What's New In Biological Control Of Weeds?

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What's Inside:

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Manaaki Whenua

New Broom Agent Unleashed

In November the broom leaf beetle (*Gonioctena olivacea*) was released for the first time in New Zealand, at Lincoln. After getting clearance from MAF we were at long last able to take this new agent out of quarantine. We planted out some bushes that had eggs, larvae and adults on them and covered them with a cloth cage to provide extra security while the biocontrol agents settled in. "We are hoping that by releasing a variety of life stages we will improve the likelihood of the beetles establishing successfully," said Hugh Gourlay.

We have been keeping a watchful eye on how the beetles are doing and, although we have not yet seen any hard evidence, there are promising signs that the adult beetles have been busy reproducing. "Males become more colourful when they are sexually active and the ones we found still had their 'racing stripes'," said Hugh.

The leaf beetle was also released near Culverden in North Canterbury in February. As well as being one of the worst broom-infested parts of the country this place was chosen because it is home to the group of farmers that provided the impetus for strengthening the broom attack. The Amuri Broom Action Group formed in 1995 (morphing more recently into the Canterbury Broom Group) and now after more than 10 years their patience and support has finally been rewarded.

Mass-rearing of the beetle is in full swing and as soon as we can we will offer them more widely. Both the adults and larvae attack the foliage and can be extremely damaging to broom in Europe.

This project is funded by the Canterbury Broom Group thanks to a MAF Sustainable Farming Fund grant with contributions from The Forest Health Research Collaborative, and the National Biocontrol Collective.

Left: Hugh Gourlay making the first release of the broom leaf beetle. Right: Male broom leaf beetle.

Buddleia Weevil Welcomed

Another agent that has been in the pipeline for many years has also recently been liberated. Scientists at Ensis have been carefully studying the buddleia weevil (*Cleopus japonicus*) for 10 years and finally got permission from the Environmental Risk Management Authority (ERMA) to release it in 2006. The weevil (nicknamed mokai, meaning pet, by the local Hapu) was first released in September at Whakarewarewa Forest, Rotorua.

Buddleia (*Buddleja davidii*) was introduced from China as an ornamental shrub. Its sprays of purple flowers attract butterflies and other insects. However, since its introduction "butterfly bush" has become one of the biggest weed problems for forestry. "It out-competes young trees and presently costs the industry between $0.5 and $2.9 million a year," said Darren Kriticos of Ensis. The fast-growing weed also invades roadsides, riverbeds, and native forest. Modelling suggests that buddleia has the potential to become a serious problem in many parts of New Zealand (see *Not Just a Pretty Shrub*, Issue 33), so the release of the weevil has come not a moment too soon!

Ensis Forest Biosecurity and Protection

Buddleia weevil larvae feeding on buddleia leaves.

The weevil caught the eye of Nod Kay (Ensis) a decade ago in its native homeland, China. "We chose it because it was common and causing noticeable damage," said Nod. Both the small brown adults and yellow slug-like larvae feed on the plant. The adults eat ragged holes in the leaves while the larvae leave little "windows" after nibbling off the green leaf tissue. This agent has the potential to stunt buddleia growth, giving plantation trees and native vegetation the upper hand.

"We are looking forward to seeing the impact the weevil has on buddleia and will carefully monitor its establishment and spread," said Darren.

Ensis is a joint venture between CSIRO in Australia and Scion (the new trading name of the New Zealand Forest Research Institute Ltd).

Double-Whammy Application Submitted

We are continuing to keep staff at the Environmental Risk Management Authority (ERMA) busy, with another application submitted just before Christmas, this time to release two new thistle munchers. While the Californian thistle stem miner (*Ceratapion onopordi*) and the green thistle beetle (*Cassida rubiginosa*) were initially investigated in the hopes of improving Californian thistle (*Cirsium arvense*) control, they could be much more useful than that as they will attack a range of thistles (see *Thistles Beware*, Issue 37). We hope to have a decision from ERMA by the end of April 2007.

South African Weed Safari

Most people visit Africa for the big-game animals, but Chris Winks recently visited South Africa to check out some much smaller creatures. New Zealand and South Africa have several weeds in common (at least one native plant from each country is a weed in the other), and like us the South Africans are heavily into developing biocontrol strategies.

As previously reported, we have had a few hiccups getting a population of the boneseed leaf roller moth (*Tortrix* s.l. sp. *"chrysanthemoides"*) from South Africa. However, we knew if anyone could succeed in getting us some then it would be Chris, and he did not let us down. Petra Muller, from the University of Cape Town, took Chris on a safari around the city to track down and collect leaf roller caterpillars. "Being able to get my eye in like this will be really useful when it comes to looking for this insect after it has been released in New Zealand," said Chris. The caterpillars were taken back to the laboratory and reared until there was a sufficient number to send a shipment to New Zealand. The shipment arrived safely and was held in quarantine at Lincoln for a couple of months so the identity of the leafrollers could be confirmed and they could be guaranteed free of parasites and disease. In January MAF issued a permit allowing the leafrollers to come out of containment, reuniting them with Chris, in Auckland, who will be responsible for mass-rearing them. All going well it may be possible to make some initial releases this season.

Still on the boneseed front our South African colleagues are also helping us to test a promising rust fungus (*Endophyllum osteospermi*). Chris took 11 native New Zealand species, which need to be tested, with him to South Africa. Unfortunately not all the plants survived the long journey and some will need to be sent over again. One native plant locally available there is pohutukawa (*Metrosideros excelsa*), which is becoming a bit of weed. "In fact, restrictions on growing and selling pohutukawa are now in place," revealed Chris.

Climbing asparagus (*Asparagus scandens*) is another South African native that is making its weedy presence felt in New Zealand. Carien Kleinjan, from the University of Cape Town, took Chris on a 6-day field trip to investigate what natural enemies the plant has, as this has never been well documented before. In South Africa, climbing asparagus has a fairly restricted distribution. It is mainly found in tall moist forest scattered along a 600-km stretch between Cape Town and Port Elizabeth to the east. Chris found that climbing asparagus was not very common, even in its preferred habitat, and no potential biocontrol agents were immediately obvious. A full report from Carien covering the results of all the surveys she has undertaken for us is expected soon.

Woolly nightshade (*Solanum mauritianum*) is a weed that South Africa and New Zealand share. Chris met up with Terry Olckers at Pietermaritzburg University to learn about their biocontrol project for this weed. A lace bug (*Gargaphia decoris*) was released in South Africa in 1999 and has successfully established on woolly nightshade at a number of sites. Terry has recently conducted host specificity tests on native and commercial *Solanum* species from New Zealand. "The results look good and we may work towards introducing the lace bug into New Zealand pending further research on whether factors such as climate and predation may limit its effectiveness here," said Chris. Terry showed Chris their testing procedures and how to rear the lace bug.

The South Africans have investigated a flower-eating weevil (*Anthonomus santacruzi*) for woolly nightshade and are awaiting permission to release it. If permission is granted Terry will test the weevil to see if it might be suitable for New Zealand too. Other potential agents are known that might be worth further investigation including a weevil (*Conotrachelus squalidus*) whose larvae bore into woolly nightshade shoots and can cause severe damage to the weed, and foliage-feeding beetles (*Platyphora* spp.).

Towards the end of his trip Chris visited the Agricultural Research Council Plant Protection Research Institute (ARC PPRI) in Pretoria. Some of the weed biocontrol projects ARC PPRI researchers are working on of interest to us include lantana (*Lantana camara*), *Acacia* species, parrot's feather (*Myriophyllum aquaticum*) and water fern (*Azolla filiculoides*).

Chris Winks trip to South Africa was funded thanks to a QEII Technician's Study Award.

Terry Olckers from Pietermaritzburg University showing Chris how to rear the woolly nightshade lace bug (Insert).

Team Has Growth Spurt

In recent years the number of projects requiring the input of a plant pathologist or the use of molecular techniques has increased and this trend is expected to continue. We are delighted to introduce two recently recruited staff that will increase our capacity to undertake such work. Both are called Sarah and both are based at our Auckland office.

Before joining us in January Sarah Dodd was a plant pathologist with Crop and Food Research at Lincoln for 3 years where she was involved in a range of projects applying molecular technologies to understanding the dynamics of microbes in different environments. One project involved working with the mushroom industry in New Zealand, on microbes involved in composting, and in Australia, on the early detection of mushroom diseases. In another project Sarah researched the non-target impacts of biocontrol agents against fungi to control disease in cropping systems. In collaboration with HortResearch she used molecular techniques to find where diseases reside in boysenberry plants. Sarah also studied *Armillaria*, the bootstrap fungus, which is native to New Zealand but attacks *Pinus radiata* and kiwifruit. However, the need to control the fungus is complicated by its close relationship with a native orchid that needs it to grow.

Sarah Wells with tradescantia plants in the glasshouse.

Before joining Crop and Food Sarah worked at Lincoln University on the biocontrol of plant pathogens and earlier did a 2-year postdoc at the United States Department of Agriculture in Beltsville, Maryland, on the taxonomy of the fungal biocontrol agent *Trichoderma*. Sarah did her PhD at HortResearch, and so knows quite a few of our Auckland staff from those days when we shared the campus at Mt Albert.

Sarah Dodd next to the waka at Waitangi, Bay of Islands.

While she comments that she does not really have much time for hobbies, Sarah enjoys competitive sailing and hopes to get back into it with the move to Auckland.

Sarah Wells recently completed an internship as a research technician in the molecular ecology lab at the University of Auckland. She investigated the population genetics of the bottlenose dolphin and long-finned pilot whale. This work included weeks on a boat collecting ecological data and biopsy tissue samples from dolphins in the Bay of Islands for DNA analysis. She also analysed samples from pilot whales that stranded in Tasmania.

Before moving to New Zealand Sarah gained a BSc Honours degree in marine biology from the University of Southampton, UK. Her Honours project was on the distribution and intensity of chlorophyll-a concentrations in the gulf stream of the North Atlantic. Her data were collected from devices attached to yachts competing in the Volvo Ocean Race – an ideal way to get data from around the world!

Having an ecological bent, Sarah enjoys being out and about: walking, surfing, scuba diving, sailing, "… anything outside, really," she says.

Slow but Steady Progress at the Sharp End

Chilean needle grass (*Nassella neesiana*) is a serious problem in Australia and New Zealand. "Both the range and density of Chilean needle grass have increased significantly since 1987 and so far not a single infestation of the weed in Marlborough has been eradicated," reported Mike Bell of the Marlborough District Council at a recent conference. Hearing this news Jane Barton set off to Argentina with renewed determination to assist Freda Anderson, in her quest to find biocontrol agents against this weedy grass on behalf of the CRC for Australian Weed Management. So far two rusts, *Uromyces pencanus* and *Puccinia graminella,* seem to have the most potential (See *Grass Agents Slow to Reveal Their Secrets*, Issue 36).

Jane, Freda and Andrea Flemmer went on an epic road trip to observe the rusts in their natural habitat. They drove north from Bahía Blanca to Santa Rosa de Calamuchita, a round trip of about 2500 km. Along the way the team looked for possible alternative hosts (i.e. plants other than grasses that the two rusts might be able to infect), and for Chilean needle grass plants heavily infected with *P. graminella* that could be used as a source of spores for experiments. They also kept an eye out for new isolates of *U. pencanus* because the isolates Freda has worked with so far happily infect Australian but not New Zealand material.

Back in the lab they sought a suitable method for inoculating grasses with *U. pencanus* spores so that host-range testing can begin. Freda has had good results from applying dry rust spores using a needle under a microscope, but this process is time-consuming and tedious. Freda and Jane trialled a new method that involved mixing the spores with talcum powder and applying them with a paint brush, which was successful. "The new method saves time and is very economical with spores," said Jane. "This is important because every spore has to be produced by 'bulking up' the rust on living plants, as they cannot be grown in artificial culture."

Another challenge involved finding a way to "bulk up" *P. graminella* aeciospores since it does not produce the urediniospores we would normally work with. The aeciospores do not survive long in the freezer, so experiments have had to rely on spores from infected plants found in the field. "We have figured out that younger aeciospores seem to germinate better than older ones, and that the rust prefers temperatures between 10 and 18ºC," said Freda, "but we are still trying to work out how much moisture it needs to produce a good infection." Until a reliable method can be found to produce large quantities of aeciospores, it will be difficult to determine if this fungus can infect Chilean needle grass from New Zealand. Fortunately, there is nothing in published studies to suggest that it will not do so.

Definite progress is being made in a project that has been fraught with difficulties. Recently, the prospects for continued funding from Australia were looking shaky as the government across the ditch was focused on tackling their serious drought, but at the 11th hour they appear to have come through with further financial support. Given that Chilean needle grass is very difficult to control with herbicide and that without effective management it is likely to continue to spread, it is essential to both countries that this project continues.

The New Zealand contribution to this project is funded by a national collective of regional councils and the Department of Conservation. Jane Barton is a contractor to Landcare Research.

Freda and Andrea in the field digging up Chilean needle grass plants infected with *Puccinia graminella.*

Judgement Day

The aim of weed biocontrol is to reduce the population of the target weed. Despite this obvious goal there are few studies actually documenting this result for programmes in New Zealand or even worldwide. Amazingly there are even fewer studies, for any method of weed control, that record what the target weed is replaced by or any benefits to native plant communities. This is what makes our recently published study documenting the impacts of the successful mist flower (*Ageratina riparia*) biocontrol programme so significant.

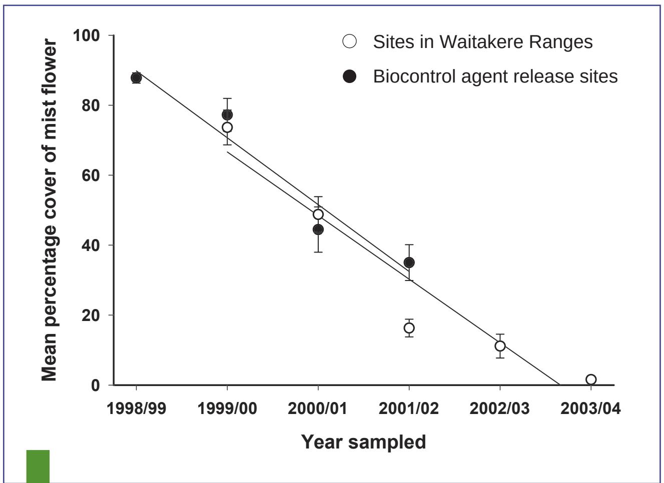
Before introducing the first mist flower biocontrol agent, the smut fungus (*Entyloma ageratinae*), we started an intensive 5-year study in the Waitakere Ranges to monitor vegetation change. The study showed that mist flower was out of control and spreading rapidly until the fungus intervened, causing average levels of cover at highly infested sites to drop from 80% to less than 2% .

The mist flower gall fly (*Procecidochares alani*) was introduced halfway through the study and established well. While it did not build up to high enough numbers to have a significant impact on mist flower during the study period, there were some promising signs. In the Karamatura Valley the number of galls per stem was measured for the first 3 years after the flies were released, and increased exponentially. "The number of galls per stem (1.96) was significantly higher than levels reported from a study in Hawai'i (0.46), where the gall fly is considered to have contributed to the successful suppression of the weed," said Simon Fowler.

Mist flower was primarily replaced by native plant species, which is a reflection on the seed sources available in the native-dominated Waitakere Ranges. Department of Conservation staff have claimed benefits to two threatened endemic plants from mist flower biocontrol. *Hebe acutiflora* was until recently ranked as "nationally endangered" or "vulnerable". Mist flower had almost eliminated it from one site and had started invading the only other known population. Now the plant's ranking has improved to "range restricted". *Hebe bishopiana* is endemic to the Waitakere Ranges and, while it continues to be ranked "nationally vulnerable", if mist flower populations continue to decline and pampas (*Cortaderia* spp.) populations are also reduced, it may be removed from the "vulnerable" list altogether.

The replacement of a target weed with another is frequently seen as a potential problem for weed control but, again, documented cases to show if this really happens are a bit like hens' teeth. Our study showed a weak trend that African club moss (*Selaginella kraussiana*) is replacing mist flower in the Waitakere Ranges. "However, the club moss is also invading plots that have never had mist flower, which suggests that this is another species we should be concerned about," cautioned Simon. It is possible that a biocontrol project for African club moss may be initiated in the future. The study suggests other exotic plants to watch out for in the Waitakere Ranges are greater periwinkle (*Vinca major*) and Mexican daisy (*Erigeron karvinskianus*), which also have the potential to limit native regeneration. While these species were not yet present in a lot of plots they did have relatively high cover where they occurred, suggesting that they are emerging weeds.

At a suburban release site in Mount Eden it appears that other weeds present, such as exotic grasses, Montpellier broom (*Teline monspessulana*) and tree privet (*Ligustrum lucidum*), were able to take advantage of mist flower's demise. However, mist flower's greatest threat is



The decline of mist flower percentage cover due to biocontrol agents.

Ewen Cameron

The biocontrol of mist flower has reduced the pressure on threatened *Hebe acutiflora*.

as an environmental weed, and its ability to invade pristine native vegetation and suppress regeneration in areas like the Waitakere Ranges was what needed to be stopped.

Another indication of the success of the project is that no other form of mist flower control was undertaken in any of the study areas during the study or has been required since. While it seems likely that mist flower is probably still going to spread, the two biocontrol agents will ensure that it does not build up to the high levels of cover it achieved in the past and will only be a minor part of the vegetation in disturbed areas.

Identifying and quantifying flow-on effects of weed biocontrol, such as what replaces the target weed, is vital not only for assessing the success of a programme but also for documenting the costs and benefits of such programmes. Over recent years the Environmental Risk Management Authority has requested this kind of information when applications to import and release new biocontrol agents are made, so it is really useful to have at least one case study where the benefits of biocontrol can be so clearly demonstrated.

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

Reference

Barton, J.; Fowler, S.V.; Gianotti, A.F.; Winks, C.J.; de Beurs, M.; Arnold, G.C.; Forrester, G. 2006: Successful biological control of mist flower (*Ageratina riparia*) in New Zealand: Agent establishment, impact and benefits to the native flora. *Biological Control* in press.

What Will It Take to Topple Tradescantia?

Scientists at AgResearch are modelling the growth patterns of tradescantia (*Tradescantia fluminensis*) to determine just how much damage biocontrol agents would need to do to make a difference. Tradescantia does not set seed in New Zealand and spreads by vegetative growth. Therefore, agents that can reduce the amount of foliage are currently being sought (see *Brazilian Excursion Bears Fruit*, Issue 35). The team at AgResearch is aiming to work out how much leaf cover must be removed to either stop tradescantia from spreading or, alternatively, that reduces the weed's dense smothering mat sufficiently that seedlings of native plants can grow through it.

The study is particularly focusing on the impacts of various levels of leaf loss, and is being conducted in different locations, under different light intensities, and at different times of the year. At Ruakura, Anis Rahman, Trevor James and Erin Summersby have been simulating biocontrol using low rates of herbicides. At Lincoln, Sue Malloy, a new PhD student, will examine the population ecology of tradescantia and the effect of herbivory on the plant. The results from both studies will be used in models being developed by Shona Lamoureaux and Sue to predict the level of leaf loss that needs to be achieved, through any control measure, to significantly affect the weed's growth and development.

Much of this work requires knowing the leaf cover of tradescantia. Fortunately the Ruakura team has already established a very clear relationship between plant dry weight and leaf area for this species. This means they will not have to painstakingly measure the leaf area of every single leaf on every single plant in the experiments! The work will be continuing throughout summer and autumn.

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


Trevor James

Tradescantia plants showing different levels of defoliation.

Things To Do This Autumn

Here are a few things you might need to do before settling down for winter:

- Checking whether bridal creeper rust (*Puccinia mysiphylli*) has spread to your area. Look for the distinctive yellow and black pustules on the underside of leaves and on stems and berries. Helen Harman would like to know about any new sightings and places where the rust is not yet present (harmanh@landcareresearch.co.nz).

- Checking for the presence of the gorse pod moth (*Cydia ulicetana*). Look inside pods for the caterpillars, or their granular frass, and entry/exit holes in the pod wall. You may see the small brown adult moths fluttering around gorse bushes, especially on sunny days. If need be this agent can be redistributed by moving branches of infested pods.

- Checking gorse bushes for gorse thrips (*Sericothrips staphylinus*). Beat non-flowering plants over a piece of white material. If numbers are good you could shift infested material to new sites.

- Checking release sites of the gall-forming agents. The swellings caused by the mist flower gall fly (*Procecidochares alani*), hieracium gall midge (*Macrolabis pilosellae*), hieracium gall wasp (*Aulacidea subterminalis*), and Californian thistle gall fly (*Urophora cardui*) become most obvious in early autumn. If present in good numbers you could harvest mature galls and release them at new sites. The hieracium gall midge, however, is best redistributed by transplanting whole infested plants in the spring.

- Harvesting Scotch and nodding thistle gall flies (*Urophora stylata* and *U. solstitialis*). Infested flowerheads look fluffy and feel hard and lumpy when squeezed. Collect infested flowerheads in an onion or wire mesh bag and hang it on a fence at the new release site. Over winter the galls will slowly rot down and the flies will emerge in the spring.

More Crown Weevil Samples Needed

We are still trying to clarify what species of crown weevil we have attacking thistles in New Zealand. In order to check this out we need samples of weevils from all over the country, from sites where they are doing well and doing poorly, and from nodding, Scotch (*Cirsium vulgare*), winged (*Carduus tenuiflorus*), slender-winged (*Carduus pynocephalus*), plumeless (*Carduus acanthoides*), and cotton (*Onopordum acanthium*) thistles. **We are especially keen to receive weevils from Northland, Waikato, Taranaki, Marlborough, North Canterbury, and Southland.** If you think you might be able to collect a few weevils for us please contact Lynley Hayes (hayesl@landcareresearch.co.nz, Ph 03 321 9694) for a collecting kit. Thanks to all who have sent in specimens to date.

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