What's New In Biological Control Of Weeds?

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Manaaki Whenua

What's Inside:

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Headlines

- Welcome to the sixth 16-page edition of *What's New in Biological Control of Weeds?*, which we produce annually, in addition to three smaller quarterly issues, to help you stay informed about biocontrol of weeds in New Zealand.
- A group based in Taumarunui has formed to tackle tutsan (*Hypericum androsaemum*), and another at Te Anau will give biocontrol a boost in that area.
- We have begun surveys to investigate the role that parasitoids play in causing biocontrol projects to go awry. So far parasitoids do not appear to be a major cause of biocontrol failure, and information we have gained should help us to get better at selecting the least vulnerable agents.
- We are beginning to narrow down the list of potential biocontrol agents for moth plant (*Araujia sericifera/hortorum*), and have ruled out viruses.
- We have investigated one rust fungus for biocontrol of lantana (*Lantana camara*), and are now studying a second.
- We have investigated the feasibililty of biocontrol for field horsetail (*Equisetum arvense*) and this ancient species would appear to be a good target.
- A third potential new agent for alligator weed (*Alternanthera philoxeroides*) has failed to make the grade, but we still have other possibilities up our sleeve.
- We suggest some activities you might need to be planning for this spring.
- We provide a summary of the status of all our weed biocontrol agents, plus some suggestions for further reading.

"I'd like something for mothplant please"

In Brief

Newsletter mailing list update

Thanks to all our New Zealand subscribers who sent back the form that went out with the last issue, advising me of their updated postal details or their desire to move from hard copy to electronic copy etc. If you have requested a change that has not been made please contact Lynley Hayes (hayesl@landcareresearch.co.nz or Ph 03 321 9694) as there were a couple of forms that came back with insufficient information to be able to identify whose details needed to be changed (especially in organisations where the mail is opened centrally). If any of our overseas readers would be happy to receive the newsletter electronically, or a notification when new issues are posted on the Web, please contact Lynley.

Weeders Digest

Weeders Digest is a electronic newsletter that started life as a means of improving internal communication so Landcare Research staff working on weeds and their collaborators could keep in touch with each other. However, along the way *Weeders Digest* has been passed around more widely to others who have found it useful and who have asked to be included on the distribution list. Issues are currently produced every 2 months. If you think it would be helpful to know more of the details of our working lives and you would like to receive *Weeders Digest* then please email Helen Harman (harmanh@landcareresearch.co.nz).

Training course

Every year in late spring or early summer we run a 2-day workshop at Lincoln for those who would like to learn more about biocontrol of weeds and become more proficient in managing their own biocontrol programmes. Numbers are limited and preference is given to those who currently fund or support our work in some way. We run this biocontrol workshop back to back with another offered by the herbarium on plant identification, so people can potentially do both. People wishing to register their interest for one or more workshops should complete the flier with this newsletter or contact Lynley Hayes (hayesl@landcareresearch.co.nz).

New group forms to promote biocontrol in Te Anau

In April a group of people interested in biological control of weeds met to form the Te Anau Biocontrol Group. The group aims to promote and facilitate the use of biocontrol insects to reduce the impact of invasive weeds on farmland and conservation land in the Te Anau area. The group will work in conjunction with Environment Southland's Biological Control of Weeds Programme and in time intends to raise funds to carry out its own releases of new biocontrol insects as they become available. While the group has a Te Anau focus anyone interested in biocontrol is welcome to join. For more information contact the secretary, Jesse Bythell (Ph 027 356 7752 or email: jesse@biosis.co.nz).

Control Agents Released in 2007/08

Species	Releases made
Boneseed leaf roller (*Tortrix* s.l. sp. "*chrysanthemoides*")	40
Broom leaf beetle (*Gonioctena olivacea*)	12
Broom gall mite (*Aceria genistae*)	2
Broom shoot moth (*Agonopterix assimilella*)	1
Californian thistle gall fly (*Urophora cardui*)	1
Green thistle beetle (*Cassida rubiginosa*)	7
Gorse soft shoot moth (*Agonopterix ulicetella*)	5
Hieracium gall midge (*Macrolabis pilosellae*)	1
Hieracium gall wasp (*Aulacidea subterminalis*)	1
Ragwort crown-boring moth (*Cochylis atricapitana*)	2
Ragwort plume moth (*Platyptilia isodactyla*)	17
Total	**84**

Some members of the Te Anau Biocontrol Group (left to right): Ted Loose (chairman), Jesse Bythell (secretary), Randall Milne, Lynne Huggins, Alistair Hay and Sue Lake.

Tussling with Tutsan

Tutsan (*Hypericum androsaemum*) was described as a serious pasture weed in New Zealand back in 1955 and has become a significant invasive plant in the Taumarunui area. In recent times tutsan appears to have begun to spread even more rapidly into valuable pastureland, production forestry, and conservation areas, and has formed monocultures in some areas. The plant is estimated to have a greater than 60% cover over 1500 ha in Taumarunui alone, and threatens a much greater area than that. Tutsan is also found, and is of concern, in seven other regions throughout New Zealand. Like its close relative St John's wort (*Hypericum peforatum*), tutsan is also harmful to livestock because it contains hypericin, which induces photosensitisation and dermatitis in sheep and cattle.

Conventional methods for tackling tutsan are inadequate, uneconomic and unsustainable. Spraying is difficult because there are no chemicals registered for tutsan control in New Zealand, and the results of off-label herbicides are not always satisfactory. The plant also often grows in places where spraying and mechanical control are difficult or impossible owing to the topography.

Biological control of tutsan was explored in a cursory manner in New Zealand about 60 years ago. While its primary host is St John's wort, the lesser St John's wort beetle (*Chrysolina hyperici*) was also released on tutsan in some areas in 1948 and 1950, and there are anecdotal reports that they achieved good results on several farms in the Taumarunui area. However, the beetle did not persist and is believed to no longer be found on tutsan infestations, possibly because the plant is a suboptimal host on which the beetle can only survive for a short time.

A rust (*Melampsora hypericorum*) was found to be attacking tutsan in the Wellington Region about the same time, and spread rapidly throughout New Zealand from Raglan to Stewart Island. Rust symptoms appear in late spring or early summer causing characteristic yellow to red blotches on the upper surface of the leaves with corresponding golden rust pustules underneath. The leaves may turn brown and shrivel up, and if the infection is severe the whole plant may be defoliated and even killed. Unfortunately severe infections do not seem to commonly occur in New Zealand and therefore the rust is not able to provide adequate control.

Recently a group of concerned people – including farmers, regional council and Department of Conservation staff – in the Taumarunui area formed to tackle the tutsan problem head on. They have called themselves the Tutsan Action Group and have successfully applied for funds from the MAF Sustainable Farming Fund and Meat and Wool New Zealand. This year Landcare Research, on their behalf, will look at the feasibility of developing an effective biological control programme against tutsan in New Zealand. The Tutsan Action Group will also obtain information about the economic impacts of tutsan and better document its current distribution. Lesser St John's wort beetles will be sourced and released this spring so the group can study what happens when they are released on tutsan. If the feasibility study suggests that promising biocontrol agents might be available then the group hopes in future to apply for funding to pursue them further.

If you wish to contact the Tutsan Action Group, Graham Wheeler is the chairman (g.k.wheeler@xtra.co.nz) and Rosalind Burton is the secretary/treasurer (gtb@xtra.co.nz).

Dave Alker

Tutsan infestation, Taumaranui.

Parasitism – a Major or Minor Cause of Biocontrol Failure?

No one wants to go to all the trouble of finding, testing, importing, rearing and releasing a stunning looking biocontrol agent only to find that it crashes and burns due to interference by parasitoids. It is not just the waste of resources and disappointment and disillusionment that need to be avoided – there could be other, less obvious fallout. If by acting as an additional host a biocontrol agent allows a parasitoid to become more abundant this could mean it is better placed to more heavily exploit its other hosts, which might be native or beneficial insects. Clearly it would be much better all round if we could identify potential agents that might be at risk of getting knobbled or sharing nasties early on, and quickly discard them.

With that aim in mind we have recently begun a major nationwide survey and literature review to look seriously into the role of parasitism in weed biocontrol in New Zealand. We are interested to see whether or not parasitism is taking a toll, and if we can draw any conclusions that might assist with future agent selection. To date we have collected more than 10,000 individuals of 24 different invertebrate species, and where possible all life stages, from more than 50 locations, to find out what unwanted guests they have associating with them. We will be running the survey for another year, but we already have some interesting results to share with you.

So far we have uncovered evidence that just over a third of invertebrate weed biocontrol agents are being parasitised to some degree (see table). But how significant is this? We know that biocontrol of insect pests is rarely successful if the control agents take out less than 40% of their hosts and is usually successful if they can hit more than 60% of them. So we can infer from this that we don't need to worry too much if parasitism levels of weed biocontrol agent are below 40%. The agents being hardest hit here are the cinnabar moth (*Tyria jacobaeae*), old man's beard leaf miner (*Phytomyza vitalbae)*, mist flower gall fly (*Procecidochares alani*), and Mexican devil weed gall fly (*Procecidochares utilis*). Parasitism levels of more than 60% have been measured for these agents so it is likely that they are being adversely affected. Fortunately this is not as serious as it might sound, as ragwort (*Senecio jacobaea*) and mist flower (*Ageratina riparia*) are under good control in most places due to other biocontrol agents. There is also anecdotal evidence that Mexican devil weed gall fly and a fungus, *Phaeoramularia eupatorii-odorati,* significantly suppress Mexican devil weed (*Ageratina adenophora*).

We have found that the duration of exposure has no bearing on whether or not biocontrol agents get hit by parasitoids. Some very recent introductions, like the boneseed leafroller, have been nailed straight away while some agents released in the 1930s and 40s, like the St John's wort beetles (*Chrysolina* spp.), are still not being exploited by parasitoids.

Given that only about 10% of insects in New Zealand have been described so far, there is still a lot that we don't know

Invertebrate weed biocontrol agents known to be parasitised in New Zealand

Agent	Parasitoid	Comments
Boneseed leafroller (*Tortrix* s.l. sp. *"chrysanthemoides"*)	1 exotic species: *Trigonospila brevifacies*	Introduced from Australia in 1967–73 to control orchard pests.
Broom seed beetle (*Bruchidius villosus*) & gorse seed weevil (*Exapion ulicis*)	1 exotic species: *Pteromalus sequester*	First reported in NZ in 1967, and attacks these species in Europe.
Old man's beard leaf miner (*Phytomyza vitalbae*)	8 native species: mainly *Neochrysocharis* & *Proacrias* spp., also *Opius* spp.. 2 exotic species: *Diglyphus isaea* & *Pnigalio soemius*	7 of the native species also reared from native *Clematis* leaf miner (*P. clematadi*). *D. isaea* was introduced from Pakistan in 1969–71 to control leaf miner pests. *P. soemius* was accidentally introduced c.1950 with its host, the oak leaf miner.
Mist flower gall fly (*Procecidochares alani*) & Mexican devil weed gall fly (*Procecidochares utilis*)	1 exotic species: *Megastigmus* sp.	Unknown (possibly Australian) origin. First recorded here in 1968.
Nodding thistle receptacle weevil (*Rhinocyllus conicus*)	Reported to be parasitised by 1 exotic species: *Microctonus aethiopoides*	Deliberately introduced from Europe to control pasture pest (*Sitona discoideus*).
Cinnabar moth (*Tyria jacobaeae*)	2 native species: *Phorocera casta, Echthromorpha intricatoria*	Also attack native magpie moth (*Nyctemera annulata*).
St John's wort gall midge (*Zeuxidiplosis giardii*)	1 native species: *Torymoides* sp.	Likely to be native but native hosts unknown.

Magpie moth and cinnabar moth side by side on ragwort.

about the parasitoid species present here. The number of parasitoids present in New Zealand is growing all the time as new species are deliberately introduced or get here under their own steam. All of these factors affect our ability to make useful predictions, and could also cause scenarios to change over time. However, at least for deliberate introductions it is likely that with the more rigorous host-range testing that is used today, and the stringent process that controls the introduction of new organisms, the risk of parasitoids being deliberately released without considering the impacts on beneficial insects like weed biocontrol agents is likely to be much reduced.

Often we can gather enough information to make useful predictions when we survey target plants for natural enemies at the outset of projects. "For example we found that generalist leafrollers living on boneseed (*Chrysanthemoides monilifera monilifera*) here are attacked by generalist parasites, so we were able to say in advance that the boneseed leafroller (*Tortrix* s.l. sp. *chrysanthemoides*) was also likely to get hit," said Quentin Paynter, who is masterminding the survey. However, we decided to proceed anyway as we knew that the boneseed leafroller still outbreaks in its homeland of South Africa despite heavy parasitism by nine species there.

Sometimes we can make an educated guess because of what we know about other similar biocontrol agents. For example we knew that because the Mexican devil weed gall fly is parasitised here that it was almost certain that the very similar mist flower gall fly would be utilised by the same wasp species (*Megastigmus* sp.). However, again we went ahead with the introduction of the gall fly anyway because the Mexican devil weed gall fly is still common and damaging in New Zealand, despite parasitism by *Megastigmus*, and reports from Hawai'i indicated that the mist flower gall fly was still able to be useful against mist flower despite being heavily attacked by several parasitoid species there.

Possibly our most important finding so far with respect to predicting parasitism is the role of native counterparts. "Only three agent species are attacked by native parasitoids and all of them were released against target weeds which have closely related native plant species, which in turn have native natural enemies which attack the plant in a similar way," explained Quent. For example cinnabar moth on ragwort is analogous to the native magpie moth (*Nyctemera annulata*) on native *Senecio* species (and ragwort). Likewise old man's beard leaf miner on old man's beard (*Clematis vitalba*) is analogous to a native leaf miner (*Phytomyza clematadi*) on native *Clematis* species (and occasionally old man's beard). However, ragwort flea beetle (*Longitarsus jacobaeae*) gets a clean bill of health and has no equivalent species on native *Senecio* species.

It stands to reason then that for target plants that have native congeners, the risk of parasitism and indirect non-target effects may be significantly reduced if we select agents that have no native counterparts. For example we would expect that the chances of the old man's beard sawfly (*Monophadnus spinolae*) being adversely affected by parasites to be low since there are no native sawflies here. Unfortunately we can't check this prediction as the old man's beard sawfly appears to have failed to establish in New Zealand, but we don't think parasitism is likely to be the reason!

So to conclude, current evidence indicates that while parasitism of weed biocontrol agents is reasonably common it has probably only contributed to the failure of one programme out of 14 to date. However, we should not write off the old man's beard project just yet as it is not considered complete. An additional agent, the old man's beard beetle (*Xylocleptes bispinus*), is currently being tested in the UK, and further efforts to establish the sawfly may also be made. It is also heartening to know that lessons we are learning from this retrospective survey should be able to help us make even better choices when selecting agents in the future.

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

The Noose Tightens for Moth Plant

We seem to be spoiled for choice when it comes to potential biocontrol agents for moth plant (*Araujia sericifera/hortorum*). The official Latin name for moth plant is currently in limbo. Carlos Villamil, a botanist who works for the Universidad Nacional del Sur in Bahía Blanca, Argentina, has been trying to sort out the taxonomy of the *Araujia* genus (see *Don't Cry for Moth Plant in Argentina*, Issue 36). Carlos has studied *Araujia* plants throughout their native range in South America and has also looked at *Araujia* herbarium specimens from various places. He believes that *Araujia sericifera* and *A. hortorum* should be considered two different entities. "All the material from New Zealand and Australia corresponds to the second one," he says. While the two taxa are definitely different, Carlos believes they are not two different species but rather two different subspecies within a single species. However, he wants to do some more fieldwork before writing a paper to officially change the taxonomy of the genus, so we will have to continue to sit on the fence when referring to moth plant until that is done.

One of the most exciting prospective biocontrol agents is a rust (*Puccinia araujiae*) that can be extremely damaging and is easy to spread. Rolf Delhey and Mirta Keihr, who are attached to the same university as Carlos, have confirmed that the rust is autoecious, i.e. it does not complete part of its lifecycle on another host. They have also shown that the rust is pathogenic to moth plant, by applying its teliospores to seedlings grown in their laboratory and getting good infection.

"One of the most exciting prospective biocontrol agents is a rust"

Spore pustules of the rust *Puccinia araujiae* on leaves of a moth plant seedling inoculated in the laboratory.

The next step with the development of the rust is to undertake host-range testing. Moth plant from New Zealand, and a range of closely related plants including swan plant (*Gomphocarpus fruticosus*), will need to be tested. Host-testing of exotic pathogens cannot be undertaken in New Zealand at present because we do not have suitable facilities, and must be done offshore. Unfortunately not all the plants that need to be tested are available in Argentina, so we will have to get permission for plants to be imported from New Zealand. "Gaining permission to import plants into Argentina for the Chilean needle grass (*Nassella neesiana*) project has been a major headache, but we believe this issue might soon be resolved," confirmed Jane Barton.

The second-most promising fungal agent is a *Pseudocercospora* species that causes an angular leaf spot. "The leaf spot fungus is more widespread than the rust in the field and seems to have an important impact on the plant," reported Rolf. This fungus will also be tested in due course.

Clustered flowers typical of *Araujia sericifera* (left) and single flowers of *A. hortorum* (right).

Meanwhile, still on the pathogen trail we have looked at some of the pathogens that infect moth plant in New Zealand to see if they have any potential (see *Virus Verification* page 7). Nick Waipara (now with the Auckland Regional Council) looked at the bioherbicide potential of one of the fungi (*Colletotrichum gloeosporioides*) he collected during a New Zealand survey at the outset of the programme. "This fungus has been used successfully as a bioherbicide overseas, so we thought it was worth a quick look to see whether it could be used to damage moth plant," explained Nick. However, the answer appears to be "no" as none of the plants that Nick sprayed with *C. gloeosporioides* spores developed any serious disease symptoms.

Carlos Villamil hard at work.

The chances of finding suitable insect agents would appear to be high, with quite a few candidates to choose from including some quite attractive beasts like a species of monarch butterfly. Diego Carpintero of the Natural Museum in La Plata, Buenos Aires, who undertook the insect surveys for us, has suggested that 13 species appear to have all the right hallmarks for good insect biocontrol agents, and a further 11 species are also worthy of further study. We just need to make up our minds as to which ones to work on first and this year we hope to gain permission to import at least one species into containment at Lincoln for further study. This way we will not be affected by any hold-ups arising from getting plants into Argentina. However, procedures for getting species out of Argentina have also become more complex and it is likely to take many months for our collaborators to collect all the necessary approvals.

While it would be nice to be able to move faster against moth plant, the development of biocontrol programmes is always a slow process, and we can take heart from the fact that the plant would appear to be a very good target, and its days as a rampant climber are hopefully numbered.

This project is funded by The National Biocontrol Collective. Jane Barton is a subcontractor to Landcare Research.

Virus Verification

In 2004 an Auckland Regional Council staff member found a strange and stunted-looking moth plant (*Araujia sericifera/hortorum*) at Awhitu Regional Park. The appearance of the plant (mottling, yellowing, misshapen and stunted leaves) suggested it was being attacked by a virus. This was an interesting find given that we knew in its native range moth plant is attacked by several viruses, the best known one being *Araujia* mosaic virus (AjMV). Viruses have rarely been considered for weed biocontrol, and worldwide to date only one has come to fruition (tobacco mild green mosaic tobamovirus, TMGMV, against tropical soda apple, *Solanum viarum,* in the USA). Viruses have not received much attention because there are relatively few people at present who have plant virology skills, especially compared with mycologists and entomologists.

Since viruses were a bit out of our league we sought the assistance of MAF virologist Francisco Ochoa-Corona, but even he was not able to isolate any causative agent from the Awhitu specimen. We could not use molecular methods to check if AjMV was present as the RNA of the virus had never been sequenced. Even though we were unable to resolve the Awhitu question, our interest in viruses as weed biocontrol agents had been ignited. We are always

Baxter looking for moth plant with symptoms of viral attack.
Insert: moth plant showing symptoms of CMV attack.

looking for ways to potentially expand the weed biocontrol tool box! So we asked our organisation if we could explore the potential for using viruses further and gain some experience in working with them – and got a favourable response.

So early in 2007 Xianlan Cui and Baxter Massey headed off to spend some time in Professor Raghavan Charudattan's lab at the University of Florida. "Charu" is the leading world expert on using plant viruses for biocontrol (he worked out how to successfully use TMGMV) and fortunately he and his team were happy to share their expertise. With their help our guys were able to partially sequence AjMV and develop a molecular tool for identifying this virus. "We were also able to undertake some host-testing, and discovered that AjMV, while it has a fairly narrow host range, is not likely to be a suitable biocontrol agent for New Zealand because it attacks swan plant," said Cui. That is unless we tinkered with the virus, so that it cannot be transmitted by aphids, and develop it as a bioherbicide, which is all a bit of long shot but may be possible to do in the future.

Back home, armed with his new detection technique, Baxter snooped around Auckland looking for diseased moth plants, but could not find any evidence that AjMV has made it to our shores. Ironically at the Awhitu site the plant that sparked the whole thing appeared to have made a recovery. We now believe that previously this plant was probably displaying signs of nutritional deficiency, which can look similar to virus attack. "I found cucumber mosaic virus (CMV) attacking moth plant at three sites," explained Baxter. CMV is known to attack lots of plants but was only recently found attacking moth plant, and can be quite damaging. In the lab Baxter was able to show that CMV can be vectored by the oleander aphid (*Aphis nerii*), which sometimes lives on moth plant and can build to large numbers on this host. The wide host range of CMV and the fact that aphids could potentially spread it to other desirable plants mean that it probably could not be used as a bioherbicide. "I also found other viral symptoms that are not caused by CMV so it is likely there is at least another yet to be identified virus attacking moth plant here," confirmed Baxter. It was noted that moth plant in Auckland displays considerable variation in its leaves and fruit, which may have implications for biocontrol, as plants may also vary in their susceptibility to plant pathogens.

Our funding to work on viruses has now come to an end, and it seems that invertebrates and fungi offer better potential for moth plant control (see *The Noose Tightens for Moth Plant*, page 6). However, it may be that viruses might still come in handy in the future against other targets, and now that we know how we will definitely be looking out for them from now on.

The project was funded by Landcare Research's discretionary Capability Fund. Thanks to Francisco Ochoa-Corona for his support throughout the project.

Two Possible Shots at Lantana

Lantana (*Lantana camara*) is a problem for land managers from Northland to the Bay of Plenty. This notorious weed was the first to ever be targeted for biological control at the turn of the 20th century. Since then more than 40 biocontrol agents, including three rusts, have been released in as many countries with mainly disappointing results, but in some cases have provided partial control. One of the insect agents, the lantana plume moth *(Lantanophaga pusillidactyla)*, has managed to colonise lantana in New Zealand – it was first noticed in Auckland in 1982. This moth probably came via Australia, where it was accidentally introduced back in 1936. Both the adults and larvae feed on the flowers but usually have a limited impact.

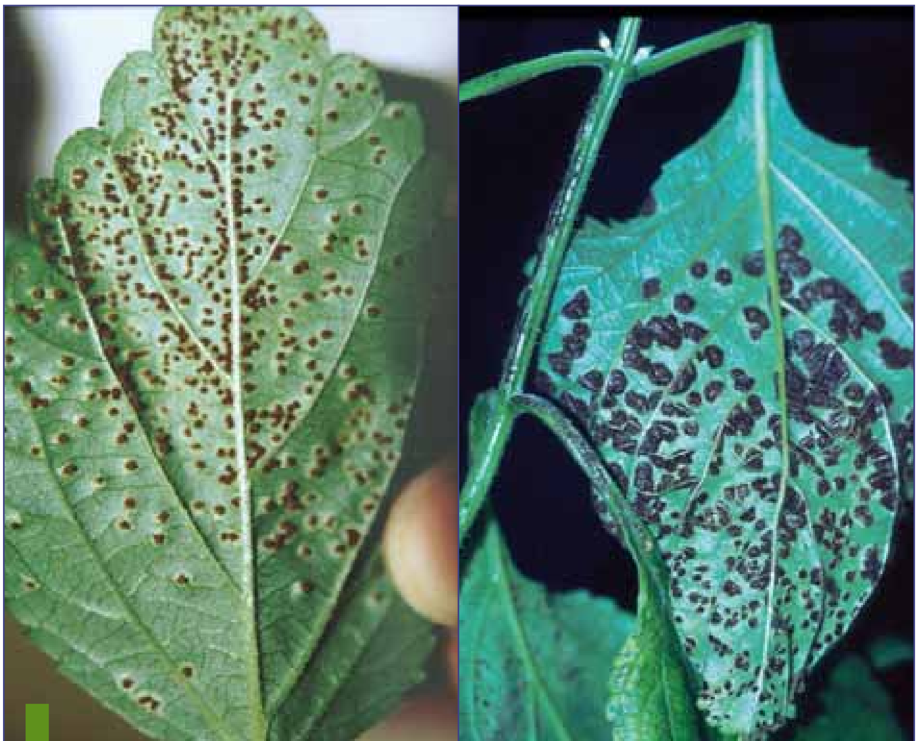
One of the reasons that lantana biocontrol has proven to be extremely challenging is that extensive horticultural "improvement" has been undertaken of this ornamental, resulting in a genetically diverse species complex to which many of the highly specific insect agents are not adapted. Lantana is also 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 biocontrol of this target for more than a decade, advised us early on that New Zealand conditions were unlikely to be suitable for any of the insect agents. However, fortunately by that time a potentially useful pathogen had been identified.

A Brazilian rust fungus (*Prospodium tuberculatum*) was first released in Australia in 2001. It mainly affects the leaves causing rapid senescence, but can sometimes infect stems and petioles leading to significant dieback of branches. Initially the rust was severely hampered by the prolonged dry spells that the east coast of Australia has experienced since the release. However, following a more typical wet season, Michael reports, "Rust populations are beginning to build up and cause obvious damage to lantana plants, as well as spreading to new areas." A mini-survey here in 2006/07 could not find any evidence that the rust has yet managed to blow across the Tasman.

We also needed to check that New Zealand lantana was susceptible, as this rust is a fussy beast and not even able to infect all forms of lantana. We are fortunate in only having two forms of lantana here. The most common one has pink/yellow flowers, and the less common one has reddish/orange flowers. Natasha Riding of the Alan Fletcher Research Station was able to confirm that New Zealand material was indeed a suitable host. Quentin Paynter then prepared a list of the other plants that would need to be tested, and low and behold found that CABI Europe-UK had already done all the necessary work on behalf of the Australians.

While we were mulling over what to do next we heard about a second Brazilian rust (*Puccinia lantanae*), and decided to investigate. *Puccinia lantanae* is supposedly more damaging than *Prospodium tuberculatum*, causing cankering and dieback, and is able to infect a slightly wider range of lantana forms. However, it may not be as well matched climatically for New Zealand. Australia is also interested in this rust, and Carol Ellison at CABI Europe-UK is about to undertake tests for both countries to check its host-range. If this pathogen passes these tests we can save money and time by preparing a single application to cover the release of both species.

Northland Regional Council is currently funding this project. Auckland Regional Council has also previously contributed to this project.



Carol Ellison

The two rusts: *Puccinia lantanae* (right) and *Prospodium tuberculatum* (left).

Could We Dock Horsetail?

Recently at the request of Horizons Regional Council, Quentin Paynter and Jane Barton explored the feasibility of undertaking a biological control programme for field horsetail (*Equisetum arvense*). No biocontrol programme has ever been attempted for any horsetail species anywhere in the world.

In its native range (Europe, Asia, and North America), field horsetail can become a weed of field and vegetable crops. It can spread by spores and develops extensive underground rhizomes that are resistant to herbicides so that, once established, it is extremely difficult and expensive to control. Movement of rhizomes or tubers on tillage implements is a common means of starting new infestations. Simulations done to predict the rate of spread estimated that 6 years after introducing horsetail into an agricultural field it will have gone on to infest 1 hectare.

Since the time of Ancient Rome, field horsetail has been used in traditional medicine in Europe. Its main uses are as a diuretic, for osteoporosis, and for wound healing. Modern studies have shown that field horsetail produces compounds with antimicrobial activity that are active against a wide range of organisms including bacteria and fungi. While the weed may be useful in small doses, in larger quantities it can be toxic. The coarse stems are not often eaten by grazing animals because they contain silica deposits. However, if the plant is eaten, acute thiamine deficiency can result leading to a condition known as "equisetosis". Symptoms include unthriftiness followed by weakness, "staggers", nervousness, faulty vision, and difficulty in turning. Horses may die if large amounts of horsetail are consumed. Sheep are affected to a lesser degree, and equisetosis is rarely fatal for cattle.

Field horsetail was first recorded here in 1922 and has become an aggressive weed. It forms pure stands in a wide range of damp habitats, preventing the seedlings of native species from establishing and in some areas blocking and altering watercourses, causing flooding. "Although field horsetail is most commonly found in acidic and wet soil conditions, it is not particularly fussy about where it grows," confirmed Quent. Well-drained sites including fields, orchards and nursery crops, and even sites with sandy or gravel soil such as along roadsides, railway tracks and beaches, are all fair game. As well as New Zealand, field horsetail has naturalised in Madagascar, South Africa, South America, and Australia.

Field horsetail still has a relatively limited distribution in New Zealand, but has the potential to become much more widespread. Infestations have been recorded so far from Kawhia, Havelock North, New Plymouth, Wanganui, and Lower Rangitikei in the North Island and from Marlborough, Nelson (including a 200-ha infestation near Karamea), the West Coast, Christchurch, and Dunedin in the South Island. "The recent rate of field horsetail spread along the

Horizons Regional Council

Field horsetail infestation in urban Wanganui, a consequence of spreading contaminated gravel.

Wanganui River has been phenomenal and unstoppable," warned Craig Davey of Horizons Regional Council.

Horsetails are considered to be very ancient species. Recent molecular analyses place the horsetails within, but only distantly related to, other ferns (Pteridophyta), having diverged by the end of the Devonian (~354 million years ago). Two other introduced *Equisetum* species became naturalised in New Zealand. *Equisetum fluviatile* is believed to have been eradicated. Attempts to eradicate *Equisetum hyemale* are believed to have been unsuccessful but it is not a common plant. There are no native horsetail species in New Zealand and all *Equisetum* species are banned from sale and distribution. The fact that there is nothing important in New Zealand that is particularly closely related to field horsetail would help to keep testing costs down. Another plus is that no one grows it here for medicinal purposes or highly values it for any other commercial reasons.

Even more promising is that numerous natural enemies of field horsetail are reported in its native range (although not much is reported about their impacts) and many are apparently specific to *Equisetum*. "Potential candidates that would be worthy of further study include a flea beetle (*Hippuriphila modeeri*), a weevil (*Grypus equiseti*), numerous sawflies and several fungal pathogens, such as *Stamnaria persoonii* and *Ascochyta equiseti*," reported Quent. Because the plant has such a huge native range it may be necessary to identify the provenance of New Zealand material in order to know where best to look for agents. Good care would also need to be taken with climate matching.

Quent and Jane concluded that the prospects of finding sufficiently specific classical biological control agents for introduction into New Zealand appear to be extremely good. The major barrier is likely to be, as usual, attracting funding to work on a potentially very serious weed that is not yet causing chaos and concern throughout the country.

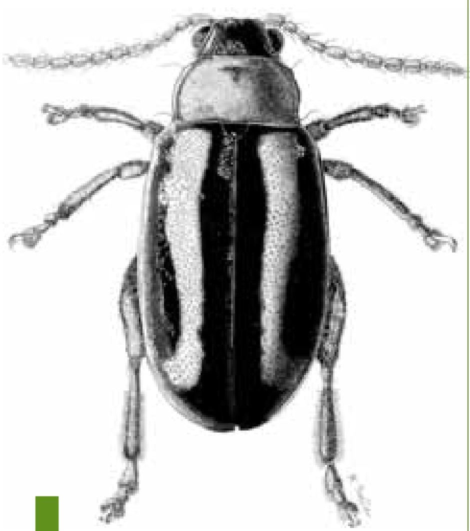
This project was funded by an Envirolink Medium Advice Grant (HZLC49). The full report is available from www.envirolink.govt.nz/reports/index.htm. Jane Barton is a subcontractor to Landcare Research.

Another Alligator Weed Agent Bites the Dust

The alligator weed beetle (*Agasicles hygrophila*) and alligator weed moth (*Arcola malloi*) provide effective control of alligator weed (*Alternanthera philoxeroides*) in some situations where the weed is a problem in New Zealand, such as on lakes. However, more agents are needed to improve the level of control in flowing water, colder areas, and where this versatile plant spills over onto land. We are contributing to a project in Australia to seek suitable additional biocontrol agents.

> **"Things have not quite gone according to plan so far."**

Things have not quite gone according to plan so far. The first two insects to be tested, a thrips (*Amynothrips andersoni*) and a beetle (*Disyoncha argentinensis*) were rejected because they posed a risk to native *Alternanthera* species. "We were quietly confident that the third agent would fly through host testing as it is gall former, and they have a reputation for having narrow host-ranges," said Quentin Paynter. However, Shon Schooler of CSIRO has recently relayed the bad news that the tiny gall midge (*Clinodiplosis alternantherae*) has also failed safety testing for the same reason as the other two.



The flea beetle to be tested next.

Fortunately we are not washed up yet as all options have not yet been exhausted. A foliage-feeding flea beetle (*Systena nitentula*) and a leaf-mining fly (*Ophiomyia alternanthereae*) will be imported from Argentina into containment in Australia for testing as soon as the paperwork can be completed. Pathogens also remain an option to be explored further.

This project is funded by the National Biocontrol Collective.

Spring Activities

There are lots of biocontrol activities that you might need to plan for this spring, such as:

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

- Check release sites. From mid-spring look for the feeding shelters the caterpillars make by webbing together the tips of two or more neighbouring leaves. Small caterpillars are olive-green in colour and become darker as they get older and develop two parallel rows of white spots along the length of their bodies. If you see any severe damage to the foliage, we would be very interested to know about this.
- Unless you find enormous numbers of caterpillars it is probably best to hold off harvesting and shifting them around until we have a better idea of the minimum number you need for a release.

Bridal creeper rust *(Puccinia myrsiphylli)*

- Keep an eye out for signs that the bridal creeper rust has found its way to bridal creeper infestations (*Asparagus asparagoides*) where it has not been seen before (especially east coast of both islands). Infected plants will have yellow and black pustules on the undersides of leaves and on the stems and berries, and may look a little sickly through suffering from complete defoliation.
- Because bridal creeper rust is still officially a "new organism" in New Zealand you should not attempt to spread it around. ERMA are working to get the rust "de-newed".

Broom leaf beetles *(Gonioctena olivacea)*

- Although it is early days yet, some of you might be tempted to check the sites where you released these beetles a year ago. If you are lucky you may be able to see the smallish (2–5 mm long) adult beetles. Females are goldish-brown and males have an orangey-red tinge, but colouration can be quite variable. In late spring you might be able to see the larvae feeding on the leaves and shoot tips. They look like mini dark-coloured crocodiles. If your eyesight isn't too flash then it is probably best to wait a bit longer. A beating tray may also come in helpful.
- We would not expect you to find enough beetles to be able to begin harvesting and redistribution just yet.

Broom psyllids *(Arytainilla spartiophila)*

- Check release sites. From mid-spring look on new growth for the pink to orangey-brown nymphs, which later in the spring become brown-winged aphid-like adults. If you come across an outbreak, plants may be covered in sticky droplets and have blackened stems, greyish, mottled foliage, and dead or blackened leaf buds. Please let us know if you come across such an outbreak.
- If the psyllids are not yet widespread, you can help to move them around. Do this by cutting material with nymphs on. 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.
- If the beetles are not yet widespread, you can help to move them around. Collect them by either beating broom flowers with a stick over a sheet and sucking the beetles up with a pooter or putting a large bag over flowers and giving them a good shake. Alternatively, if you are too busy now you can 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 or early December when the caterpillars are about half-grown. Look for webbed or deformed growing tips with a dark brown or greyish-green caterpillar inside. Please let us know if you find an outbreak or this agent anywhere that you didn't expect. We are especially interested to hear how they are doing in the North Island and lower South Island.
- If the moths are not yet widespread, you can help to move them around. Shift the caterpillars by harvesting branches or even whole 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. Please let us know if you find any, anywhere, as we still have only confirmed establishment at a few sites in Canterbury.
- If you can find the webs in good numbers then there is a lot of work to be done to increase the distribution of this moth. You can harvest branches with webs in late spring when large caterpillars or pupae are present.

Green thistle beetles *(Cassida rubiginosa)*

- Again this one has only just gotten out of the starting blocks but some of you may be desperate for an early look. The adults emerge on warm days towards the end of winter and

Ragwort plume moth larva (left) and blue stem borer larva (right) before the latter has developed its distinctive bluish colouration.

feed on the first thistle leaves to appear in the spring, making round window holes in the leaves. The adults, being green, can be quite well camouflaged, but are at least a reasonable size for a biocontrol agent (6–7.5 mm long). The larvae are extremely distinctive with prominent lateral and tail spines and a protective covering of old moulted skins and excrement. They also make windows in the leaves.

- We would not expect you to find enough beetles to be able to begin harvesting and redistribution just yet.

Mist flower fungus *(Entyloma ageratinae)*

- If you haven't seen it before, spring is the best time to see the white smut in action. The leaves develop lesions with corresponding white spores on the undersides. The lesions coalesce and the leaves die and fall prematurely from the plant. Stem tissue may also become infected leading to dieback of shoots. You will hopefully see mist flower (*Ageratina riparia*) over large areas turning up its toes.
- The fungus is widespread so it is unlikely you will need to spread it around.

Ragwort crown boring moth *(Cochylis atricapitana)*

- Check release sites. Look for thickened stems and bunched leaves or rosettes with damaged centres and black frass. To see the caterpillars you may need to pull apart damaged plants in August–September. Damaged plants may be found in October–November. The caterpillars are quite short and fat, creamy-white, with black heads that become brown or tan when they are older. We are not confident that they have established at any sites yet and would be very pleased to hear of any likely finds.
- It is unlikely that you will find enough to be able to begin harvesting and redistribution just yet.

Ragwort plume moth *(Platyptilia isodactyla)*

- Check release sites. October is probably the best time to do this. Look for plants that have wilted or blackened or blemished shoots. Damaged shoots will also have holes in the stems and an accumulation of debris, frass or silken webbing. You will need to pull some damaged plants apart to see the caterpillars, which are initially pale and later become green and hairy. Large larvae and pupae can be found at the surface of the root crown in October. Pull back the leaves at the crown to see if larvae are present. Also look where the leaves join bolting stems for holes and frass. You may come across blue stem borer (*Patagoniodes farinaria*), which can look a bit similar to plume moth larvae, before they develop their distinctive bluish colouration (see photos).
- If you can find this moth in good numbers it may be possible for you to begin harvesting now and the best time to do this is in late spring. Dig up damaged plants, roots and all. Retain as much of the surrounding soil as possible as it may contain pupae. The more caterpillars and/or pupae you can shift, the greater the chance they will establish, and we recommend shifting at least 50–100 plants. At the release site place one or two infested plants beside a healthy ragwort plant so any caterpillars can crawl across.

Send any reports of interesting, new or unusual sightings to Lynley Hayes (hayesl@landcareresearch.co.nz, Ph 03 321 9694). Monitoring forms for most species can be downloaded from www.landcareresearch.co.nz/research/biocons/weeds/book/ under Release and Monitoring Forms.

Who's Who in Biological Control of Weeds?

Alligator weed beetle (*Agasicles hygrophila*)	Foliage feeder, common, often provides excellent control on static water bodies.
Alligator weed beetle (*Disonycha argentinensis*)	Foliage feeder, released widely in the early 1980s, failed to establish.
Alligator weed moth (*Arcola malloi*)	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 release made in early 2007 and widespread releases made later in 2007, establishment success not yet known.
Bridal creeper rust (*Puccinia myrsiphylli*)	Rust fungus, self-introduced, first noticed in 2005, widespread, appears to be causing severe damage at some sites.
Broom gall mite (*Aceria genistae*)	Gall former, was imported recently but not considered a new organism to NZ, first release made late 2007 and it is hoped widespread releases can begin in 2009.
Broom leaf beetle (*Gonioctena olivacea*)	Foliage feeder, recently approved for release by ERMA, first releases made in 2006/07 and widespread releases began in 2007/08, establishment is looking likely.
Broom psyllid (*Arytainilla spartiophila*)	Sap sucker, becoming more common, slow to disperse, two damaging outbreaks seen so far, impact unknown.
Broom seed beetle (*Bruchidius villosus*)	Seed feeder, becoming more common, spreading well, showing potential to destroy many seeds.
Broom shoot moth (*Agonopterix assimilella*)	Foliage feeder, recently approved for release by ERMA, first release made early in 2008 and it is hoped widespread releases can begin later in 2008.
Broom twig miner (*Leucoptera spartifoliella*)	Stem miner, self-introduced, common, often causes obvious damage.
Californian thistle flea beetle (*Altica carduorum*)	Foliage feeder, released widely during the early 1990s, not thought to have established.
Californian thistle gall fly (*Urophora cardui*)	Gall former, rare, galls tend to be eaten by sheep, impact unknown.
Californian thistle leaf beetle (*Lema cyanella*)	Foliage feeder, only established at one site near Auckland where it is causing obvious damage. Further releases may be made from this site.
Californian thistle rust (*Puccinia punctiformis*)	Systemic rust fungus, self-introduced, common, damage not usually widespread.
Californian thistle stem miner (*Apion onopordi*)	Stem miner, will attack a range of thistles, recently approved for release by ERMA, and it is hoped releases can begin later in 2008.
Green thistle beetle (*Cassida rubiginosa*)	Foliage feeder, will attack a range of thistles, recently approved for release by ERMA, and first releases began in 2007/08, establishment success not yet known.
Echium leaf miner (*Dialectica scalariella*)	Leaf miner, self-introduced, becoming common on several *Echium* species, impact unknown.
Gorse colonial hard shoot moth (*Pempelia genistella*)	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 (*Scythris grandipennis*)	Foliage feeder, failed to establish from small number released at one site, no further releases planned due to rearing difficulties.
Gorse pod moth (*Cydia succedana*)	Seed feeder, becoming more common, spreading well, can destroy many seeds in spring but is not so effective in autumn and not well synchonised with gorse in some areas.
Gorse seed weevil (*Exapion ulicis*)	Seed feeder, common, destroys many seeds in spring.
Gorse soft shoot moth (*Agonopterix umbellana*)	Foliage feeder, becoming common in Marlborough and Canterbury with some impressive outbreaks, impact unknown.
Gorse spider mite (*Tetranychus lintearius*)	Sap sucker, common, often causes obvious damage, but persistent damage limited by predation.
Gorse stem miner (*Anisoplaca pytoptera*)	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 (*Sericothrips staphylinus*)	Sap sucker, gradually becoming more common and widespread, impact unknown.
Hemlock moth (*Agonopterix alstromeriana*)	Foliage feeder, self-introduced, common, often causes severe damage.

Hieracium crown hover fly (*Cheilosia psilophthalma*) **Hieracium gall midge** (*Macrolabis pilosellae*) **Hieracium gall wasp** (*Aulacidea subterminalis*) **Hieracium plume moth** (*Oxyptilus pilosellae*) **Hieracium root hover fly** (*Cheilosia urbana*)	Crown feeder, only one release made so far and 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 under laboratory conditions. Gall former, widely released and has established but is not yet common in the South Island, impact unknown. Foliage feeder, only released at one site so far, impact unknown, further releases will be made if rearing difficulties can be overcome. Root feeder, limited releases made so far and success unknown, rearing difficulties need to be overcome to allow widespread releases to begin.
Heather beetle (*Lochmaea suturalis*)	Foliage feeder, released widely in Tongariro National Park, established at five sites there and three sites near Rotorua, severe localised damage seen already, especially at Rotorua.
Lantana plume moth *(Lantanophaga pusillidactyla)*	Flower feeder, self-introduced, 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.
Mist flower fungus (*Entyloma ageratinae*) **Mist flower gall fly** (*Procecidochares alani*)	Leaf smut, common and often causes severe damage. Gall former, now well established and common at many sites, impact not yet known.
Nodding thistle crown weevil (*Trichosirocalus horridus)* **Nodding thistle gall fly** (*Urophora solstitialis*) **Nodding thistle receptacle weevil** (*Rhinocyllus conicus*)	Root and crown feeder, becoming common on several thistles, often provides excellent control in conjunction with other nodding thistle agents. Seed feeder, becoming common, can help to provide control in conjunction with other nodding thistle agents. 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*) **Old man's beard leaf miner** (*Phytomyza vitalbae*) **Old man's beard sawfly** (*Monophadnus spinolae*)	Leaf fungus, initially caused noticeable damage but has since either become rare or died out. Leaf miner, common, one severely damaging outbreak seen so far but appears to be limited by parasites. Foliage feeder, limited widespread releases have been made, establishment is looking unlikely.
Phoma leaf blight (*Phoma exigua* var. *exigua*)	Leaf spot fungus, self-introduced, becoming common, can cause minor–severe damage to a range of thistles.
Scotch thistle gall fly (*Urophora stylata*)	Seed feeder, limited releases to date, appears to be establishing readily, impact unknown.
Tradescantia leaf beetle *(Neolema ogloblini)*	Foliage feeder, awaiting permission from ERMA to release.
Cinnabar moth (*Tyria jacobaeae*) **Ragwort crown-boring moth** (*Cochylis atricapitana*) **Ragwort flea beetle** (*Longitarsus jacobaeae*) **Ragwort plume moth** (*Platyptilia isodactyla*) **Ragwort seed fly** (*Botanophila jacobaeae*)	Foliage feeder, common in some areas, often causes obvious damage. Stem miner and crown borer, widespread releases made in past 2 years but establishment success not yet known. Root and crown feeder, common in most areas, often provides excellent control in many areas. Stem, crown and root borer, widespread releases made in past 2 years, appears to have established at at least four sites so far, impact not yet known. Seed feeder, established in the central North Island, no significant impact.
Greater St John's wort beetle (*Chrysolina quadrigemina*) **Lesser St John's wort beetle** (*Chrysolina hyperici*) **St John's wort gall midge** (*Zeuxidiplosis giardi*)	Foliage feeder, common in some areas, not believed to be as significant as the lesser St John's wort beetle. Foliage feeder, common, often provides excellent control. Gall former, established in the northern South Island, often causes severe stunting.

Further Reading

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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 11–44 are available from the Landcare Research website (details below).

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