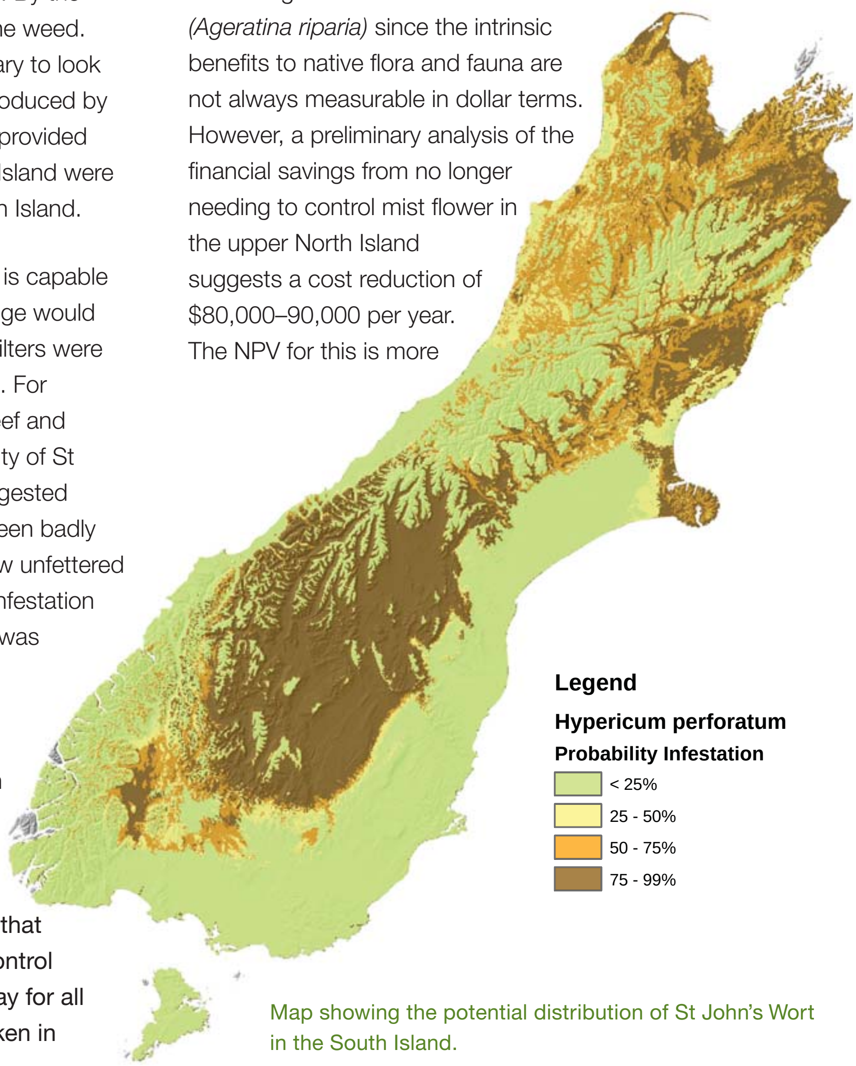
A recent economic analysis by Simon Harris (Harris Consulting) and Simon Fowler looked at whether it has been cost-effective to release biocontrol agents against weeds in New Zealand. In Australia the economic benefits of using biocontrol to control weeds have been well studied, but until now this kind of information has not been available for New Zealand programmes. There are several reasons for this. As Simon Fowler explains, "there isn't much demand for retrospective studies as sponsors would rather spend money finding new biocontrol agents, and it has not been considered a priority by funding agencies. Also the long-term nature of biocontrol can mean that it may not be appropriate to undertake an economic analysis for several decades after agents are released."

To address this important knowledge gap, Landcare Research has made a start on gathering data, beginning with successful agents such as the St John's wort beetles *(Chrysolina* spp.). At the time that beetles were first released in the 1940s, St John's wort *(Hypericum perforatum)* was rapidly expanding in distribution, particularly in high country pastures. By the 1980s, the beetles were successfully controlling the weed. To assess the economic gains, it was first necessary to look at results from ecoclimatic models. These were produced by Grant Humphries (University of Otago) using data provided by Landcare Research. Only data from the South Island were used, as the plant is not such an issue in the North Island.

The models were used to predict where the weed is capable of invading and to determine what its potential range would have been in the absence of any control. Various filters were added into the model to create a realistic scenario. For example, only areas of pasture used for sheep, beef and deer farming and where there was a high probability of St John's wort infestation were used. The model suggested that 660,000 ha of the South Island would have been badly infested if St John's wort had been allowed to grow unfettered until 2042. The negative impact from this level of infestation (based on loss of pasture and grazing to farmers) was calculated to be \$109/ha with a smaller cost of \$6/ha for manual weed control. The final figures suggested that the Net Present Value (NPV) of the introduction of the beetles is between \$140 million (given a conservatively slow rate of spread) and \$1,490 million (with a faster rate of spread) over 70 years. The respective benefit-to-cost ratios are therefore an impressive 10:1 and 100:1. Note that the savings provided by the St John's wort biocontrol programme, even at the lower end, more than pay for all the other weed biocontrol programmes undertaken in New Zealand to date!

Another approach to gaining data was taken by a project supported by the Sustainable Farming Fund (administered by the former Ministry of Agriculture and Forestry, now the Ministry for Primary Industries). The West Coast Ragwort Control Group surveyed farmers on the West Coast of the South Island to find what the average cost was of controlling ragwort (*Jacobaea vulgaris*) on dairy farms. They estimated this to be \$980 per farm per year. If you multiply this by the 12,000 dairy farms in New Zealand you reach a total cost of \$12 million per year to control ragwort in the absence of biocontrol agents. If you do the assessment based on areas where the ragwort flea beetle (*Longitarsus jacobaeae*) is successful there is a net saving of \$7 million per year. It is anticipated that now, with the establishment of the ragwort plume moth *(Platyptilia isodactyla)* in wetter areas of New Zealand such as the West Coast where the flea beetle was not effective, the benefits could be as high as an additional \$5 million per year.

It is more difficult to determine the financial gains from controlling environmental weeds such as mist flower *(Ageratina riparia)* since the intrinsic benefits to native flora and fauna are not always measurable in dollar terms. However, a preliminary analysis of the financial savings from no longer needing to control mist flower in the upper North Island suggests a cost reduction of \$80,000–90,000 per year. The NPV for this is more



Map showing the potential distribution of St John's Wort in the South Island.

than $3 million with a benefit-to-cost ratio of 2.5:1, which is still considered very good over a 13-year period.

These three examples give a good indication of the substantial economic benefits to New Zealand already provided by weed biocontrol. We are now planning to collect economic data for other biocontrol targets, e.g. alligator weed (*Alternanthera philoxeroides*) and heather (*Calluna vulgaris*).

Funding for this project was provided by the former Ministry of Science and Innovation (now the Science and Innovation Group of the Ministry of Business, Innovation and Employment) to the Beating Weeds Programme and Landcare Research's Discretionary Capability Fund.

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New Agent Approvals

The Environmental Protection Authority (EPA) has approved an application to release the lantana leaf rust (*Prospodium tuberculatum*) and the lantana blister rust (*Puccinia lantanae*) in New Zealand. Northland Regional Council was the applicant on behalf of the National Biocontrol Collective (NBC). Plans are now being made to import these rusts as soon as the new pathogen containment facility is completed at our Auckland site, and to get releases underway as soon as possible. These will be the first and likely only biocontrol agents to be released against lantana (*Lantana camara*) in New Zealand.

The EPA is currently considering an application put forward by Environment Southland on behalf of the NBC to release the first two biocontrol agents for Darwin's barberry (*Berberis darwinii*). They are a flower-feeding weevil (*Anthonomus kuscheli*) and a seed-feeding weevil (*Berberidicola exeratus*). They will also shortly be considering an application put forward by Auckland Council on behalf of the NBC to release a fourth agent for tradescantia (*Tradescantia fluminensis*), a yellow leaf spot fungus (*Kordyana* sp.)

The Darwin's barberry seed-feeding weevil.

Note that we have created a new section on our website relating to agent approvals (see http://www.landcareresearch.co.nz/science/plants-animals-fungi/plants/weeds/biocontrol/approvals). The aim of this section is to make key information more readily accessible to those with an interest in new-agent applications. Background to, and the rationale for, current applications is provided, along with key references and reports, details about consultation, and answers to frequently asked questions. We hope you find this useful!

Changes to Pages

If you are making an effort to keep your copy of The Biological Control of Weeds Book – Te Whakapau Taru up to date you need to go online and download some new and revised pages. Go to www.landcareresearch.co.nz/publications/books/biocontrol-of-weeds-book (note the new URL) and print out the following:

- Index
- Tradescantia summary
- Tradescantia leaf beetle
- Tradescantia stem beetle
- Tradescantia tip beetle

Biocontrol Agents Released in 2011/12

Species	Releases made
Broom leaf beetle (*Gonioctena olivacea*)	5
Broom shoot moth (*Agonopterix assimilella*)	1
Broom gall mite (*Aceria genistae*)	71
Green thistle beetle (*Cassida rubiginosa*)	22
Tradescantia leaf beetle (*Neolema ogloblini*)	28
Tradescantia stem beetle (*Lema basicostata*)	28
Woolly nightshade lace bug (*Gargaphia decoris*)	5
Total	138

Who Is Eating Our Agents?

When new agents establish themselves on host plants, they enter existing food webs and their effectiveness can be influenced by the presence of other species, either native or exotic. Interactions can occur between different insect species or can involve larger predators, and because they are not always obvious, they have not been well studied. Recent work by Quentin Paynter found that the likelihood of parasitism can be predicted when biocontrol agents have analogues in the native biota. He is now interested in looking at whether the chance of predators (such as spiders, predatory bugs, beetle larvae, soldier flies, lacewing larvae, and birds) hindering the establishment and effectiveness of biocontrol agents is also predictable.

"Some agents that have been introduced to New Zealand are well concealed – stem and seed borers for example, while others leave themselves more open to attack when browsing on leaves," said Quentin. "The degree of predation on agents appears to depend on how well concealed they are on a plant, but having said that, some unconcealed agents, such as the St John's wort beetles (*Chrysolina* spp.), are still hugely successful, so we have a lot of questions to answer yet."

One reason why we know so little about predation of agents is that we have relied primarily on casual field observations for information because the more detailed research required to investigate properly can be very time consuming. Quentin adds that studying predation is even more challenging than studying parasitism. Until recently you either had to catch predators in the act of feeding on their prey or use predator exclusion techniques to indirectly determine what is feeding on a biocontrol agent. A good example of the latter was the exclusion experiments we conducted on the boneseed leaf roller *(Tortrix s.l.* sp. "*chrysanthemoides")*. They showed that the leafroller does poorly when scale insects are present on boneseed (*Chrysanthemoides monilifera monilifera*) as predatory ants and wasps are attracted to their honeydew.

Mirid attacking a broom psyllid nymph.

However, experiments on this scale would be prohibitively expensive to perform on all weed biocontrol agents.

"Now that molecular biology techniques are becoming more sophisticated we should soon be able to routinely perform rapid tests for predation of biocontrol agents instead," revealed Quent. We will be able to collect all potential predators found living close to weed biocontrol agents and test their gut contents for biocontrol agent DNA. It won't be totally straightforward as there is a high chance of specimen contamination between predators and prey when they are processed. Also, it will be important to collect predators individually to reduce the chance of getting 'false positive' results from predators eating agents in the collection tube that they would rarely feed upon in more natural circumstances. Also the DNA only remains viable in the gut of predators for a few hours so the samples will have to be fresh and carefully stored to preserve their integrity. Quent is in the process of putting together a sampling protocol to maximise the utility of the specimens collected.

Preliminary laboratory-based DNA work conducted by co-workers Simon Connell and Zhi-Qiang Zhang has confirmed that native mites, which have adapted to living in broom galls, feed on the broom gall mite (*Aceria genistae*). Current research is investigating the interactions between these two mite species and other fungus-feeding mites that make up a surprisingly complex community in these galls. Further investigations to test the viability of the DNA approach in the field are likely to begin with predation of the gorse spider mite (*Tetranychus lintearius*) by an endemic beetle (*Stethorus bifidus*). Predation of the spider mites has been reasonably well documented, with beetles feeding more rapidly when the density of mites is higher. "If we find spider mite DNA in field-collected *Stethorus* beetles, that should confirm that our technique is working," said Quentin. "We can then study other important predator–prey interactions that we think may be occurring. For example, we suspect the accidentally introduced mirid bug (*Sejanus albisignatus*) may feed on the broom psyllid (*Arytainilla spartiophila*) and broom leaf beetle (*Gonioctena olivacea*)."

If all goes according to plan, it seems inevitable that this study will generate useful data for helping to select the most effective weed biocontrol agents in the future.

This project is funded by the Ministry of Business, Innovation and Employment as part of the Beating Weeds Programme.

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Never a Dull Moment with Woolly Nightshade!

A number of additional species have been found attacking woolly nightshade (*Solanum mauritianum*) in New Zealand since we undertook comprehensive surveys of its natural enemies in 2000/01.These include two fungi (*Phoma glomerata* and *Fusarium sambicinum*), a bacterium (*Erwinia persicinus*), and a psyllid (*Acizzia solanicola*). The latter was found by Quentin Paynter earlier this year in Auckland on a woolly nightshade plant in his home garden on which he was cultivating lace bugs (*Gargaphia decoris*). “Since I know the fauna of woolly nightshade well I realised this was an unusual find, and I reported it to the Ministry for Primary Industries (MPI),” explained Quent. MPI confirmed the psyllid was a new incursion for New Zealand, and potentially a threat to eggplant (*Solanum melongena*), but it was already too widely established to consider eradication or containment efforts. However, MPI are interested to know about any further sightings of this new incursion. The psyllid is thought to be native to Australia, and it is not known how it got here.

Interestingly, the potato/tomato psyllid (*Bactericera cockerelli*) has not yet been found on woolly nightshade in New Zealand. This serious new pest was first found in New Zealand in 2006 and is still spreading. This psyllid’s host-range includes a range of *Solanum* species and other genera including *Ipomoea* and *Convolvulus*, so they may well be found on woolly nightshade in due course.

Unfortunately none of these pathogens or insects lend themselves to being used for biocontrol since they also attack desirable plant species. Fortunately some woolly nightshade specialists do exist. Releases of the first biocontrol agent for woolly nightshade in New Zealand got underway in November 2010. Since that time 30 populations of the lace bug (*Gargaphia decoris*) have been released in Northland, Auckland, Bay of Plenty, Waikato, Taranaki, Manawatu-Wanganui, Gisborne and Tasman. Detailed follow-up of their establishment success will be undertaken once the lace bugs have had a little longer to settle in, but we have received some encouraging reports already that suggest establishment is occurring.

The second agent to be considered for New Zealand is a flowerbud-feeding weevil (*Anthonomus santacruzi*). Weevil host testing has been undertaken for us by Terry Olckers and some of his students at the University of KwaZulu-Natal, in South Africa. Terry has been responsible for the biocontrol programme for woolly nightshade in South Africa for many years and a great help to our New Zealand project. Flowerbud-feeding weevils were first released in South Africa in 2008, nearly a decade after lace bug releases first began there. Both agents have established and are dispersing. One

The new psyllid (*Acizzia solanicola*) found recently in Auckland.

damaging outbreak of the lace bug has been observed but the site was unfortunately destroyed by fire soon after. “It is unclear at present if these two agents will be able to do the job for South Africa or if others will be needed,” confirmed Terry.

All potential woolly nightshade biocontrol agents have shown a tendency, during host testing in cages, to attack plants that they avoid under more realistic, natural conditions (this is known as false-positive results). We were therefore not surprised when Terry told us that the flowerbud-feeding weevil had attacked one of our native poroporo species (*Solanum aviculare*) in cage tests. We asked Terry if he could do some field tests for us and he willingly obliged. Unfortunately the result was the same. While poroporo was a vastly less preferred host than woolly nightshade the weevil did complete its life cycle on this species in the field. The weevil is therefore not an acceptable biocontrol agent for New Zealand, and we will not be proceeding any further with it. While it is disappointing for an agent to fail at the final hurdle it is comforting to know that host-testing methods can identify agents that pose unacceptable risks. The next task is to decide what potential agent to study next. The two top contenders are likely to be another flowerbud-feeding weevil (*Anthonomus morticinus*) and a stem-boring weevil (*Conotrachelus squalidus*), both of which occur in southern Brazil.

This project was funded by the National Biocontrol Collective.

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Secrets of Wild Ginger Revealed

In previous issues we have detailed how CABI – Europe UK are searching for potential biocontrol agents for wild ginger (*Hedychium* spp.) in India, and some of the interesting beasts they have found. We also explained that Landcare Research was assisting the project by undertaking molecular studies of *Hedychium* to develop diagnostic tools for the various species, which can be hard to tell apart in the field. We also hoped to be able to pinpoint the geographic origins of the weedy populations so CABI could further concentrate their searches for biocontrol agents. However, as so often happens when you study plants in finer detail, we have come up with some interesting and unexpected results!

The two problematic species in New Zealand are known as kahili ginger (*Hedychium gardnerianum)* and yellow ginger *(H. flavescens).* The molecular studies showed that New Zealand, Hawaiian and Indian yellow ginger have a similar genetic sequence throughout their various ranges, which makes surveying for potential biocontrol agents in India quite straightforward – any part of the range would be fine in terms of agent–host compatibility. However, the same cannot be said for kahili ginger. While New Zealand and Hawaiian material were again uniform, and similar to each other, they were quite different to any material from India collected to date. "Our results indicate that the specimens from New Zealand and Hawai'i appear to be hybrids," explained plant population geneticist Gary Houliston. Chromosome counts of New Zealand material show that it is tetraploid, meaning it has four sets of chromosomes. "We think that one parent is *H. gardnerianum* and the other is probably white ginger *H. coronarium,"* said Gary. Although white ginger is present in New Zealand, it is not currently a problem here, but it is weedy in Hawai'i. *Hedychium* has been widely hybridised by the nursery trade over the last 70 years so in that context this result is really not that surprising. Most of the hybrids tend to resemble one of the parents, so their true identity can easily be overlooked without using molecular tools. Two samples from the Manawatu-Wanganui Region suggest that another hybrid may also be present in New Zealand and we will be following up on that further. We are also hoping to get further samples from the invaded range, including the Azores, Hawai'i and South Africa, to complete the picture.

So what does this finding mean for attempts to find suitable biocontrol agents? If our kahili ginger is likely to be an artificially bred hybrid it is quite likely that none of the ginger growing in the wild in India will be a match. Instead it will be crucial at an early stage to test whether potential agents are capable of attacking this hybrid material, and it is possible that any species that are very highly host specific may well be ruled out. One of the most promising species found to date, the large red and black weevil (*Tetratopus* sp.), was found attacking kahili, white, and yellow ginger in India, which augers well. This striking weevil is thought to damage all parts of the plant. However, a frit fly (*Merochlorops dimorphus*), commonly associated with shoot death, stunting, and flower abortion in India, and the gregarious leaf-feeding moth (*Artona flavipuncta*) have only been found on kahili ginger, so fingers crossed they can attack the hybrid material. CABI recently made new collections of the most promising potential control agents from India and are working to establish breeding populations to allow host-range testing to be undertaken. Fortunately ginger appears to have many natural enemies in its native range and the chances that some will prove to be useful biocontrol agents remain high.

This project is funded by the National Weed Biocontrol Collective and the Nature Conservancy of Hawai'i.

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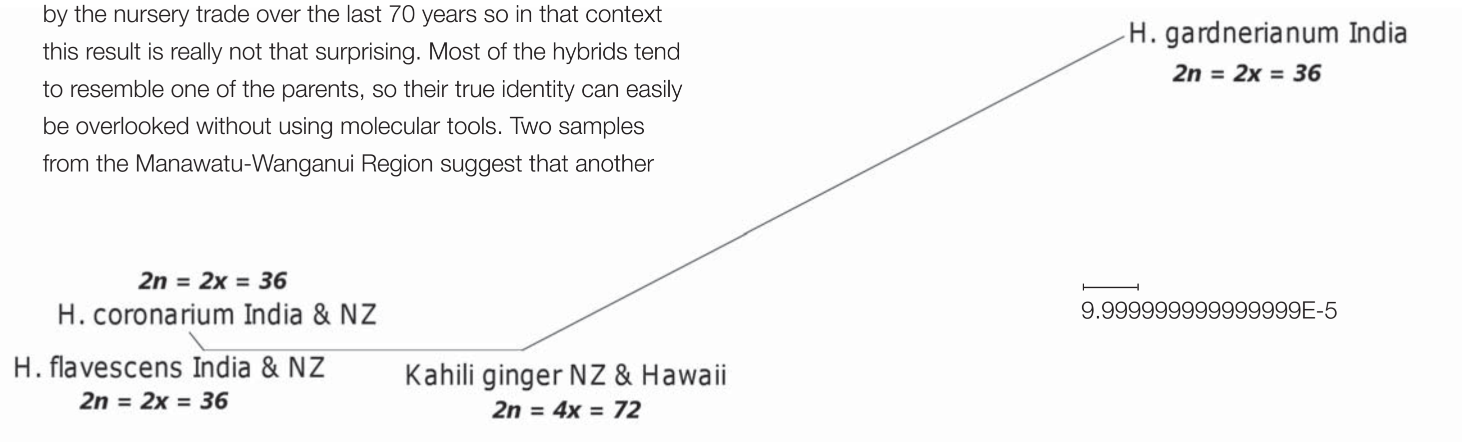

Figure showing the placement of NZ and Hawaiian kahili ginger (*Hedychium gardnerianum* x *coronarium*?) compared to kahili ginger (*H. gardnerianum*) from India, and placement of yellow ginger (*H. flavescens*) and white ginger (*H. coronarium*) from NZ and India. Note that the NZ kahili ginger sample has four sets of chromosomes (*tetraploid*), and we suspect Hawaiian material will be the same when tested, whereas the other species only have two sets (diploid).

Key Hurdle Cleared for Alligator Weed Project

The only aquatic weed we have attempted to biocontrol in New Zealand is alligator weed (*Alternanthera philoxeroides*). The alligator weed beetle (*Agasicles hygrophila*) and moth (*Arcola malloi*) provide good control of the weed on static water bodies in warmer parts of the country. However, they are not able to control terrestrial infestations of the weed, or aquatic infestations that are regularly flooded or situated in cooler parts of the country. So in the past 5 years we have been keen to find additional biocontrol agents that could potentially fill these key gaps, and have supported an Australian programme to screen for new agents. Unfortunately the results obtained by CSIRO were disappointing. All six potential insect agents they tested were able to feed and develop on other *Alternanthera* species. Because Australia has native *Alternanthera* species this has ruled out any plans to further consider these insects for release on that side of the Tasman. However, the situation was not quite so clear-cut for New Zealand.

In the past, it would not have been a problem if the other *Alternanthera* species in New Zealand (*A. denticulata, A. pungens* and *A. sessilis*) were attacked, as they were all considered to be exotic introductions. No one disputes that *A. pungens* is exotic, and many believed that *A. denticulata* might have been a recent arrival. But things got tricky when a recent paper re-described New Zealand *A. sessilis* as an endemic species *A. nahui*. The chances of making a successful case to release a biocontrol agent in New Zealand that could potentially harm an endemic plant were fairly slim, leaving us with only two potential avenues to follow. The first was to attempt to develop more sophisticated testing methods to show that while some attack was possible, any attack on non-targets in the field would be insignificant; and the second was to further investigate the status of *A. nahui* in New Zealand. Since the molecular data supporting the revision paper was limited, and Australian material in the Allan Herbarium at Lincoln appeared to resemble *A. nahui*, we decided to have a crack at both.

The taxonomy of *Alternanthera* is quite confused, which is not helped by the fact that the conditions plants are growing in can have a big impact on what they look like. We have confirmed that molecular methods are the only way to accurately identify some *Alternanthera* plants. Luckily our plant population geneticist, Gary Houliston, was quickly able to identify material in Australia that is identical to *A. nahui* here, and it appears we have a subset of the genetic material present in Australia. “This suggests that *A. nahui* is a recent introduction to New Zealand,” confirmed Gary. We also got a similar result for *A. denticulata*, clearing the way for a potential application for additional agents for alligator weed to be released in New Zealand in due course.

Alternanthera nahui, no longer a major impediment to developing biocontrol for alligator weed.

So what might be in this application? Of the six insects studied in recent times we have identified the two which look the most promising: a stem/root galling fly (*Ophiomyia marellii*) that attacks the nodes, and a foliage-feeding beetle (*Systena nitentula*). We have imported a shipment of flies from Australia and are attempting now to establish a rearing colony, and we will look at importing the beetle from its native range in Argentina when funds permit. We still hope to gain better information about what these insects might do in the field if released in New Zealand, but some damage to *A. denticulata* and *A. nahui* is no-longer likely to be a fatal impediment to this project.

This project is funded by the National Biocontrol Collective and the Ministry of Business, Innovation and Employment, under the Beating Weeds Programme. We thank everyone who sent in various Alternanthera *specimens for our molecular studies, especially John Hosking (Department of Primary Industries, New South Wales) and Jo Palmer (CSIRO). We also acknowledge Shon Schooler and Richard Chan (CSIRO) for all their efforts seeking new insect agents.*

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International Effort Underway against Tutsan

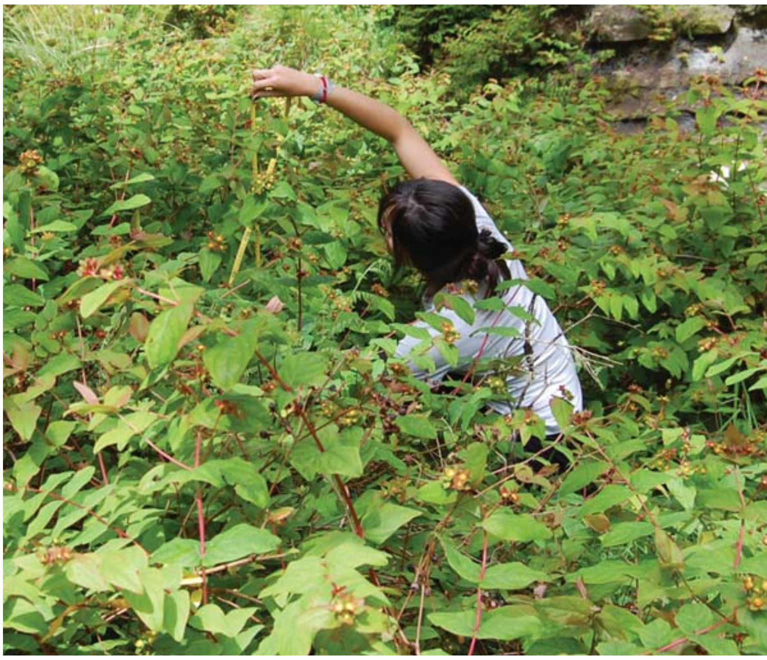
Tutsan (*Hypericum androsaemum*) is an invasive weed that originates from Europe and has become a significant pest in the North Island. The Tutsan Action Group secured funding to conduct a feasibility study into the potential for tutsan biocontrol and this was carried out by Ronny Groenteman in 2009. Given the lack of other effective control measures and that there are no closely related plants used for economic purposes in New Zealand, Ronny recommended that the programme should proceed. She noted that there are two endemic *Hypericum* species (one of which is threatened with extinction) so cautioned that any agents would have to be highly host specific. Ronny recommended that the following steps be undertaken:

- Map the current distribution of the plant in New Zealand to get a better understanding of the extent of the tutsan problem here.
- Use molecular techniques to assess the origin of New Zealand material.
- Survey plants in New Zealand to see what insects and pathogens already occur on tutsan that might negatively affect biocontrol attempts.
- Survey plants in its native range for potential agents.

Over the past year there has been significant progress in addressing these points.

Elizabeth (Lizzie) Rendell, a British intern, recently spent 6 months with Landcare Research, teaming up with Hugh Gourlay to undertake surveys of New Zealand tutsan. They surveyed 37 sites around New Zealand to determine the extent and density of tutsan distribution. The most significant infestations were found in Taumarunui and the Eastern Bay of Plenty, with most sites in the South Island only consisting of a few plants. The amount of damage to plants from insects was low (approximately 4%) and the majority of this was caused by generalists like the bronze beetle *(Eucolaspis brunnea)* and leafroller caterpillars. “This is an important finding,” said Hugh. “It means that if insects are eventually brought to New Zealand for biocontrol of tutsan, they are unlikely to displace native invertebrates or face too much competition for resources.”

Lizzie commonly found the tutsan rust (*Melampsora hypericorum*) during her surveys. This rust is also commonly found on tutsan in Australia, and initially looked promising as an agent, but more recent studies have found it has some drawbacks. A number of successive rust outbreaks are required to kill vigorous plants, and if the environmental conditions that trigger rust outbreak do not strike regularly,



Lizzie surveying tutsan in the North Island.

some plants can recover between attacks. In addition, tutsan populations are thought to vary in their susceptibility to the rust, and strains of the rust can vary in their pathogenicity (ability to cause disease)!

Currently it appears that tutsan is not behaving in an invasive manner in the South Island while tutsan in the North Island is becoming widespread in some regions. We are not yet sure why there is a difference between the two islands, and whether the rust is implicated at all. At least part of the answer may lie in the recent finding that the two populations have different genetics. DNA from plant material collected from 13 sites from throughout New Zealand has been analysed and we appear to have two distinct groups. Plants from the South Island are genetically similar and, from a limited amount of published data available, appear to match some material found in the UK. North Island populations are also similar to each other (but different to South Island material), and originate from an as yet unknown European site. “The benefit of pinpointing where the plant originates from is that we can target that specific region to look for potential agents, including perhaps other strains of the rust that might be better adapted to attack New Zealand tutsan,” said Hugh. It is fortunate the tutsan in New Zealand is not more genetically variable, as this could potentially have made the project more challenging.

Meanwhile in the Northern Hemisphere, CABI Europe – Switzerland has been contracted to survey tutsan in its native range to look for natural enemies and collect material for DNA sampling. Such surveys have not been undertaken before and we are hoping they will uncover some potentially useful biocontrol agents. This year, MSc student Elena Olsen has joined CABI to undertake the surveys, which will continue until 2013. Elena has initially focused on the UK, Ireland, France and Spain, and has already found a foliage-feeding beetle and a stem-boring moth that appear to be worth further study. The plant material collected by Elena will undergo DNA analysis to see if we can find a match for our North Island plant populations. This molecular work will be carried out in September by Lizzie, who is now back in the UK, using skills she learnt during her time with us.

In addition to Lizzie and Elena this project is benefitting from other international co-operation. Chantal Morin, a plant pathologist with experience in working with *Melampsora* species, is currently collaborating with CABI and helping Elena with rust identification and virulence testing. Also, an Australian student, Tracey Nel, has recently submitted a Masters thesis on her research that attempted to better understand why some plants are susceptible to the rust in Australia while others are not. She will be meeting up with Chantal and Elena shortly to share her findings. "Hopefully before too long we will have a better idea about whether tutsan rust offers any further biocontrol potential, and what our other options might be," explained Hugh.

Tutsan invading hillsides in Taumaranui.

This project is funded by an MPI Sustainable Farming Fund grant to the Tutsan Action Group, with contributions provided by other co-funders.

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Spotlight Finally on Privet

Privet (*Ligustrum* spp.) has a large native range, across Europe to eastern Asia and south to Queensland, Australia. There are approximately 40 species, but only four have been introduced to New Zealand: tree privet (*L. lucidum*), Chinese privet (*L. sinense*), common privet (*L. vulgare*), and Californian privet (*L. ovalifolium*). Only tree privet and Chinese privet (referred to subsequently as privet) are considered to be seriously invasive weeds here currently. They are most common north of the Bay of Plenty, but also occur elsewhere throughout the North Island. Both species are only rarely found in the warmer parts of the South Island.

Privet can be highly invasive because it produces abundant dark bluish or purplish black berries that are eaten and dispersed by birds. In New Zealand bird dispersal of seeds is allowing privet to invade native plant communities where it suppresses regeneration of native species by reducing seedling survival and growth. Privet is also seriously unpopular with many people as its pollen can cause allergies including hay fever and asthma. Regional council phone lines ring red hot with complaints during the flowering season. This is slightly ironic given that privet was introduced to New Zealand as an ornamental and has been a popular hedge plant for many years in home gardens. The leaves of mature privet are also poisonous to stock.

Privet control is difficult because many of the habitats it invades preclude blanket spraying and make individual plants hard to find. Seedlings can be pulled or dug out, while older plants can be cut down, but the stumps must be treated with herbicide to prevent resprouting. Plants can also be poisoned by stem injection. Biocontrol potentially offers a much more cost-effective and sustainable method of control for privet. We looked into the feasibility of this back in 2000, but funds to begin a project did not become available until nearly a decade later. As usual our first step was to survey the plants in New Zealand to gain an appreciation of their current natural enemies here, which was completed recently. Between July 2009 and May 2012 we sampled three species of privet (*L. lucidum*, *L. sinense* and *L. vulgare*) from 39 New Zealand sites, ranging from Kaeo in the north of the North Island to Maruia and Granity in the South.

The result was typical of what we tend to find during such surveys. A wide range of native and introduced invertebrates are associated with privet in New Zealand but the damage caused is minimal (<2% of foliage currently consumed). Moth larvae, and in particular leafrollers (Tortricidae) and looper moths (Geometridae), appear to be causing the most obvious damage to privet foliage. One particularly interesting moth found (currently thought to be *Trichophysetis cretacea*) was

Tip necrosis symptoms on Chinese privet.

reared from privet berries. Adults of this moth were first found in New Zealand in 1999 but its host plants were unknown until now. The larvae of this moth feed inside the berries and leave a neat round exit hole when they leave to pupate. The moth was not present at all sites, but where it was present it was sometimes causing a moderate amount of damage to berries. *T. cretacea* is native to China and Japan where it is known to be a pest of jasmine (*Jasminium polyanthum*), which is in the same family (Oleaceae) as privet. Further research is needed to determine whether they offer any potential for biocontrol purposes in New Zealand, especially given jasmine is both a very popular ornamental species and an up and coming weed in warmer parts of the country.

“Native puriri moth caterpillars (*Aenetus virescens*) are also quite common on privet, producing characteristic tunnels and feeding scars in the trunks,” explained Chris Winks, who did much of the actual survey work. Passionvine hopper (*Scolypopa australis*) and the green plant hopper (*Siphanta acuta*) were common at many sites but the damage caused by sap-feeders like these, either directly by removal of nutrients or indirectly by puncturing the plant and possibly allowing the entry of pathogens, is very difficult to quantify. The combined effect of generalist predators such as spiders, earwigs, ants, and praying mantids could inhibit the effectiveness of some potential invertebrate biocontrol agents for privet, and parasitoids identified during this survey could affect some potential lepidopteran biocontrol agents. These factors will need to be considered down the track when shortlists of potential biocontrol agents are being prepared.

Trichophysetis cretacea, which was reared from privet berries and may have a narrow host range.

Few primary fungal pathogens were found on privet, and the plant was healthier than many other weeds we have surveyed here. Symptoms observed included discrete leaf spots, tip and marginal scalds, but no obvious candidates for biocontrol purposes. Overall there appear to be no specialist privet natural enemies in New Zealand (apart from perhaps *T. cretacea*, whose host-range is not yet fully understood) and therefore there would appear to be good potential for improving privet control by introducing some. “We will look into this further and undertake screening of potential biocontrol agents once funds permit,” explained Stan Bellgard, who currently has overall responsibility for the project.

Some potential biocontrol agents are already known, as various privet species are considered to be weeds in the USA, Australia, Argentina, Mauritius and Réunion, so some work has already been undertaken. CABI Europe – UK has surveyed in Sri Lanka, India, Vietnam and China for potential biocontrol agents for *L. robustum* subsp. *walkeri*, which is problematic in Mauritius and Réunion. They identified three insect agents one of which, a moth (*Epiplema albida*), was found to be sufficiently host specific to be considered for release but has not yet been mobilised. Chinese privet has become one of the worst invasive plants in the south-eastern United States where it is considered a severe threat to ecosystems from Texas to Florida, and north as far as the New England states. Surveys for potential insect biocontrol agents for the USA were conducted in China during 2005 and 2006 with more than 100 species found feeding on the plant. The two thought to be the most promising, a leaf-mining flea beetle (*Argopistes tsekooni*) and a lacebug (*Leptoypha hospita*), have since been studied in more detail. James Hanula, of the US Forest Service, Georgia, reports that the beetle is probably not sufficiently specific to release in the USA and that they are currently completing testing of the lace bug and hope to request permission to release it shortly.

This project is funded by the National Biocontrol Collective. Thanks to Richard Toft (Entecol) for assistance with South Island surveys.

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Ecofriendly *Agapanthus* – Myth or Reality?

The typical large-growing form of *Agapanthus*, *A. praecox* subsp. *orientalis*, has become a weed that is increasingly worrying some regional authorities and environmental organisations. As a result, on 1 July 2008 it was included in the Auckland Regional Pest Management Strategy as a Surveillance Pest Plant. This sparked debate from the public, and media attention was rekindled by recent suggestions to include it as a National Pest Plant Accord species.

Agapanthus is widely grown and the numerous cultivars available are popular for amenity plantings and home gardens, providing year-round foliage, hardiness and low maintenance, with the bonus of a long flowering period and showy flowers. To meet the demand for *Agapanthus* selections that the public can still buy and grow, the New Zealand nursery industry has released a range of low-growing ('dwarf') cultivars that they promote under various terms, including 'Auckland safe', 'eco-friendly', 'environment safe', 'low-fertility' and 'sterile'.

The key questions here are which, if any, cultivars are truly of low fertility? And are the dwarf cultivars able to hybridise with typical large-growing *Agapanthus praecox* subsp. *orientalis*? In response to concerns over *Agapanthus* in its region, Auckland Regional Council (now Auckland Council) contracted Landcare Research botanists Kerry Ford and Murray Dawson to help answer these questions. Over two years, Kerry and Murray conducted detailed fertility assessments of *Agapanthus*. Their research investigated the sterility and low-fertility claims made of two dwarf cultivars, *Agapanthus* 'Finn' and *A.* 'Sarah', and their ability to hybridise with the common tall-growing *A. praecox* subsp. *orientalis*. A fertile dwarf cultivar, *A.* 'Streamline', was included for comparison.

A wide range of methods were used to test both male and female fertility: observations of floral morphology and pollen viability, artificial crossing experiments (self, sib and outcrosses), observations of pollen tube growth, seed counts and germination, and flow cytometry. "These fertility assessments revealed that none of the plants assessed were fully sterile and all were capable of producing seedlings," said Murray.

Agapanthus 'Finn' had the lowest overall fertility. It was self-sterile and yielded <10% seed in any outcross with it. Pollen viability was also low at 40%. These results may set a good benchmark for low fertility in *Agapanthus*. *Agapanthus* 'Sarah' was self-sterile and had the lowest female fertility (about 6% seed set) when outcrossed. However, male (pollen) fertility was relatively high at 85%. As expected, the typical tall-growing *Agapanthus praecox* subsp. *orientalis* had the highest fertility across the various assessments (74% seed set when sib-crossed; >95% pollen viability). Note that when self-pollinated this wild-type *Agapanthus* had low self-fertility (9.5% seed set). This highlights that self-sterility claims made of some cultivars are rather meaningless. Also as expected, *A.* 'Streamline' was fertile, but also had moderate self-fertility (with 40% seed set).

So where do these results leave the industry? Kerry and Murray recommend further fertility testing of existing selections claimed to be of low fertility (e.g. *Agapanthus* 'Agapetite', *A.* 'Baby Pete', *A.* 'Double Diamond', *A.* 'Goldstrike', *A.* 'Pavlova', *A.* 'Peter Pan', *A.* 'Senna', *A.* 'Thunderstorm' and *A.* 'Tinkerbell'). Female sterility – the inability to set seed – is the important criterion to screen for. "There is huge potential for deliberate breeding programmes to create fully sterile cultivars, which we are exploring further," said Murray.

With further research it may well be possible to find ways of using and enjoying this popular garden plant without harming the environment. That way everyone wins.

This project was funded by the Auckland Regional Council and a full report is available online see: www.landcareresearch.co.nz. *An Envirolink small advice grant, in association with Tasman District Council (TSDC85), has allowed this information to be made more widely available.*

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Agapanthus 'Sarah'.

Spring Activities

Most biocontrol agents become active during spring, making it a busy time of year. Some activities that you might want to fit in over this time include:

Boneseed leafroller (*Tortrix* s.l. sp."chrysanthemoides")

- Check release sites from mid-spring for feeding shelters made by caterpillars webbing together leaves at the tips of stems. Small caterpillars are olive-green in colour and become darker with two parallel rows of white spots as they mature. We would be very interested to hear if you find any severe damage to boneseed foliage.
- Caterpillars can be harvested if you find them in good numbers. Cut off infested boneseed tips and wedge them into plants at new sites. Aim to shift at least 500 caterpillars to sites where scale insects and invasive ants are not known to be present.

Bridal creeper rust *(Puccinia myrsiphylli)*

- Check bridal creeper infestations for bridal creeper rust, particularly sites where it has not been found before. Plants infected by the rust have yellow and black pustules on the undersides of leaves and on stems and berries. They may look defoliated and sickly.
- If you need to redistribute bridal creeper rust see detailed instructions at http://www.csiro.au/en/Outcomes/Safeguarding-Australia/Bridal-Creeper-Rust-Fungus.aspx.

Broom gall mite *(Aceria genistae)*

- Spring and summer are the best times to check plants at release sites for galls, which look like deformed lumps and range in size from 5 to 30 mm across. They will probably be fairly close to the release point. Occasionally galls can be found on broom that are not made by the gall mite, but these are much less dense. We are happy to help confirm the identity of any galls you find.
- If galls are present in good numbers you may be able to begin harvesting and redistributing them in summer when they are mature. Aim to shift at least 50 galls, and tie them onto plants at the new site so the tiny mites can shift across. Because the mites are showing much promise but are expected to disperse quite slowly it will be important to plan a comprehensive redistribution programme.

Broom gall mite galls.

Broom leaf beetles *(Gonioctena olivacea)*

- Check sites where beetles have been released for three or more years for signs of establishment. The adults are 3-5 mm long and females tend to be goldish-brown while males have an orangey-red tinge – although colouration can be quite variable. Look for larvae in late spring – they are a greyish-brown and feed on leaves and shoot tips. Use a beating tray to help find this agent, and don't be surprised if you only find one or two beetles at this stage.
- It is probably still a bit soon to find enough beetles to be able to begin harvesting and redistribution just yet.

Broom seed beetles *(Bruchidius villosus)*

- Look for adult beetles gathering together on broom flowers or for eggs on the pods.
- If need be the beetles can be moved around fairly easily. Use a beating tray and a pooter to collect adults or put a large bag over a branch of flowers and give them a good shake.

Broom shoot moth *(Agonopterix assimilella)*

- Late spring is the best time to check broom shoot moth release sites. Look for the caterpillars' feeding shelters made by webbing twigs together. Small caterpillars are dark brown and turn dark green as they get older. We have not yet seen any good evidence of likely establishment at any of the release sites so we will be especially interested to hear if you find any sign of the moth.
- We would not expect you to find enough caterpillars to be able to begin harvesting and redistribution just yet.

Green thistle beetles *(Cassida rubiginosa)*

- Check release sites for adult beetles, which emerge on warm days towards the end of winter and feed on new thistle leaves making round window holes. The adults are 6–7.5 mm long and green, but are quite well camouflaged against the leaf. The larvae also make windows in the leaves. They have prominent lateral and tail spines and a protective covering of old moulted skins and excrement.

- The beetles may have built up to harvestable numbers at some of the oldest sites so it may be possible to begin redistribution. Use a garden-leaf vacuum machine and aim to shift at least 50 adults in the spring. Be careful to separate the beetles from other material collected during the vacuuming process, which may include pasture pests.

Ragwort crown-boring moth *(Cochylis atricapitana)*

- No signs of establishment of this moth have been seen yet so it would be good to check release sites one last time. Look for rosettes with damaged centres and black frass or thickened stems and bunched leaves. If present the caterpillars should be most easily found by pulling apart damaged plants during August–September. They are creamy-white, with black heads that become brown when they are older, and are quite short and fat. Please let us know if you find any.

Ragwort plume moth *(Platyptilia isodactyla)*

- October is the best time to check release sites for caterpillars. Look for plants with wilted or blackened or blemished shoots with holes and an accumulation of debris, frass or silken webbing. Pull back the leaves at the crown of damaged plants to look for large hairy, green larvae and pupae. Also check where the leaves join bolting stems for holes and frass. Don't get confused by larvae of the blue stem borer (*Patagoniodes farinaria*), which look similar to plume moth larvae until they develop their distinctive bluish colouration.
- If this moth is present in good numbers the best time to harvest it is in late spring. Dig up damaged plants, roots and all. Pupae may be in the surrounding soil so retain as much as possible. We recommend shifting at least 50–100 plants but the more you can shift, the greater the chance the moth will establish. Place one or two infested plants beside a healthy ragwort plant at the release site so any caterpillars can crawl across.

Tradescantia leaf beetle *(Neolema ogloblini)*

- Although most release sites are still less than 18 months old some people have already been able to find signs of the beetles early on so it is probably worth taking a look. The dark metallic bronze adults may be hard to spot as they tend to drop when disturbed. Look instead for the slug-like larvae in areas where there is damage to the leaves. Adults chew holes around the edges of leaves, and may consume entire leaves. The larvae graze the epidermal tissue off the leaves, mostly on the undersides, and can skeletonise them.
- We would not expect you to find enough beetles to be able to begin harvesting and redistribution just yet.

Tradescantia stem beetle *(Lema basicostata)*

- Given that the first release only went out last autumn it may well be far too early to find the stem beetle at release sites this spring, but there is no harm in taking a look! The shiny black knobbly adults may be hard to spot as they also tend to drop or fly away when disturbed. They chew elongated windows in the upper surfaces of leaves and sometimes consume entire leaves. The larvae are inside the stems so look for signs of their feeding (collapse and necrosis of stems) and brown frass.
- We would not expect you to find enough beetles to be able to begin harvesting and redistribution just yet.

Woolly nightshade lace bug *(Gargaphia decoris)*

- Once the weather warms up look on the undersides of leaves at release sites for the adults and nymphs, especially on leaves showing signs of bleaching or black spotting around the margins.
- We expect the lace bugs might also be slow to disperse so if good numbers are present it would be worth collecting some to release in other areas. Always wear gloves when handling woolly nightshade foliage to avoid any health issues. Cut leaf material that is infested with adults and/or nymphs and wedge or tie this material firmly into new woolly nightshade plants so the lace bugs can move across. We recommend that you shift at least 1000 individuals to each new site at any time during the warmer months.

Other agents

You might also need to check or distribute the following this spring (for further details see http://www.landcareresearch.co.nz/publications/books/biocontrol-of-weeds-book):

- Gorse soft shoot moth (*Agonopterix ulicetella*)
- Gorse colonial hard shoot moth (*Pempelia genistella*)

Send any reports of interesting, new or unusual sightings to Lynley Hayes (hayesl@landcareresearch.co.nz, Ph 03 321 9694).

Tradescantia stem showing typical damage caused by a stem beetle larva.

Who's Who in Biological Control of Weeds?

Alligator weed beetle *(Agasicles hygrophila)* **Alligator weed beetle** *(Disonycha argentinensis)* **Alligator weed moth** *(Arcola malloi)*	Foliage feeder, common, often provides excellent control on static water bodies. Foliage feeder, released widely in the early 1980s, failed to establish. Foliage feeder, common in some areas, can provide excellent control on static water bodies.
Blackberry rust *(Phragmidium violaceum)*	Leaf rust fungus, self-introduced, common in areas where susceptible plants occur, can be damaging but many plants are resistant.
Boneseed leaf roller (*Tortrix* s.l. sp. "chrysanthemoides")	Foliage feeder, first released in 2007, establishment confirmed at some North Island sites but no significant damage seen yet. Appears to be limited by predation and parasitism.
Bridal creeper rust *(Puccinia myrsiphylli)*	Rust fungus, self-introduced, first noticed in 2005, widespread, appears to be causing severe damage at many sites.
Broom gall mite *(Aceria genistae)* **Broom leaf beetle** *(Gonioctena olivacea)* **Broom psyllid** *(Arytainilla spartiophila)* **Broom seed beetle** *(Bruchidius villosus)* **Broom shoot moth** *(Agonopterix assimilella)* **Broom twig miner** *(Leucoptera spartifoliella)*	Gall former, first released at limited sites in late 2007, establishing well and severe damage to plants already seen at some sites, widespread releases are continuing. Foliage feeder, first released in 2006/07 and establishment appears likely at a few sites so so far. Widespread releases are continuing. Sap sucker, becoming common, some damaging outbreaks seen so far but may be limited by predation, impact unknown. Seed feeder, becoming common, spreading well, showing potential to destroy many seeds. Foliage feeder, first released early in 2008, limited releases made so far and establishment success not yet known. Stem miner, self-introduced, common, often causes obvious damage.
Buddleia leaf weevil *(Cleopus japonicus)*	Foliage feeder, first released in 2006, heavily defoliating plants at some sites.
Californian thistle flea beetle *(Altica carduorum)* **Californian thistle gall fly** *(Urophora cardui)* **Californian thistle leaf beetle** *(Lema cyanella)* **Californian thistle rust** *(Puccinia punctiformis)* **Californian thistle stem miner** *(Ceratapion onopordi)* **Green thistle beetle** *(Cassida rubiginosa)*	Foliage feeder, released widely during the early 1990s, not thought to have established. Gall former, rare, galls tend to be eaten by sheep, impact unknown. Foliage feeder, only established at one site near Auckland where it is causing obvious damage. Further releases may be made from this site. Systemic rust fungus, self-introduced, common, damage not usually widespread. Stem miner, attacks a range of thistles, first released early in 2009, limited releases made so far and establishment success not yet known. Difficult to rear, releases will continue as available. Foliage feeder, attacks a range of thistles, widespread releases began in 2007/08 and are continuing, establishment is looking promising at most sites and obvious damage seen at some sites already.
Chilean needle grass rust *(Uromyces pencanus)*	Rust fungus, permission to release granted in 2011 and it is hoped releases can begin in autumn 2013. Only South Island populations are likely to be susceptible.
Gorse colonial hard shoot moth *(Pempelia genistella)* **Gorse hard shoot moth** *(Scythris grandipennis)* **Gorse pod moth** *(Cydia succedana)* **Gorse seed weevil** *(Exapion ulicis)* **Gorse soft shoot moth** *(Agonopterix umbellana)* **Gorse spider mite** *(Tetranychus lintearius)* **Gorse stem miner** *(Anisoplaca pytoptera)* **Gorse thrips** *(Sericothrips staphylinus)*	Foliage feeder, limited releases to date, established only in Canterbury, impact unknown but obvious damage seen at several sites. Foliage feeder, failed to establish from small number released at one site, no further releases planned due to rearing difficulties. Seed feeder, becoming common, spreading well, can destroy many seeds in spring but is not so effective in autumn and not well synchonised with gorse-flowering in some areas. Seed feeder, common, destroys many seeds in spring. Foliage feeder, becoming common in Marlborough and Canterbury with some impressive outbreaks, establishment success in the North Island poor to date, impact unknown. Sap sucker, common, often causes obvious damage, but persistent damage limited by predation. Stem miner, native insect, common in the South Island, often causes obvious damage, lemon tree borer has similar impact in the North Island. Sap sucker, gradually becoming more common and widespread, impact unknown.
Heather beetle *(Lochmaea suturalis)*	Foliage feeder, released widely in Tongariro National Park, some damaging outbreaks now occurring, also established near Rotorua and severely damaging heather there.
Hemlock moth *(Agonopterix alstromeriana)*	Foliage feeder, self-introduced, common, often causes severe damage.
Hieracium crown hover fly *(Cheilosia psilophthalma)* **Hieracium gall midge** *(Macrolabis pilosellae)*	Crown feeder, limited releases made so far, establishment success unknown, rearing difficulties need to be overcome to allow widespread releases to begin. Gall former, widely released and has established but is not yet common at sites in both islands, impact unknown but very damaging in laboratory trials.

Hieracium gall wasp *(Aulacidea subterminalis)*	Gall former, widely released and has established but is not yet common in the South Island, impact unknown but reduces stolon length in laboratory trials.
Hieracium plume moth *(Oxyptilus pilosellae)*	Foliage feeder, only released at one site so far and did not establish, further releases will be made if rearing difficulties can be overcome.
Hieracium root hover fly *(Cheilosia urbana)*	Root feeder, limited releases made so far, establishment success unknown, rearing difficulties need to be overcome to allow widespread releases to begin.
Hieracium rust *(Puccinia hieracii* var. *piloselloidarum)*	Leaf rust fungus, self-introduced?, common, may damage mouse-ear hawkweed but plants vary in susceptibility.
Lantana blister rust *(Puccinia lantanae)*	Rust fungus that causes dead patches on the leaves, leaf stalks and stems, can cause systemic infection triggering stem dieback, permission to release granted in 2012 and releases are planned to begin later this year.
Lantana leaf rust *(Prospodium tuberculatum)*	Rust fungus that causes leaf death and defoliation, permission to release granted in 2012 and releases are planned to begin later this year.
Lantana plume moth *(Lantanophaga pusillidactyla)*	Flower feeder, self-introduced, host-range, distribution and impact unknown.
Mexican devil weed gall fly *(Procecidochares utilis)*	Gall former, common, initially high impact but now reduced considerably by Australian parasitic wasp.
Mexican devil weed leaf fungus *(Passalora ageratinae)*	Leaf fungus, probably accidentally introduced along with the gall fly in 1958, common and almost certainly having an impact on the weed.
Mist flower fungus *(Entyloma ageratinae)*	Leaf smut, common and often causes severe damage.
Mist flower gall fly *(Procecidochares alani)*	Gall former, now well established and common at many sites, in conjunction with the leaf smut provides excellent control of mist flower.
Moth plant beetle *(Colaspis argentinensis)*	Root feeder, permission to release granted in late 2011 and it is hoped releases can begin in 2013.
Nodding thistle crown weevil *(Trichosirocalus horridus)*	Root and crown feeder, becoming common on several thistles, often provides excellent control in conjunction with other nodding thistle agents.
Nodding thistle gall fly *(Urophora solstitialis)*	Seed feeder, becoming common, can help to provide control in conjunction with other nodding thistle agents.
Nodding thistle receptacle weevil *(Rhinocyllus conicus)*	Seed feeder, common on several thistles, can help to provide control of nodding thistle in conjunction with the other nodding thistle agents.
Old man's beard leaf fungus *(Phoma clematidina)*	Leaf fungus, initially caused noticeable damage but has since either become rare or died out.
Old man's beard leaf miner *(Phytomyza vitalbae)*	Leaf miner, common, only one severely damaging outbreak seen, appears to be limited by parasites.
Old man's beard sawfly *(Monophadnus spinolae)*	Foliage feeder, limited widespread releases have been made, has probably failed to establish.
Phoma leaf blight *(Phoma exigua* var. *exigua)*	Leaf spot fungus, self-introduced, becoming common, can cause minor–severe damage to a range of thistles.
Cinnabar moth *(Tyria jacobaeae)*	Foliage feeder, common in some areas, often causes obvious damage.
Ragwort crown-boring moth *(Cochylis atricapitana)*	Stem miner and crown borer, limited number of widespread releases made in 2006/07, establishment looking unlikely.
Ragwort flea beetle *(Longitarsus jacobaeae)*	Root and crown feeder, common in most areas, often provides excellent control in many areas.
Ragwort plume moth *(Platyptilia isodactyla)*	Stem, crown and root borer, widespread releases made in past 5 years, appears to be establishing readily and reducing ragwort already at some wetter sites where the flea beetle is ineffective.
Ragwort seed fly *(Botanophila jacobaeae)*	Seed feeder, established in the central North Island, no significant impact.
Greater St John's wort beetle *(Chrysolina quadrigemina)*	Foliage feeder, common in some areas, not believed to be as significant as the lesser St John's wort beetle.
Lesser St John's wort beetle *(Chrysolina hyperici)*	Foliage feeder, common, nearly always provides excellent control.
St John's wort gall midge *(Zeuxidiplosis giardi)*	Gall former, established in the northern South Island, often causes severe stunting.
Scotch thistle gall fly *(Urophora stylata)*	Seed feeder, limited releases to date, establishing readily, impact unknown.
Tradescantia leaf beetle *(Neolema ogloblini)*	Foliage feeder, permission to release granted in 2008, releases finally got underway in autumn 2011 after beetle successfully cleared of a gut parasite, widespread releases now underway and establishment is looking promising.
Tradescantia stem beetle *(Lema basicostata)*	Stem borer, permission to release granted in 2011, releases got underway in 2012 and will be continuing.
Tradescantia tip beetle *(Neolema abbreviata)*	Tip feeder, permission to release granted in 2011 and releases are scheduled to begin later this year.
Woolly nightshade lace bug *(Gargaphia decoris)*	Sap sucker, permission to release granted by ERMA in 2009, releases began in late 2010 and establishment has been confirmed at many sites.

Further Reading

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Previous issues of this newsletter are available at:www.landcareresearch.co.nz/publications/newsletters/biological-control-of-weeds/whats-new-newsletter

Workshops

We will hold a basic biocontrol workshop at Lincoln in late November / early December 2012 and an advanced biocontrol workshop in Auckland in March/April 2013 if there is sufficient interest. If you would like to attend either workshop, and have not already sent through an expression of interest, please complete the form distributed with this newsletter or contact Lynley Hayes (hayesl@landcareresearch.co.nz).

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