What's New In Biological Control Of Weeds?

Issue 49 August 2009

Landcare Research
Manaaki Whenua

What's Inside:

ISSN 1173-762X (Print)
ISSN 1173-8784 (Online)

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Headlines

- Welcome to the seventh 16-page edition of this newsletter. We produce this annually, in addition to three smaller quarterly issues, to help you keep your finger on the pulse of biocontrol of weeds in New Zealand.
- A report on the feasibility of biocontrol for tutsan (*Hypericum androsaemum*) has concluded that little is known about the natural enemies of this plant, but there is no reason not to proceed to the next stage of undertaking surveys in the native range if funding can be found.
- A recently completed project has confirmed what tough targets hawkweeds (*Hieracium* spp.) are. It will be sometime before we know if any of the major hurdles still facing this project can be overcome.
- It appears that parasitoids are not a major problem for weed biocontrol projects in New Zealand. However, we will be able to minimise wastage in the future by being better able to predict agents that are most likely to be knobbled.
- After 13 years of ups and downs some recent heather beetle (*Lochmaea suturalis*) outbreaks in Tongariro National Park are providing renewed optimism.
- Further studies have shown that the species of moth plant present in New Zealand is *Araujia hortorum*.
- A project to explore the use of dung beetles to biologically control plant material after it has been consumed by mammals is getting underway.
- We suggest some spring activities, including workshops to showcase the newly developed interactive keys to identify grasses and National Pest Plant Accord species.

Paul Peterson walks through dead heather following recent heather beetle outbreaks.

Feasibility of Tutsan Biocontrol

More research is needed into the natural enemies of tutsan (*Hypericum androsaemum*), a recent study into its suitability as a target for biocontrol has concluded. Only 10 fungi and 9 insects have been recorded from tutsan, but this is most likely because the plant has not been well studied. Biocontrol has never been seriously attempted for tutsan anywhere in the world, so formal surveys of its natural enemies in its native range have never been undertaken.

Tutsan has a wide native range covering Europe, Asia Minor and North Africa, and has naturalised in New Zealand, Australia, Chile and possibly parts of the USA. The plant can be found in many places throughout New Zealand with the worst infestations currently around the Taumarunui District (see *Tussling with Tutsan*, Issue 45), and there is some evidence that the plant is actively spreading in at least some areas. On conservation land tutsan has been given a "weediness score" of 27 and a "biological success rating" of 13, which are both at the higher end of the range. Another concern is that, unlike most weeds, tutsan can establish under shade. It can also tolerate a wide range of temperatures and soil types, so large parts of New Zealand would provide suitable habitat. Current control methods are largely ineffective or impractical. The plant can regrow from root fragments and dispersal of the seeds by birds allows reinvasion. Biocontrol would therefore be a desirable option.

"Unfortunately, half of the species that are currently known to attack tutsan can be ruled out immediately because they are not specific enough," said Ronny Groenteman, who prepared the feasibility study for the Tutsan Action Group. The remaining insects are specific to the *Hypericum* genus but do not thrive on tutsan, and include the lesser St John's wort beetle (*Chrysolina hyperici*). When this beetle was introduced from Australia by the Nelson-based Cawthron Institute in the 1940s for biocontrol of St John's wort (*Hypericum perforatum*), a close relative of tutsan, no St John's wort was available locally to feed the beetles. The beetles were given tutsan instead, which they consumed readily. As a result the beetles were released onto tutsan as well as St John's wort, but, despite some anecdotal reports of them inflicting heavy damage early on, they did not persist on this host. Recent feeding trials undertaken by Ronny have shown that tutsan is a sub-optimal host. "The larvae developed very slowly and died well before reaching adulthood," confirmed Ronny.

Four species of fungi recorded from tutsan are specific to the genus *Hypericum*. A powdery mildew, called *Erysiphe hyperici*, can be such a problem for St John's wort growers that plants have to be treated with fungicide. This mildew is worth following up to see if a strain specific to tutsan exists and how infectious it is. Another powdery mildew (*Leveillula guttiferarum*) may have a narrower host range than *E. hyperici* but comes from Turkmenistan and Iran, which are not good climate matches for New Zealand. A brown leaf spot (*Diploceras hypericinum*) has been found on tutsan in New Zealand and overseas. It attacks several *Hypericum* species and can cause severe dieback on St John's wort. However, laboratory tests found that the leaf spot requires 100% humidity to infect tutsan, a condition which is not likely to occur frequently enough in the field to make this pathogen worth pursuing.

The most common species recorded on tutsan, including in New Zealand, is the rust *Melampsora hypericorum*, which is highly specific to tutsan. The rust was first noticed in New Zealand in 1952, and quickly became widespread, but has not been able to inflict enough damage to tame tutsan here. Weed biocontrollers

Tutsan infected with the rust *Melampsora hypericorum*.

Lesser St John's wort beetle larvae do poorly on tutsan (right) compared with on their main host (left).

Melampsora hypericorum rust pustules.

in Australia considered introducing the rust to control tutsan in Victoria but the programme was abandoned when the pathogen was found to have made its own way there. The rust had a huge impact on tutsan in south-western Victoria, and between 1991 and 1997 tutsan went from being common to difficult to find. Deliberate releases followed this success with mixed results and the rust did not even establish at some sites.

Further research in Australia showed that genetic variation between tutsan populations was responsible for differences in susceptibility to the rust, and that there are several isolates of the rust which vary in their virulence. Rust infection was also limited by temperature, and occurred only over a narrow range. "Since the reasons for the variable success of the rust are known it would be worth undertaking further work to see if any of them could be overcome," recommended Ronny. For example are other rust isolates available that could inflict more damage on New Zealand tutsan?

The report also looked into possible conflicts of interest. "A number of beneficial uses of tutsan have been recorded overseas, but the only minor beneficial use of the plant in New Zealand is for ornamental purposes," confirmed Ronny. No major conflicts of interest are expected should a biological control programme be undertaken. Although several *Hypericum* species are grown in gardens, some have naturalised and may be weeds of the future. Rose of Sharon (*H. calycinum*) is widely planted as ground cover in traffic islands where it forms dense mats and is great in this context as a low maintenance plant, but its ability to suppress other plants would be a less desirable characteristic if it starts growing in places where it was not wanted. However, any agents considered for biocontrol of tutsan would need to be highly host specific as we have four native species of *Hypericum* in New Zealand. Two are endemic and one of these, *H. minutiflorum*, is critically endangered. Having weighed up all available information Ronny has concluded that there is no reason why a biocontrol programme for tutsan should not be undertaken. Surveys in the native range are urgently needed and should quickly confirm our suspicions that promising, as yet undiscovered agents are waiting to be called up for duty.

This work was funded by a MAF Sustainable Farming Fund grant given to the Tutsan Action Group. The Tutsan Action Group is now hoping to raise funds to begin a biocontrol programme for tutsan. If you could help to support this project please contact the secretary, Ros Burton (Ph 07 895 8052, or email gtb@xtra.co.nz).

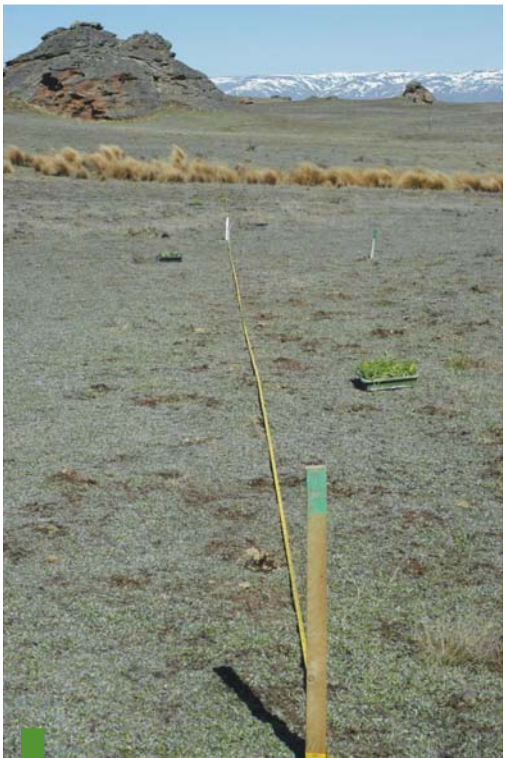
Biocontrol Agents Released in 2008/09

Species	Releases made
Broom leaf beetle (*Gonioctena olivacea*)	7
Broom gall mite (*Aceria genistae*)	4
Broom shoot moth (*Agonopterix assimilella*)	6
Californian thistle gall fly (*Urophora cardui*)	1
Green thistle beetle (*Cassida rubiginosa*)	32
Thistle stem miner (*Ceratapion onopordi*)	2
Gorse soft shoot moth (*Agonopterix ulicetella*)	5
Ragwort plume moth (*Platyptilia isodactyla*)	6
Total	63

Can We Hinder High Country Hieracium?

A first step in assessing biocontrol impact is often demonstrating that an agent is capable of damaging individual plants, before embarking on population-level studies. Previously a lab trial had shown that the hieracium gall wasp (*Aulacidea subterminalis*) can reduce the length of mouse-ear hawkweed (*Pilosella officinarum*, previously *Hieracium pilosella*) stolons and therefore potentially slow its vegetative spread. More recently similar trials into the impact of the hieracium gall midge (*Macrolabis pilosellae*) have been completed and have demonstrated that they are also able to reduce hawkweed growth. "After being attacked by only one generation of gall midges, mouse-ear hawkweed had shorter stolons, fewer smaller leaves and less root material than control plants," confirmed Lindsay Smith. For two other hawkweed species, field hawkweed (*Hieracium caespitosum*) and king devil hawkweed (*H. praealtum*), two generations of gall midge attack were able to reduce the total length of stolons. Given that the gall midge has three generations a year, these results may underestimate its potential impact.

Lab trials provide useful information, but results in the field are what really count. So in 2003 we initiated a trial to look at the impact of the two gall-formers in the field. We released the insects at trial sites in Canterbury and Otago under various management regimes: grazed, retired and improved grassland. The release sites are situated on vegetation transects (some established as early as the 1960s) that are part of a long-term monitoring project looking at vegetation changes in high country grasslands. Data from the transects clearly show how the vegetation has changed over past decades with the invasion of *Hieracium* species into high country, and in particular the increase in mouse-ear hawkweed cover. *Hieracium* species have sadly now become very common in high country grasslands. For example, at the Upper Manorburn sites in Central Otago mouse-ear hawkweed is now present in 95% of the transects and is responsible for more than half of the total vegetation cover.



A transect in Central Otago dominated by hieracium.

Unfortunately neither the gall midge nor gall wasp established well on the vegetation transects, despite establishing readily at many other release sites. "While using the vegetation transects provided us with excellent baseline vegetation data, in hindsight they may not have been the best place to establish insect populations," said Lindsay. The transects selected for releases tended to be in areas exposed to extreme cold and wind in winter and dry conditions in summer. Insects that live inside plants, such as gall-formers, are particularly vulnerable to climatic extremes such as drought. "In drought conditions the leaves and stolons of mouse-ear hawkweed often shrivel up. While the plants can often recover, the gall midge and gall wasp larvae inside them often die," said Lindsay. Six years was simply not long enough under these conditions to achieve populations of these gall-formers at levels where any impact could be detected. It is hoped that the sites can be reassessed sometime in the future.

Over coming decades the two gall-formers should become more common and widespread but are unlikely to be able to do the job on their own. Three other insect agents have been approved for release in New Zealand but are not yet established. The hieracium plume moth (*Oxyptilus pilosellae*), crown hover fly (*Cheilosia psilophthalma*) and root-feeding hover fly (*C. urbana*) have all proven nightmarishly difficult or impossible to rear, so only a few, smallish releases have been made. "The root-feeding hover fly may be the only agent that is able to survive in areas with extreme droughts," claimed Lindsay. "When the plants die back the roots, which this insect feeds on, often remain alive, so it should be able to survive where the other agents cannot." A new project is beginning shortly looking at "recalcitrant" agents – those which appear promising but fail to achieve their potential as they cannot be reared in decent numbers or established in the field. This will allow some serious effort to go into trying to work out what makes the more difficult species tick and hopefully will produce some important breakthroughs in due course. As usual we will keep you posted…

Given that biocontrol of hawkweeds is still a long way off, if achievable at all, other control options continue to be explored. A trial undertaken recently has looked at the effect of adding fertiliser

Mouse-ear hawkweed plant heavily damaged by the gall midge.

appeared to only reduce mouse-ear hawkweed cover by around 10%, and this minor effect did not persist. It appears that fertiliser applications can potentially raise soil micro-organisms to

to mouse-ear hawkweed in the field. Compost tea was used as a natural fertiliser in an attempt at reducing hawkweed dominance by boosting beneficial soil micro-organisms and stimulating the growth of other plant species. Applications of compost tea a level which is harmful to hawkweed growth, but as regular follow-up applications would be necessary to maintain the effect, this is unlikely to be cost-effective or a practical solution. Fingers crossed then for biocontrol in the longer term.

This work was funded by the Hieracium Control Trust through MAF Sustainable Farming Fund grants 02-053 and 06-052.

Do you really need a hard copy?

Did you know that this newsletter is available electronically? We can send it to you quarterly as a PDF file or you can download it from our website (www.landcareresearch.co.nz/publications/newsletters/weeds/). The cost of producing and posting hard copies is not insignificant so if you think you could make do with an electronic version instead then please email Lynley Hayes (hayesl@landcareresearch.co.nz). Thanking you in anticipation!

Introducing Daniel

Daniel Than is our new plant pathology technician and he is based in Auckland. When he is not assisting our pathologists Stan Bellgard and Sarah Dodd, Daniel can be found helping out in Landcare Research's ecological genetics lab. Since his arrival in late May, Daniel has been looking at isolating and identifying diseases found on pampas (*Cortaderia* spp.) in New Zealand, which is our first step towards developing biocontrol for this new target.

Daniel with pathogens isolated in the lab.

Before starting with us, Daniel worked for two and a half years at Biodiscovery, a commercial company in Auckland. There he researched endophytes (plant pathogens that live in plants often with no obvious symptoms), screening to find ones that promote plant growth and provide protection from pests and diseases.

Originally from Malaysia, Daniel came to New Zealand to study for a Bachelor of Technology in Biotechnology at the University of Auckland. During his Honours year Daniel studied yeast, investigating how genetic recombination and natural selection could make strains more tolerant to heat and ethanol.

Outside of work Daniel plays badminton and enjoys a bit of paintballing – a nice contrast to lab work. Welcome to the team Daniel!

Is It Possible to Predict Parasitism?

Parasitoids and their hosts have not been well studied in New Zealand, but a project that we completed recently has increased our understanding of how parasitism is affecting weed biocontrol in New Zealand. We have identified some factors that can help us to predict the risk of weed biocontrol agents being attacked by parasitoids.

We found that flies tend to be more prone to parasitism than beetles, moths and butterflies. Also, species which are not very good at concealing themselves tend to be more at risk of parasitism than hidden species (such as gall formers and stem miners), or species which do not try to hide at all. This slightly counter-intuitive result may be because species that live out in the open are more vulnerable to predators than parasitoids, and because concealed, harder to get at, species require specialised parasitoids. "These findings agree with overseas studies, but were not statistically significant, perhaps due to the low levels of parasitism we found," said Quentin Paynter.

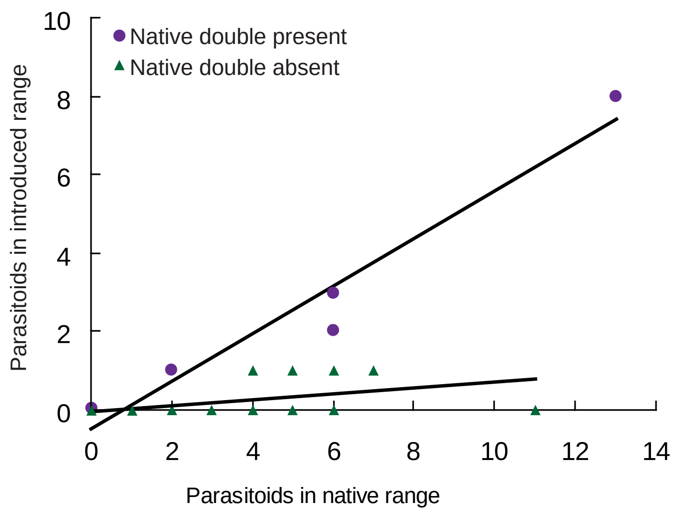
Two factors that were statistically significant are the level of parasitism the agent experiences in its native range and whether it has a native counterpart in New Zealand. Species that have numerous parasitoids at home are more likely to pick up a large number in their introduced range, and agents with a native equivalent here are more likely to be parasitised than those without. "These two factors together are good predictors of parasitoid attack in New Zealand and, with the benefit of hindsight, parasitism of seven biocontrol agents here could have been predicted before they were introduced," said Quent. The remaining three cases of parasitism could not have been predicted because the parasitoid was either accidentally or self-introduced after the agent was released, or not enough was known about native equivalents.

So are native insects at risk of increased parasitism due to parasitoids attacking weed biocontrol agents? Only five agents show levels of parasitism high enough to warrant concern. Any crossover by parasitoids from the cinnabar moth (*Tyria jacobaeae*) to the magpie moth (*Nyctemera annulata*) and St John's wort gall midge (*Zeuxidiplosis giardi*) to native gall midges is likely to be minor as their target weeds are under good control. When a weed is much less common so are its biocontrol agents and their associated parasitoids, and the likelihood that agents will come into contact with native species and share parasitoids is reduced. However, old man's beard (*Clematis vitalba*) is not under effective control and the old man's beard leaf miner (*Phytomyza vitalbae*) is common despite parasitism. While the native *Clematis* leaf miner (*P. clematadi*) could be at significant risk of increased attack they were no less abundant on native *Clematis foetida* plants close to old man's beard infestations than on plants far away from them. Research on *Megastigmus* sp., the parasitoid which attacks mistflower and Mexican devil weed gall flies (*Procecidochares alani* and *P. utilis*), also shows attacks on native insects are exceedingly rare.

All in all, the current evidence suggests that native insects are at low risk of serious indirect effects through parasitism of weed biocontrol agents. While parasitism has perhaps reduced the efficacy of about 20% of agents, it has not affected the overall outcome of weed biocontrol programmes, because control has still been achieved by other unaffected agents. However, insights gained from this study will allow us in future to avoid wasting resources by selecting the agents that are least likely to be knobbled by parasitoids.

See also Parasitism – a Major or Minor Cause of Biocontrol Failure?, Issue 45.

This study was funded by the Foundation for Research, Science and Technology as part of the Beating Weeds project (Contract No. C09X0210).



The number of parasitoids in its native range and whether it has a native equivalent here best predicts whether an agent will be parasitised here.

Army Recruits One Million

Despite struggling for 13 years to get one of the world's most promising biocontrol agents working in New Zealand, a watershed point may have finally been reached. At one site on New Zealand Army land, where 500 heather beetles (*Lochmaea suturalis*) were released 8 years ago, Simon Fowler and Paul Peterson now estimate that a million beetles have occupied 11 ha of heather (*Calluna vulgaris*) infested tussock grassland. The beetles are systematically munching their way through the heather leaving, as expected, all other plants untouched. Plots that have been sprayed with insecticide to remove the beetles, as part of an impact assessment trial, demonstrate just how effective this biocontrol agent is (see photo). Once heather has been heavily damaged by the beetles it turns greyish-brown and dies.

A 5 × 5 m plot that has been sprayed with insecticide to remove heather beetles as part of an impact assessment trial. The surrounding heather has been eaten by the beetles.

Since 1996, we have been releasing heather beetles to help the Department of Conservation and New Zealand Army deal with a 50 000+ ha infestation of heather on the Central Plateau of the North Island. For many years the beetle failed to live up to expectations, and after much research to rule out potential causes Simon and Paul now believe that large fluctuations in spring temperatures at high altitude, low soil nitrogen levels and small beetle size (due to genetic bottlenecking) are all related to previous poor establishment and performance. "Relatively mild spring conditions over recent years, releasing beetles at lower altitude sites, and adding nitrogen to release sites have probably all contributed to recent successes," said Paul.

"We were really surprised that plants from high altitude sites in Tongariro National Park have such significantly lower nitrogen content than plants from the UK," revealed Simon. Heather from the release sites at Rotorua, where the beetles did well from the word go, is also higher in this key nutrient. Research to test the theory that fertilising release points with nitrogen can help "kick start" populations through better nutrition, allowing the beetles to become larger and have more reserves to cope with climatic challenges, is ongoing and appears to show some promise. A single application may be all that is needed.

However, if current outbreak heather beetle populations continue to grow exponentially they may eventually be able to move into the higher areas when conditions are favourable. "We expect beetles to disperse over 513 ha next year and 10,000 ha the year after that. At this rate they could be throughout the entire heather infestation on the Central Plateau within 3 years," predicts Simon.

However, if down the track the beetles have still failed to thrive at high altitudes all is not lost. We could introduce more beetles from an area with a better climatic match, such as eastern Scotland or Northern Spain, and larger specimens from the original collection sites in England. Previously this has not really been an option because of the difficulties we had previously in obtaining beetles that were not infected with a microsporidian disease. However, new molecular tools can these days allow much more accurate and rapid disease detection, and if single females do not have to be line-reared for multiple generations to obtain clean colonies, then the problem of genetic bottlenecking could also be overcome.

This project is funded by the Department of Conservation, the New Zealand Army and the Foundation for Research, Science and Technology as part of the Beating Weeds project (Contract No. C09X0210).

Moth Plant Measures Up

Face-to-face meetings with overseas collaborators are often productive in unexpected ways. When Jane Barton and Carlos Villamil (Universidad Nacional del Sur, Argentina) were chatting about moth plant in the latter's garden in Bahía Blanca, they realised there was a simple way of checking the taxonomic identity of moth plant in New Zealand once and for all. Carlos is a leading authority on the genus that moth plant belongs to (*Araujia*). As we have mentioned previously, Carlos's work had led him to believe that what we call "moth plant" in New Zealand belongs to the species known in South America as *Araujia hortorum*, not *A. sericifera* as it is currently called, but there was still a nagging doubt that we might perhaps have both species. Obviously it is very important that we know exactly what we have got in New Zealand, so that we can choose appropriate biocontrol agents.

Carlos Villamil

Pollinia from *A. serificera* (top) and *A. hortorum* (below).

As part of Carlos's quest to straighten out the taxonomy of *Araujia* he grew an *A. sericifera* plant in his home garden. Since the plant was flowering when Jane was in Bahía Blanca in February, he invited her to come and see for herself the differences between this species and New Zealand moth plant.

The "Eureka" moment occurred when Carlos revealed that one of the most consistent differences between *A. sericifera* and *A. hortorum* was the dimensions of a part of the flower called the pollinia (see photo). "The pollinia of *A. sericifera* are consistently larger than those of *A. hortorum*," explained Carlos, "and they also have different length-to-width ratios." Jane and Carlos realised that by measuring the pollinia of flowers from all over New Zealand it should be possible to say with confidence whether all of the plants in New Zealand belong to the same *Araujia* species, and whether that species should be referred to as *A. sericifera* or *A. hortorum.*

So in March Lynley Hayes sent out a request for moth plant flowers from around the country for Jane to inspect. Jane also contacted staff at two herbaria and asked if they had any dried specimens of the weed with intact flowers. Everyone was very helpful, and Jane was able to measure pollinia from 20 populations. Fresh flowers were examined from eight populations in the North Island and dried flowers from herbarium specimens were dissected from a further 12 populations (five each from the North and South islands, and one each from Waiheke and Great Barrier islands).

"They matched nicely with *A. hortorum*"

And the results? Jane sent her measurements to Carlos and he replied that "they matched nicely with *A. hortorum*." We can now be certain that all the plants in New Zealand are very closely related to each other, and also to plants in the Pampas region of Argentina that have traditionally been called *A. hortorum*. However, the name will not be officially changed in New Zealand until such time as Carlos's results can be published, and the proposed revision is accepted by the botanists here at Landcare Research who authorise any name changes.

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

We are very grateful to people who supplied flowers: Craig Davey and Hilary Webb, Horizons Regional Council; Phil Karaitiana, Gisborne District Council; Darin Underhill, Hawke's Bay Regional Council; Ken Massey, Northland Regional Council; Chris Winks, Landcare Research; Ewen Cameron, Auckland Museum; and Ines Schönberger, Allan Herbarium.

Biocontrol of Dung Gets Rolling

Landcare Research staff are embarking on a biological control project with a difference: one that focuses on tackling plant material once it has passed through the digestive tract of grazing animals and been turned into dung! When large grazing animals were brought to New Zealand the beetles that have evolved to clean up after them were left behind. At any one time it has been estimated that 5% of all grazing land in New Zealand is covered in dung, and it can take up to 6 months to break down. Normally dung beetles would quickly descend upon any fresh deposits, which they break up and bury in the ground to lay their eggs in.

New Zealand has 14 species of native dung beetles, but they are forest and high country tussock dwellers and do not occur in pastoral habitats. A tropical species (*Copris insertus*) was introduced in 1956 but only established at Whangarei, as most of New Zealand is too cold. Two Australian species (*Onthophagus*) have self-introduced and are widespread, but are not up to the job required and have little impact. Fortunately, there are many species of dung beetles that could be expected to perform well in New Zealand, and the Dung Beetle Release Strategy Group has recently gained funding, mainly from the MAF Sustainable Farming Fund, to look into them further. "The potential benefits of establishing pastoral dung beetles are huge," reports Shaun Forgie, a dung beetle expert with Landcare Research. Conservative estimates from the USA state that dung beetles are worth around US$380 million annually to the US economy.

One obvious benefit is increased pasture productivity. Unless very hungry, stock will not graze near dung pats, avoiding an area of up to five times the dung pats themselves. Breaking up and burying dung makes pasture available again much more quickly, and enhances grass growth through more effective nutrient recycling and lowers the need for fertiliser application.

Dung beetles can also reduce the incidence of parasitic worms in livestock. Dung commonly contains infective stages of gut worms, which subsequently are ingested by grazing stock. Dung beetles can help to break the infection cycle as they bury dung too deeply for parasitic larvae to migrate back to the surface. "While in the future dung beetles could reduce the need to use drenches, some products currently used are also toxic to dung beetles, and parasite control regimes will need to be modified for dung beetles to establish widely and have maximum impact," cautions Shaun.

A less obvious benefit of dung beetles is a reduction in nuisance flies that breed in dung. In Hawai'i, introduced dung beetles managed to reduce fly emergence from dung by 95%. Similar claims have been reported in Australia following the establishment of dozens of exotic dung beetles. New Zealand has a very high rate of seasonal campylobacteriosis compared with other OECD countries (up to 14,000 cases reported each year), and flies breeding in cattle dung are believed to be the main source and vector of this disease.

Dung beetles could also have wider positive environmental benefits. Tunnelling by the beetles increases aeration of the soil and allows better water penetration. Soil erosion is reduced, and there is less runoff from pastures to pollute waterways. Dung beetles could also help with efforts to mitigate climate change through reducing nitrous oxide emissions. When dung is buried by dung beetles 70% less nitrogen escapes into the atmosphere than when it remains on the surface.

The plan is to now prepare a shortlist of species of dung beetles that would be best suited to New Zealand conditions. Later an application to import and release between 5 and 12 species of beetles will be prepared for the Environmental Risk Management Authority.

Adult dung beetle in Italy.

Spring Activities

Spring is one of the busiest times in the biocontrol calendar and there are lots of activities that you might need to plan for, such as:

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

- From mid-spring check release sites 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.
- If you find good numbers of caterpillars you can begin harvesting and shifting them around. Cut off infested boneseed tips and wedge them into plants at new sites. Aim to shift at least 100 caterpillars. Do not release the leafrollers in areas where Argentine ants are established as they are unlikely to survive.

Bridal creeper rust (*Puccinia myrsiphylli*)

- Keep an eye out to see if bridal creeper rust has found its way to bridal creeper infestations (*Asparagus asparagoides*) where it has not been seen before (especially the 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 right through to suffering from complete defoliation.
- Bridal creeper rust is no longer considered a new organism in New Zealand so you can now spread it around. For detailed instructions on how to distribute the fungus see www.csiro.au/resources/BridalCreeperRustFungus.

Broom leaf beetle larva.

Broom gall mite (*Aceria genistae*)

- It is probably too soon to be looking for this agent but if you can't resist a peek at your release site then spring and summer are the best time to look for galls. These deformed lumps range in size from 5 to 30 mm across and are likely to be close to the release point. Sometimes galls can be found on broom that are not made by our new biocontrol agent, but these are much less dense. Contact us if you find galls so we can help to confirm their identity.
- We would not expect you to find enough galls to be able to begin harvesting and redistribution just yet.

Broom leaf beetles (*Gonioctena olivacea*)

- Although it is early days yet, some of you might be tempted to check release sites where you released these beetles 1–2 years 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. A beating tray may also come in handy.
- We would not expect you to find enough beetles to be able to begin harvesting and redistribution just yet.

Broom psyllids (*Arytainilla spartiophila*)

- 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*)

- Look for adults in the spring congregating on broom flowers or for eggs on the pods.
- If the beetles are not yet widespread,

Ragwort crown-boring moth larva mining a leaf on hatching in spring.

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.

Broom shoot moth (*Agonopterix assimilella*)

- It is probably too soon to be looking for this agent but if you can't resist a peek at your release site then late spring is the best time to do so. Look for feeding shelters made by the caterpillars tying twigs together with webbing. Small caterpillars are dark brown and they become dark green as they mature.
- We would not expect you to find enough caterpillars to be able to begin harvesting and redistribution just yet.

Gorse soft shoot moth *(Agonopterix ulicetella)*

- Check release 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 it is early days for this one, but signs of the beetle have been seen at some release sites a year after they were released. The adults emerge on warm days towards the end of winter and 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 larger than many of our agents (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 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 the late-winter months of

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 for plants that have wilted or blackened or blemished shoots. October is probably the best time to do this. 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.
- 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 Guidelines for keeping track of biocontrol agents.

Spring Workshops

We will again be holding a basic biocontrol workshop at Lincoln in early December 2009. This is a 2-day introductory course that aims to give people a good feel for what biological control is all about. We cover as many aspects of the underlying philosophy and current projects as we can in the time available, and augment indoor sessions with practical activities in the field. If your organisation contributes to or supports our research in some way then there is no charge for this course, and it is ideal for new staff or people wishing to upskill in this area. If not, you may still be able to attend, if there are places available, for a small fee.

We will also be offering a plant identification workshop in conjunction with the basic biocontrol workshop, so people can attend both if they wish. The plant identification workshop is a 1-day course that aims to give people the confidence and skills to identify plants, especially weeds. Instead of just learning how to recognise a set number of plants, participants are taught how to go about identifying any plant they come across. They are taught basic botany skills and how to use plant identification keys (including the newly developed interactive keys for National Pest Plant Accord species and grasses). All levels of experience can be catered for, and participants are encouraged to bring any material they would especially like to work on. The cost of this course is likely to be about $500 per person (excluding travel, accommodation and meals).

If you are interested in either workshop please contact Lynley Hayes (hayesl@landcareresearch.co.nz or Ph 03 321 9694).

Plant Identification Keys Now Online

Interactive keys are powerful identification tools and much easier to use than traditional printed keys found in floras. Two new computer-based identification keys are now available for use, free of charge, on the Landcare Research website (see www.landcareresearch.co.nz/research/biosystematics/plants/).

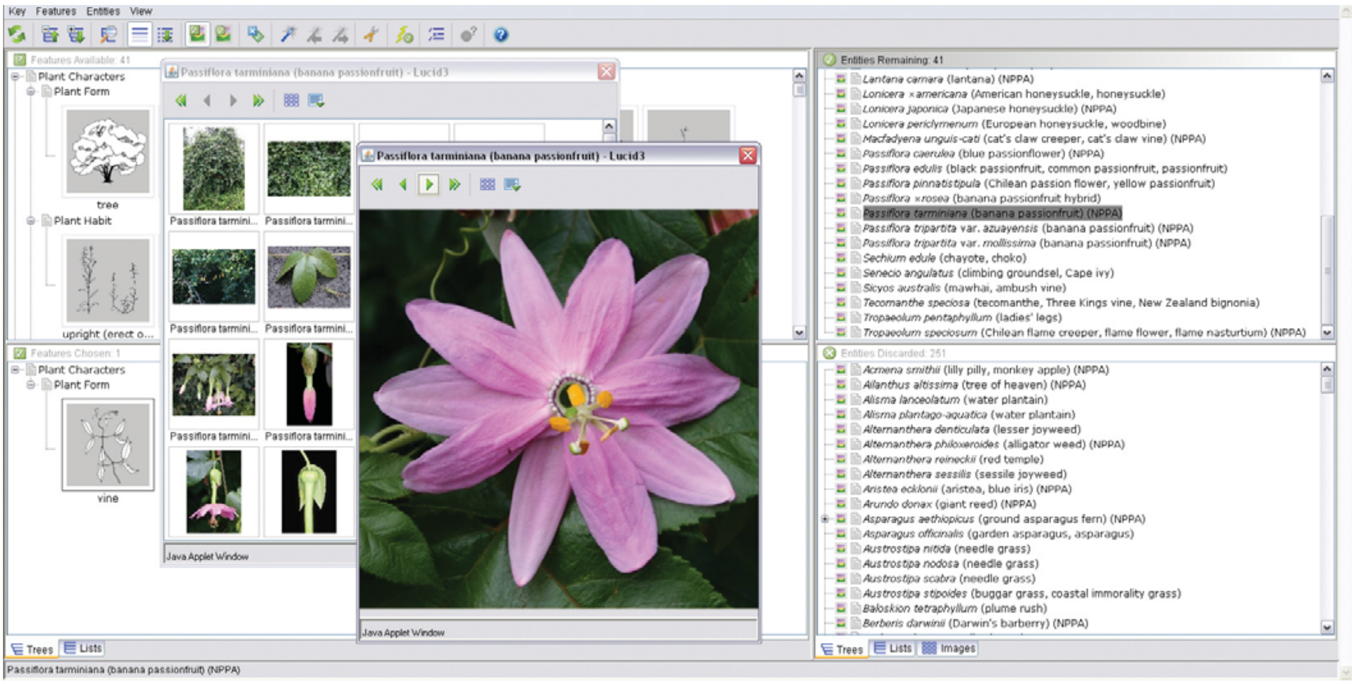
The NZGrass Key was developed by Kerry Ford and David Glenny of Landcare Research and Trevor James of AgResearch. This key includes 428 species and 4 hybrids of native and naturalised grasses of New Zealand, and is illustrated with more than 1,500 images. "Grasses are notoriously difficult to identify," said Kerry. "People attending our plant identification workshops tell us every year that they find grasses the most difficult species to identify." While there is a comprehensive flora devoted to grasses, the book is loaded with technical terms and descriptions and is very difficult for a novice to use. The new online key draws on information contained in the flora but makes the data more accessible. "You don't need to be an expert to use the interactive grass key – it is very user friendly," confirmed Kerry.

Also easy to use is the NPPA Key, which was completed more recently by Murray Dawson of Landcare Research. This key was developed to assist with the identification of the 150 pest plant species currently banned from sale, propagation, and distribution within New Zealand. "The plants on this list are a diverse bunch. Some are already serious weeds, and others have the potential to be," said Murray. Also included in the key is an equal number of similar and related lookalike species, which are commonly confused with the real NPPA plants.

This NPPA project was very much a team effort. It was the brainchild of Peter Heenan (also of Landcare Research), who secured the funding to make it possible. Others involved included: Trevor James, who contributed the majority of images used; Sheldon Navie (University of Queensland), who provided Lucid character data; and Paul Champion (NIWA), who provided expert advice on aquatics. Many people helped out with images including: Weedbusters, the Department of Conservation, MAF Biosecurity New Zealand, New Zealand regional authorities, and even contributors from other countries. "Everyone has been extremely generous," said Murray. "From a collection of 12,000 images we were able to choose 5,000 of the best to use in our key."

Landcare Research is planning to develop further interactive keys in the future, including one for environmental weeds of New Zealand.

The development of these keys was funded by the Terrestrial & Freshwater Biodiversity Information System (TFBIS) Programme and are based on Lucid software (developed by the CBIT in Australia). *The NPPA key will be demonstrated at a National Pest Plant Accord training workshop in Hamilton and Lincoln, on 29–30 September 2009. If you want to attend please contact Katherine Garnett (Katherine.Garnett@maf.govt.nz). The NZGrass and NPPA keys will also be demonstrated at a Plant Identification Workshop in early December 2009 (see previous page for more details).*



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 released in 2007, establishment confirmed at some North Island sites but no significant damage seen yet.
Bridal creeper rust (*Puccinia myrsiphylli*)	Rust fungus, self-introduced, first noticed in 2005, widespread, appears to be causing severe damage at many sites.
Broom gall mite (*Aceria genistae*)	Gall former, first released at limited sites in late 2007 and establishment has been confirmed at one site already, widespread releases will begin in 2009.
Broom leaf beetle (*Gonioctena olivacea*)	Foliage feeder, recently approved for release by ERMA, first releases made in 2006/07 and establishment already confirmed at two sites. Widespread releases are continuing.
Broom psyllid (*Arytainilla spartiophila*)	Sap sucker, becoming more common, some damaging outbreaks seen so far but may be limited by predation, 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 widespread releases will continue in 2009.
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 (*Ceratapion onopordi*)	Stem miner, attacks a range of thistles, recently approved for release by ERMA, first two releases made early in 2009. Difficult to rear, releases will continue as available.
Green thistle beetle (*Cassida rubiginosa*)	Foliage feeder, attacks a range of thistles, recently approved for release by ERMA, widespread releases began in 2007/08, establishment is looking promising at most sites.
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.
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 common, spreading well, can destroy many seeds in spring but is not so effective in autumn and not well synchonised with gorse-flowering in some areas.
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*)	Crown feeder, limited releases made so far, establishment success unknown, rearing difficulties need to be overcome to allow widespread releases to begin.
Hieracium gall midge (*Macrolabis pilosellae*)	Gall former, widely released and has established but is not yet common at sites in both islands, impact unknown but very damaging in laboratory trials.

Hieracium gall wasp (*Aulacidea subterminalis*) **Hieracium plume moth** (*Oxyptilus pilosellae*) **Hieracium root hover fly** (*Cheilosia urbana*) **Hieracium rust** (*Puccinia hieracii* var. *piloselloidarum*)	Gall former, widely released and has established but is not yet common in the South Island, impact unknown but reduces stolon length in laboratory trials. Foliage feeder, only released at one site so far and did not establish, further releases will be made if rearing difficulties can be overcome. Root feeder, limited releases made so far, establishment success unknown, rearing difficulties need to be overcome to allow widespread releases to begin. Leaf rust fungus, self-introduced?, common, may damage mouse-ear hawkweed but plants vary in susceptibility.
Heather beetle (*Lochmaea suturalis*)	Foliage feeder, released widely in Tongariro National Park, some damaging outbreaks now starting to occur, also established near Rotorua and severely damaging heather there.
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, in conjunction with the leaf smut provides excellent control of mist flower.
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, only one severely damaging outbreak seen, appears to be limited by parasites. Foliage feeder, limited widespread releases have been made, has probably failed to establish.
Phoma leaf blight (*Phoma exigua* var. *exigua*)	Leaf spot fungus, self-introduced, becoming common, can cause minor–severe damage to a range of thistles.
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, permission to release has been granted by ERMA but remaining in quarantine until it can be cleared of a gut parasite.
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 2006/07, but no evidence of establishment yet. 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 3 years, appears to be establishing readily and reducing ragwort already at some sites. 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.
Woolly nightshade lace bug (*Gargaphia decoris*)	Sap sucker, application to release currently with ERMA.

Further Reading

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Note that the **Proceedings of the XII International Symposium on Biological Control of Weeds**, which was held in France in 2007, have now been published. Many papers by team members are included in these proceedings. Available from www.cabi.org/bk_BookDisplay.asp?PID=2147

If you need assistance in locating any of the above references please contact Lynley Hayes. *What's New In Biocontrol of Weeds?* issues 11-48 are available from the Landcare Research website (details below).

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Editors: Lynley Hayes, Julia Wilson-Davey
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Thanks to: Christine Bezar
Layout: Anouk Wanrooy

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