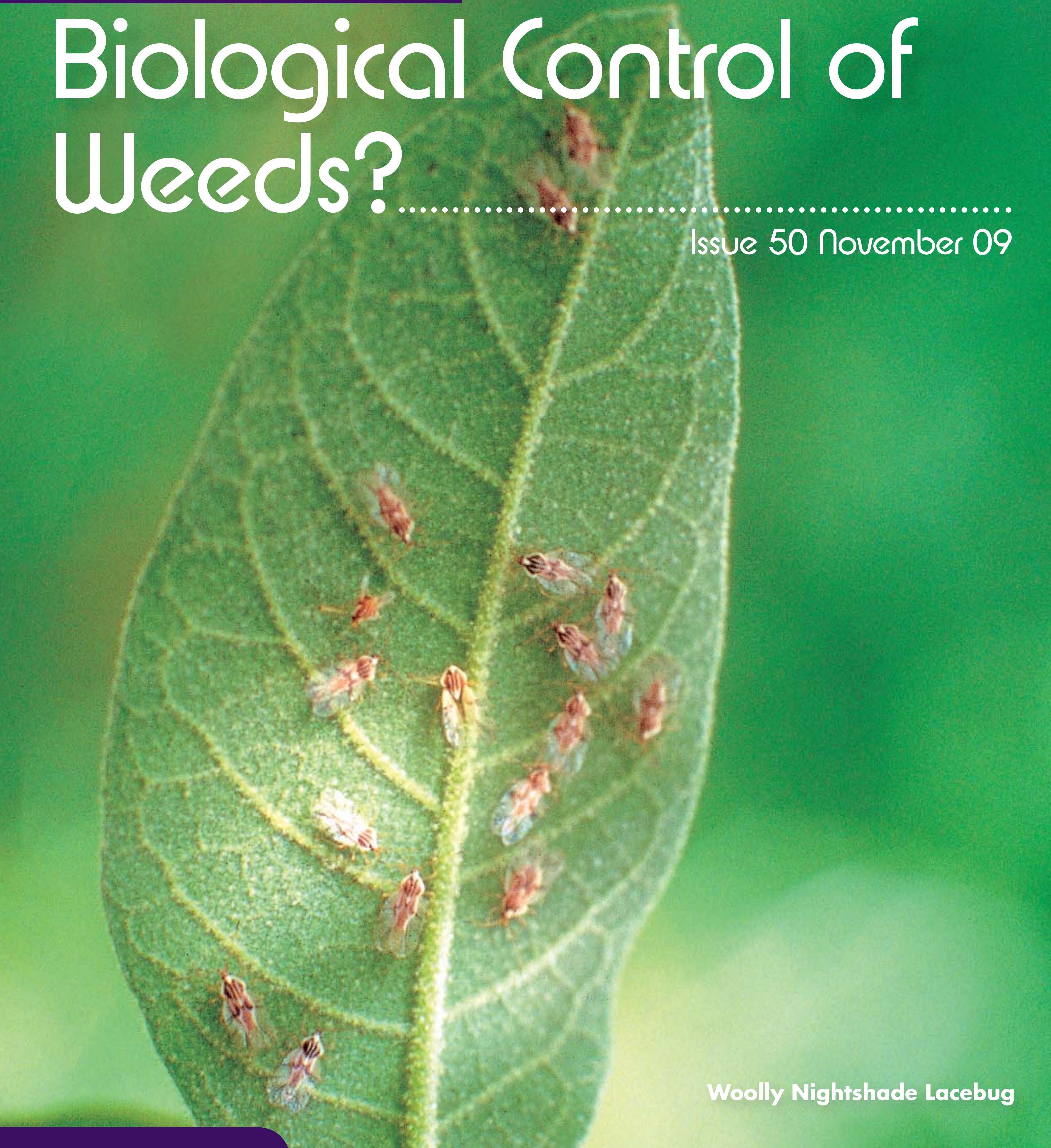
WHAT'S NEW IN

Biological Control of Weeds?

Issue 50 November 09



Woolly Nightshade Lacebug

What's Inside?

Landcare Research
Manaaki Whenua

War Against Woolly Nightshade Begins

The all-clear has been given to release the first biocontrol agent against woolly nightshade (*Solanum mauritianum*) in New Zealand. In September we received the good news from ERMA that we can import and release the woolly nightshade lace bug (*Gargaphia decoris*). Our South African colleague Terry Olckers (University of KwaZulu-Natal) has been a huge help in this project conducting all the required host testing for us. South Africa is the only other country where the lace bug has been released as a biocontrol agent and so far it has caused major damage to the weed at one site there.

Typical lace bug frass along leaf margins.

Both the adult and nymph life stages damage woolly nightshade by sucking on the leaves causing them to bleach, dry out and fall prematurely. "In the field, typical signs that the woolly nightshade lace bug is present include white patches on the upper surface of leaves and specks of frass deposited along the leaf margin," said Terry. "You most commonly find the adults and nymphs in groups on the underside of leaves." The adults tend the young, which helps to reduce predation. Up close this aptly named insect looks very delicate with lace-like sculpturing on its head, thorax and wings.

We intend to import a colony of the lace bugs from South Africa in the New Year from a population that originated from south-west Brazil. We will mass-rear the lace bugs over winter and, all going well, we will be able to make the first releases next spring.

This project is funded by the National Biocontrol Collective.

CONTACT: Lynley Hayes (hayesl@landcareresearch.co.nz)

Japanese Honeysuckle Set to Explode

Akihiro Konuma monitoring Japanese honeysuckle flowers.

Our Japanese collaborator Dr Akihiro Konuma recently spent 6 months in New Zealand on an OECD fellowship, which enabled him to undertake further studies of our Japanese honeysuckle (*Lonicera japonica*). Akihiro had already determined that Japanese honeysuckle in New Zealand is more diverse than is typical for populations in its native range, and (based on chloroplast DNA data) appears to have been introduced from China or Korea and Japan. In the past the plant has set relatively few seeds here, so spread has been due mainly to human activities. Poor seed production can be due to a lack of suitable pollinators and/or genetic factors. Akihiro has found that Japanese honeysuckle is an obligate outcrosser, which means it cannot self-pollinate and only sets seed if it is pollinated by an unrelated plant. In the past when Japanese honeysuckle was less common, unrelated plants had a low chance of pollinating each other, as bumblebees (the main pollinator in New Zealand) did not fly the long distances between plants, and so this climber rarely set seed. However, Akihiro has confirmed that the plant is now fruiting freely at many sites. It is likely that a critical threshold has been passed – now that Japanese honeysuckle is more common, pollinators are more frequently encountering unrelated plants and pollination success has increased. This means that the lag phase for Japanese honeysuckle is well and truly over and we can now expect to see it spreading much more quickly. It would appear that a biocontrol project for this target has not begun a minute too soon.

CONTACT:
Quentin Paynter (paynterq@landcareresearch.co.nz)

Successful Bid to Keep on Beating Weeds

We are pleased to announce that we have received 6 years of funding from the Public Good Science Fund for our Beating Weeds II proposal. This was a great outcome as it is 2 years longer than our previous Beating Weeds funding and includes a 20% increase. Many people have worked hard on this proposal and we would like to thank them.

The new Beating Weeds programme essentially will investigate the best ways to use limited resources to manage environmental weeds in New Zealand. While led by Landcare Research, Beating Weeds is a collaborative venture with major research inputs from two other CRIs (AgResearch and Scion), universities (Auckland, Canterbury, Lincoln and Massey), and the Department of Conservation. Some of the work is directly continuing on from the first Beating Weeds programme, for example weed prioritisation, however, it also contains many completely new areas of research. Beating Weeds II is divided into two parts: Improved Targeting of Weeds (Intermediate Outcome 1) and Improved Environmental Weed Management (Intermediate Outcome 2).

Improved Targeting of Weeds focuses on tackling weeds before they become widespread and it becomes increasingly expensive to control them. There are many localised exotic plants that have shown potential as weeds but which, as they have not spread widely, could be fairly easily controlled. As there is such a large number of weeds to tackle it is essential to prioritise them. Research in this area aims to enable end-users to do this by developing a robust, quantitative system using models incorporating the plants' potential distribution, spread rate, difficulty of control, and impacts on the agricultural and conservation sectors. In addition, through analysing successful biocontrol programmes from around the world, we will predict the best targets for biocontrol in New Zealand.

Improved Environmental Weed Management contains two objectives. The first is to provide better weed control tools to improve cost-effectiveness and efficacy, and reduce non-target damage. Biocontrol may be the only effective and sustainable management tool for weeds that are widespread in natural ecosystems. "However, more research is needed into factors which limit agent efficiency, such as parasitism and predation, and reducing the risk of non-target damage," said Simon Fowler, who is leading the Beating Weeds programme. This is where work on the gregarine gut parasite infecting the tradescantia leaf beetle (*Neolema ogloblini*) will take place (see *Tummy Bug for Tradescantia Beetle*, page 4). Work is planned on improving our understanding of biocontrol agent ecology and evolutionary interactions, and exploring the potential of bacteria and viruses as control agents. Chemical herbicides are commonly used for weed control but they are expensive and often damage native plants. Research will be made into substantially improving and refining herbicide efficiency and minimising damage to non-target species.

The second objective focuses on quantifying the benefits of weed control for native biota and ecosystem services. "Weed management in natural ecosystems tends to be measured in terms of the effort or impacts on the target weeds rather than the benefits to ecosystems, which are the real outcomes we want," said Simon. This will be done by developing bioeconomic models that combine new knowledge of invasive weed and native plant population ecology and the economics of different control methods. The aim is to help managers to maximise ecosystem gains for the amount spent on weed control.

The new Beating Weeds programme covers many aspects of improving weed control in New Zealand and we look forward to reporting on the discoveries and new tools developed over the next six years.

Beating Weeds II: Better Prioritisation, Improved Tools and Enhanced Biodiversity Benefits is funded by the Foundation for Research, Science and Technology.

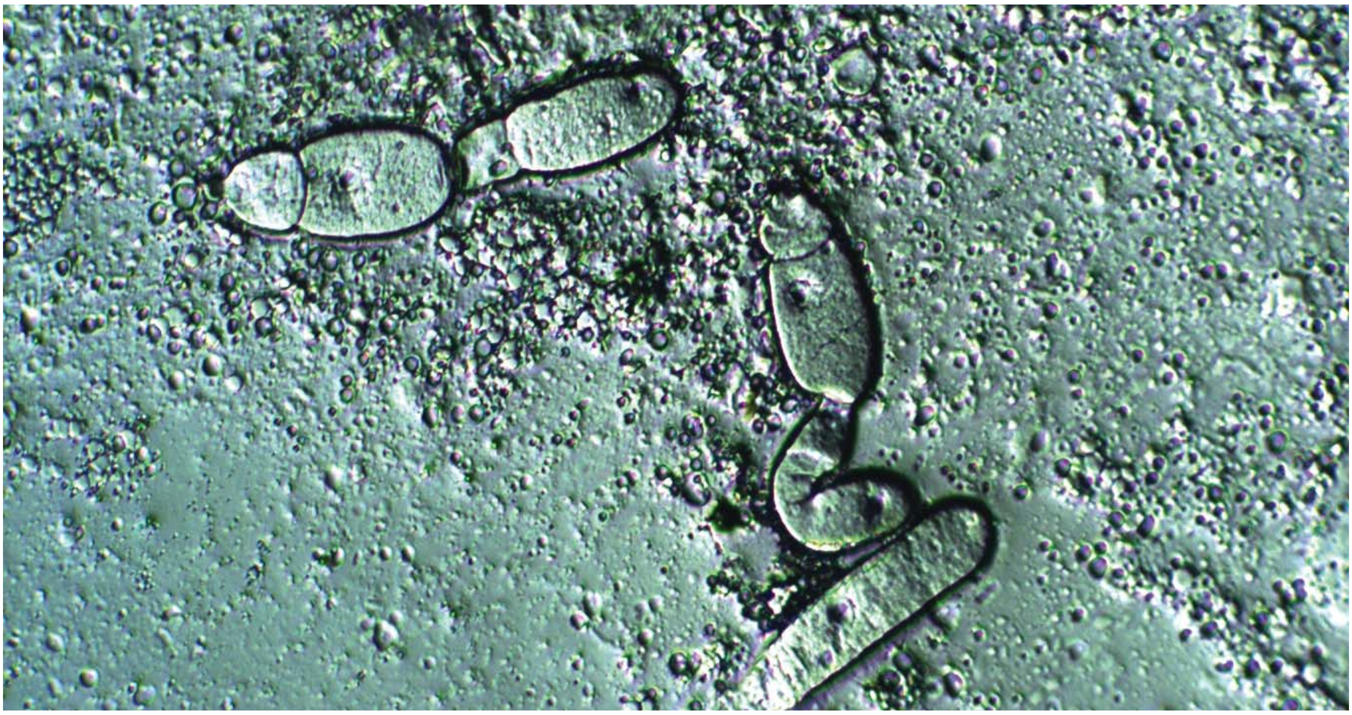
CONTACT: Simon Fowler (fowlers@landcareresearch.co.nz)

Tummy Bug for Tradescantia Beetle

Nearly a year after gaining ERMA approval to release the tradescantia leaf beetle (*Neolema ogloblini*) we have not yet been able to take the beetles out of containment. Routine testing revealed the beetles were infected with a gregarine (protozoan of subclass Gregarinia) gut parasite, and we have been working hard to obtain a clean colony of this highly promising control agent. We are taking a precautionary approach as we do not know whether this parasite is already present in New Zealand, how debilitating it is to the beetles, or whether it could infect other species. Little is known about these parasites worldwide (their life cycles are not even understood) but thanks to gaining continued funding for the Beating Weeds programme (see *Successful Bid to Keep on Beating Weeds*, page 3) we are now able to look into some of the important questions.

This lack of information about gregarine parasites has made it extremely challenging to achieve a clean colony. Sterilising the beetle's eggs and maintaining strict hygiene protocols was unsuccessful. So in January we visited Brazil and collected additional leaf beetles in the hope that some of them would be free from infection. It is very difficult to detect the parasite at low levels so we have been rearing these beetles as isolated single female lines, and lines where the parasite has shown up have been destroyed. "Our efforts have dramatically reduced the incidence of the parasite in the population," said Simon Fowler. "We now have five promising lines but we need to rear them through two more generations to be absolutely certain that they are clean." All going well it may be possible to apply to MAF to take the beetles out of containment in March and begin making releases in April. If we don't achieve a clean colony by March it may be necessary to drop this species and focus on other agents. This would be extremely disappointing for all concerned, but fortunately there are plenty of other agents that could be used to control tradescantia.

As well as three other highly promising beetle species, we have identified a sawfly, gall midge, moth, and several pathogens in Brazil which show potential too. Colonies of two of these beetles (*Neolema abbreviata* and *Lema basicostata*) are in containment at Lincoln and host-range testing is underway. These beetles are being checked regularly for gut parasites and none have been detected so far in *Lema basicostata*, but low levels of another gregarine parasite have been detected in *Neolema abbreviata*. We are following the methods we established for the leaf beetle to achieve a clean colony of *Neolema abbreviata*. We hope to be able to prepare an application to ERMA to release one or both beetle species by March 2010. These beetles should complement the leaf beetle extremely well by damaging the stems and tips.



Mature gregarine gut parasites from the tradescantia leaf beetle (×100 magnification).

We are studying a fourth beetle, *Buckibrotica cinctipennis*, in containment, which looks promising as it causes considerable damage to potted plants and is not showing any signs of gut parasite infection. Originally it was dropped down the priority list because it was thought to have root-feeding larvae, which would have made host range testing very difficult. However, we have discovered that it has stem-feeding larvae and it has been elevated back up the list. Rearing methods are being developed to allow host range testing to begin, and once we have enough specimens we can also check them for gut parasites.

On the pathogen front, two species we were investigating have been rejected because of lack of specificity (*Burkholderia andropogonis*) or lack of damage (*Uredo* sp. nov). On the upside, a biotype of the yellow leaf spot fungus (*Kordyana tradescantiae*) that infects New Zealand tradescantia has been successfully located in Brazil, and is being studied by Dr Robert Barreto (University of Viçosa, Brazil). It appears to be host specific and very damaging to New Zealand plants. However, although the infection is readily passed from plant to plant in the wild, Robert has not yet managed to deliberately infect plants by inoculating them. This inoculation problem needs to be resolved because we would not import and release diseased live plants into New Zealand because of possible contaminants, so we would need a pure culture of the fungus. Finally, a new and promising isolate of *Cercospora apii* has recently been found that may work well in wet situations, and will be studied when funds permit.

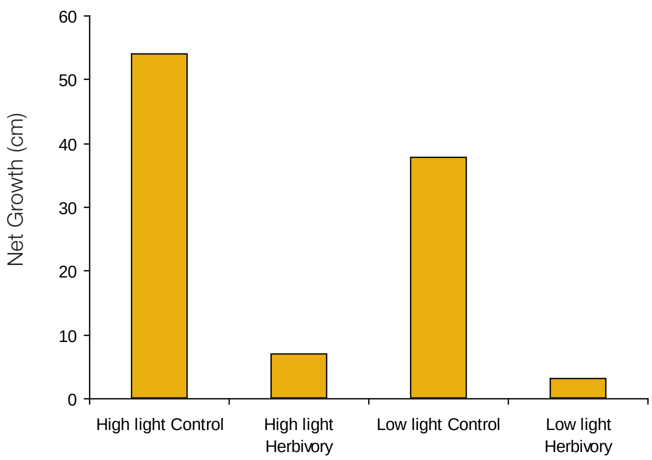
Sue Molloy has been conducting defoliation experiments as part of her PhD to model what we might expect the impact of the tradescantia leaf beetle and other potential biocontrol agents for tradescantia to be. Simulated leaf-eating significantly reduced stem growth in both high and low light levels (see graph). "From these results we would expect that the tradescantia leaf beetle would restrict invasion of the weed into new areas," said Sue. "Tradescantia tends to establish in high light then move into shaded areas, but light level did not alter the significant impact simulated herbivory had on the weed."

When the growing tip is damaged on a tradescantia stem, new branches grow from nodes close to the injured site. Plants in Sue's experiment subjected to the herbivory treatment grew fewer branches than control plants. One implication from this work is if both leaf- and tip-feeding biocontrol agents are present, such as *Neolema ogloblini* and *Neolema abbreviata*, they could magnify the impact of each other. The leaf feeder would restrict branching at tips thus making the tip-feeder more effective than if it was not present.

These data will be used to construct a mathematical model of tradescantia growth under various light and herbivory levels and will help us identify which parts of the plant are best to target for biocontrol. A model is presently being checked and tested.

This project is funded by the Department of Conservation, National Biocontrol Collective and the Foundation for Science, Research and Technology under the Beating Weeds programme.

CONTACT: Simon Fowler (fowlers@landcareresearch.co.nz)



Simulated leaf-eating significantly reduces tradescantia stem growth in both high and low light.

New Look Newsletter

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

Climbing Asparagus Dropped as Biocontrol Target

Recently it has become clear that climbing asparagus (*Asparagus scandens*) is not a suitable target for classical biocontrol. The prospects did not look good right from the start when surveys of the weed's natural enemies were undertaken in its home range of South Africa. While plants displayed a variety of damage, caused by a range of fungal and arthropod species, most was relatively minor. "Many of the species responsible proved to be generalists or are known to attack cultivated asparagus (*A. officinalis*), thus ruling them out as potential biocontrol agents," said Carien Kleinjan from the University of Cape Town, who led the surveys. Amazingly the roots and tubers in particular were practically untouched by natural enemies.

The surveys suggested that the restricted range and abundance of climbing asparagus in South Africa is due more to the availability of suitable habitat than the effects of natural enemies. The location of infestations is strongly influenced by rainfall and topographic characteristics with climbing asparagus preferring damp sites with a southerly aspect. At these sites the plant can be the dominant understorey species despite substantial pathogen infection and arthropod attack. Unfortunately no equivalent of the bridal creeper rust (*Puccinia myrsiphylli*), which is so damaging to *Asparagus asparagoides*, occurs on climbing asparagus.

The one bright spot offering some hope was that both fruit production and seed viability are low in South Africa. Although most of the problems we have with the weed in New Zealand are due to its vegetative growth, the fruits are eaten by birds, which is helping the plant to spread to new areas, so reducing reproductive output would be useful. Unfortunately the organisms responsible for poor fruiting and seed viability in the native range are not suitable to introduce to New Zealand. The pathogens isolated were bacteria, yeasts and common endophytes with no prospects for biocontrol. "A wasp (*Eurytoma* sp.), which feeds on the seeds, may need access to a range of *Asparagus* hosts for high levels of attack to occur on climbing asparagus," said Carien. Also one of these alternative hosts is cultivated asparagus and, since all commercial crops of this popular vegetable in New Zealand are produced from crowns grown from seed, any application to release this wasp would be vigorously opposed by the industry.

Climbing asparagus smothering native bush in the Waitakere Ranges.

Of the hundreds of different fungi isolated from the vegetative material, only two, *Colletotrichum* and *Phomopsis*, were deemed worthy of further study. The *Phomopsis* was not able to be recollected from the field for further study. Estianne Retief, from the Plant Protection Research Institute in South Africa, has tested the isolates collected of *Colletotrichum* to see how infectious they are. "Unfortunately the *Colletotrichum* does not appear to be virulent enough to compete with the vigorous growth of climbing asparagus," said Estianne, "and the plant outgrows the infection." Also attempts to infect plants from New Zealand with the *Colletotrichum* isolates were unsuccessful without wounding. The fungus appears to be opportunistic, infecting plants through wounds made by other organisms, and does not spread very quickly on its own. Given no insect biocontrol agents are available to make the necessary damage this fungus could only be useful if it could be developed into a mycoherbicide, where a high concentration of spores could be applied after mechanically damaging the plant. However, developing mycoherbicides is an expensive process and given the size of the market in New Zealand is unlikely to be an economically viable option. Instead we recommend that efforts should now focus on finding other ways to control the weed, such as obtaining better results with herbicides.

This project was funded by the National Biocontrol Collective.

CONTACT: Lynley Hayes (hayesl@landcareresearch.co.nz)

Summer Activities

With increasing day-length and rising temperatures many of our biocontrol agents enter a busy stage in their life cycles. Some activities to fit in during coming months include:

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

- Check release sites. Look for curled leaves tied together with webbing at the stem tips, black frass, and "windows" in the leaves where the caterpillars have eaten the green tissue away and the leaf may be turning brown. We would be very interested to hear if you see severe damage to the foliage.
- If you find good numbers of caterpillars you can begin harvesting and shifting them around. Cut off infested boneseed tips and wedge them into plants at new sites. Aim to shift at least 100 caterpillars. Do not release the leafrollers in areas where Argentine ants are established as they are unlikely to survive.

Broom leaf beetle (*Gonioctena olivacea*)

- Check release sites, although it is still early days. If you are lucky you may see larvae feeding on the leaves and shoot tips. Adults are small (2–5 mm). The females are orangey-brown and the males have an orangey-red tinge, although colouration can be quite variable. You may need to beat plants to see the beetles.
- We would not expect you to find enough beetles to begin harvesting yet.

Broom seed beetle (*Bruchidius villosus*)

- Harvest and redistribute beetles while they are still inside mature brown pods, avoiding green ones as the beetles will not be completely developed. Cut and shift infested branches as soon as the first pods have started to burst open.

Heather beetle larvae.

Gorse soft shoot moth (*Agonopterix ulicetella*)

- Check gorse for these now, but get onto it straight away. By late November or early December the caterpillars are quite large, dark brown or greyish-green feeding on or near webbed growing tips. We would be very interested to hear of any outbreaks or caterpillars found in new locations – areas of particular interest are the North Island and lower South Island.
- Caterpillars can be redistributed by harvesting infested branches or even whole bushes.

Green thistle beetle (*Cassida rubiginosa*)

- Check release sites (see *Spotting Green Thistle Beetles in the Field*, page 8).
- We would not expect you to find enough beetles to begin harvesting and shifting them around yet.

Gorse thrips (*Sericothrips staphylinus*)

- Check release sites when gorse isn't flowering so you won't be confused with flower thrips (*Thrips obscuratus*). You will probably need to use a hand lens and/or beat plants.
- If you find good numbers thrips can be harvested and redistributed by cutting infested branches and wedging them in bushes at a new site.

Heather beetle (*Lochmaea suturalis*)

- Check release sites. If there is noticeable damage and numbers are high, you should see the greyish larvae. If larvae are hard to find, beat plants with a stick over a white sheet or by use of a sweep net. It is best to redistribute new adults in the autumn.

Hieracium gall midge (*Macrolabis pilosellae*)

- Check release sites for plants with swollen and deformed leaves caused by larval feeding. Summer is not a good time to redistribute this agent as whole infected plants must be moved and it is crucial that they do not dry out.

Send any reports of interesting, new or unusual sightings to:

CONTACT: Lynley Hayes (hayesl@landcareresearch.co.nz)

Spotting Green Thistle Beetles in the Field

It is always challenging to spot tiny biocontrol agents out in the field. Methodical searching can be needed to determine whether agents have established at a release site. But before you even start you need to know what you are searching for! Having a clear idea of the signs of agent damage, what it looks like and whereabouts on the plant it is likely to hide out is essential. Often there is no substitute for experience and we would like to pass on some tips for spotting green thistle beetles (*Cassida rubiginosa*) from Jesse Bythell. Jesse is a contractor to Environment Southland, and has already spent many hours on her hands and knees looking for these beetles, and fortunately not in vain. The beetles have only been out in the field for 2 years so it is early days yet, but Jesse has found them at some sites after only 1 year. The photos accompanying this story were also taken by Jesse.

A good indication that the beetles are present is windows in the thistle leaves caused by adult and larval feeding. This damage makes the leaves become discoloured, turning yellow and then brown as the leaf dies. Adult beetles themselves can be hard to spot as they are often a very similar green to the thistle leaf. It is easier to see them when they are sitting across the leaf's white midrib or if they have taken on a slightly yellowy colour, like this one Jesse spotted in late summer. The larvae are often easier to spy than adults. The larvae carry dark bundles of dried frass and dead plant material over themselves like a protective umbrella. The eggs are laid in batches, are brown and found on the underside of leaves.

Hopefully this information will help you with your searches. We are interested to hear where green thistle beetles have established.

Thanks very much to Jesse Bythell for sharing her experiences and photos with us!

CONTACT: Jesse Bythell (jesse@biosis.co.nz) and
Hugh Gourlay (gourlayh@landcareresearch.co.nz)

Typical feeding damage by the green thistle beetle.

A more yellowy adult green thistle beetle.

Green thistle beetle larva on a leaf.

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Editors: Julia Wilson-Davey, Lynley Hayes
Contributions: Jane Barton
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Any enquiries to Julia Wilson-Davey

www.weedbusters.org.nz

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