



What's New In Biological Control Of Weeds?

Annual Review

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Introduction

Welcome to the fourth full-colour 16-page edition of What's New in Biological Control of Weeds?, which we produce annually to help you keep your finger on the pulse of biological control of weeds and related projects in New Zealand. We report on important happenings and progress over the past year, and preview the coming year.

Headlines

- We have some new faces in the weeds group so meet Hilary, Baxter, Cui, Vaughan and Helen, and find out how they are all adding value to our research programmes.
- Two new forces have been unleashed in an attempt to knock over the last bastions of ragwort in New Zealand. Learn more about these winged warriors and their methods of attack.
- Two new agents that are being considered for Californian thistle are likely to add pressure to other thistle species too. Read about why we think such a multi-targeting approach might just be a goer.
- We have done further work to check on weed biocontrol agents in the field to make sure they are not unexpectedly going awry. Check out our findings for pathogens, and the latest in the gorse pod moth and old man's beard leaf miner sagas.
- The Biocontrol Collective is a powerful force in New Zealand for deciding what biocontrol of weeds projects should be undertaken. Discover how the Collective works and see what work they will be driving over the next year.
- Collective decision-making is also the favoured approach to deciding how to

"Ok winged warriors we have reached our target, ready aim. Fire!"



Landcare Research
Manaaki Whenua

- spend government funding ear-marked for weeds research. Read about key findings from a recent workshop.
- It is unusual for a single biocontrol agent to be able to control a weed on its own, so get up to speed with what we have in mind to work on next for boneseed.

- We are one of the few countries that haven't yet had a go at biocontrol for lantana. Learn why that might be about to change.
- A search for potential agents against Darwin's barberry has begun in Chile – find out why initial results are a little disappointing.

- Spring can be the busiest time of the biocontrol of weeds year, so remind yourself of some activities you might need to be planning for.
- Finally check out our summary of where all our weed biocontrol agents are now at, plus some tips for further reading.

New Lincoln Contact Details

Landcare Research is progressively upgrading its telephone system so all its phone numbers will be changing. The Lincoln numbers have now changed and you should now use the following if you want to contact us: **Phone: 03 321 9999, Fax: 03 321 9998.** Or you may find it more convenient to use our direct dial numbers, which are:

Lincoln also has new postal details: **PO Box 40, Lincoln 7640.**

| | |
|---------------|-------------|
| Xianlan Cui | 03 321 9843 |
| Simon Fowler | 03 321 9671 |
| Hugh Gourlay | 03 321 9683 |
| Lynley Hayes | 03 321 9694 |
| Vaughan Myers | 03 321 9753 |
| Helen Parish | 03 321 9766 |
| Lindsay Smith | 03 321 9805 |

New Faces

In recent times our biocontrol of weeds group has grown and it seems timely to introduce these folk to you. So starting north and working our way south:

Hilary Kitchen

Hilary is a science and biology teacher who is taking time out from the classroom to extend her knowledge and skills, under the Royal Society's Science and Mathematics Teacher Fellowship scheme. Hilary is working with us on the project that is attempting to develop a molecular technique to tell apart the different strains of the old man's beard fungus (*Phoma clematidina*) (see *Are They Behaving Themselves?*, page 7). Hilary tells us that having a year off school has done her so much good that all her friends are commenting on how well she looks! "It has given me time to reflect on my life as a teacher and has given me a quality of life that I have not enjoyed for 18 years! The joys of discovery have been renewed, and my enthusiasm for learning has been invigorated. In fact I'm astounded that my old brain can still take in new information!" confided Hilary. As a result of this experience Hilary will be much better equipped to advise senior

students about science career options and will definitely be encouraging them to study science. Her added knowledge of biotechnology, biocontrol, genetic applications, and mycology will benefit junior and senior students alike. Oh, and Hilary knows lots of scientists now that she can hit up to come and talk to her classes.

Baxter Massey

Baxter has been working with us at Tamaki since the beginning of 2005. Prior to that he did an MSc at Auckland University on molecular microbiology studying microbial biofilms found in streams. In between he worked for Auckland University on such diverse things as bacterial communities in kiwi (as in the birds) and viruses of kiwis (as in the fruit). Since Baxter has been with Landcare Research he has used his skills in a range of projects, from determining stream health by studying

aquatic invertebrates, avian malaria, to weed biocontrol using pathogens. It is our gain that Baxter has decided he now wants to focus on the latter. Outside work Baxter is kept busy with his involvement in two bands and he apparently writes



Baxter Massey working in the lab.

songs, sings, composes music and plays his guitar until his fingers bleed!

Xianlan Cui

Cui (pronounced tree), as he prefers to be known, is based at Lincoln. Cui grew up in Henan province in central China. He originally trained as a vet and as part of his Master of Veterinary Science Degree studied viral diseases of pigs. In 1990 he spent some time in Australia studying avian virology, so if you have any queries about bird flu Cui is your man! Cui returned to China to work on avian diseases until 1995 when he returned to Australia to study English and undertake a PhD on diseases of poultry. In 2000 Cui moved across the Tasman to help us out in our possum biocontrol programme, designing, testing and developing vaccines to see if we can make possums sterile. Recently the weeds group has realised we need a virologist to help us explore whether we could make use of this group of plant pathogens for biocontrol, and Cui has agreed to do this

part time. He will be cutting his teeth working with the virus that turned up on moth plant (*Araujia sericifera*) in Auckland. Cui is married with two children, and enjoys growing vegetables in his backyard, including Chinese vegetables that aren't otherwise readily available, which he puts to good use in cooking delicious traditional Chinese dishes.

Vaughan Myers

Vaughan has been working at Lincoln for over 40 years and has mainly specialised in looking at very small things via scanning and transmission electron microscopy. But he has also been involved recently in the possum biocontrol programme and stoat hormone monitoring, and stomping around broom patches studying pollination. We also roped Vaughan into helping with rearing biocontrol agents and he has become a dab hand at mass-rearing the new ragwort moths – so if you have an order in, expect to hear from him this spring! In his spare time Vaughan is a doting grandfather, who also enjoys cooking, listening to music, trout fishing, rugby, tinkering with hifi gear, and the odd tippie of good wine.

Helen Parish

Helen is based at Lincoln. She started working for Landcare Research on a casual basis three and a half years ago and showed herself capable of turning her hand to anything, including rearing insects, so we recently made the arrangement more

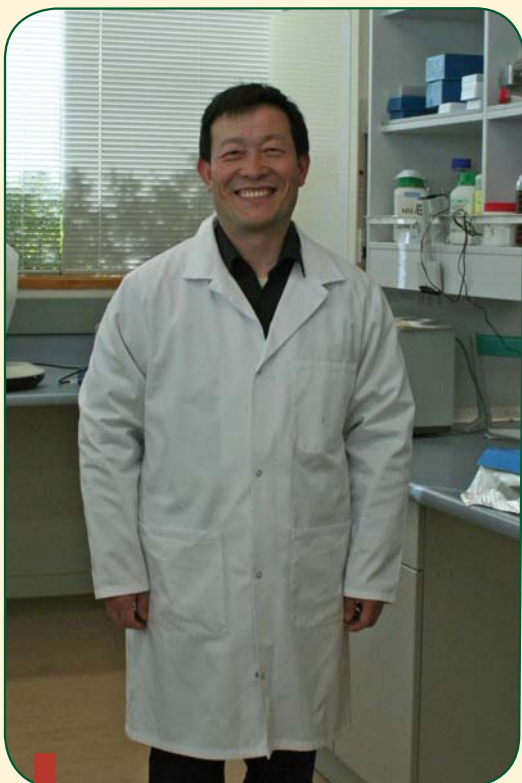


Helen Parish looking after her charges.

permanent. Helen is caring for our new agents while they are inside quarantine, and then helping to mass-rear them once they are allowed out. Looking after insects requires much dedication, as it can be a 7-day-a-week job, and needs much care and attention to small details. Previously Helen worked as a police officer so we can be extra sure our precious charges are in safe hands! Helen is married with two children and lives on 10 acres near Rolleston. Helen is keen on horses and dogs so she and Lynley always have lots to chat about at lunchtime.

Julia Wilson-Davey

Julia has been away on maternity leave and will be returning to work part-time in August. She will largely be working in the area of biosafety (what might happen if you genetically modify organisms and then release them into the environment), but will also be taking a larger role in the production of this newsletter.



Our new virologist Xianlan Cui.

Hello Moths, Goodbye Ragwort!

The ragwort flea beetle (*Longitarsus jacobaeae*) has brought about the demise of ragwort (*Senecio jacobaea*) throughout most of New Zealand, but there are still some areas where the weed has managed to persist. A group of people concerned about ragwort on the West Coast (farmers, and representatives from the dairy industry, Regional Council, and Department of Conservation) came together and with the help of the New Zealand Landcare Trust formed the West Coast Ragwort Control Trust in 2003. The group was successful in gaining funding to allow options for improving control of the weed to be explored.

Landcare Research was asked to find out why the beetles were not doing well on the Coast. "It seems likely that conditions there (high rainfall and disturbance) suit ragwort very well but not the beetles," concluded Hugh Gourlay. "The Trust also asked us to find some new biocontrol agents better suited to these conditions, and in 2005 we made an application to the Environment Risk Management Authority to release two new moths."

The ragwort plume moth (*Platyptilia isodactyla*) and ragwort crown-boring moth (*Cochylis atricapitana*) are European species that have been successful in

Australia. Across the Tasman the plume moth has reduced ragwort density by 60–80% at some release sites after only 1–2 years. Also a 40% reduction in the height (and seed production) of flowering plants and a significant reduction in both size and survival of rosettes has been recorded at one site 10 years after the crown-boring moths were released. Testing showed the moths are unlikely to pose problems to populations of any plants other than ragwort, and they appear to be well suited to New Zealand conditions.

The plume moth is found over a wide range of climates in its native range including wet climates in particular and is therefore expected to be well suited to areas like the West Coast of the South Island. Newly hatched caterpillars burrow into the leaf stalks until they reach the crown of the plant. Older caterpillars tunnel into the crown, stems and roots of ragwort. The caterpillars are the damaging stage and can severely harm the crown and roots of ragwort plants. Attack by as few as two or three larvae can kill a plant; if plants are not killed then they produce fewer flowers and seeds. In some years as many as three generations may be produced.

The crown-boring moth is also found

over a wide range of climates in its native range. Caterpillars that hatch in the spring mine into a leaf and then into the midvein and work towards the stem. Older caterpillars mine up the stem or occasionally climb up it to feed on the developing shoots and flowers. Mining causes growing stems to thicken, leaves to bunch, and flowering to be suppressed. Mining of older stems tends to kill them. Caterpillars produced in the autumn bore into the crown of rosettes, but not the roots, causing them to stop growing. In some years three or more generations may be produced.

"We will be making the moths available to other areas this coming spring"

Permission to release the moths was granted in late 2005 and Landcare Research immediately began a mass-rearing programme. "We made a number of releases on the West Coast last autumn, and we will be making the moths available to other areas this coming spring," confirmed Hugh.

This project is funded by the MAF Sustainable Farming Fund with smaller contributions from a number of organizations on the Coast.



Ragwort crown-boring moth



Ragwort plume moth

Thistles Beware

Usually with biocontrol projects it is critically important to find agents that only attack the weed we want to control. The Californian thistle (*Cirsium arvense*) project, however, is eyeing up two new agents that could never be accused of being picky eaters. So why this change in approach? Californian thistle belongs to the Cardueae tribe. This group also includes the majority of introduced thistles in New Zealand (e.g. Scotch (*Cirsium vulgare*), nodding (*Carduus nutans*), and variegated thistle (*Silybum marianum*)), and a number of others that have the potential to become serious weeds. "There are no native plants in this tribe so we are presented with a great opportunity to have a go at a whole lot of problematic species at once. It is the killing two birds with one stone approach!" explained Hugh Gourlay. However, there are two plants of potential economic importance, globe artichoke (*Cynara scolymus*) and safflower (*Carthamus tinctoria*), in this tribe, that need to be considered.

"It is the killing two birds with one stone approach!"

The first multi-tasker is a tiny black weevil that bores into thistle stems (*Apion onopordi*). This weevil is an exciting prospect because, in addition to the damage it causes by feeding on thistle stems and roots, it also vectors the Californian thistle rust (*Puccinia punctiformis*). This rust is present in New Zealand but is limited in its ability to disperse and infect Californian thistles. The rust benefits from improved dispersal by the weevil, which in turn does better on rust-infected thistle stems than uninfected ones. Host range tests showed the weevil is specific to plants within the Cardueae. It prefers Scotch thistle and Californian thistle (if rust-infected)



The green thistle beetle.

and is also quite partial to variegated and nodding thistles. "However, these tests showed that when there is no other food source available it is possible the weevil might attack globe artichoke and safflower," revealed Hugh. We asked our colleagues at CABI, Switzerland, to explore this further, but there are no reports of the weevil ever being a pest of either globe artichoke or safflower in Europe.

The second multi-tasker is a green leaf-feeding shield beetle (*Cassida rubiginosa*). Host-range tests showed that the green thistle beetle is also restricted to the Cardueae, but attacks a few more species than the weevil. The beetle prefers Californian thistle but is likely to have a go at most thistles. Again although, lab testing suggested the beetle can feed on both globe artichoke and safflower, there are no reports of it ever being a pest of either plant in Europe or the USA (where it was an accidental introduction).

So while testing has suggested it is possible that both agents may

occasionally nibble globe artichoke and safflower, the bulk of evidence would suggest this to be unlikely in real life. As an additional measure CABI researchers are looking into organic and non-organic insecticide sprays that could be used to deter the weevil and beetle from feeding on these plants, should this ever be necessary.

In September the Californian Thistle Action Group will apply to the Environmental Risk Management Authority to release both agents. Better biocontrol agents are desperately needed for Californian thistle, and the fact they could reduce the impacts of other thistles is likely to broaden the smile of many New Zealand farmers!

This project is funded by the Californian Thistle Action Group, thanks to a MAF Sustainable Farming Grant, and also by the Foundation for Research, Science and Technology through the joint AgResearch/Landcare Research "Outsmarting Weeds Programme".

Are They Behaving Themselves?

Our team of intrepid detectives has been back on the case checking that none of our biocontrol agents are attacking anything they shouldn't be! This work is very important because our host-testing should accurately predict how agents will behave in the field once released. If it does not then we need to find out why and, if necessary, make improvements to testing procedures. Most of the latest work over the past year has focused on pathogens, and insect agents not previously studied. We have also put more work into the insects for which non-target attack has already been found, and are now closer to understanding such things as why the gorse pod moth (*Cydia succedana*) has been found consorting with exotic legumes other than gorse (*Ulex europaeus*).

We suspect the reason for unexpected non-target attack by the pod moth is to do with moths being imported from two different populations (the UK and Portugal). Originally, extensive host-range testing was performed on UK moths only, so we imported a new population of moths from Portugal to re-examine their host preferences in more detail. "Unfortunately, they don't like the artificial conditions you get inside a containment facility and we haven't yet had many moths to play with," said Hugh Gourlay. "However, testing so far indicates the UK and Portuguese moths may have slightly different host preferences. For example, the Portuguese moths seemed to more readily attack lotus (*Lotus pedunculatus*) than did those from the UK population. "It seems that host-race definitely is a key issue here," explained Quentin Paynter. "The lesson from this is to never release a biocontrol agent from a population that you have not tested and, although this wasn't the case back in the 1990 when the moths were imported, this is nowadays standard best practice."

Further work on the old man's beard leaf miner (*Phytomyza vitalbae*) this year has involved repeating field surveys of previous years and confirming those earlier findings of occasional attack on *Clematis foetida* and *C. forsteri*. The adult females must feed on old man's beard (*C. vitalba*) to become sexually mature, and again we have been impressed by the exceptional dispersal ability of such tiny little beasts. We occasionally found very low levels of attack on native *C. foetida* plants in areas over 3 km away from infested old man's beard. However, the pattern of non-target attack, which declined significantly with increasing distance from old man's beard infestations, and the very low levels of non-target attack recorded are consistent with minor "spillover" type of attack, rather than permanent colonisation of *C. foetida* plants.

We have also been looking at what parasitoids attack the old man's beard leaf miner and the native leaf miner (*P. clematadi*), and whether there are any interactions going on between the two. "This work has been hampered by the fact that many parasitoid species are not yet described, and even simple things like

determining if two specimens represent a male and female of the same species or two separate species cannot yet be resolved," outlined Quent. However, it seems that regardless of what the species turn out to be, the native leaf miner suffers near double the amount of parasitism (~32%) as the biocontrol agent (~16%). The old man's beard leaf miner and the native leaf miner do appear to be sharing parasitoids (see table below). The fact that some of the native leaf miner parasitoids have been able to attack the old man's beard leaf miner may explain why it has a lower impact than we would have hoped.

We are also investigating the possibility that the presence of old man's beard leaf miners may lead to increased parasitism of native leaf miners living in close proximity to old man's beard infestations. Preliminary data indicate that percentage parasitism of the native leaf miner by the most commonly shared parasitoids (*Neochrysocharis* and *Opius* spp.) does decline with increasing distance from old man's beard infestations. "However, there is no correlation between the abundance of the native leaf miner on *C. foetida* and the distance from the nearest known old

Parasitoids identified from *Clematis* leaf miners so far

| | |
|-----------------------------|---|
| <i>Diglyphus isaea</i> | Introduced from Pakistan to control pest leaf miners. A few reared from both species. |
| <i>Pnigalio soemius</i> | Also an introduced species. A few reared from both species. |
| <i>Neochrysocharis</i> spp. | Possibly two undescribed species. By far the most common parasitoid attacking both species. |
| <i>Chrysocharis</i> sp. | Two individuals reared from native leaf miner only. |
| <i>Trigonogastrella</i> sp. | One or more, probably undescribed, species. A few reared from the native leafminer only. |
| <i>Opius</i> spp. | Possibly two undescribed species. Moderately common, attacking both species. |
| <i>Proacrias</i> sp. | Probably endemic. Just one reared from the old man's beard leaf miner. |

man's beard plants, so if there are indirect non-target impacts going on there is no detectable impact on the abundance of the native leaf miner," concluded Quent.

Work on the field host range of the ragwort flea beetle (*Longitarsus jacobaeae*) has also continued. This year we conducted an experiment in which we planted out ragwort (*Senecio jacobae*) and native *S. wairauensis* plants (the only native New Zealand *Senecio* to support development, albeit at low levels, in host-specificity tests) in an area populated by flea beetles. "As expected, all the ragwort plants were attacked but we also got some nibbling on the native species," explained Quent. To clarify these findings we have had a preliminary look at a wild *S. wairauensis* population for signs of attack by the flea beetle. We found none, but will need to check again at other times of the year. New insect agents that have been under surveillance this year include the broom psyllid (*Arytainilla spartiophila*), gorse colonial hard shoot moth (*Pempelia genistella*), and gorse soft shoot moth (*Agonopterix ulicetella*). As was predicted from their host-testing all three do not appear to be straying from their target weeds in the field.

On the pathogen side of things, starting with the straightforward cases, the news on the mist flower fungus (*Entyloma ageratinae*) is all good, with only mist flower (*Ageratina riparia*) being attacked. It also appears that all our self-introduced rust agents (hieracium rust (*Puccinia hieracii* var. *piloselloidarum*), Californian thistle rust (*Puccinia punctiformis*), and blackberry rust (*Phragmidium violaceum*)) are behaving as expected. "In fact, the hieracium rust is so specific to mouse-ear hawkweed (*Hieracium pilosella*) that it only attacks a particular biotype and does not even infect all plants of this species," said Nick Waipara.

In regard to old man's beard leaf fungus (*Phoma clematidina*), however, we are in a bit of a quandry. When old man's beard was first surveyed in New Zealand for potential biocontrol agents a leaf fungus was found that caused mild to moderate spotting, and was identified as *P. clematidina*. The potential of this fungus was recognised by a HortResearch scientist, Adrian Spiers, who introduced a more aggressive strain of it. During the surveys for non-target attack we found small lesions and rot on several native *Clematis* species. "While this was predicted from host-testing I suspect we are actually dealing with more than one fungal species," revealed Nick. "We have found specimens that are morphologically identical but which have different spores, and yet both have been identified as *P. clematidina*." It could be that the minor non-target attack we have seen on native *Clematis* is due to the original strain. Different pathogens can cause similar symptoms! In order to be able to sort out

once and for all what we are dealing with, we are developing a molecular technique that will allow us to tell strains of the fungus apart, but it is proving difficult to do. "At least we still have DNA from the original isolate that was released and so can compare specimens to it," disclosed Nick.

So far our intensive follow-up on biocontrol agents released in New Zealand has reinforced that if biocontrol agents are tested and released in accordance with accepted best practice it remains a low-risk form of weed control, and is much less damaging than not controlling the weeds at all!

See also *No Surprise that Aussie Rust Misbehaves*, Issue 32; *Making Sense of Field Findings*, Issue 33.

This project was funded by the Foundation for Science, Research and Technology as part of the "Beating Weeds" Project.



Hilary Kitchen working on a project that will enable us to tell different strains of the old man's beard fungus apart.

For the Good of the Country: The National Biocontrol Collective

The National Biocontrol of Weeds Collective continues to be an important source of funding for our work. Regional councils nationwide and the Department of Conservation contribute to the Collective. "Every year the Collective meets to discuss progress and set priorities for the coming year, and this approach is proving to be a highly effective model that benefits the country as a whole," explained Lynley Hayes. There is lots of discussion about the directions that various projects should take as well as of the merits of beginning biocontrol for new targets. The wish list is also inevitably bigger than the funding available so all projects are ranked using a voting system. The ranked list is subsequently scrutinised to ensure it has an appropriate North/South balance, no critical opportunities get missed, and previous investment is maximised. Lowest-ranked projects do not go ahead unless a higher-ranked project is unable to proceed for some reason, and are reconsidered as part of the mix the following year.

In the 2006/07 year the Collective will be funding:

- Completion of safety-testing of the foliage-feeding banana passionfruit moth (*Pyrausta norella*), and efforts to gain permission to import for testing another promising agent that has come to light, a stem borer (*Aepyptus sertis*).
- Safety-testing in South Africa of a second agent for boneseed (*Chrysanthemoides monilifera monilifera*), a rust fungus (*Endophyllum osteospermi*).
- Support for a MAF Sustainable Farming Fund project to import and release three new agents for broom: the leaf beetle (*Gonioctena olivaceae*), shoot moth (*Agonopterix assimilella*) and

gall mite (*Aceria genistae*).

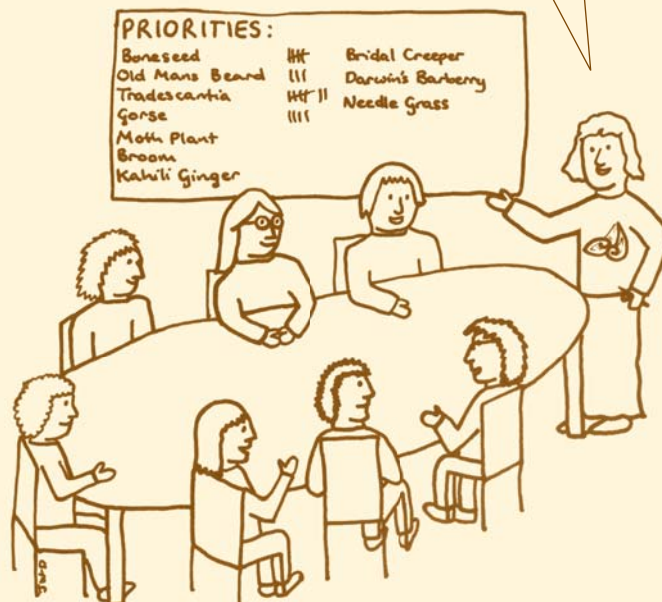
- Continuation of work to identify, study and test potential agents for tradescantia (*Tradescantia fluminensis*).
- Continuation of field trials in Europe to assess the host specificity of the old man's beard bark beetle (*Xylocleptes bispinus*) against New Zealand native *Clematis*.
- Continuation of testing the suitability of a flowerbud-feeding weevil (*Anthonomus santacruxi*) and a lace bug (*Gargaphia decoris*) for woolly nightshade (*Solanum mauritianum*).
- Completion of surveys to see what pathogens and invertebrates can be found on bridal creeper (*Asparagus asparagoides*) in New Zealand, and to look for potential agents for climbing asparagus (*A. scandens*) in South Africa.
- Continuation of surveys to look for potential agents for Darwin's barberry (*Berberis darwinii*) and moth plant (*Araujia sericifera*) in South America, and also to allow host-testing of potential moth plant agents already identified to begin.
- Contributions to new international surveys to look for pathogens that attack gorse (*Ulex europaeus*), and for natural enemies of kahili ginger (*Hedychium gardnerianum*) and yellow ginger (*H. flavescens*) in the Pakistan region of the Himalayan foothills (which is

believed to be part of the native range of the *Hedychium* complex).

- Completion of a survey to see what pathogens and invertebrates are currently utilising kahili ginger in New Zealand. Also attempts to source endemic strains of the rhizome-rotting bacterium *Ralstonia solanacearum* (that is being successfully used in Hawai'i) to see if any are pathogenic to kahili and/or yellow ginger.
- An objective to ensure that previously released agents can be adequately followed up in the field.
- Contributions to Australian programmes to develop biocontrol for Chilean needle grass (*Nassella neesiana*) and nassella tussock (*N. trichotoma*), and find additional agents for alligator weed (*Alternanthera philoxeroides*).

That should keep us out of mischief for another year. Thanks to the Collective for ensuring that all this essential work is undertaken for the good of New Zealand!

Hands up if you wish to vote for the moth plant project



United We Stand

The Landcare-Research-led "Beating Weeds" programme and the AgResearch-led "Outsmarting Weeds" programme joined forces to hold a two-day meeting in April. "AgResearch and Landcare Research staff work closely together on weeds and, as the underlying science behind these two programmes and issues facing them are similar, it made sense to run a joint workshop to review progress and think about future directions," explained Simon Fowler, who leads "Beating Weeds". "We hoped the workshop would pave the way for even more collaboration with other agencies, and give birth to a research environment in which competition for limited research funds is minimised and weed management outcomes are maximised," outlined Graeme Bourdôt, who leads "Outsmarting Weeds". The workshop was attended by those who study weeds for a living, as well as a wide range of people who actually have to manage them on the ground.

On the first day existing relationships between scientists and end-users were explored to tease out what has or has not contributed to the successful delivery of weed management outcomes. An interesting case study was *nassella tussock* (*Nassella trichotoma*) where the relationship between scientists, regional council staff and farmers got off to a rocky start. "Dave Saville (AgResearch) and I published a paper in 1992 suggesting that the annual grubbing regimes, that had been diligently carried out for decades, were never going to result in eradication of the plant," confided Graeme. "Some of the people who had been involved with the control programmes were outraged by this, as it went against many of their own beliefs." Some remained dubious even after Shona Lamoreaux (AgResearch) subsequently carried out extensive field trials and modelling to support these claims. However, after 10

years of AgResearch scientists working closely with regional council staff and landowners, many have gradually come around to the fact that the science is solid and practices do need to change.

A key finding of a number of case studies like this was that mutually beneficial relationships develop slowly over many years of open and honest collaboration, and the shared desire to beat an unwanted pest. These relationships can't be forced and need to be long term as weeds can't be beaten overnight. Another key finding was that the successful transfer of science knowledge does not occur at the organisational level, but rather between individuals who form these ongoing working relationships.

Looking to the future it was suggested that in an ideal world there would be systems and structures that better support collaboration (including amongst end-users), the knowledge of end-users would be put to better use, it would be easier to find out what scientists are doing, and there would be more co-ordination nationally including collective goals and priority setting. "The "Beating Weeds" and "Outsmarting Weeds"

programmes will explore ways to make these things happen, such as perhaps forming a "Weeds Research Council" that would involve all relevant Crown research institutes and universities", confirmed Simon.

Some of the areas identified as priorities for research include social science (how can we get the public more on side?), better ways of working out which plants may become weeds and which of those pose the most serious threats, improving our understanding of how weeds grow and prosper so we know how best to target them, and new and improved weed control tools. We also need better information about the impacts of weeds, including the cost to New Zealand.

Thanks to all those who participated at the workshop. It was really great to experience the genuine desire that people have to work together more effectively, so those pesky plants don't end up having the last laugh.

"Beating Weeds" and "Outsmarting Weeds" are funded by the Foundation for Research, Science and Technology.



Simon Fowler and Trevor James (AgResearch) swap notes over that useful relationship-building device – a good old cuppa.

What's Next for Boneseed?

We got permission from the Environmental Risk Management Authority to release the boneseed leaf roller (*Tortrix* s.l. sp. "*chrysanthemoides*") back in February 2005. Unfortunately we have not yet been able to import a colony because of problems at the South African end. So we are going to resort to Plan B and go there and collect some ourselves. Chris Winks has applied for a grant to travel to South Africa, and if he is successful we will finally be able to begin mass-rearing and hopefully make the first releases this summer.

Given that one biocontrol agent is unlikely to be able to control boneseed effectively on its own some thought has been given about the next agent to tackle for this target. All the "experts" agree that it should be the rust fungus (*Endophyllum osteospermi*), which is highly damaging to boneseed in its home range. This rust causes witches' brooms (branches that are stunted and distorted), reduces growth and seed production, and can even kill severely infected boneseed plants. There is a hitch though! There is usually a 1- to 2-year gap between infection and the development of visible disease symptoms. This means that traditional host-range testing, in which test plants are inoculated and then observed for symptom development, would be a logistical nightmare.

Fortunately, Australian and South African pathologists have come up with a way around this problem. They reasoned that there are a number of interactions that need to occur between the spores of the fungus and the outer cells of the host leaves, before infection and subsequent disease development can occur. They realised that if you observed these interactions with a microscope, you can narrow down the list of plants that require traditional host-range testing to

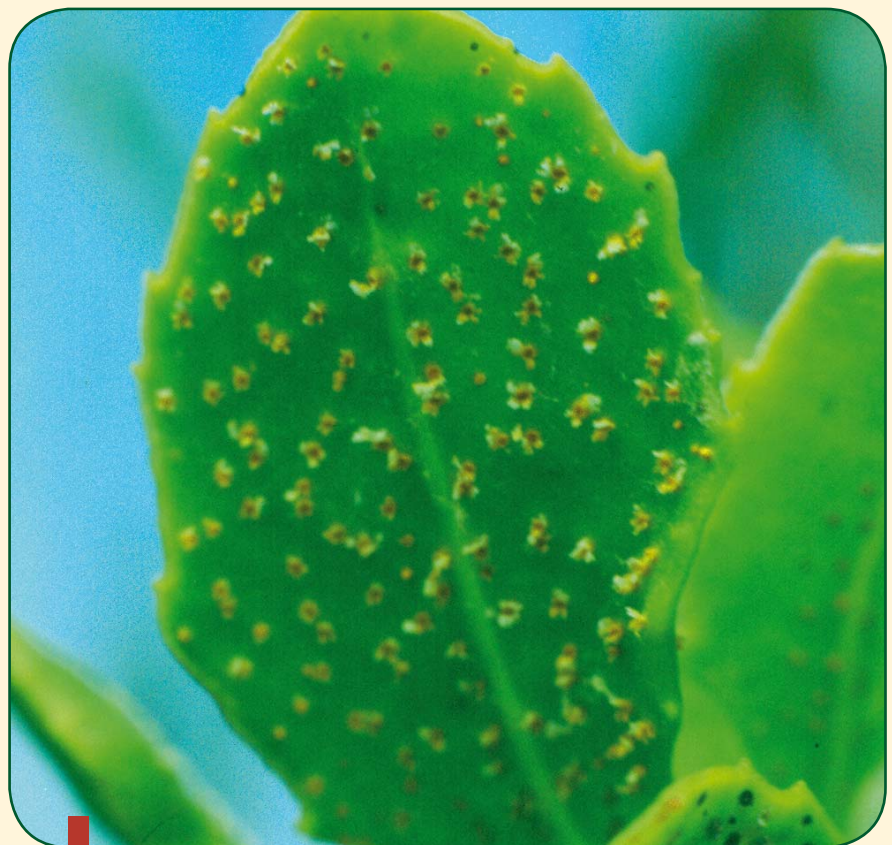
those on which the spores were able to (a) germinate and grow on the leaf surface, (b) penetrate the wall of the host cells, and (c) infect the cells without them self-destructing (a common host defence).

Alan Wood of the ARC-Plant Protection Research Institute in South Africa, has done some preliminary host-range testing for Australia by applying the rust to detached leaves in Petri dishes and then using the microscope observation method described above. "Of the 36 plant species we tested, the spores were only able to penetrate the host cells of eight of them," said Alan. Two of the species where penetration did occur were known hosts of the rust in the field (bitou bush and another close relative of boneseed), but the rest required further testing. Louise Morin of CSIRO, Australia, tackled this further by inoculating leaves that were still attached to plants (as host defence may be altered in detached

leaves), until she ran out of funds. Louise has recently applied for a grant to finish the work and, if the results are good, she hopes to apply for permission to import the rust into Australia.

Meanwhile, in New Zealand we have devised a list of plants we need to test. Since Australia has already broken the back of this ours is quite a short list (15 species). We plan to use the same microscopic methods as the Australians, and only do further traditional testing if this proves necessary. The work will be done in South Africa, hopefully under the watchful eye of Dr Wood, and it is hoped that testing will be able to begin in 2006/07. Chris Winks will chaperone our test plants during his planned spring visit to make sure they arrive safely.

This project is funded by the national collective of regional councils and the Department of Conservation.



Boneseed leaf covered with rust pustules.

Alan Wood

In Brief

Lantana rust clears first hurdle

Lantana (*Lantana camara*) is a problem in the top part of the North Island as far south as the Bay of Plenty. This showy but problematic plant is a weed in numerous countries and was the first ever to be targeted for biological control at the turn of the 20th century. Since then 42 insect species have been released in 42 countries with mainly disappointing results. However, in some cases they have provided partial control. One of the main reasons for this is the extensive horticultural "improvement" undertaken, which has resulted in a genetically diverse species complex that many of the highly specific insect agents are not able to cope with. The weed is also able to thrive in a wider climatic and geographical range than these insects.

Michael Day of the Alan Fletcher Research Station in Queensland, who has been working on the biocontrol of lantana for the past 10 years, advised that New Zealand conditions were unlikely to be suitable for many of the insect agents and that our only current hope for biocontrol might be the rust fungus (*Prospodium tuberculatum*). The rust was imported from Brazil and first released in Australia in October 2001. It mainly affects the leaves causing rapid senescence, but can sometimes infect stems and petioles

leading to significant dieback of branches. The rust can now be found at over 40 sites along the east coast of Australia, but it hasn't really taken off yet. "This is at least partially due to the prolonged dry spells we have been experiencing in recent years," suggested Michael.

The rust is not able to infect all forms of lantana so the first thing we needed to do was see if New Zealand material was susceptible, and the Northland Regional Council provided some funding to allow this to happen. According to the New Zealand Flora most wild plants in New Zealand belong to the variety *aculeata* and seem to correspond to the cultivar 'Common Pink'. Chris Winks collected cuttings from sites in Northland, Auckland and the Bay of Plenty and sent them over to Australia for testing. Natasha Riding at the Alan Fletcher Research Station found that New Zealand material was indeed susceptible including, surprisingly, the

less common reddish/orange flowering form collected from the Bay of Plenty. This means that the way is now clear to proceed with host-range testing provided sufficient funding can be found. Also while we don't think the rust has yet made it to New Zealand of its own accord, we need to double-check before proceeding too much further.



The yellowish-pink flowering form of lantana that is common in New Zealand.

MAF launches regional pest management website

The Ministry of Agriculture and Forestry (MAF) has a national biosecurity oversight role, requiring it to oversee all biosecurity-related activities. For this reason MAF has recently launched an interactive website on regional pest management. It shows which pest species, including weeds, are managed and how, in each region of New Zealand. Visitors to the site can search by species, region, or management programme, and can view results as maps, tables or graphs. The information has been extracted from individual regional pest management strategies and will be updated whenever councils alter them. To find out more see www.biosecurityperformance.maf.govt.nz.

Control agents released in 2005/06

| Species | Releases made |
|---|---------------|
| Gorse colonial hard shoot moth (<i>Pempelia genistella</i>) | 3 |
| Gorse thrips (<i>Sericothrips staphylinus</i>), Portuguese strain | 10 |
| Hieracium gall wasp (<i>Aulacidea subterminalis</i>) | 1 |
| Hieracium gall midge (<i>Macrolabis pilosellae</i>) | 19 |
| Hieracium crown hover fly (<i>Cheilosia psilophthalma</i>) | 1 |
| Hieracium root hover fly (<i>Cheilosia urbana</i>) | 1 |
| Ragwort crown-boring moth (<i>Cochylis atricapitana</i>) | 8 |
| Ragwort plume moth (<i>Platyptilia isodactyla</i>) | 7 |
| Scotch thistle gall fly (<i>Urophora stylata</i>) | 4 |
| Total | 54 |

Search for barberry agents gets off to a slow start

Over the past year surveys to identify potentially useful natural enemies of Darwin's barberry (*Berberis darwinii*) have begun in South America, led by Sergio Rothmann, of Servicio Agrícola y Ganadero (which is roughly equivalent to our Ministry of Agriculture and Forestry), in Chile. Unfortunately in the six regions of Chile surveyed first-up, the plant was not only quite hard to find but was also in general very healthy. No mites or diseases



Leaves deformed by *Trioza* sp.

Sergio Rothmann

were detected, and insects damaging the plant were not very common. An aphid (*Aphis berberidorum*) and a psyllid (*Trioza* sp.) were occasionally found damaging the leaves. "The aphid is known to be present in Chile and Argentina on *B. darwinii* and *B. empetrifolia*, but there have been no studies done on its biology," reported Sergio. At least seven *Trioza* species are known to be associated with *Berberis* in Chile, including *T. fissa*, *T. berberidis* and *T. lischines* on Darwins' barberry. "We also found a beetle (*Dicordylus balteatus*) but there was no evidence that it was actually causing any damage to the plant, explained Sergio. "No damage to fruit or flowers was observed, but unusual weather experienced in Chile in the past year affected flowering and may have reduced the chance of finding organisms that feed on these parts." In 2006/07 our Chilean colleagues will continue to search in other areas including the Strict Valdivian Forest, which is considered to be a biodiversity

hotspot and where the plant is believed to be more common. It is hoped surveys in this area will prove to be more fruitful, and perhaps yield the seed-feeding weevil that has previously been reported from *Berberis* spp.

This project was funded by the national collective of regional councils and the Department of Conservation.

Weeds educational resource goes bilingual

Thanks to Margaret Stanley and Karen Scott the weeds education pages on our website have recently gone bilingual, with the addition of a Māori version. This should prove to be an extremely useful resource, not only for those wishing to teach or learn more about weeds, but for those wishing to simply use or enhance their skills in Te Reo. See <http://www.landcareresearch.co.nz/education/weeds/index.asp>

Note on the taxonomy of *Alternanthera*

Further to the story in the previous issue "Alligator Weed Agents Dip Out" here is some further clarification on the current state of the taxonomy of *Alternanthera* in New Zealand from our botanist, Peter Heenan. Currently *Alternanthera* in New Zealand comprises two clearly naturalised species, alligator weed (*A. phylloxeroides*) and khaki weed (*A. pungens* – a failed introduction known from one old collection), while a third, *A. denticulata* is possibly indigenous and naturalised. A further species treated by Webb et al. (1988) as *A. sessilis* is present in New Zealand. As stated by Heenan & de Lange (2004), New Zealand plants of

A. sessilis comprise plants with "shorter and narrower, linear-oblong, dark green leaves that are usually entire or with rarely obscurely denticulate margins. In contrast, specimens of *A. sessilis* from Australia and the Pacific have elliptic to broadly elliptic and entire leaves". De Lange et al. (2005) also considered the widespread New Zealand form to differ from *A. sessilis* in the Pacific. The taxonomic status of the New Zealand plants remains unresolved, and research on this issue is currently underway.

For further information see:

de Lange, P.J.; Gardner, R.O.; Sykes, W.R.; Crowcroft, G.M.; Cameron, E.K.; Stalker, F.; Christian, M.L.; Braggins, J.E. 2005. Vascular flora of Norfolk Island: some additions and taxonomic notes. *New Zealand Journal of Botany* 43: 563–596.

Heenan, P.B.; de Lange, P.J. 2004. *Alternanthera denticulata* R.Br. (Amaranthaceae) a new addition to the indigenous or naturalised New Zealand flora. *New Zealand Journal of Botany* 42: 739–745.

Webb C.J.; Sykes W.R.; Garnock-Jones P. J. 1988. Flora of New Zealand. Volume IV. Christchurch, DSIR Botany Division.

Spring Activities

There are quite a few biocontrol activities that you might need to plan for this spring, such as:

Broom psyllids (*Arytainilla spartiophila*)

- Check release sites. You may see the pink to orangey-brown nymphs from mid- to late spring, especially feeding on new growth, or later brown-winged aphid-like adults. Plants covered in sticky droplets, blackened stems, greyish, mottled foliage, and dead or blackened leaf buds may all be present during an outbreak. We would love to hear from you if you come across such an outbreak.
- Move psyllids around. Collect nymphs by cutting infested material and carefully putting it into paper rubbish bags. Later wedge the cut material firmly into uninfested broom bushes. Although psyllids can establish from extremely low numbers, aim to release at least several hundred. It is best not to shift adults as they are quite fragile and may be too old to lay many eggs.

Broom seed beetles (*Bruchidius villosus*)

- Check release sites. Look for adults in the spring congregating on broom flowers or for eggs on the pods.
- Move beetles around. Either beat broom flowers with a stick over a sheet and suck the beetles up with a pooter, or put a large bag over flowers and give it a good shake. Shift at least several hundred. Alternatively, wait and harvest infested pods when they are mature and blackish-brown in colour and beginning to burst open.

Gorse soft shoot moth (*Agonopterix ulicetella*)

- Check release sites. Aim to visit sites in late November/early December when the caterpillars are about half-grown. Look for webbed or deformed growing tips with dark brown or



Shoot tips webbed by gorse soft shoot moth caterpillars.

greyish-green caterpillars (they change colour as they age). Leafroller caterpillars are quite common on gorse but are generally brighter green and smaller. We would be interested to know if you find an outbreak or this agent anywhere that you didn't expect.

- Shift moths around. Harvest branches or even whole bushes. Shift at least several hundred webs to each new site and wedge them firmly into new bushes.

Gorse colonial hard shoot moth (*Pempelia genistella*)

- Check release sites. Look in late spring when the green-and-brown striped caterpillars and their webs are at their largest and before plants start to put on new growth. Look for die-off that is similar to damage caused by the gorse stem miner (*Anisoplaa pytoptera*) or lemon tree borer (*Oemona hirta*). We would be very interested to know if you find them anywhere as we are so far only aware of establishment in Canterbury.
- Shift moths around. If the moths are present in good numbers harvest

branches with webs in late spring when large caterpillars or pupae are present. Shift at least 50 webs to each new site and wedge them firmly in new bushes.

Mist flower fungus (*Entyloma ageratina*)

- Check release sites. Look for plants with leaves that have died and fall from the plant prematurely. Plants may be heavily defoliated over wide areas. Infected leaves initially have lesions on the upper surfaces of leaves, and white spores form on the undersides. As the disease progresses, the lesions coalesce and become dark brown. The fungus is already widespread so no further effort should be required to spread it around.

Nodding thistle crown weevil (*Trichosirocalus* spp.)

- Collect some weevils for our study to check their identity, as per the item in the previous issue. We only need 8–10 specimens. Please contact Lynley Hayes (hayesl@landcareresearch.co.nz, Ph 03 321 9694) for a collecting kit.

Who's Who in Biological Control of Weeds?

| | |
|--|--|
| Alligator weed beetle (<i>Agasicles hygrophila</i>) | Foliage feeder, common, often provides excellent control on static water bodies. |
| Alligator weed beetle (<i>Disonycha argentinensis</i>) | Foliage feeder, released widely in the early 1980s, failed to establish. |
| Alligator weed moth (<i>Arcola malloi</i>) | Foliage feeder, common in some areas, can provide excellent control on static water bodies. |
| Blackberry rust (<i>Phragmidium violaceum</i>) | Leaf rust fungus, self-introduced, common in areas where susceptible plants occur, can be damaging but many plants are resistant. |
| Boneseed leaf roller (<i>Tortrix</i> s.l. sp. "chrysanthemoides") | Foliage feeder, permission to release has been granted by ERMA, first releases may be made this coming summer. |
| Bridal creeper rust (<i>Puccinia myrsiphylli</i>) | Rust fungus, self-introduced, first noticed in 2005, distribution still patchy, appears to be causing severe damage at some sites. |
| Broom gall mite (<i>Aceria genistae</i>) | Gall former, not considered a new organism to NZ, was imported recently and releases may begin next year. |
| Broom leaf beetle (<i>Gonioctena olivacea</i>) | Foliage feeder, application to release currently with ERMA. |
| Broom psyllid (<i>Arytainilla spartiophila</i>) | Sap sucker, becoming more common, slow to disperse, two damaging outbreaks seen so far, impact unknown. |
| Broom seed beetle (<i>Bruchidius villosus</i>) | Seed feeder, becoming more common, spreading well, showing potential to destroy many seeds. |
| Broom shoot moth (<i>Agonopterix assimilella</i>) | Foliage feeder, application to release currently with ERMA. |
| Broom twig miner (<i>Leucoptera spartifoliella</i>) | Stem miner, self-introduced, common, often causes obvious damage. |
| Californian thistle flea beetle (<i>Altica carduorum</i>) | Foliage feeder, released widely during the early 1990s, not thought to have established. |
| Californian thistle gall fly (<i>Urophora cardui</i>) | Gall former, rare, galls tend to be eaten by sheep, impact unknown. |
| Californian thistle leaf beetle (<i>Lema cyanella</i>) | Foliage feeder, rare, no obvious impact, no further releases planned. |
| Californian thistle rust (<i>Puccinia punctiformis</i>) | Systemic rust fungus, self-introduced, common, damage not usually widespread. |
| Californian thistle stem miner (<i>Apion onopordi</i>) | Stem miner, will attack a range of thistles, application to release currently being prepared. |
| Green thistle beetle (<i>Cassida rubiginosa</i>) | Foliage feeder, will attack a range of thistles, application to release currently being prepared. |
| Echium leaf miner (<i>Dialectica scariella</i>) | Leaf miner, self-introduced, becoming common on several <i>Echium</i> species, impact unknown. |
| Gorse colonial hard shoot moth (<i>Pempelia genistella</i>) | Foliage feeder, limited releases to date, established at three sites, impact unknown but obvious damage seen at one site, further releases planned. |
| Gorse hard shoot moth (<i>Scythris grandipennis</i>) | Foliage feeder, failed to establish from small number released at one site, no further releases planned due to rearing difficulties. |
| Gorse pod moth (<i>Cydia suceedana</i>) | Seed feeder, becoming more common, spreading well, showing potential to destroy seeds in spring and autumn. |
| Gorse seed weevil (<i>Exapion ulicis</i>) | Seed feeder, common, destroys many seeds in spring. |
| Gorse soft shoot moth (<i>Agonopterix ulicetella</i>) | Foliage feeder, becoming common in Marlborough and Canterbury with some impressive outbreaks, impact unknown. |
| Gorse spider mite (<i>Tetranychus lintearius</i>) | Sap sucker, common, often causes obvious damage, but persistent damage limited by predation. |
| Gorse stem miner (<i>Anisoplaca pyoptera</i>) | Stem miner, native insect, common in the South Island, often causes obvious damage, lemon tree borer has similar impact in the North Island. |
| Gorse thrips (<i>Sericothrips staphylinus</i>) | Sap sucker, limited in distribution as the UK strain is slow to disperse but the more recently released Portuguese strain may move faster, impact unknown. |
| Hemlock moth (<i>Agonopterix alstromeriana</i>) | Foliage feeder, self-introduced, common, often causes severe damage. |

| | |
|---|---|
| <p>Hieracium crown hover fly (<i>Cheilisia psilophthalma</i>)</p> <p>Hieracium gall midge (<i>Macrolabis pilosellae</i>)</p> <p>Hieracium gall wasp (<i>Aulacidea subterminalis</i>)</p> <p>Hieracium plume moth (<i>Oxyptilus pilosellae</i>)</p> <p>Hieracium root hover fly (<i>Cheilisia urbana</i>)</p> <p>Hieracium rust (<i>Puccinia hieracii</i> var. <i>piloselloidarum</i>)</p> | <p>Crown feeder, only one small release made so far and success unknown, rearing difficulties need to be overcome to allow widespread releases to begin.</p> <p>Gall former, widely released and has established but is not yet common at sites in both islands, impact unknown but very damaging under laboratory conditions.</p> <p>Gall former, widely released and has established but is not yet common in the South Island, impact unknown.</p> <p>Foliage feeder, only released at one site so far, impact unknown, further releases will be made if rearing difficulties can be overcome.</p> <p>Root feeder, limited releases made so far and success unknown, rearing difficulties need to be overcome to allow widespread releases to begin.</p> <p>Leaf rust fungus, self-introduced?, common, may damage mouse-ear hawkweed but plants vary in susceptibility.</p> |
| <p>Heather beetle (<i>Lochmaea suturalis</i>)</p> | <p>Foliage feeder, released widely in Tongariro National Park, established at three sites there and three sites near Rotorua, severe localised damage seen already, especially at Rotorua.</p> |
| <p>Lantana plume moth (<i>Lantanophaga pusillidactyla</i>)</p> | <p>Foliage feeder, self-introduced, distribution and impact unknown.</p> |
| <p>Mexican devil weed gall fly (<i>Procecidochares utilis</i>)</p> | <p>Gall former, common, initially high impact but now reduced considerably by Australian parasitic wasp.</p> |
| <p>Mist flower fungus (<i>Entyloma ageratinae</i>)</p> | <p>Leaf smut, common and often causes severe damage.</p> |
| <p>Mist flower gall fly (<i>Procecidochares alani</i>)</p> | <p>Gall former, now well established and common at many sites, impact not yet known.</p> |
| <p>Nodding thistle crown weevil (<i>Trichosirocalus</i> spp.)</p> <p>Nodding thistle gall fly (<i>Urophora solstitialis</i>)</p> <p>Nodding thistle receptacle weevil (<i>Rhinocyllus conicus</i>)</p> | <p>Root and crown feeder, becoming common on several thistles, often provides excellent control in conjunction with other nodding thistle agents.</p> <p>Seed feeder, becoming common, often provides excellent control in conjunction with other nodding thistle agents.</p> <p>Seed feeder, common on several thistles, often provides excellent control of nodding thistle in conjunction with the other nodding thistle agents.</p> |
| <p>Old man's beard leaf fungus (<i>Phoma clematidina</i>)</p> <p>Old man's beard leaf miner (<i>Phytomyza vitalbae</i>)</p> <p>Old man's beard sawfly (<i>Monophadnus spinolae</i>)</p> | <p>Leaf fungus, common, sometimes causes obvious damage especially in autumn, but can exist as a symptomless endophyte.</p> <p>Leaf miner, common, laboratory studies suggest it is capable of stunting small plants, one severely damaging outbreak seen so far.</p> <p>Foliage feeder, limited widespread releases have been made, establishment success and impact unknown.</p> |
| <p>Phoma leaf blight (<i>Phoma exigua</i> var. <i>exigua</i>)</p> | <p>Leaf spot fungus, self-introduced, becoming common, can cause minor-severe damage to a range of thistles.</p> |
| <p>Scotch thistle gall fly (<i>Urophora stylata</i>)</p> | <p>Seed feeder, limited releases to date, appears to be establishing readily, impact unknown.</p> |
| <p>Cinnabar moth (<i>Tyria jacobaeae</i>)</p> <p>Ragwort crown-boring moth (<i>Cochylis atricapitana</i>)</p> <p>Ragwort flea beetle (<i>Longitarsus jacobaeae</i>)</p> <p>Ragwort plume moth (<i>Platyptilia isodactyla</i>)</p> <p>Ragwort seed fly (<i>Botanophila jacobaeae</i>)</p> | <p>Foliage feeder, common in some areas, often causes obvious damage.</p> <p>Stem miner and crown borer, releases began last autumn and establishment success unknown.</p> <p>Root and crown feeder, common in most areas, often provides excellent control in many areas.</p> <p>Stem, crown and root borer, releases began last autumn and establishment success unknown.</p> <p>Seed feeder, established in the central North Island, no significant impact.</p> |
| <p>Greater St John's wort beetle (<i>Chrysolina quadrigemina</i>)</p> <p>Lesser St John's wort beetle (<i>Chrysolina hyperici</i>)</p> <p>St John's wort gall midge (<i>Zeuxidiplosis giardi</i>)</p> | <p>Foliage feeder, common in some areas, not believed to be as significant as the lesser St John's wort beetle.</p> <p>Foliage feeder, common, often provides excellent control.</p> <p>Gall former, established in the northern South Island, often causes severe stunting.</p> |

Naturally occurring fungal agents under development as mycoherbicides are not included in this table.

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If you need assistance in locating any of the above references please contact Lynley Hayes. *What's New in Biological Control of Weeds?* issues 1–36 are available from Lynley Hayes and issues 11–32 are available from the Landcare Research website (details below).

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