Patua Te Otaota - Weed Clippings

Biological Control of Weeds Annual Review 2001/2002

What's Inside:

Manaaki Whenua
Landcare Research

Introduction

- Welcome to the eighth issue of *Patua Te Otaota - Weed Clippings,* which we have published to keep clients, stakeholders, and colleagues informed about our progress in developing sustainable biological control solutions for weed problems.

Headlines

- Familiarise yourself with our first bone-seed agent, which has recently passed through testing with flying colours.
- Avoid tears before bedtime by checking out the do's and don'ts for using herbicides around broom agents.
- Marvel at the mist flower gall fly and white smut's outstanding performances.
- Find out if predictions made about the safety of the gorse pod moth have actually stood the test of time.
- See if we ought to be cutting some barberry species and yet another climber, Japanese honeysuckle, down to size.
- Rejoice in the news that a tricky little lace bug for woolly nightshade is not impressed with our natives at all.
- Check out why we think life will be much easier for the heather beetle here than back home.
- Probe the likely consequences if the two new hawkweed debutants and their buddies do a good job.

- Learn about how colleagues in Australia are helping us to make the most of one of their exports, blackberry rust.
- Read about steady progress in the search for agents to cut down two of our most undesirable grasses, and field trials to test the potential of a couple of mycoherbicides for gorse and broom.
- Uncover the reasons why we think two thrips are better than one for gorse control.
- Take a look at the agents that are likely to be our next weapons against Californian thistle.
- Peruse our summary of who's who in biological control of weeds and the most important vital statistics you need to have at your fingertips.

Biological control workshops continue to be popular - Lynley Hayes puts another group through their paces.

Landcare Research celebrated its 10th anniversary on 1 July 2002.

Control Agents Released in 2001/02

Species		Releases made
Broom psyllid	(*Arytainilla spartiophila*)	1
Broom seed beetle	(*Bruchidius villosus*)	20
Californian thistle gall fly	(*Urophora cardui*)	1
Gorse colonial hard shoot moth	(*Pempelia genistella*)	6
Gorse thrips, Portuguese strain	(*Sericothrips staphylinus*)	9
Heather beetle	(*Lochmaea suturalis*)	3*
Hieracium gall wasp	(*Aulacidea subterminalis*)	13
Hieracium gall midge	(*Macrolabis pilosellae*)	2
Hieracium hover fly	(*Cheilosia urbana*)	1
Mist flower gall fly	(*Procecidochares alani*)	5
Old man's beard sawfly	(*Monophadnus spinolae*)	1
Total		62

* some redistribution was also undertaken at Tongariro

The Next High Roller?

This year we broke some new ground, making our first foray into agents for bone-seed (*Chrysanthemoides monilifera* ssp. *monilifera).* Bone-seed is attacked by a wide range of native and exotic species here, but the damage is not usually severe and so some specialist biological control agents were deemed necessary. Chris Winks travelled to South Africa to test the bone-seed leaf roller ('*Tortix*' sp.). He was based at CSIRO's Biological Control Unit at the University of Cape Town and ably assisted there by Petra Muller. "We chose this moth because, despite being heavily parasitised in its homeland (up to 80%), it can still cause considerable damage to bone-seed," explained Chris. It is believed that damaging outbreaks occur when the moth manages to give its enemies the slip from time to time. The larval stage does the damage by webbing together the tips of branches to make a shelter and then munching on the leaf material inside. Large caterpillars can also web older leaves further down the stems so whole plants can be defoliated and killed.

Ninety-six plant species belonging to 31 families were tested under the Australian programme. "During indoor cage tests the moths gave researchers a few sleepless nights when they attacked lots of non-target hosts, which was quite contrary to the high level of specificity seen in the field in South Africa," revealed Chris. This meant that extensive more-realistic outdoor tests became the order of the day. These tests suggested that the leaf roller is restricted to the genus *Chrysanthemoides*, with limited attack possible on another member of the same tribe, *Calendula,* if grown cheek to jowl. We do not have any native Calenduleae in New Zealand, but the two most commonly grown ornamental members of this tribe (*Calendula officinalis* and *Osteospermum fruticosum)* have been tested along with representatives from other tribes within the Asteraceae family. "We are happy to report that the leaf rollers only attacked the bone-seed plants and ignored all the others," exclaimed Chris enthusiastically. He has recommended that an application should now be submitted to the Environmental Risk Management Authority requesting permission to released the leaf roller here. We hope to start work on this application soon and would like to thank Environment Canterbury for offering to be the applicant.

Bone-seed devastated by the leaf roller in South Africa (inset the culprit).

The leaf roller has already been tested and cleared for release in Australia. The first field releases were made in April 2000 but establishment is proving difficult thanks to aggressive predators, such as ants, that are common on bone-seed over there. "We are hoping that the leaf roller will find the natives here a little friendlier," said Chris.

This project was funded by Auckland, Northland, Taranaki, and Wellington Regional Councils; Environments Bay of Plenty, Canterbury, and Waikato; horizons.mw; and Tasman District Council.

Keeping Broom Agents Safe

This year we completed some studies on the impact of herbicides on broom (*Cytisus scoparius*) biological control agents. We tested the products (or equivalents) that are most commonly used by farmers and contractors in one of the worst broom-infested parts of the country, North Canterbury. These were Renovate® (triclopyr), Tordon Brushkiller® (triclopyr and picloram), and Roundup® (glyphosate), plus the surfactants Pulse® (polydimethylsiloxane) and Boost® (dimethicone copolyol)*. There tends to be considerable variation in the recommended (and actual) application rates for herbicides so, as well as testing knapsack and spray gun field rates, we also tested the strongest possible concentrations the broom control agents might ever come into contact with.

Most herbicides are thought to have low direct toxicity to insects because their active ingredients have been specifically selected to act on systems only found in plants. "However, we have found that the herbicides and surfactants commonly used for broom control can harm biological control agents," revealed Lindsay Smith. The three broom agents varied quite a lot in their susceptibility to the herbicides and this is likely to be related to their differing morphology as well as the variety of formulations tested. Our main findings were:

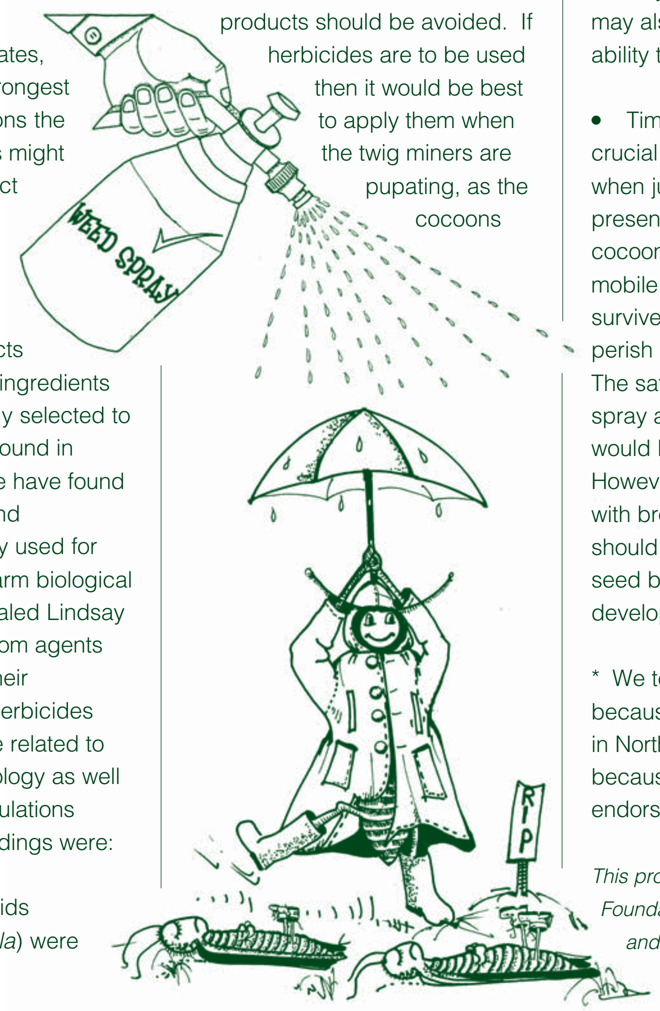
- Adult broom psyllids (*Arytainilla spartiophila*) were extremely sensitive, which isn't surprising given their delicate bodies and membranous wings. They suffered high mortality at the recommended field rates of all substances tested. Tordon Brushkiller® was the least damaging herbicide tested but is still likely to kill about half of your psyllid population. If possible, it would be best not to expose psyllids to any herbicides at all.

- Adult broom twig miner moths (*Leucoptera spartifoliella*) were moderately sensitive, as their scaled wings appear to provide some protection. The moths were not seriously affected by field rates of Roundup® or Tordon Brushkiller®, but the other products should be avoided. If herbicides are to be used then it would be best to apply them when the twig miners are pupating, as the cocoons appear to offer extra protection and subsequent adult emergence does not seem to be affected.

- Adult broom seed beetles (*Bruchidius villosus*), with their tough exoskeletons, were the hardiest of the lot. Field rates of Roundup® and Renovate® did not harm the adult beetles.

- The surfactants proved more toxic than any of the herbicides and should be avoided at all costs. Surfactants act by reducing the surface tension of herbicides and dissolving plants' waxy protective cuticles. They may act in a similar way on insects, making them more prone to dehydration and chilling, and may also interfere with the insect's ability to breathe.

- Timing of spraying can be crucial. Avoid spraying at times when juvenile life stages are present (except for twig miner cocoons) because they are less mobile and, even if they can survive a dose of herbicide, will perish if their food source dies. The safest time of the year to spray and not harm twig miners would be October-November. However, this conflicts slightly with broom seed beetles as you should not spray when broom seed beetle eggs and larvae are developing (October-February).



* We tested the above products because they are commonly used in North Canterbury and not because Landcare Research endorses them in any way.

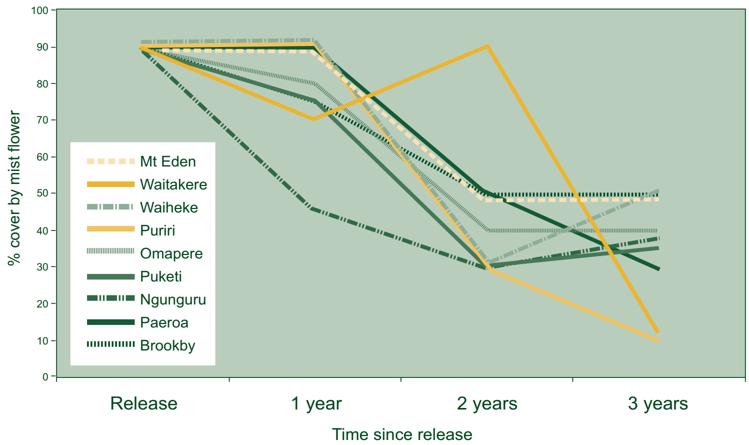
This project was funded by the Foundation for Science, Research and Technology.

Galls All Round

The mist flower (*Ageratina riparia*) project continues to excite and enthrall. Like its predecessor (the white smut fungus, *Entyloma ageratinae*) the mist flower gall fly (*Procecidochares alani*) is living up to expectations. "Although it's only just over a year since the first flies were released, nearly half of the 31 release sites have been checked and galls were found at two-thirds of them," explained Chris Winks. At the Mt Eden site, in central Auckland, huge numbers of galls were present. More than three-quarters of stems sampled were galled, which works out at 72.5 galls/m^2 – an astonishing result given that only 180 flies were released here last autumn. This level of attack suggests that the gall fly could already be having a considerable impact on mist flower .

The white smut fungus has had a head start on the gall fly, and has spread rapidly (more than 100 km in 3 years) to attack the weed now virtually throughout its range. It's also beginning to make a difference. "There has been a reduction in mist flower cover at all nine of the original release sites – the average reduction is 55%," revealed Jane Fröhlich (see graph). Trials set up in the Waitakere Ranges, near Auckland, showed that this aggressive weed was still actively expanding its range, until the fungus kicked in in 1999 (see table). The reduction achieved here between 1999 and 2001 is huge, estimated to be around 74%.

A big fat juicy gall (with fly exit hole) photographed at Mt Eden.



Estimated percentage cover of mist flower within 5 m of tracks in Waitakere Ranges parkland	Oct-Nov 1998	Oct-Nov 1999	Oct-Nov 2001
	24 100 m^2	32 920 m^2	8 450 m^2

So what does this reduction in the percentage cover of mist flower achieved so far mean in real terms for the Waitakere Ranges at least? The heartwarming news is that follow-up studies are showing that native plants, rather than other weeds, are beginning to bounce back. The fungus hits hardest in early spring and the plants do their best to replace lost foliage throughout summer and autumn.

Now that the gall fly is out and about we can expect to see them hone in on this regrowth and for the plants to suffer greater losses. We expect to see mist flower become only a shadow of its former self in years to come.

The assessment work reported here was funded by the Auckland Regional Council and Environment Waikato.

Searching for Evidence of Bugs Gone Bad

Multichoice?

Before any biological control agent is released in New Zealand it undergoes rigorous host specificity testing (using internationally accepted procedures) to ensure that, to the best of our knowledge, it is safe to release. These days insect behaviour is taken carefully into consideration, which helps us to make better predictions about the risk of non-target attack. For example, moths often react badly to being caged and after crashing into the walls a few times become desperate enough to lay their eggs anywhere. On the other hand, beetles cope far better with being caged (they tend to crawl around) and are more discriminating.

A more complex issue is whether to test insects by giving them no-choice (starvation tests) or a choice of plants (including their normal food). The problem with starvation tests is that insects will sometimes attack plants that they would normally never touch in the field. The likelihood of false positive results increases the longer tests are run and the insects become increasingly desperate. Also, if you have a limited supply of insects (which often happens when testing is done in quarantine) then reusing them can compound the problem. "In the past, both no-choice and choice tests have been used, and this remains our preferred option," explained Simon Fowler.

Starvation tests are useful in that they help to identify a worst-case scenario, i.e. what might briefly happen if the normal host is not available for some reason. "It can also gives us clues about where to look if we want to check that agents are continuing to behave themselves, " said Simon.

Toni Withers beside a light trap at the top of Tomahawk Gully.

Going retro

Given the recent controversy over nodding thistle receptacle weevil (*Rhinocyllus conicus*) attacking native thistles in the USA, we are now carefully following up on agents released here. We have been sifting through historical documents and double-checking exactly what testing was done in earlier times. Many agents were tested when the methods used were less rigorous and more focused on crop and ornamental plants than native species. "However, I was pleased to find that even though cinnabar moth (*Tyria jacobaeae*) and gorse seed weevil (*Exapion ulicis*) were tested more than 70 years ago, some critical native plants (*Senecio* and *Carmichaelia* respectively) were included," revealed Simon. Since the 1980s it has become routine to test a range of native plants, including any close relatives; so a good grasp of plant classification is required.

A case in point

We have always claimed that releasing biological control agents is a low risk activity* and we are now carefully checking that this claim still holds true. Toni Withers (an expert in host specificity testing with Forest Research) has helped us to scrutinise gorse pod moth (*Cydia succedana)* testing that took place prior to its release in 1992. "The original testing indicated that the potential range of the larvae might be wider than just gorse (*Ulex europaeus*)," said

Toni. In laboratory tests the larvae were able to feed on a range of other leguminous pods including kōwhai (*Sophora* spp.), lentils (*Lens culinaris*), kakabeak (*Clianthus puniceus*), and peas (*Pisum sativum*). However, as female moths refused to lay on any of these plants, the risks were deemed to be low. "It is quite common for larval stages to chew on a variety of plants during laboratory tests, and not actually attack them in the field," explained Toni. "Especially when their preferred food is abundant (like gorse)."

As we have reported earlier, we have been following up on the finding 3 years ago of large numbers of gorse pod moths in Tomahawk Gully, near Twizel, by Graham White (Lincoln University). We have pulled out all the stops on this one because this area has lots of prostrate kōwhai (*Sophora prostrata*) and no gorse. A team led by Simon has been investigating. "We sampled flowers and small pods from about 40% of the kōwhai plants," explained Simon. "We had to be certain that if any non-target attack was occurring, we were going to find it!" Pheromone trapping showed that plenty of adult pod moths were present in the gully but fortunately no attack on kōwhai flowers or pods was found. This was a relief, considering that when Toni took some moths back to her laboratory in Rotorua, she was able to force the larvae to attack the kōwhai pods during starvation tests. This confirmed what we knew all along, that the potential for attack was certainly there, but also our argument about safety due to the moths being unwilling to lay on other plants has also been borne out. So where were the pod moths coming from? The source is now thought to be a small gorse infestation 4 km away. The moths are good fliers and strong winds may sometimes channel them up into the gully.

We have also recently checked out peas too. Richard Hill (Richard Hill & Associates) was responsible for bringing in the gorse pod moth to New Zealand, and he has checked pea crops surrounded by gorse hedges in Canterbury. He found that about 30% of gorse pods in these hedges were being attacked so there was no shortage of moths present in the area. He also podded hundreds of peas and was able to breathe a sigh of relief when he found not a single gorse pod moth! Thank goodness for that too.

To complete our search we now need to look for signs of non-target impacts (or evidence that none is occurring) on kakabeak, other species of kōwhai, and perhaps even on other exotic plants such as lentils and broom (*Cytisus scoparius*). "This research will help us to get to the stage where we can be 100% confident that our predictions really will come true when we release any new agents," said Toni.

This research was funded by the Foundation for Science, Research and Technology.

*Only one of the agents we have released here has so far caught us by surprise. We did not predict that the broom seed beetle (*Bruchidius villosus*) would attack a close relative, tree lucerne (*Chamaecytisus palmensis*), and Melanie Haines is undertaking a PhD study to figure out how this happened and what we can learn from it. Fortunately it's not a serious glitch since tree lucerne is an exotic plant (with weedy tendencies), and there will still be plenty of undamaged seeds if people wish to persist with growing it.

More Plants Behaving Badly

Taking on the barberrians

Three species of barberry (*Berberis* spp.) from three different continents are starting to raise eyebrows, so we have looked into the possibility of developing a biological control programme against them. Darwin's barberry (*B. darwinii*) is widely distributed throughout the country, being especially bad in the Wellington, Otago and Southland regions. Barberry (*B. glaucocarpa*) is common throughout lowland areas here, especially where rainfall is high, and European barberry (*B. vulgaris*) occurs mainly in inland areas of Canterbury and Otago. The latter appears to be less invasive than the other two, which can take over lightly grazed pasture, open scrub and bush, and even mature forests. Both Darwin's barberry and barberry produce bountiful crops of berries that attract possums and birds, which disperse the seeds.

Because of their ability to form impenetrable prickly thickets, barberry species have been a popular choice for hedging, as well as being widely grown in gardens for their good looks alone. A number of *Berberis* species and cultivars are still commonly sold here, but we should be cautious of these too. "Japanese barberry (*B. thunbergii*), for example, has become a significant weed in the United States and there is a good chance it could do the same here," warns Peter McGregor. Overseas, *Berberis* species have been used extensively for medical purposes (mainly treating infections and liver and heart problems) for more than 3000 years in Indian and Chinese medicine. Recent studies have confirmed the value of these traditional medicines.

As luck would have it we don't have any indigenous plants here that are closely related to *Berberis,* or any economically or culturally important species. We just need to sort out what species of *Berberis* we would like any potential control agents to attack. "If it is not deemed necessary to keep ornamental *Berberis* out of the line of fire, then the pool of potential control agents could be extremely large," concluded Peter. If we only go for the weedy ones, then there are still likely to be plenty of candidates to choose from. A good number of natural enemies are already known to attack *Berberis* species (see table) and surveys in their native ranges are likely to turn up more. It may be possible to target flower and fruit production only, leaving the plants themselves undamaged for continued use as hedges. Overall the prospects for developing biological control for barberry species look extremely good.

Some well known barberry pests

Aphid (*Liosomaphis berberidis*) – causes deformation and premature leaf fall of Japanese barberry in Poland. Recorded here from barberry

Barberry rust (*Aecidium berberidis*) – has caused serious damage to European barberry in Iran

Fly (*Lasioptera* sp.) – damages fruit of *B. chitryia* in India

Fruit fly (*Rhagoletis meigenii*) – attacks European barberry in Belgium

Fungus *(Lanzia parasitica)* – causes severe leaf drop in European barberry

Leaf spot fungus (*Pseudocercospora berberis-vulgare*) – infects European barberry

Mites (*Eriophyes caliberberis, Aceria* sp.) – attack Japanese barberry in Poland

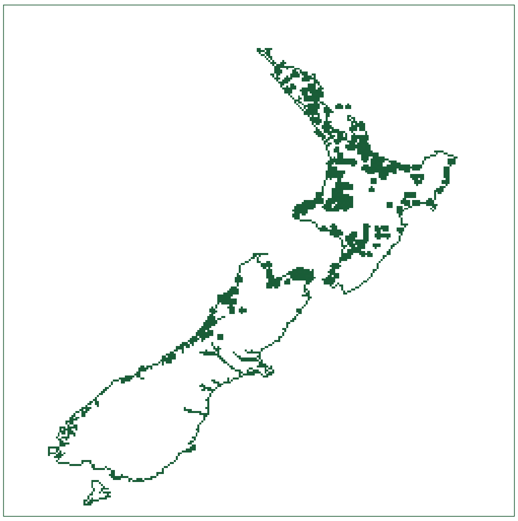
Rust (*Puccinia* spp.) – several species infect *Berberis* spp. but some may require alternate hosts, e.g. grasses and cereals; not well studied

Sawfly (*Arge berberidis*) – a pest of Japanese barberry in the Netherlands

Sweet-smelling strangler

Yet another climber is beginning to make a nuisance of itself in parts of New Zealand. Japanese honeysuckle (*Lonicera japonica*), a native of eastern Asia, was available for purchase here way back in 1872 and, like old man's beard (*Clematis vitalba*), was a popular garden plant with early settlers. This sweet-smelling climber is believed to have jumped the fence in the Auckland area somewhere between 1940 and 1970. Although birds disperse the seeds, seedlings are rare and spread has occurred relatively slowly through human activities such as the dumping of stem fragments, deliberate plantings, and machinery use (e.g. hedge trimmers), as well as by grazing mammals. Its current distribution is believed to be only a fraction of where it could grow. "The plant has also naturalised in Australia, North America, Hawai'i, South America, and parts of Europe so there could be some overseas interest in a collaborative project," explained Rachel Standish, who carried out this investigation for us.

A system designed to rank the relative threats posed by our weeds has come up with a score of 31 out of 34 for Japanese honeysuckle, placing it between old man's beard (33) and banana passionfruit (*Passiflora* spp.) (27). At present the plant is causing the most grief in the lower half of the North Island and the top of the South Island (see map). It finds many habitats to its liking including hedges and roadsides, wasteland, open scrubland, woodlands and shrublands, forest margins (including pine plantations), wetlands and riparian areas. "Many people regard Japanese honeysuckle as difficult to eradicate," said Rachel. A wide range of herbicides can be used to control the plant but follow-up treatments are often necessary and non-target damage can result. Manual control can work for small infestations, provided you get every bit, and dispose of the material carefully so that it doesn't regrow.



Distribution of Japanese honeysuckle on conservation land (data supplied by the Department of Conservation, 2002).

As far as prospects for biological control go, there are some hurdles that would need to be overcome but they may not be insurmountable. "There has been much debate about where the Caprifoliaceae fit into plant classification," revealed Rachel. The most recent placement would suggest that we don't have any closely related native plants to contend with. However, this family is important to horticulture, with 32 other *Lonicera* cultivars alone sold in nurseries here. Any potential control agents are therefore likely to require a high degree of specificity, and the pathogen approach would appear to be the way to go. Fourteen fungal pathogens are known to attack the plant overseas, but possibly only two of these are restricted to Japanese honeysuckle (*Microsphaera erlangshanensis, M. penicillata*). Further research is needed, and surveys in the plant's native range may uncover other candidates, including insects. An alternative approach would be to make a case that the damage caused by this weed greatly outweighs the value of cultivated honeysuckle to gardeners and utilise less-specific agents. "Better information on the impact of Japanese honeysuckle and its removal is needed before a new biological control programme against this target could begin," concluded Rachel.

These feasibility studies were funded by Auckland, Northland, Taranaki, and Wellington Regional Councils; horizons.mw; and Environments Bay of Plenty, Canterbury, Southland and Waikato. *Copies of the full reports are available from Lynley Hayes (see back cover for contact details).*

News Flashes

No Longer in the Dark

A programme against woolly nightshade (*Solanum mauritianum*) has been underway in South Africa for a number of years and we have been following it with great interest. The project has been challenging because there has been a tendency for potential agents to attack desirable *Solanum* species, e.g. egg plant (*S. melongena*), in cage tests. However, they have never done so in real-life field situations. South African colleagues have been keen to collaborate with us and we recently took up their kind offer of screening our native poroporo (*S. laciniatum, S. aviculare),* the cosmopolitan small-flowered nightshade (*S. americanum),* as well as egg plant, and two minor crops, pepino (*S. muricatum*), and naranjilla (*S. quitoense*), against their newly released lace bug (*Gargaphia decoris*). These lace bugs can feed on the leaves causing extensive damage and premature leaf fall. Toni Withers, a host specificity testing expert with Forest Research, has been helping us with this project and she flew over to South Africa in February to oversee the tests. "The lace bugs absolutely hated our natives," reports Toni. "They weren't very impressed with small-flowered nightshade or egg plant either." The pepino and naranjilla plants hadn't grown well enough to be tested at the same time and Terry Olckers (Plant Protection Research Institute) will test them for us later. We know from previous testing that the lace bugs might attack another of our weeds, apple of Sodom *(S. linnaeanum*), to some extent, which would be a bonus. "I strongly believe it would be worth importing the lace bug into quarantine for further evaluation," concluded Toni.

Woolly nightshade lace bugs

Enemy-Free Zone for Heather Beetle?

The heather beetle (*Lochmaea suturalis*) is continuing to do well at Te Piripiri in Tongariro National Park, and is starting to move out from the release point. We have been keeping a close eye out for any native parasites or predators that might throw a spanner in the works. Heather beetle populations are known in Europe to outbreak sporadically and then fairly quickly collapse again, and we have been looking into this phenomenon more closely to find out why. "By delving into literature records, we have found that anywhere from 6 to 100% of larvae can be killed by a parasitic wasp (*Asecodes mento*), and our own data show that up to 88% of adults can be parasitised by a fly (*Degeeria collaris*)," revealed Simon Fowler. We also know from earlier work that a microsporidian (protozoan) disease is prevalent in heather beetle populations overseas and we now believe that a combination of parasitism and disease limits these beetles in Europe, and not a shortage of food.

Obviously, if heather beetles could be freed from these restraining forces in New Zealand, then our outbreaks could be larger and more prolonged than they are in Europe. At this early stage there is no sign of any egg, larval or adult parasitism at the Te Piripiri site. One native bug (*Cermatulus nasalis*) has been caught in the act of feeding on larvae, but appears to be an opportunistic generalist predator. It is likely that some eggs are being lost to predators. In one instance about 5% of eggs concealed under moss had disappeared after 5 days and a voracious carabid beetle was found suspiciously close to the remaining eggs. It seems unlikely that either of the above predators pose much of a threat to the heather beetles though. “We breathed huge sighs of relief that no sign of the dreaded microsporidian turned up when we deliberately reared beetles in crowded conditions, designed to make the disease rear its ugly head, “ explained Paul Peterson. We have battled long and hard to free the beetles of this disease and it seems to be paying off. We will continue to monitor the situation closely for a number a years.

TV One News interviewing Allan Innes, of the Hieracium Control Trust, about the first release of the hieracium gall midge.

Two More Join the Fray

Two new agents joined the struggle against hawkweeds (*Hieracium* spp.) this year. The gall midge (*Macrolabis pilosellae*) was released for the first time at two sites and the root hover fly (*Cheilosia urbana*) at one site in Canterbury. Additional releases of the gall wasp (*Aulacidea subterminalis*) have helped to fill in the gaps, particularly in the North Island. The gall wasp seems to be establishing well with galls found at just under half of the sites. To help to you to remember which agent is likely to attack which species of hawkweed, we have prepared a summary table (see below).

Trials began in 1994 to simulate what might happen if the cover of hawkweeds is reduced. Results so far suggest that biological control is likely to have the greatest benefit in the early stages of hawkweed invasion and at fertile sites where competing vegetation can readily fill the gaps. At degraded sites, and places where hawkweeds have been dominant for a long time, the recovery process can be painfully slow, and we have seen little change over 8 years. There is likely to be an increase in the amount of bare ground before mosses and lichens kick-start the succession process by gradually colonising gaps left by

Predicted impact of the five insect control agents for hawkweeds

Hawkweed Species	Plume Moth (*Oxyptilus pilosellae*)	Gall Wasp (*Aulacidea subterminalis*)	Gall Midge (*Macrolabis pilosellae*)	Root-Feeding Hover Fly (*Cheilosia urbana*)	Crown Hover Fly (*Cheilosia psilophthalma*)
Mouse-ear (*H. pilosella*)	• •	• •	• •	• •	• •
King devil (*H. praealtum*)	•		• •	• •	• •
Field (*H.caespitosum*)	• •		• •	• •	• •
Tussock (*H. lepidulum*)	•			• •	•
Orange (*H. aurantiacum*)		•			

••= equivalent level of attack to mouse-ear hawkweed, •= lower level of attack than mouse-ear hawkweed, blank = no attack hawkweeds. Land managers in degraded, severely infested areas will need to take this likely outcome into consideration and plan for it.

DNA Finger Printing Points the Way

Blackberry (*Rubus fruticosus* agg.) was introduced to New Zealand as a food source around 1867 and has gone on to become a major weed. The 'agg.' (aggregate) is included after the scientific name to indicate that it is actually a bit of a grab bag – there are at least 22 naturalised species and hybrids of blackberry in New Zealand alone. In 1998 blackberry was ranked as our 4th worst weed and it is believed to cost the country about $21 million per year. The blackberry rust (*Phragmidium violaceum*) turned up in New Zealand in 1990 about 6 years after it was illegally released in Australia (another strain was legally released there in 1991). The rust is now quite common throughout New Zealand and can defoliate and weaken plants with spectacular results; but unfortunately not all forms of blackberry are attacked. The same problem exists in Australia where there is a very real risk of simply replacing susceptible forms of blackberry with resistant ones. Researchers at the University of Adelaide have been undertaking the daunting task of sorting out exactly what forms of blackberry they have, how many strains of the rust are present, and which strains damage which plants. They have been sorting out the chaos with the aid of modern DNA finger printing techniques. The ultimate aim is to identify what additional strains of the rust might need to be imported to ensure that all forms of the plant are attacked. It seemed sensible for us to enlist the help of our Australian colleagues to do the same here. With some funding provided by Environment Bay of Plenty and the Forest Health Collaborative we have managed to collect samples of blackberry rust from around the country, and bulk up each strain (which proved to be trickier than expected) and extract DNA to send to Australia for testing. We hope to have some answers back this spring.

Grass Not Always Greener

This year we have supported the Weeds CRC project in Australia to find biological control agents for nassella tussock (*Nassella trichotoma*) and Chilean needle grass (*Nassella neesiana*) in Argentina. Three promising agents have been found to date: a rust (*Puccinia nassellae*), a smut (*Ustilago* sp.), and an unidentified mushroom species belong to the Corticiaceae family. Both grasses appear to be susceptible to the rust, which can kill plants in the field in Argentina. The rust is especially effective in shady areas where dew probably lasts longer on the plant surface, giving better conditions for infection. Host-range testing of this potential control agent is now underway.

The smut shown here on Chilean needle grass (drooping black flowerhead).

The Corticeaceous species can also be responsible for severe dieback, and infected plants are much easier to uproot. This fungus has only been found on nassella tussock so far, and does not seem to attack Chilean needle grass. The smut attacks the inflorescences of both *Nassella* species, replacing seeds with fungal spores; and could help to reduce spread. A number of test plants have been exposed to the smut in the glasshouse, but we will not know whether any have been infected until flowering in the spring. Test plants have also been exposed to the Corticiaceous species, and are being monitored for signs of disease.

Trials Bring Smiles

Last year we told you that we were setting up some field trials to see if two gorse (*Ulex europaeus*) and broom (*Cytisus scoparius*) pathogens could be used as mycoherbicides together with better results than either one alone. Fusarium blight (*Fusarium tumidum*) works best on young plants, whereas silver leaf fungus (*Chondrostereum purpureum*) likes older, woodier plants, so in theory together we could have all bases covered. Field trials were set up near Christchurch and Auckland in May 2001 to test this theory and to also find out the best time for inoculation. They will be running until May 2003. Promising signs are already showing up at the Christchurch site with both pathogens contributing to dieback of regrowing shoots.

A Tale of Two Thrips

Gorse thrips (*Sericothrips staphylinus*) have proven darned slow at dispersing. While it is nice to know that when you revisit a release site there is a good chance of finding the little blighters right where you left them, it can be disappointing to discover that they haven't moved on at all. Because this agent is so tiny there has also been an almost universal reluctance for people to get involved in harvesting and shifting them around. We found out from colleagues in Hawai'i that they too had had similar results with thrips from the UK but much better success with a Portuguese strain (e.g. they managed to thoroughly infest one 3000-ha gorse infestation in Hawai'i in just 6 years). Once we got wind of this, we swiftly dispatched Hugh Gourlay over to Hawai'i to get his hands on some. The new thrips were safely installed in quarantine at Lincoln by the end of July 2001. We got permission to release them in double quick time, and have put out colonies at nine sites already. Early observations suggest that this new strain seems to produce more winged forms and are keener to disperse. Let's all hope so!

A Prickly Subject

Californian thistle (*Cirsium arvense*) is the most common thistle in New Zealand and has proven to be one of the most painful biological control targets. So far only one of the agents, the gall fly (*Urophora cardui*), is showing any promise at all. However, there are some question marks about whether the flies will ever be able to establish widely here as experience has shown that sheep make a beeline for galled plants. The search for better agents, especially potentially more harmful root- and stem-feeders, has been going on in earnest. A gall-forming mite (*Aceria anthocoptes),* a better strain of a foliage-feeding beetle (*Altica carduorum),* a root-feeding weevil (*Apion onopordi),* a root and crown-feeding weevil *(Cleonus piger*), and a foliage-feeding beetle (*Luperus* nr. *altaicus)* are among the leading contenders at this stage. In 2002/03 we hope to import the root-feeding weevil into quarantine at Lincoln for final testing. This weevil is of particular interest because it may be able to vector a rust fungus (*Puccinia punctiformis*) that is already present in New Zealand. Work towards developing a mycoherbicde for the weed is also continuing. AgResearch scientists are working to gain a better understanding of the infection process of *Sclerotinia sclerotiorum* and to develop improved formulations, possibly involving new "bio-polymer" technologies. Plans are also afoot to compare the potential of this pathogen with another that has turned up more recently (*Phoma exigua* var. *exigua).*

Lucky Last

This winter we have prepared the seventh batch of pages for "The Biological Control of Weeds Book". The "Basics" section now has new pages on predictions made by the gorse and broom models, more insects and pathogens that are commonly mistaken for biological control agents, plus a glossary of terms. The broom section boasts a new page about how to minimise damage to broom agents when using herbicides. A page has been prepared on pathogens that commonly attack Californian thistle, and the mist flower gall fly one has been updated to colour. Black-and-white pages on the new hawkweed agents have been prepared and the index has been updated to help you to keep track of everything. The new pages will be distributed in August and are likely to be the last large batch for a while – we intend to shift our focus for the next couple of years to updating all the older information sheets and making them available on the web.

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.
Broom leaf beetle (*Gonioctena olivacea*)	Foliage feeder, application to release stalled while economic data on the cost/benefits of broom and tree lucerne are collated and evaluated.
Broom psyllid (*Arytainilla spartiophila*)	Sap sucker, becoming more common, slow to disperse, one damaging outbreak seen so far, impact unknown.
Broom seed beetle (*Bruchidius villosus*)	Seed feeder, becoming more common, spreading well, showing potential to destroy many seeds.
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, impact unknown.
Californian thistle leaf beetle (*Lema cyanella*)	Foliage feeder, rare, no obvious impact, no further releases planned.
Gorse colonial hard shoot moth (*Pempelia genistella*)	Foliage feeder, limited releases to date, established at one site, impact unknown, further releases planned.
Gorse hard shoot moth (*Scythris grandipennis*)	Foliage feeder, failed to establish from small number released at one site, no further releases planned due to rearing difficulties.
Gorse pod moth (*Cydia succedana*)	Seed feeder, becoming more common, spreading well, showing potential to destroy seeds in spring and autumn.
Gorse seed weevil (*Exapion ulicis*)	Seed feeder, common, destroys many seeds in spring.
Gorse soft shoot moth (*Agonopterix ulicetella*)	Foliage feeder, rare, no obvious impact, no further releases planned.
Gorse spider mite (*Tetranychus lintearius*)	Sap sucker, common, often causes obvious damage.
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, limited in distribution as the UK strain is slow to disperse but the more recently released Portuguese strain should move faster, impact unknown.
Hemlock moth (*Agonopterix alstromeriana*)	Foliage feeder, self-introduced, common, often causes severe damage.
Hieracium crown hover fly (*Cheilosia psilophthalma*)	Crown feeder, permission to release recently granted, rearing underway to enable releases to begin.
Hieracium gall midge (*Macrolabis pilosellae*)	Gall former, only two releases made so far and success unknown, rearing underway to enable releases to begin.

Hieracium gall wasp (*Aulacidea subterminalis*)	Gall former, released widely now throughout the South Island and more recently released in the North Island, established but not yet common in the South Island, impact unknown.
Hieracium plume moth (*Oxyptilus pilosellae*)	Foliage feeder, only released at one site so far, impact unknown, further releases will be made if rearing difficulties can be overcome.
Hieracium root hover fly (*Cheilosia urbana*)	Root feeder, only one release made so far and success unknown, rearing underway to enable releases to begin.
Hieracium rust (*Puccinia hieracii* var. *piloselloidarum*)	Leaf rust fungus, self-introduced?, common, may damage mouse-ear hawkweed but plants vary in susceptibility.
Heather beetle (*Lochmaea suturalis*)	Foliage feeder, released widely in Tongariro National Park, established at at least one site, severe localised damage seen already.
Mexican devil gall fly (*Procecidochares utilis*)	Gall former, common, initially high impact but now reduced considerably by Australian parasitic wasp
Mist flower fungus (*Entyloma ageratinae*)	Leaf smut, becoming common, spreading fast, often causes severe damage.
Mist flower gall fly (*Procecidochares alani*)	Gall former, only recently released but establishing readily, already common at some sites, impact not yet known.
Nodding thistle crown weevil (*Trichosirocalus horridus*)	Root and crown feeder, becoming common on several thistles, often provides excellent control in conjunction with other nodding thistle agents.
Nodding thistle gall fly (*Urophora solstitialis*)	Seed feeder, becoming common, often provides excellent control in conjunction with other nodding thistle agents.
Nodding thistle receptacle weevil (*Rhinocyllus conicus*)	Seed feeder, common on several thistles, often provides excellent control of nodding thistle in conjunction with the other nodding thistle agents.
Old man's beard leaf fungus (*Phoma clematidina*)	Leaf fungus, common, often causes obvious damage.
Old man's beard leaf miner (*Phytomyza vitalbae*)	Leaf miner, becoming common, laboratory studies suggest it is capable of stunting small plants at least, one severely damaging outbreak seen so far.
Old man's beard sawfly (*Monophadnus spinolae*)	Foliage feeder, only released at four sites, establishment success unknown, further releases will be made if rearing difficulties can be overcome.
Scotch thistle gall fly (*Urophora stylata*)	Seed feeder, limited releases to date, appears to be establishing readily, impact unknown.
Cinnabar moth (*Tyria jacobaeae*)	Foliage feeder, common in some areas, often causes obvious damage.
Ragwort flea beetle (*Longitarsus jacobaeae*)	Root and crown feeder, common in most areas, often provides excellent control.
Ragwort seed fly (*Botanophila jacobaeae*)	Seed feeder, established in the central North Island, no significant impact.
Greater St John's wort beetle (*Chrysolina quadrigemina*)	Foliage feeder, common in some areas, not believed to be as significant as the lesser St John's wort beetle.
Lesser St John's wort beetle (*Chrysolina hyperici*)	Foliage feeder, common, often provides excellent control.
St John's wort gall midge (*Zeuxidiplosis giardi*)	Gall former, established in the northern South Island, often causes severe stunting.

Further Reading

Fowler, S. V.; Peterson, P.; Barrett, P; Smith, L. 2002: **Biological control of heather, *Calluna vulgaris*, in New Zealand using heather beetle, *Lochmaea suturalis*: imminent success in enemy-free space.** Proceeding of the 51st Entomological Society of New Zealand Conference, Otago Museum, Dunedin, 3–6 April 2002. Pp. 23.

Fowler, S. V. 2001: **Maximising impacts on target weeds: can we exploit synergies between biological control agents?** Proceedings of the 50th Entomological Society of New Zealand Conference, Unitec, Auckland, 1–4 July 2001. Pp. 26.

Fröhlich, J.; Gianotti, A. F. 2001: **Monitoring the spread and impact of *Entyloma ageratinae*, a white smut fungus introduced to New Zealand for the biological control of mist flower (*Ageratina riparia*).** Proceedings of the 5th Australian Mycological Society Conference, Cairns, Queensland, Australia, 28 September 2001. Pp. 6.

Fröhlich, J.; Bourdôt, G.; Gianotti, A.; Hurrell, G. 2001: **Determining the potential of two complementary fungi to suppress gorse and broom in New Zealand.** Proceedings of the 13th Biennial Australasian Plant Pathology Society Conference, Cairns, Queensland, Australia, 24–27 September 2001. Pp. 80.

Fröhlich, J. 2001: **Development of mycoherbicides for gorse (*Ulex europaeus*) and broom (*Cytisus scoparius*) in New Zealand.** International Bioherbicide Group News 10 (2):8.

Fröhlich J. 2001: **Mist flower project and other biological control projects involving pathogens.** International Bioherbicide Group News 10 (2): 2.

Grosskopf, G.; Smith, L. A.; Syrett, P. 2002: **Host range of *Cheilosia urbana* (Meigen) and *Cheilosia psilophthalma* (Becker) (Diptera: Syrphidae), candidates for the biological control of invasive alien hawkweeds (*Hieracium* spp., Asteraceae) in New Zealand.** *Biological Control* 24: 7–19.

Harman, H.; Memmott, J.; Syrett, P. 2001: **Weed biocontrol agents as model invaders.** Proceedings of the Jubilee New Zealand Ecological Society Conference, University of Canterbury, Christchurch, 27–30th August 2001. Pp. 34.

Hill, R. L.; Gourlay, A. H.; Barker, R. J. 2001: **Survival of *Ulex europaeus* seeds in the soil at three sites in New Zealand.** *New Zealand Journal of Botany* 39: 235–244.

Hill, R. L.; Gourlay, A. H. 2002: **Introduction and establishment of *Cydia succedana* (D&S) (Lepidoptera: Tortricidae) a biological control agent for gorse (*Ulex europaeus* L.) in New Zealand.** *Biological Control*, in press.

Hill, R. L.; Wittenberg, R.; Gourlay, A. H. 2001: **Biology and host-range of *Phytomyza vitalbae* and its establishment for the biological control of *Clematis vitalba* in New Zealand.** *Biocontrol Science and Technology* 11: 459–473.

Syrett, P.; Smith, L.; Meurk, C.; Partridge, T. 2001: **Predicted impact of insect biological control agents on *Hieracium pilosella*.** Proceedings of the Jubilee New Zealand Ecological Society Conference, University of Cantebury, Christchurch, 27–30 August 2001. Pp. 49–50.

Withers, T.; Fowler, S.; Gourlay, H. 2001: **Putting our money where our mouth is: searching for non-target impacts by *Cydia succedana*, a biological control agent against gorse.** Proceedings of the 50th Entomological Society of New Zealand Conference, Unitec, Auckland, 1–4 July 2001. Pp. 50.

What's New In Biological Control Of Weeds? (issues 1–21) are available from Lynley Hayes (address below).

Contact Addresses

Lincoln Staff:
Hugh Gourlay, Lynley Hayes, Lindsay Smith, Pauline Syrett.
Landcare Research
PO Box 69
Lincoln 8152, New Zealand
Ph +64 3 325 6700
Fax +64 3 325 2418

Nelson Staff:
Richard Toft
Landcare Research
Private Bag 6
Nelson,
New Zealand
Ph +64 3 548 1082
Fax +64 6 546 8590

Palmerston North Staff:
Peter Berben, Peter McGregor, Paul Peterson.
Landcare Research
Private Bag 11052
Palmerston North,
New Zealand
Ph +64 6 356 7154
Fax +64 6 355 9230

Auckland Staff:
Alison Gianotti, Helen Harman, Simon Fowler, Jane Fröhlich, Chris Winks.
Landcare Research
Private Bag 92170
Mt Albert, Auckland,
New Zealand
Ph +64 9 815 4200
Fax +64 9 849 7093

Editor: **Lynley Hayes**
Cartoons: **Anouk Wanrooy**
Thanks to: **Christine Bezar**
Layout: **Denice Webb**

Published By:
Landcare Research
New Zealand Ltd
PO Box 69, Lincoln 8152.

Email: surname+initial@landcareresearch.co.nz
Web: http://www.landcareresearch.co.nz

ISSN 1173-6356