WHAT'S NEW IN

Biological Control of Weeds?

Issue 65 Aug 13

Heather beetles

What's Inside?

Landcare Research
Manaaki Whenua

Scottish ‘Laddies’ Flown in for Genetic Rescue

A novel experiment is underway to improve the vigour of heather beetles (*Lochmaea suturalis*). The beetles have been established in Tongariro National Park to control heather (*Calluna vulgaris*) planted by a park superintendent in the 1800s wanting to provide habitat for grouse. Although the grouse never established, heather soon became a serious weed, displacing native vegetation and spreading over vast areas of the Central Plateau. Once it became apparent that biocontrol offered good prospects, heather beetles were collected from several sites in the UK and released here in 1996 following extensive efforts to eliminate a microsporidian disease. This involved considerable line-rearing of individual beetles and culling of any diseased lines until a clean population was achieved.

At high densities heather beetles do a fantastic job of killing heather, reducing the need to apply herbicides, which are expensive and have undesirable effects on native vegetation. However, while there have been some impressive outbreaks in recent years, overall the beetle populations have been painfully slow at establishing and spreading. Research has been underway to try to identify what factors might be limiting them. Several theories have been put forward over the past decade including:

1. Predators, parasitoids or diseases were attacking the beetles in New Zealand.
2. Climate match between UK and the Central Plateau was not close enough.
3. Insufficient nitrogen in the foliage here to support the beetles.
4. The beetles were genetically constrained, small and not able to adapt to New Zealand conditions.

Paul and Paul setting up the genetic rescue attempt at Lincoln.

Careful research has shown that pressure from natural enemies is not an issue, but the nitrogen content of the heather foliage is extremely low compared with heather growing in the UK. The genetic diversity among the New Zealand heather beetles is also low, as a result of genetic bottlenecking during the disease eradication phase, and beetles here are considerably smaller than their UK counterparts. Experiments conducted to simulate winter conditions showed that the fat reserves held by the beetles were an important factor in determining their ability to survive over winter. Their small size, in combination with the low nutritional value of the heather, means that the beetles find it difficult to build up sufficient fat reserves to survive winter on the Central Plateau.

With this in mind Paul Peterson (Landcare Research) and Paul Barrett (Massey University) went to Scotland in May to collect some ”nuggety” male heather beetles to mate with the smaller females back here in New Zealand. “Climate and body size data suggest that beetles of Scottish origin will be better adapted to the harsh climatic conditions found on the Central Plateau and past experience suggests that Scottish populations are less likely to be infected with the microsproridian disease than populations from England,” said Paul. “By bringing in Scottish males for only brief matings with New Zealand females we further reduce the risk of infection because the disease is not sexually transmitted,” he added.

On their journey from Scotland, the beetles not only faced long flights with no in-flight entertainment or meals, but also had to endure inspections at customs and were subjected to a scrupulous hygiene regime on arrival into containment where they were checked for diseases. It was little wonder that they were initially a bit reticent about “performing” when they were first introduced to the females! “Despite our observations of many matings, only a few females have produced fertile eggs. We have re-mated the same pairs in the hope this will stimulate more females into egg production,” said Lindsay Smith, who is caring for the beetles in containment at Lincoln. Any offspring will be checked to make sure they are disease-free before releasing them into Tongariro National Park.

This project represents a novel approach to explore the possibility of enhancing the performance of already established biocontrol agents so that they can better adapt to the local conditions and more effectively control the target weed. Only time will tell if this genetic rescue mission is successful.

This project is funded by the Ministry of Business, Innovation and Employment as part of Landcare Research’s Beating Weeds Programme. Paul Peterson’s trip to Scotland was funded by a Queen Elizabeth II Technicians’ Study Award.

CONTACT: Paul Peterson
petersonp@landcareresearch.co.nz

Finding a Perfect Match

Our project to develop biocontrol for pampas (*Cortaderia* spp.) has thrown up a few surprises. We initially planned to survey for potential biocontrol agents in Argentina, the only place in South America where both *Cortaderia selloana* and *C. jubata* were reported to occur. It did not take long to discover that taxonomic treatments can be problematic for identifying pampas, and there was a danger of looking at the wrong material. Molecular analysis quickly showed that *C. jubata* from Argentina was different to material in New Zealand of the same name. However, we were able to match New Zealand *C. jubata* with material in southern Ecuador, and Dr Maria Eugenia Ordonez and Dr Charlie Barnes (Pontificia Universidad Católica del Ecuador) have now undertaken two surveys for us there. A similar suite of fungi have been found on *C. jubata* in both countries. Unfortunately in the native range the plants also generally appear to be quite healthy, and only a black smut (*Ustilago* sp.) that damages the flowerheads is showing any potential as a biocontrol agent.

H. Norambuena

The soccer field site in Chile where we found the first match for New Zealand *Cortaderia selloana* material.

Finding a match for *Cortaderia selloana* has been much trickier. We struck out a second time with samples from Argentina, apart from two small infestations of pampas in Nelson and Southland, which were genetically different to *C. selloana* in the rest of the country. "We recommended these infestations should be eradicated as they represent a third pampas entity for New Zealand," said Gary Houliston. Recently we found more samples with some similarity to Argentinean pampas, growing in Auckland, that appear to be intermediate between the other two *C. selloana* entities in New Zealand. We have requested more pampas samples from Northland, Bay of Plenty, Waikato, and other parts of Auckland, to check if this material is widespread. If this proves to be the case then the project will have to take this into account.

Having ruled out Argentina as the source of the most common New Zealand genotype we looked next in neighbouring Uruguay. Dr Carlos Villamil (Universidad Nacional del Sur, Argentina) again collected and shipped samples to us, but they were also not the match we were hoping for. With the help of Dr Hernan Norambuena we then focused on Chile. In a small stroke of luck we found a perfect match for New Zealand material at a site where a handful of pampas plants had been deliberately planted next to a soccer field. But where had these plants come from? Fortunately Hernan was able to track down the man responsible for the planting 20 years earlier. Hernan then visited the source of these plants and collected further samples, which we have confirmed are the same. Further sampling around the two hotspots has provided further matches, and surveys for potential biocontrol agents can now get underway in earnest this spring. For the sake of completeness we will also check material from Brazil collected by Professor Henrique Pedrosa Macedo (University of Parana).

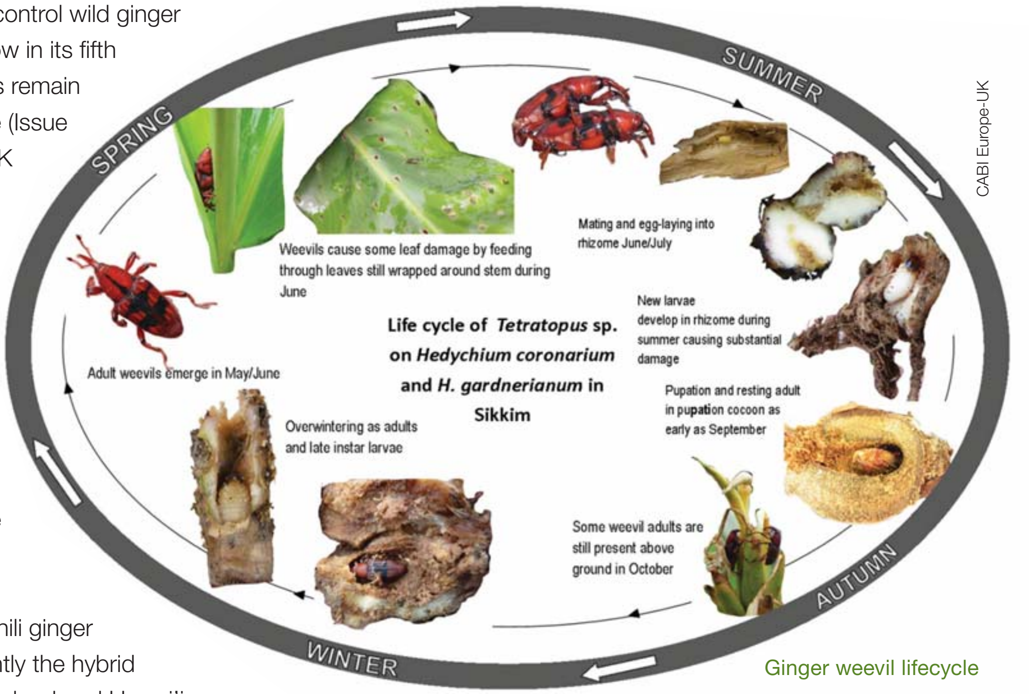
In additional to our classical biocontrol approach, Stan Bellgard is exploring whether the utility of synthetic and organic herbicides can be increased through co-formulation with a plant pathogen (*Nigrospora oryzae*) recovered from pampas. This could potentially allow the rates of herbicides used, and non-target damage, to be reduced and initial results are promising. Plants treated with Greenscapes ® (formulated from "fatty acid") died back initially, but resprouted after a month. Half of the plants were then treated with *Nigrospora*, which caused a significant reduction in growth. "Plants treated with just *Nigrospora* and water also had 50% less shoot biomass than those just treated with water, showing that *Nigrospora* can potentially have a useful impact on its own," said Stan. This work to beat pampas will be continuing, along with research in at least three South American countries, this spring.

This project is funded by the National Pampas Biocontrol Initiative through a grant from the Ministry for Primary Industries' Sustainable Farming Fund (11/049), supported by a number of co-funders, including the National Biocontrol Collective.

CONTACT: Lynley Hayes
hayesl@landcareresearch.co.nz

Ginger Biocontrol Edges Closer to Fruition

Research aiming to biologically control wild ginger (*Hedychium gardnerianum*) is now in its fifth phase and prospects of success remain promising. Since our last update (Issue 61), the team at CABI Europe-UK have continued to make progress.



Ginger weevil lifecycle

The large red and black weevil (*Tetratopus* sp.) is still looking good following further host-range testing. Despite some feeding on test plants in the Zingiberaceae by adults, egg-laying and feeding by larvae was only observed on white ginger (*Hedychium coronarium*), yellow ginger (*H. flavescens*), kahili ginger (*H. gardnerianum*), and importantly the hybrid species that is weedy in New Zealand and Hawai'i (thought to be *H. gardnerianum* x *H. coronarium*). The weevil appears to have a preference for *Hedychium* spp. both in the lab and in the field. The larvae feed in the rhizomes and can cause spectacular damage. Field observations and other evidence suggest that their developmental rate is slow and that there is only one generation per year. This has meant it is taking a long time for CABI to build up a sizeable captive population of the weevils for study and testing. They are now making efforts to see if development can be speeded up by feeding the larvae on a highly nutritious semi-artificial diet. This technique has worked well for other insects, such as purple loosestrife root-feeding weevil, which developed in just 2–3 months instead of 1–2 years. Unfortunately the ginger weevils were not interested in feeding on the prototype diet offered, and some experimentation will be required to identify a suitable formula.

The ginger frit fly (*Merochlorops dimorphus*), which is a stem-miner, is also still shaping up well. Some good advances have been made in understanding its life cycle, helping overcome initial difficulties rearing the fly in containment. "It takes about 2–3 months to develop from an egg to the adult stage and the fly makes its first appearance in spring when it emerges from the tip of the ginger stem," said Djami Djeddour, the lead scientist for the project. A second generation makes its appearance later in the summer. In the fly's native range, the winter is sufficiently cold to induce a dormant phase in their life cycle but it is not clear whether they over winter as adults or pupae in the ginger stem. Testing to date suggests that the fly will only complete its life cycle on kahili ginger and the hybrid species of interest to New Zealand and Hawai'i. None of the other test plants offered have been attractive to the fly. Although the fly has been challenging to rear, the team at CABI are optimistic about establishing a large culture so they can complete host testing and are well placed for mass rearing down the track.

On the flip side the gregarious moth (*Artona* spp.) is now looking like a less promising potential agent. Larval choice tests have shown that while they had a clear preference for yellow and white ginger they only fed to a limited degree on the hybrid ginger species of interest to New Zealand. There was also some feeding on plants outside of the Zingiberaceae such as canna lily (*Canna indica*). Unfortunately the larvae proved to be heavily parasitised with few making it through to adults, so oviposition tests to see what plants the moths will actually lay eggs on could not be carried out, and the colony died out. "Maintaining good breeding populations is critical to successful host testing and all of the most promising ginger agents have proved challenging in that regard," explained Djami.

Work to identify and study other insects found during recent surveys in India is also continuing and may yield more potential candidates. But for now the red and black weevil and the ginger frit fly are the front-runners and it is hoped that host testing of at least one of them can be completed in the next year.

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

CONTACT: Quentin Paynter
paynterq@landcareresearch.co.nz

Manchurian Wild Rice, Coming to a Wetland near You?

Manchurian wild rice (MWR; *Zizania latifolia*) is a valued food crop in its native range where it grows symbiotically with a fungus (*Ustilago esculenta*) that causes the stem to enlarge, forming a sizable vegetable. As its name suggests, MWR is a member of the grass family, Poaceae. The *Zizania* genus includes four species of wild rice. Apart from MWR, which is native to Taiwan, Eastern China and South-east Asia, the other three species are native to North America. The species most commonly harvested and eaten as grain is the annual species *Z. palustris*. MWR, gathered from the wild, was once an important grain in ancient China, but gradually lost importance with increasing population density and its habitat was converted for use in raising rice (*Oryza sativa*).

The plant was accidentally introduced into New Zealand via soil ballast from ships, and it is now considered a weed around waterways in Northland where it grows up to 4 m tall. MWR grows in fresh water, on river banks, in roadside ditches and poorly drained paddocks. It can even tolerate salt-water conditions, growing in lagoons and on tidal flats. Key infestations are around Dargaville, but the plant has recently established in Whangarei and the Far North. There are also small populations present in the Auckland, Waikato and Wellington regions. MWR is clearly a very invasive plant and one to be wary of. It can invade pastures, blocking or impeding drainage, and the rhizomes of the plant can also penetrate into and through stopbanks, opening them up and eventually destroying them. The effects of the plant are not limited to agricultural land of course, and many of the wetlands in New Zealand, which support rare biodiversity, could potentially be affected. Until now, herbicides have provided an effective control measure, but once the plant has become widespread it becomes logistically difficult to use them as a control tool. Also, herbicide use on a large scale is costly and can negatively affect waterways. MWR seed is spread by birds and spread can also occur when rhizome fragments break away, or are transported between water bodies by machinery and other human activities. Large floating mats can take root, forming new infestations.

Stan Bellgard and his colleagues recently prepared a study on the feasibility of biocontrol options for this weed. The natural enemies of wild rice and rice species – being commercially important crops – are well known. "There are a number of very promising host-specific insect agents that could be considered for biocontrol of wild rice in New Zealand," said Simon Fowler, who has studied rice pests in Sri Lanka and India. Insect options include a stem sucker (*Saccharosydne procerus*), stem borer (*Chilo suppressalis*), and a stem and head borer (*Apamea apamiformis*). "There are also several pathogens that could lend themselves to biocontrol of wild rice including the smut mentioned earlier (*Ustilago esculenta*) and a rust fungus (*Uromyces coronatus*), as well as a range of stem rots that might lend themselves to inundative control options," explained Stan.

Northland Regional Council

Manchurian wild rice.

The feasibility study also found that MWR is considered a good biocontrol target when run through the scoring system developed by Quentin Paynter. Attributes in its favour include the fact that it is not a weed its native range, and it is an aquatic plant, which have proven to be easier biocontrol targets than terrestrial weeds. Host-testing would also be relatively straightforward and cheap. Although in New Zealand we have some native, endemic and exotic plants in the Ehrhartoideae they are in a different sub-tribe (Ehrharteae) to MWR (Oryzeae), and there are unlikely to be any contentious issues of economic importance. The key question now is whether investment in developing a biocontrol programme is justified, given the relatively limited distribution of MWR currently. It is likely that biocontrol could be developed for this target for around $500,000.

This feasibility study was funded by and prepared for Northland Regional Council on behalf of the Ministry for Primary Industries.

CONTACT: Stan Bellgard
bellgards@landcareresearch.co.nz

Value of Silver Leaf Fungus Explored

No-one wants their drinking water contaminated with chemical herbicide residues. Nonetheless, we need to control weeds that grow in and beside water (riparian weeds). Control of willows growing in wetland areas of New Zealand is typically done by cutting them down and then applying glyphosate to the cut stumps to prevent resprouting. While this method undoubtedly reduces the amount of glyphosate entering waterways, when compared with aerial application, some of the chemical is still likely to be washed into catchments. Consequently, we have been exploring non-chemical alternatives for willow control in Auckland water-catchment areas, where there has been strong opposition to the use of chemicals by some residents. We have found a living organism (the silver leaf fungus, *Chondrostereum purpureum*) that can damage willows and are investigating its potential to be used against them. A herbicide having a plant-pathogenic microbe as its active ingredient is called a bioherbicide. If the microbe is a fungus, as is the case here, then it belongs to a subset of bioherbicides called mycoherbicides.

There are many steps to the successful development of a mycoherbicide, and with respect to using silver leaf fungus against riparian weeds we are at the early stages. So far we have done some work on step 1 (finding a suitable pathogen), step 2 (finding a suitable isolate of that pathogen), and step 3 (developing a method for mass producing the organism). Some research has also been done on step 6 (developing an appropriate formulation and application technology) by our colleagues at EnForm Tech.

Silver leaf fungus was identified as having potential for control of woody riparian weeds in Auckland water-catchments for two reasons: it has a wide host range among woody plants;

Dr Von Johnson of EnformTech surveying glasshouse trials.

and, it has already been developed successfully overseas as a cut-and-paste mycoherbicide, or rather as a “wood rot promoter”, a product that is much easier to register. The fungus is used to control red alder (*Alnus rubra*) and other woody weeds in utility rights-of-way (i.e. areas of forest cleared to make way for power lines etc.) in Canada and to control black cherry (*Prunus serotina*) and other woody weeds in plantation forests in the Netherlands. The products used in these two countries are “ChontrolTM” or “EcoclearTM” and “BioChonTM” respectively.

There are many isolates of silver leaf fungus stored in Landcare Research’s International Collection of Micro-organisms from Plants (ICMP) at Tamaki. Three of these were grown in several different artificial media (liquid broths) to determine which, if any of them, could be easily grown in this way. While all three isolates grew in the broths, the amount (biomass) of silver leaf fungus produced varied significantly according to which broth was used and which isolate was grown. “Happily, there was one clear winner in each case,” explained Stan Bellgard, who is leading this project. “The best broth was one containing malt extract, and the best isolate was one recovered from a *Prunus* (plum, peach or cherry) tree.”

Now that we had a silver leaf isolate that we could grow easily in the lab we applied it to two species of willow in glasshouse experiments, to see if it could damage these weeds. The two willow species targeted were crack willow (*Salix fragilis*) and grey willow (*S. cinerea*).

Stems of both crack and grey willow were harvested from a site in the Hunua Ranges – a southern water-catchment area of Auckland. Three- to four-metre lengths were cut in the field and transferred back to our laboratory at Tamaki where they were cut into smaller, 20-cm-long lengths for the experiment. One end of each stem was dipped in rooting hormone gel and planted in sterile potting mix. Each stem was then covered with one of the following four treatments: the silver leaf isolate in one of two different gel formulations, glyphosate 360 (full strength) in a commercially available gel formulation, or water (as a negative control).

After 22 weeks in a glasshouse the willow stems were harvested. We weighed them and counted the number of healthy and dead shoots. Small pieces of tissue were taken from each stem, surface sterilised (to remove contaminating organisms on the surface) and plated on to agar so that any fungi present within the willow tissue would grow. We analysed the sequences of any fungi resembling the silver leaf fungus that grew from the tissue fragments and compared them with the sequence of the isolate we applied.

This allowed us to tell whether the fungus we applied had successfully infected the woody stems and check that it wasn't already present (through infection in the field) on the stems treated with water or glyphosate.

The results of the glasshouse trial were promising. Our selected silver leaf isolate was found infecting the stems of both crack willow and grey willow that had been treated with it, while it wasn't present on the stems treated with water or glyphosate. Best of all, there were significantly more dead stems in the groups that were treated with one of the silver leaf fungus formulations when compared with the water treatment, for both species of willow. In fact, this silver leaf fungus formulation was just as effective as full-strength glyphosate when it came to killing cut stems. "When applied in the other formulation the fungus was just as effective as glyphosate on crack willow, but was significantly less effective than glyphosate (and statistically speaking, no better than water) on grey willow," observed Stan. "Since we want to develop a mycoherbicide that can be used against several different woody weeds, the formulation that worked well on both willow species seems to be the better choice at present."

With these promising results under our belt we applied the same four treatments to cut stems of crack and grey willow in the field. The field site was the same spot in the Hunua Ranges where the cut stems had been collected. After 32 weeks, 50% of all the cut and treated willow stumps had been colonised successfully by the silver leaf fungus. In the field, both of the gel formulations tested worked equally well with respect to allowing the fungus to colonise the cut stems. Data have been collected, but not yet analysed, on shoot regrowth and stem death. Once the analysis has been completed we will be able to compare the silver leaf treatments with the glyphosate and water treatments.

Our next steps towards developing a mycoherbicide for riparian weeds will be to "scale-up" our production and ensure we can produce stable inoculum with a long shelf-life, and to test the efficacy of our selected isolate and formulations on other riparian weeds including basket willow (*Salix viminalis*) and privet (*Ligustrum* spp.). We also plan further fieldwork to test the impact of weather conditions on efficacy (i.e. application in summer vs winter) and to develop "liquid" formulations that could be applied through drilling and/or injection into woody weeds. If results continue to be promising, the final steps will include identifying potential users and markets and finding a commercial sponsor so that a product can be registered and commercialised.

Hopefully one day in the not too distant future, Auckland residents will sleep a little more soundly because riparian weeds are being controlled biologically, rather than chemically, in their water catchments.

Grey willow in the field showing typical silver leaf fungus disease following treatment.

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

CONTACT: Stan Bellgard
bellgards@landcareresearch.co.nz

Biocontrol Agents Released in 2012/13

Species	Releases made
Broom leaf beetle (*Gonioctena olivacea*)	9
Broom gall mite (*Aceria genistae*)	54
Tradescantia leaf beetle (*Neolema ogloblini*)	7
Tradescantia stem beetle (*Lema basicostata*)	10
Tradescantia tip beetle (*Neolema abbreviata*)	12
Woolly nightshade lace bug (*Gargaphia decoris*)	5
Total	97

Mite We Have the Answer for Old Man's Beard?

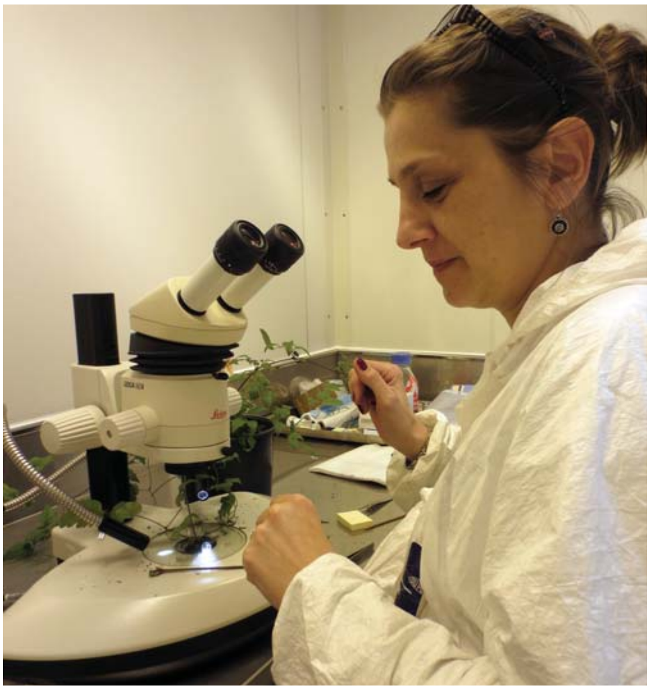
Three agents have already been released to control old man's beard (*Clematis vitalba*) (OMB) but none have been able to do the job for different reasons. However, a new line of enquiry involving an eriophyid mite sourced from Serbia and a fresh attempt to test a bark beetle in the UK offer some new hope. OMB has proved to be a very tough biocontrol target because surveys in the native range did not yield a long list of potential biocontrol agents and New Zealand has native *Clematis* species (e.g. *C. marata*, *C. forsteri*, *C. foetida*, *C. quadribracteolata*, *C. paniculata)* so any agents needed to be highly host specific.

The first agent, released in 1996, was a leaf-mining fly (*Phytomyza vitalbae*) that showed early promise, establishing readily and dispersing throughout New Zealand within a couple of years. But it didn't take long for its own natural enemies to catch up and it now regularly gets "hammered" by six native and two exotic parasitoids, which are usually hosted by other leaf-mining species. Parasitism significantly reduces the effectiveness of the OMB leaf miner as a biocontrol agent, but damaging outbreaks are still occasionally seen.

The second agent, released around the same time, was believed to be a superior strain of a fungus (*Phoma clematidina*) already known to be in New Zealand that generally caused only cosmetic damage to OMB. Initially heavy damage to OMB was observed at release sites, but did not persist. Subsequent studies could find no trace of the released strain, and it is possible that other strains already present, often as symptomless endophytes, were able to outcompete the introduced strain.

The OMB sawfly (*Monophadnus spinolae*) was released a few years later. It proved to be a very difficult insect to mass rear and then disappointingly failed to establish at any of the 16 sites where it was released, and so it was back to the drawing board.

A bark beetle (*Xylocleptes bispinus*), which was known to regularly kill vines in Europe, was investigated by colleagues at CABI in Switzerland early on, but had proved difficult to test. The beetle's behaviour ruled out tests in confined spaces, and New Zealand native *Clematis* plants failed to reach stems of sufficient diameter for any attack to occur before funding for the work ran out. Tests attempted with cut stems, shipped from New Zealand, also proved unsatisfactory. However, with a solution for OMB still desperately needed we revisited the bark beetle about 5 years ago. "Attempts were made to set up a field trial in the UK using mature New Zealand native *Clematis* shipped over from New Zealand," explained Hugh Gourlay. Unfortunately it proved to be too cold for our native Clematis to thrive and we were thwarted once again. However, a new collaboration with a small botanical garden in the Isle of Wight has provided a new ray of hope. The Isle of Wight has a more benign climate and the beetles occur there naturally. "We are establishing a new field trial there with the help of CABI Europe-UK, but the results may still be years away," warned Hugh.



Biljana transferring mites onto plants with the aid of a microscope, as the mites are not visible to the naked eye.

We are also exploring the potential of a European leaf and bud galling mite (*Aceria vitalbae*) that we only became aware of recently. The mite stunts the new growth and is likely to be highly host specific. Several attempts have been made to establish a mite colony in containment at Lincoln but again this has not proved to be straightforward. "Initial shipments of the mites arrived in bad shape after being delayed in transit or were heavily diseased," explained Lindsay Smith. Fortunately, mite expert Dr Biljana Vidovic from the University of Belgrade, Serbia, agreed to hand-deliver a colony of mites, which she painstakingly transferred onto potted OMB plants in containment in April. We are now waiting to see if they produce a colony that we can use to undertake host specificity testing. If we are unsuccessful we will explore the possibility of the host-testing being undertaken in Serbia.

This project is funded by the National Biocontrol Collective.

CONTACT: Lindsay Smith
smithl@landcareresearch.co.nz or
Hugh Gourlay
gourlayh@landcareresearch.co.nz

Spring Activities

Most biocontrol agents become active during spring, making it a busy time of year for biocontrol activities.

Broom leaf beetles (*Gonioctena olivacea*)

- Check release sites by beating plants over a tray. Look for the adults, which are 2–5 mm long and goldish-brown (females) through to orangey-red (males). Look also for greyish-brown larvae that may also be seen feeding on leaves and shoot tips.
- It is probably still a bit soon to begin redistribution.

Broom shoot moth (*Agonopterix assimilella*)

- Late spring is the best time to check release sites. Look for the caterpillars' feeding shelters made by webbing twigs together. Small caterpillars are dark reddish-brown and turn dark green as they get older. We have only found evidence of establishment at one site in Southland to date, so we will be interested to hear if you find any sign of the caterpillars
- We would not expect you to be able to begin redistribution just yet.

Green thistle beetles (*Cassida rubiginosa*)

- Check release sites for adult beetles which are 6–7.5 mm long and green, so are quite well camouflaged against the leaf. Adults and larvae make windows in the leaves. Larvae have a protective covering of old moulted skins and excrement. You may also see brownish clusters of eggs on the underside of leaves.
- It should be possible to begin redistribution at some sites. Use a garden-leaf vacuum machine and aim to shift at least 50 adults in the spring. Be careful to separate the beetles from other material collected, which may include pasture pests.

Ragwort plume moth (*Platyptilia isodactyla*)

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

Tradescantia damaged by the tip beetle larvae and adults.

Tradescantia leaf beetle (*Neolema ogloblini*)

- Check release sites for the slug-like larvae in areas where there is damage to the leaves. The larvae graze the epidermal tissue off the leaves, mostly on the undersides, and can skeletonise them. The dark metallic bronze adults may be hard to spot as they tend to drop when disturbed. Adults chew holes around the edges of leaves, and may consume entire leaves.

Tradescantia stem beetle (*Lema basicostata*)

- Most release sites are still fairly new but there is no harm in looking. The black knobbly adults also tend to drop when disturbed, but look for their feeding damage, which consists of elongated windows in the upper surfaces of leaves or sometimes whole leaves consumed. The larvae inside the stems will also be difficult to spot. Look for stems showing signs of necrosis or collapse and brown frass.

Tradescantia tip beetle (*Neolema abbreviata*)

- Releases only began earlier this year, but again there is no harm in looking. The adults are mostly black with yellow and black wing cases, but like the other tradescantia beetles tend to drop when disturbed. Larvae will also be difficult to see when they are feeding inside the tips, but brown frass may be visible. When tips are in short supply the slug-like larvae feed externally on the leaves.

Other agents

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

- Boneseed leafroller (*Tortrix* s.l. sp. "chrysanthemoides")
- Broom seed beetles (*Bruchidius villosus*)
- Gorse soft shoot moth (*Agonopterix ulicetella*)
- Gorse thrips (*Sericothrips staphylinus*)
- Gorse colonial hard shoot moth (*Pempelia genistella*)
- Woolly nightshade lacebug (*Gargaphia decoris*)

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

Who's Who in Biological Control of Weeds?

Alligator weed beetle *(Agasicles hygrophila)* **Alligator weed beetle** *(Disonycha argentinensis)* **Alligator weed moth** *(Arcola malloi)*	Foliage feeder, common, often provides excellent control on static water bodies. Foliage feeder, released widely in the early 1980s, failed to establish. Stem borer, 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, released widely, established at some NI sites but no significant damage yet. Appears to be limited by predation and parasitism.
Bridal creeper rust *(Puccinia myrsiphylli)*	Rust fungus, self-introduced, first noticed in 2005, widespread, causing severe damage at many sites.
Broom gall mite *(Aceria genistae)* **Broom leaf beetle** *(Gonioctena olivacea)* **Broom psyllid** *(Arytainilla spartiophila)* **Broom seed beetle** *(Bruchidius villosus)* **Broom shoot moth** *(Agonopterix assimilella)* **Broom twig miner** *(Leucoptera spartifoliella)*	Gall former, recently released widely, establishing well and severely damaging plants already at some sites. Foliage feeder, recently released widely, establishment appears likely at a few sites so far. Sap sucker, becoming common, some damaging outbreaks seen but may be limited by predation, impact unknown. Seed feeder, becoming common, showing potential to destroy many seeds. Foliage feeder, recently released at limited sites as difficult to rear, established at one site to date. Stem miner, self-introduced, common, often causes obvious damage.
Californian thistle flea beetle *(Altica carduorum)* **Californian thistle gall fly** *(Urophora cardui)* **Californian thistle leaf beetle** *(Lema cyanella)* **Californian thistle rust** *(Puccinia punctiformis)* **Californian thistle stem miner** *(Ceratapion onopordi)* **Green thistle beetle** *(Cassida rubiginosa)*	Foliage feeder, released widely during the early 1990s, failed to establish. Gall former, rare as galls tend to be eaten by sheep, impact unknown. Foliage feeder, only established at one site near Auckland where it causes obvious damage. Systemic rust fungus, self-introduced, common, damage usually not widespread. Stem miner, attacks a range of thistles, recently released at limited sites as difficult to rear, establishment success unknown. Foliage feeder, attacks a range of thistles, recently released widely, establishing well with obvious damage seen at some sites already.
Chilean needle grass rust *(Uromyces pencanus)*	Rust fungus, approved for release in 2011, releases are likely to begin in 2014, only South Island populations are likely to be susceptible.
Darwin's barberry flower bud weevil *(Anthonomus kuscheli)* **Darwin's barberry seed weevil** *(Berberidicola exaratus)*	Flower bud feeder, approved for release in 2012, releases are likely to begin this spring. Seed feeder, approved for release in 2012, releases are likely to begin this spring.
Gorse colonial hard shoot moth *(Pempelia genistella)* **Gorse hard shoot moth** *(Scythris grandipennis)* **Gorse pod moth** *(Cydia succedana)* **Gorse seed weevil** *(Exapion ulicis)* **Gorse soft shoot moth** *(Agonopterix umbellana)* **Gorse spider mite** *(Tetranychus lintearius)* **Gorse stem miner** *(Anisoplaca pytoptera)* **Gorse thrips** *(Sericothrips staphylinus)*	Foliage feeder, from limited releases established only in Canterbury, impact unknown but obvious damage seen at several sites. Foliage feeder, failed to establish from small number released at one site, no further releases planned due to rearing difficulties. Seed feeder, becoming common, can destroy many seeds in spring but not as effective in autumn, not well synchonised with gorse-flowering in some areas. Seed feeder, common, destroys many seeds in spring. Foliage feeder, established poorly in the NI but well established and common in parts of the SI, some impressive outbreaks seen, impact unknown. Sap sucker, common, often causes obvious damage but ability to persist is limited by predation. Stem miner, native, common in the SI, often causes obvious damage, lemon tree borer has similar impact in the NI. Sap sucker, becoming more common and widespread, impact unknown.
Heather beetle *(Lochmaea suturalis)*	Foliage feeder, established in Tongariro National Park and near Rotorua, damaging outbreaks are increasing annually at lower and mid-altitudes often killing plants.
Hemlock moth *(Agonopterix alstromeriana)*	Foliage feeder, self-introduced, common, often causes severe damage.
Hieracium crown hover fly *(Cheilosia psilophthalma)* **Hieracium gall midge** *(Macrolabis pilosellae)*	Crown feeder, released at limited sites as difficult to rear, establishment success unknown. Gall former, widely released and has established in both islands but is not yet common, 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 common at some sites in the SI and established at one site in the NI, impact unknown but reduces stolon length in laboratory trials. Foliage feeder, only released at one site due to rearing difficulties, did not establish. Root feeder, released at limited sites as difficult to rear, establishment success unknown, Leaf rust fungus, self and deliberately introduced, common, causes slight damage to some mouse-ear hawkweed, plants vary in susceptibility.
Lantana blister rust *(Puccinia lantanae)* **Lantana leaf rust** *(Prospodium tuberculatum)* **Lantana plume moth** *(Lantanophaga pusillidactyla)*	Rust fungus, approved for release in 2012, releases will begin this spring, damages leaves and stems and can cause whole branches to die back. Rust fungus, approved for release in 2012, releases will begin this spring, causes leaf death and defoliation. Flower feeder, self-introduced, host-range, distribution and impact unknown.
Mexican devil weed gall fly *(Procecidochares utilis)* **Mexican devil weed leaf fungus** *(Passalora ageratinae)*	Gall former, common, initially high impact but now reduced considerably by Australian parasitic wasp. Leaf fungus, introduced with the gall fly in 1958, common and almost certainly having an impact.
Mist flower fungus *(Entyloma ageratinae)* **Mist flower gall fly** *(Procecidochares alani)*	Leaf smut, common and often causes severe damage, has led to a dramatic reduction in mist flower. Gall former, common now at many sites, enhances excellent control of mist flower by the fungus.
Moth plant beetle *(Colaspis argentinensis)*	Root feeder, approved for release in 2011, releases are likely to begin in 2014.
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 thistle agents. Seed feeder, becoming common, can help to provide control in conjunction with other thistle agents. Seed feeder, common on several thistles, can help to provide control of nodding thistle in conjunction with other 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 become rare or died out. Leaf miner, common, damaging outbreaks occasionally seen but appears to be limited by parasitism. Foliage feeder, released at limited sites as difficult to rear, probably failed to establish.
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, released widely, probably failed to establish. Root and crown feeder, common, provides excellent control in many areas. Stem, crown and root borer, recently released widely, establishing well and quickly reducing ragwort noticeably at many 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, nearly always provides excellent control. Gall former, established in the northern South Island, often causes severe stunting.
Scotch thistle gall fly *(Urophora stylata)*	Seed feeder, released at limited sites, establishing and spreading readily, fewer thistles observed at some sites, impact unknown.
Tradescantia leaf beetle *(Neolema ogloblini)* **Tradescantia stem beetle** *(Lema basicostata)* **Tradescantia tip beetle** *(Neolema abbreviata)* **Tradescantia yellow leaf spot** *(Kordyana* sp.*)*	Foliage feeder, released widely since 2011, some promising signs of establishment seen. Stem borer, releases began in 2012 and are continuing. Tip feeder, releases began in 2013 and are continuing. Leaf fungus, approved for released in 2013, releases are likely to begin in 2014.
Woolly nightshade lace bug *(Gargaphia decoris)*	Sap sucker, recently released widely, establishing readily at many sites, some obvious damage seen, impact unknown.

Further Reading

Bellgard S, Probst C, Paynter Q, Fowler S 2013. **Feasibility study on the biocontrol of Manchurian wild rice *Zizania latifolia* (Griesb.) TurcZ. ex Stamf.** Landcare Research Contract Report LC1317. Prepared for Northland Regional Council on behalf of the Ministry for Primary Industries. 33 p.

Fowler SV, Barreto R, Dodd S, Macedo DM, Paynter Q, Pedrosa-Macedo JH, Pereira OL, Peterson P, Smith L, Waipara N, Winks CJ, Forrester G 2013. ***Tradescantia fluminensis*, an exotic weed affecting native forest regeneration in New Zealand: ecological surveys, safety tests and releases of four biocontrol agents from Brazil.** Biological Control 64: 323–329.

Gerard PJ, Barringer JRF, Charles JG, Fowler SV, Kean JM, Phillips CB, Tait AB, Walker GP 2013. **Potential effects of climate change on biological control systems: case studies from New Zealand.** Biocontrol 58: 149–162.

Gourlay AH, Shaw R, Cock MJW 2013. **The Nagoya Protocol on access to genetic resources under the convention on biological diversity: workshop report.** In: Wu Y, Johnson T, Sing S, Raghu S, Wheeler G, Pratt P, Warner K, Centre T, Goolsby J, Reardon R eds Proceedings of the XIII International Symposium on Biological Control of Weeds. Forest Health Technology Enterprise Team, USA. Pp. 493–495.

Groenteman R 2013. **Prospects for the biological control of tutsan (*Hypericum androsaemum*) in New Zealand.** In: Wu Y, Johnson T, Sing S, Raghu S, Wheeler G, Pratt P, Warner K, Centre T, Goolsby J, Reardon R eds Proceedings of the XIII International Symposium on Biological Control of Weeds. Forest Health Technology Enterprise Team, USA. Pp. 128–133.

Hill R, Campbell D, Hayes L, Corin S, Fowler S 2013. **Why the New Zealand regulatory system for introducing new biological control agents works.** In: Wu Y, Johnson T, Sing S, Raghu S, Wheeler G, Pratt P, Warner K, Centre T, Goolsby J, Reardon R eds Proceedings of the XIII International Symposium on Biological Control of Weeds. Forest Health Technology Enterprise Team, USA. Pp. 75–83.

McLaren DA, Cullen JM, Morley TB, Ireson JE, Snell KA, Gourlay AH, Sagliocco JL 2013. **Host specificity and impacts of *Platyptilia isodactyla* (Lepidoptera: Pterophoridae), a biological control agent for *Jacobaea vulgaris* (Asteraceae) in Australia and New Zealand.** In: Wu Y, Johnson T, Sing S, Raghu S, Wheeler G, Pratt P, Warner K, Centre T, Goolsby J, Reardon R eds Proceedings of the XIII International Symposium on Biological Control of Weeds. Forest Health Technology Enterprise Team, USA. Pp. 389–394.

Paynter Q 2013. **Feasibility of biocontrol of *Lagarosiphon major* in New Zealand**. Landcare Research Contract Report LC1234. Prepared for Horizons Regional Council (Envirolink 2148-HZLC93). 25 p.

Paynter Q 2013. **Feasibility of biocontrol of *Ceratophllyum demersum* and *Egeria densa* in New Zealand**. Landcare Research Contract Report LC1492. Prepared for Greater Wellington Regional Council. 35 p.

Sagliocco JL, Sheppard A, Hosking J, Hodge P, Paynter Q, Gourlay H, Ireson J 2013. **Host specificity testing, release and successful establishment of the broom gall mite (*Aceria genistae*) in Australia and New Zealand for the biological control of broom (*Cytisus scoparius*).** In: Wu Y, Johnson T, Sing S, Raghu S, Wheeler G, Pratt P, Warner K, Centre T, Goolsby J, Reardon R eds Proceedings of the XIII International Symposium on Biological Control of Weeds. Forest Health Technology Enterprise Team, USA. Pp. 409–416.

Sheppard A, Warner KD, Hill M, McEvoy P, Fowler S, Hill R 2013. **Is classical biological control a 20th century "old science" paradigm that is losing its way?: workshop report.** In: Wu Y, Johnson T, Sing S, Raghu S, Wheeler G, Pratt P, Warner K, Centre T, Goolsby J, Reardon R eds Proceedings of the XIII International Symposium on Biological Control of Weeds. Forest Health Technology Enterprise Team, USA. Pp. 488–492.

Thompson S, Fletcher JD, Ziebell H, Beard S, Panda P, Jorgensen N, Fowler SV, Liefting LW, Berry N, Pitman AR 2013. **First report of '*Candidatus* Liberibacter europaeus' associated with psyllid infested Scotch broom.** New Disease Reports 27(6). [http://dx.doi.org/10.5197/j.2044-0588.2013.027.006]

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

www.landcareresearch.co.nz

Editor: Lynley Hayes
Any enquiries to Lynley Hayes

Thanks to: Christine Bezar
Contributions: Jane Barton, Alison Evans
Design: Nicolette Faville

www.weedbusters.org.nz

ISSN 1173-762X (Print) ISSN 1177-8784 (Online)