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What's New In Biological Control of Weeds?

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Kiwi Messages at Montana

In the last issue of this newsletter (number 13) we shared some of the gems that the Kiwi contingent gleaned from the 10th International Symposium on Biological Control of Weeds last July. In this issue we reveal the messages that the Kiwis had for the rest of the world.

Keeping Things in Perspective

Rowan Emberson, a senior lecturer in entomology at Lincoln University who teaches weed biological control, gave a thought-provoking address that delivered some useful facts and figures to help dispel the paranoia surrounding the use of natural enemies to control weeds. New Zealand has been undertaking biological control for more than a century. As we all know some of the earliest projects, like the introduction of mustelids to control rabbits, were ill conceived and biological control has struggled to regain its credibility ever since. Today strict regulations are in place to make sure similar disasters don't happen again, but they may also be hindering efforts to protect our environment. The cost of

Rowan Emberson finding out first hand about the successful ragwort programme in Oregon, USA.

developing biological control programmes and the cautious approach taken by researchers have always meant that new agents have tended to come on stream slowly; recently they have slowed to a trickle. Some people seem to believe that restricting the supply of new biological control agents is a good thing. For example, these comments were submitted in response to the recent proposal to introduce the hieracium plume moth (*Oxyptilus pilosellae*):

"It may be better environmental management to put up with the status quo than to **deliberately flood** New Zealand with more alien insects."

"My concern stems from the need for overall caution over the importation of a **limitless number of alien species**, which have the potential to displace endemic New Zealand species..."

"The addition of **untold new alien species** can only be detrimental to the long-term goal of preserving our endemic diversity..."

"There is a danger that the supply of new beneficial organisms could dry up all together if these sentiments are taken as gospel and not challenged," warns Rowan. So are biological control agents really posing a threat to our endemic flora and fauna? Let's see if these critics have a valid point.

Rowan has estimated that we have about 20,000 insect species in New Zealand but acknowledges this figure could actually be much higher. "About 2,600 of these are not native species, and most have established since European colonisation," says Rowan. "Insect biological control agents for weeds represent only a tiny 1.1% of all our introduced species, and little more than 0.1% of all the insects in New Zealand — hardly a significant contribution to dilution of endemic insect biodiversity!"

Rowan also consulted Landcare Research's "All New Zealand Species Database" (which is maintained by staff at the Lincoln Herbarium) to do the same sort of comparison for

Number of vascular plant species in New Zealand, April 1999

Category	No. of species
Native	449
Endemic	1,627
Extinct	2
Total indigenous	2,079
Naturalised	1,796
Casual (only small wild populations)	313
Total adventive (not indigenous and established in the wild)	2,109
Total in cultivation only	22,257

plants. Since early settlers did their darnedest to turn New Zealand into a little piece of Europe in the South Pacific, it is probably not surprising that we actually have more introduced plants than indigenous species (see table). A significant number of these are already weeds, in the process of becoming weeds, or will be weeds in the future. "Of particular concern are the thousands of species in cultivation that could jump the fence at any time, and the number reflects the ease with which people have been able to import plant material in the past," says Rowan.

Rowan's analysis confirms that in many situations biological control is still currently the best, and least damaging, way of protecting our environment. Insects introduced for biological control are insignificant in diluting biodiversity, and have the added advantage of being carefully screened to ensure that damage to targets other than their host is minimal. The greatest threats to our indigenous plant and animal communities are the thousands of potentially invasive introduced plant species and the continuous stream of accidental insect introductions. Unlike biological control agents, these unwanted insect invaders are often generalist species with a wide host range.

The Trials and Tribulations of Working on Broom in New Zealand

Simon Fowler gave a paper explaining the difficulties we have encountered during 20 years of working on broom. While ecological studies suggest it should be quite feasible to control broom using a suite of natural enemies, in practice we are still some distance away from achieving this goal. Only two control agents, the broom seed beetle (*Bruchidius villosus*) and broom psyllid (*Arytainilla spartiophila*), have so far come to fruition and joined the self-introduced broom twig miner (*Leucoptera spartifoliella*) out in the field.

There is no shortage of insects attacking broom in Europe (Pauline Syrett has catalogued 243 species), but it has been difficult to find natural enemies that are sufficiently restricted in their host range. For example, the extremely promising broom stem miner (*Pirapion immune*) had to be discarded at the eleventh hour when it became clear that it might pose a risk to kowhai. Another sticking point has been the tendency for many of the agents tested to attack tree lucerne and tree lupin. While it is clearly unacceptable for a biological control agent to inflict even minor damage to a native iconic species such as kowhai, the jury is still out about whether or not some damage to exotic plants might be tolerable, given the serious consquences of not controlling rampant weeds. While we have identified a number of potential new agents, such as the broom leaf beetle (*Gonioctena olivacea*), gall mite (*Aceria genistae*), two foliage-feeding caterpillars (*Chesias legatella*, *Agonopterix assimilella*), and another seed feeder (*Exapion fuscirostre*), all applications have been suspended until we have gathered better information about the costs and benefits of broom to New Zealand and the consequences of broom agents attacking non-target plants.

The above logo symbolizes the importance of interactions between pathogens and root-boring insects in the biological control of weeds. The insects provide an entry point for the pathogens and, in combination, provide better control than either agent alone. The background image on the logo, the jagged line represents the Rocky Mountains, in which Bozeman is situated.

Lynley Hayes takes a close look at the yellow wild flowers in Yellowstone National Park, USA, just to check that they aren't weeds.

Taking Science to the People

Lynley Hayes gave a paper describing our highly successful technology transfer programme (which amongst other things is responsible for producing this newsletter), and how it has evolved during its 20 years of operation. She explained how the success of the programme is due to strong relationships built up between Landcare Research and participating organisations over this time, and it is probably fair to say there is still no other similar programme to rival it anywhere in the world.

In the earliest days the programme offered control agents for a single target, alligator weed. Since that time a total of 27 agents have been offered for 14 target weeds, and the scope of the programme has been widened to include strategies for managing and enhancing their impacts, more efficient monitoring and assessment techniques, the development of new biological control programmes, and comprehensive training in biological control methods. As a result a network of well-trained people now exists throughout the country, allowing biological control agents to be released faster, more widely, and more successfully (95% of agents released under the programme that we know the fate of have established) than ever before.

If you would like a copy of this paper on the technology transfer programme, please contact Lynley Hayes (see back page for contact details).

The Ultimate Test

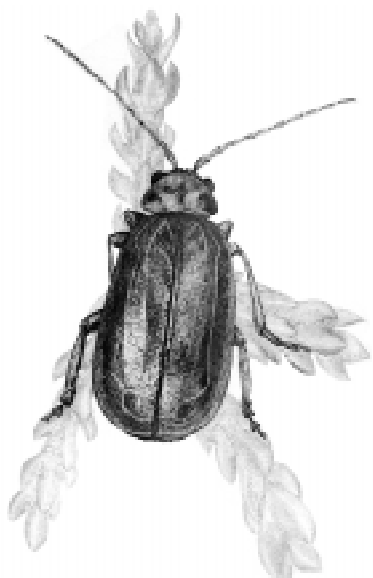
Toni Withers, from Forest Research at Rotorua, talked about how we can improve our understanding of the host range of biological control agents. She explained how no-choice tests can give either false negative or false positive results if the behaviour of the insect is not fully taken into consideration during test design. Even in choice tests, insects may respond differently depending on how hungry they are. A starving insect may try to feed on the first plant it encounters, even if it isn't the preferred host. Toni is working out testing procedures that avoid these glitches, and is helping a PhD student, Melanie Haines (see Local Hot Gossip page 7), design experiments to show how better testing could have predicted that broom seed beetles would attack tree lucerne.

A Picture Says a Thousand Words

The graphic artists at Lincoln were kept busy preparing lots of display posters for the Kiwi contingent to take to the symposium. Pauline Syrett prepared a poster outlining our experiences with the broom seed beetle and the best strategies for achieving widespread establishment. Simon Fowler delved back into his former life and summarised the history of biological control of weeds projects in Mauritius. Jane Fröhlich was responsible for two posters: one on the successful transfer of the mist flower programme from Hawai'i to New Zealand and another on the host range of fusarium blight (*Fusarium tumidum*), which is being developed as a mycoherbicide for gorse and broom. Hugh Gourlay put together a summary of the old man's beard programme and Richard Hill did the same for gorse. These posters are all available for loan (contact Lynley Hayes). We are also in the process of adapting the gorse and old man's beard posters and intend to make them available for loan or purchase along the lines of the "What's Eating?" posters that we produced previously.

Local Hot Gossip

Hooray for the **heather beetle** (*Lochmaea suturalis*)! In the last issue of "Weed Clippings" we reported that, despite intensive searching of the 17 release sites in Tongariro National Park, we were unable to find any sign that the heather beetle had survived, apart from a couple of dead bodies. However, another check just before Christmas paid off. Simon Fowler and Paul Peterson found both the brownish-coloured adults and the greyish larvae at one of the earliest release sites (January 1996). "We are amazed that



the beetles managed to survive at this site, which received a liberal coating of ash when Mt Ruapehu erupted soon after the release, " said Simon. As the old saying goes: "where there's smoke there's fire", so we are now confident that more beetles will be found on future visits to the park.

Mass rearing of the **hieracium gall wasp** (*Aulacidea subterminalis*) has gone extraordinarily well, enabling us to release this new agent at 22 sites just before Christmas. The supreme efforts of the Hieracium Control Trust are beginning to pay off as the wasps have now been released in all the worst affected areas of the South Island from Marlborough through to Alexandra. Southland will be targeted next with a further 3–4 consignments planned for this month, and next spring it will be the North Island's turn.

The **mist flower fungus** (*Entyloma ageratinae*) continues to delight everyone involved in this project. The white smut was released for the first time a year ago. Since then it has successfully established at all nine release sites and is severely defoliating mist flower plants (infected plants are losing 80–100% of their mature leaves). The plants are fighting back with substantial regrowth, but all in vain as the new leaves are quickly becoming infected. The spread and the impact of the fungus is being carefully scrutinised at one of the release sites in the Waitakere Ranges. Already native plants are beginning to grow in areas that were previously 100% mist flower, and Jane Fröhlich and summer student, Jonathan Boow, have begun to investigate successional changes that occur once mist flower loses its competitive edge. The fungus is spreading so quickly (it has already been found 14 km away from the nearest release site) that they were unable to find any unaffected patches of mist flower in the Waitakere Ranges that they could use for comparative purposes!

There have been a few **comings and goings** amongst biological control of weeds staff at Lincoln in recent times. **Jeremy Sheat** completed a 12-year stint with the group at the end of 1999 to enable him to fulfil his lifelong ambition of making a living off the land at the family farm in Dunsandel. Jeremy could be accused of moving to greener pastures as he also intends to devote a chunk of his time to promoting a new invention, known as a "Water Wizard", that was the brainchild of his late father. This piece of electronic gadgetry can be used to alert farmers that their irrigation systems are going awry and therefore maximise production while minimising water wastage. The same technology may be made available in future for a range of other uses such as warning farmers that their milk vats are overheating or that someone has come onto their property. Perhaps you can develop a "Bug Wizard" to help us keep track of some of those elusive new agents in the field, Jeremy? We wish you all the best for your new career and thank you for the legacy you leave behind, particularly the enhanced mass-rearing systems that enable us to get new agents out in the field as soon as possible.

We would like to welcome **Kylie Galway,** who has left her home in Australia and shifted across the Tasman to take up a PhD fellowship at Lincoln University to examine how we can suppress **broom** more

Jeremy Sheat does his best to avoid making a farewell speech by hiding behind his topiary rooster (one of a matched pair given to him as a farewell present from the team).

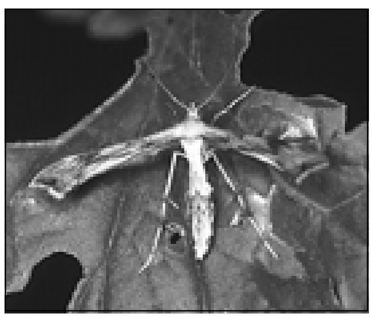
effectively by integrating the control techniques that are available to us. Landcare Research and the Co-operative Centre for Weed Management Systems in Australia have joined forces to provide funding for this study, which will provide new ammunition to allow us to tackle this weed problem more effectively. Kylie brings with her husband **Peter**, who has until recently been working on biological control of insect pests and weeds, including **lantana** (*Lantana camara*), and her labrador Molly. Kylie has previous experience in biological control, having worked until recently with two Australian plants, the **paper bark tree** (*Melaleuca quinquenervia*) and the **old world climbing fern** (*Lygodium microphyllum*), which have become invasive in the Florida Everglades, USA. We are sure that Kylie is looking forward to clambering through in broom in New Zealand without having to worry about snakes and other nasties!

The three broom PhDs: Kylie Galway, Helen Harman, and Melanie Haines (left to right).

Broom PhD's seem to be the order of the day at present as there are two others in progress at Lincoln. **Melanie Haines** began a study in 1999 on the non-target impacts of the **broom seed beetle** (*Bruchidius villosus*) and in particular its impact on tree lucerne. **Helen Harman** is coming to the end of her study using molecular techniques to DNA fingerprint the **broom twig miner** (*Leucoptera spartifoliella*) and determine its origins, and has now rejoined the group full-time. Helen's new skills should enable us to develop even more successful projects in future by, amongst other things, allowing us to identify the best strains of agents to use. We will keep you posted on the findings of all three PhD's in future issues.

Australian Hot Gossip

A natural enemy of ragwort that originates from Spain has recently been approved for release in Australia. The **ragwort plume moth** (*Platyptilia isodactyla*) is similar in appearance to our **hieracium plume moth** (*Oxyptilus pilosellae*) with its hind wings divided into three feathery plumes. The larvae initially burrow into the leaf petioles and then tunnel down into the crown and roots where they continue to feed and grow. The damage caused by older larvae is usually fatal to ragwort plants



Ragwort plume moth

Ragwort Agent	Status
Crown-boring moth *Cochylis atricapitana*	Established in Tasmania and Victoria. Reducing the height and growth of flowering plants and is killing smaller rosettes at at least one site.
Ragwort flea beetle *Longitarsus flavicornis*	Well established and reducing ragwort in Tasmania. Established only in high altitude and high rainfall areas in Victoria with no significant impact yet.
Ragwort flea beetle *Longitarsus jacobaeae*	Established at a few sites in Tasmania and Victoria with no significant impact yet.
Cinnabar moth *Tyria jacobaeae*	Establishment doubtful.

and it is hoped this new agent will strengthen the existing ragwort attack (summarised in table).

A combination of the impacts of the greater **St John's wort beetle** (*Chrysolina quadrigemina*), improved pasture management, and the use of herbicides has largely dealt with the problem of St John's wort in open flat grasslands in Australia. However, the weed has remained a problem in areas where pasture improvement is not feasible, so another agent, the **St John's wort mite** (*Aculus hyperici*), has been enlisted to add pressure to the plant. Since 1991 this tiny mite has been released at more than 300 sites and is now established throughout most of the weed's range in New South Wales, Victoria, and South Australia. As the old saying goes "size doesn't matter" and our Australian colleagues are delighted with the impact of one of the world's smallest arthropod biological control agents. A reduction in the height and density of St John's wort infestations was noticeable at release sites after only a few years and recently an assessment study has been undertaken at two sites in Victoria to quantify this. At one site the density of St John's wort increased by 12% despite mite activity; however, the mites were still having a significant impact because, when they were removed from equivalent plots, the plant density increased by 58%. At the other site the results were even more dramatic. The density of plants in plots where the mites were present decreased by 29%, whereas plots free of mites increased by 65%. Mite-infested plants were also more stunted, deformed, and generally less vigorous.

These snippets were taken from issue 11 of *Under Control - Pest Plant and Animal Management News* published by the Keith Turnbull Research Institute, Victoria, Australia, ISSN 1328–2425.

Autumn Activities

Autumn is a good time for harvesting and redistributing ragwort flea beetles, nodding thistle crown weevils (*Trichosirocalus horridus*), nodding thistle gall flies (*Urophora solstitialis*), gorse pod moths (*Cydia succedana*), old man's beard leaf miners (*Phytomyza vitalbae*), and old man's beard fungus (*Phoma clematidina*).

For the first four agents listed refer to the appropriate pages in "The Biological Control of Weeds Book" for detailed instructions on how to go about this. Avoid sealing up ragwort flea beetles with large quantities of ragwort in non-breathable containers in hot weather. Also be careful to sort through any material that you collect with your garden-leaf vacuum so that you don't shift any pests, like the clover root weevil (*Sitona lepidus*), at the same time.

Old man's beard leaf miners are dispersing extremely quickly throughout the country, but if you do come across any uninfested patches before they do, then you can easily help to fill any gaps in their distribution. Simply collect as much mined leaf material as you can from a heavily infested site and leave this on the ground at the new site where it won't get blown away. You may notice small brown pupal cases stuck to the undersides of leaves. New adults will quickly emerge from these and colonise the new sites. Any larvae still mining the leaves will complete development on the cut material, and provide additional new adults for establishment.

Likewise it is easy to shift old man's beard fungus to new sites. Collect blackened, infected leaves and wash the spores off by swilling them around in a bucket of water. Transfer the resulting liquid into a sprayer (it is better to keep one especially for this purpose to avoid contamination with herbicides etc.) and apply it to some old man's beard foliage. It is preferable to soak one area thoroughly than to apply the mixture too thinly. Because the fungus needs moisture to be effective, where possible choose shady damp sites. If it rains heavily soon after application, then the spores may get washed off and you may need to repeat the procedure.

Tell Me More ...

Question: Should I release several control agents for the same weed at the same site?

Although it may be more convenient to do so, as a general rule we would suggest that in the early stages of a biological control programme you don't put out several control agents for the same weed at the same site. Obviously the ultimate aim is to have all the agents out there working together as one big happy family, but new agents are usually rare and precious and sometimes need to be mollycoddled until they get going. To maximise their chances of survival, you want to give new agents the best possible start and that means giving them the healthiest food supply available. Be careful even if you are dealing with agents that don't attack the same part of the plant, for example, combining a foliage feeder and a seed feeder. While the seed feeder is unlikely to harm the foliage feeder, the converse is not necessarily true. If the foliage feeder does its stuff, then the plants may produce few, if any flowers, and there may not be enough pods to sustain the seed feeder. There is also the danger of putting all your eggs in one basket and having them all wiped out in a freak event such as a fire or a flood. However, it may still be feasible to release new agents, especially those that disperse slowly, within just a few hundred metres of each other. You can start to load up sites with the full complement of agents once they are well established and easy to harvest in good numbers. If in doubt about what to do don't be afraid to ask us!

Stop Press!!
This newsletter is now available online!
Check out our website!

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