WHAT'S NEW IN

Biological Control of Weeds?

Issue 62 Nov 12

Sarah and Stan outside the new facility

What's Inside?

Landcare Research
Manaaki Whenua

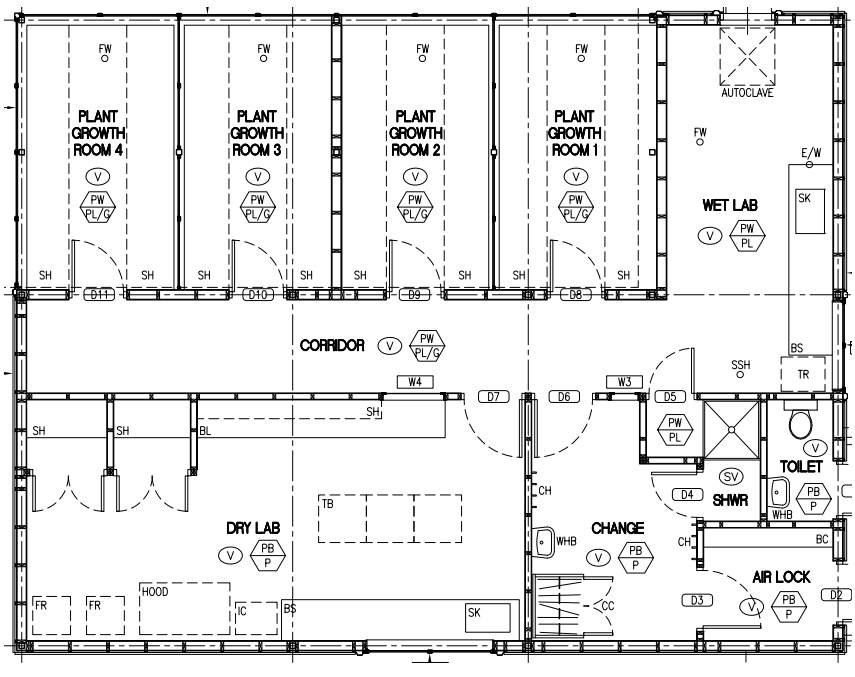
New Plant Pathogen Containment Facility

Landcare Research's new 'state of the art' transitional and containment facility for plant pathogens and invertebrates is now open and nearly ready for business at our Tamaki site in Auckland. It has been named the Beever Plant Pathogen Containment Facility in honour of the late Dr Ross Beever and his wife Dr Jessica Beever. Ross made significant contributions to fungal taxonomy, genetics, plant pathology and the conservation of New Zealand's flora, and Jessica is continuing to document and aid the conservation of New Zealand bryophytes (for more details see box on page 3). The $2.2 million dollar building, the first and only one of its kind in New Zealand, was officially opened in Auckland on 1 November by Jessica and her whānau. There was a small dawn ceremony to bless the building, followed by the official opening and viewing opportunity a few hours later.

The newly constructed facility will be a huge boost to our weed biocontrol programmes, which until now have had to rely on overseas facilities and collaborators to undertake any work involving plant pathogens. It has often been challenging to find suitably experienced people with time to undertake the work in other countries – good plant pathologists seem to be in short supply! It has also been difficult to organise the plants needed for testing overseas, as they are often not available locally. Even when permits to ship plants have been straightforward to acquire (note some have taken more than a year) some species have not survived the shipping process well or thrived under overseas conditions. Some of the facilities available overseas have also been limited meaning that only a few species of plants could be tested at one time. All these factors have caused frustrations, delays and additional costs. "Now that our own staff can do this work here in a world-class facility it will be much more straightforward to tackle some projects," said plant pathologist Sarah Dodd, who has been a key player in its development. Some work that was previously unfeasible can also now be considered. For example, the Brazilian yellow leaf spot fungus *(Kordyana* sp.), which attacks tradescantia (*Tradescantia fluminensis*), requires plant-to-plant infection, so obtaining safe, clean material for release could not be done without access to a containment facility in New Zealand, since none is available in Brazil.

"As well as weed biocontrol studies the facility will also be suitable for safely undertaking research into exotic plant pathogens that pose a threat to native flora (e.g. kauri dieback PTA) or other desirable plant species (e.g. kiwifruit PSA bacterium)," explained Stan Bellgard, who has also played a key role in its design. Other research organisations have shown an interest in using the building and access will be made available, where possible, to the Ministry for Primary Industries (MPI), other CRIs, universities, overseas research institutes, businesses, and private individuals.

Although the facility will primarily be used to securely hold and study microorganisms associated with plants, it can also be used to hold invertebrates if required (e.g. if the Miller Invertebrate Containment Facility at Lincoln is at capacity, or where projects would be better done from Auckland such as developing biocontrol for weeds that don't occur in the South). All imported material entering the facility must have approval from the Environmental Protection Agency, under section 40 of the Hazardous Substances and New Organisms (HSNO) Act 1996, as well as approval to import into containment from MPI, granted under the Biosecurity Act 1993. MPI also audits the facility, initially to certify that it is fit for purpose, and then at least annually to check for compliance with regulations.



Floor plan.

One of the key features of the facility is the ability to grow plants in sealed glasshouses under natural light. "Providing natural light

is very important so that growing conditions match those expected in the field and help to maintain healthy host plants. “Rust fungi, for example, often need natural light to sporulate and remain viable,” explained Sarah.

A detailed manual for the running of the facility has been prepared by Sarah and this describes the quality assurance systems in place to achieve a level of physical containment for plant pathogens – which have a higher risk of escape than invertebrates. The security, emergency and maintenance procedures are also provided in the manual, which is reviewed annually to reflect any changes in standards. Some of the specialised features include HEPA filters to clean the air circulating in the glasshouses and laboratories, sterilisation (using heat treatment) of all waste water before it joins regular waste water, and the ability to autoclave all solid-waste material and packaging before it is removed from the facility. There is also an air-locked entrance room containing an insect light trap, which operates continuously. This leads to a changing room, used for dressing into and out of containment clothing, as well as a decontamination shower. There are wet and dry laboratories in addition to the four plant growth rooms, which have individual air-conditioning systems. The direction of air flow is controlled to ensure the containment of airborne spores and insects within the facility and that there is no cross-contamination between plant growth rooms. All walls, ceilings, light fittings and floors have been constructed so that they are completely sealed and can be decontaminated easily.

Access to the plant growth rooms and glasshouses is strictly limited to authorised personnel only who have been specifically trained in microorganism and invertebrate containment procedures. Authorised users are required to read and understand the facility’s manual and pass a training test before being allowed access. Small groups of visitors may only be taken into the lower-containment-level parts of the building (wet and dry laboratories and corridor), but even then cannot take anything with them (cameras, jerseys, coats, bags/cases, hats, notebooks etc.).

As soon as the final checks are completed to ensure the facility is running properly, and all the paperwork is in place, we will import the first inhabitants, hopefully before Christmas. These are likely to be the newly approved lantana rusts (*Puccinia lantana* and *Prospodium tuberculatum*), allowing releases to begin in the New Year.

Watch a video about the opening (http://www.youtube.com/landcareresearch)

CONTACT: Sarah Dodd
dodds@landcareresearch.co.nz

Jessica Beever declares the facility open.

Ross and Jessica Beever

This facility is named in honour of a very special couple, Dr Jessica Beever and the late Dr Ross Beever, who have given decades of valued contribution to Landcare Research, to DSIR, and to the community.

Botanist Jessica specialises in taxonomy of New Zealand’s mosses and, through her papers, books and illustrations, is recognised nationally for her expertise. Currently she is collaborating to prepare a complete flora of New Zealand mosses. Jessica has been a Research Associate of Landcare Research since its inception in 1992. Earlier, some of her Landcare Research colleagues benefited from her lecturing role at the University of Auckland. She shares her awareness of her whakapapa and her passion for te reo and waiata with all colleagues here at Tamaki.

The late Ross Beever (1946–2010) was a mycologist, plant pathologist, fungal geneticist, botanist, and mentor to many. Ross is remembered for many achievements including his research on the destructive *Botrytis* disease of grapes, identifying the causes of cabbage tree decline and kauri dieback, and describing the truffle-like fungi of New Zealand. He also co-led establishment in 1986 of the still-continuing annual NZ Fungal Foray. Ross’s astute observational skills, insight, and clarity of thought combined in the production of an extensive list of high quality research publications in multiple fields.

Although botany was a hobby for Ross, he and Jessica have for decades been key members of the Auckland Botanical Society, with Ross awarded life membership. They also were active members of the Offshore Islands Research Group. Ross’s role in ensuring the survival of the world’s then rarest plant, *Pennantia baylisiana,* is commemorated with a dedicated tree “Te Hokingamai” planted at the entrance to the main Landcare Research building at Tamaki.

A Biocontrol Plan for the Cook Islands

A heightened awareness of the seriousness of weed problems in the Pacific region, following the Pacific Biocontrol Strategy Workshop that we hosted in 2009, has led Sarah Dodd and Quentin Paynter to scope out the opportunities for boosting weed biocontrol in the Cook Islands. The Cook Islands comprise 15 islands, the largest being the well-known holiday destination, Rarotonga. Rarotonga is known for its lush tropical vegetation that contains many plant species indigenous to the region.

Sadly, much of the Cook Islands' natural habitats and agricultural land are being threatened by invasive weeds, many of which were brought to the island for their ornamental value, as edible fruit, or as a timber species. Like here in New Zealand, there are now more introduced plant species in the Cook Islands than indigenous species. Not only are the weeds threatening native biodiversity and many traditional cultural practices, but also the sustainable development of the island group. In particular, a suite of woody vines (*Cardiospermum grandiflorum, Merremia peltata, Mikania micrantha* and *Passiflora rubra*) are smothering trees, causing massive deforestation and replacing the native forest with impenetrable vine thickets. There are concerns that this may have a devastating impact on natural watershed systems and consequently on the economy and quality of life of the islands. Unfortunately increasing tourism and global trade are likely to result in even more unwanted introductions down the track.

With funds provided by New Zealand's Ministry of Foreign Affairs and Trade (MFAT), Sarah and Quentin have recently scoped out a 5-year plan for developing weed biocontrol in the Cook Islands. They travelled to the Cook Islands to meet with regional experts involved in agriculture (forestry, horticulture, livestock), biodiversity conservation and biosecurity. At a workshop these experts provided key information needed to identify the best and worst biocontrol targets using a prioritisation framework we developed initially for Australia.

Fifty-two weeds were discussed at the workshop. Nine were rejected from further consideration because they had some desirable properties (e.g. edible fruit or cultural importance) so there would likely be opposition to any biocontrol attempts. A further two species, the giant sensitive plant (*Mimosa diplotricha*) and lantana (*Lantana camara*), were also removed from the list because they are already well controlled by biocontrol agents that have been introduced to the Cook Islands. "Successful biocontrol projects like these really help to pave the way for other biocontrol efforts," noted Sarah.

The panel of experts then ranked the remaining 41 plants as either "hot", "warm" or "cold" depending on how important they thought it was to control the plant. This was used to develop a weighted weed importance score that was combined with a biocontrol feasibility score and offset against the effort that it would take to complete the programme, to come up with an overall score. "Plants with existing biocontrol programmes in other countries are obviously cheaper targets because much of developmental work has already been done," explained Quent.

The 15 weeds with the highest total scores and which are therefore the top biocontrol targets are listed in the table on the next page. Quentin notes, "This scoring scheme still allows some species of lower importance, such as broom weed (*Sida rhombifolia*), to rank quite highly." This highlights the need to trade off the minor benefits of targeting weeds that are of relatively low importance, but have a high chance of successful control, with targeting weeds that are of high importance (potentially major benefits) but a lower chance of successful control. This was a cause for much discussion and the panel concluded that (assuming costs were comparable between plant species) they preferred to work on plants that were of higher importance but had a lower feasibility of successful biocontrol.

For this reason peltate morning glory (*Merremia peltata*), initially ranked only 15th, has made the final eight species chosen for inclusion in the 5-year plan. This vine is a highly problematic weed that can climb over and smother trees up to 20 m tall, but there is uncertainty regarding its status in Rarotonga and the wider Pacific region. Peltate morning glory was present in Rarotonga when the first European botanists began documenting the flora but may have been an early introduction rather than a native species. We have recommended that a study of the genetics of peltate morning glory should be undertaken to determine, if possible, how and when this plant colonised the Pacific region. Only if this study can provide convincing evidence that the plant is a recent introduction to the Cook Islands should biocontrol proceed.

A number of high importance weeds are excellent prospective biocontrol targets in the Cook Islands. These include two vines: grand balloon vine (*Cardiospermum grandiflorum*) and mile-a-minute (*Mikania micrantha*); a woody shrub, strawberry guava (*Psidium cattleianum*); a grass, giant reed (*Arundo donax*); and an annual herb, cockleburr (*Xanthium pungens*). Biocontrol agents are already available for all these weeds that could be released at relatively little cost.

Red passionfruit (*Passiflora rubra*) could be a more difficult biocontrol target due to the risk of a non-target attack affecting closely related *Passiflora* species that are cultivated for their edible fruit. However, the edible species of *Passiflora* grown in the Cook Islands all belong to the subgenus *Passiflora*, while *P. rubra* belongs to the subgenus *Decaloba.* Attractive *Heliconius* butterflies are a well-studied group and there is strong evidence that some species only utilise plants that belong to the subgenus *Decaloba*. Many species of *Heliconius* are readily available from suppliers for butterfly houses. So it seems likely that biocontrol of red passionfruit could proceed fairly rapidly and cheaply, without the need for extensive native-range surveys, although some host-range testing would be required.

African tulip tree (*Spathodea campanulata*) is a major invasive weed throughout the Pacific Region, for which biocontrol is predicted to have a medium feasibility. Preliminary surveys for biocontrol agents have been conducted in Ghana where this tree is native, funded by the Secretariat of the Pacific Community. Considerable investment would be required before any agents could be released in the Cook Islands but we recommend that this work should be tackled anyway.

We do not recommend starting work on any medium importance weeds withinin the next five years, with the possible exception of tree marigold (*Tithonia diversifolia*). This is currently a biocontrol target in South Africa and it may become a higher priority if researchers demonstrate that the agents currently held in containment in South Africa are adequately specific for release in the Cook Islands. Two other "medium importance" weeds (*Clerodendrum chinense*, *Ludwigia octovalvis*) are predicted to be highly feasible targets for biocontrol, but native-range surveys and host-range testing would have to be done, so they are both relatively "high effort" targets.

Gerald McCormack and Quentin Paynter looking at peltate morning glory on the edge of a coffee plantation field.

We also do not recommend starting work on any of the low importance weeds within the next five years, with the possible exception of broom weed (*Sida rhombifolia*). A biocontrol agent for this species (*Calligrapha pantherina*) could be collected in Australia at the same time as agents for cockleburr (*Xanthium pungens*) at very little extra cost, and biocontrol would almost certainly succeed.

As part of this scoping project Dr Maja Poeschko, of the Ministry for Agriculture in Rarotonga, travelled to New Zealand and spent time with our staff learning more about weed biocontrol. Maja has previously worked mostly on biocontrol for insect pests and is keen to be involved more on developing solutions for weeds. So everything is now in place to implement an exciting new weed biocontrol programme for the Cook Islands, just as soon as the necessary funding can be found, and that will be our next task…

Many thanks to MFAT for providing the funds for this scoping project and to all those who attended the workshop and provided valuable information, especially Gerald McCormack and Maja Poeschko.

CONTACT: Quentin Paynter
paynterq@landcareresearch.co.nz

The top 15 weeds from a potential of 41 weed species selected from the Cook Islands as candidates for biocontrol (where: F = Feasibility; E = Effort; I = Weed Importance). The weeds included in the 5-year plan are highlighted. Note the total score is I + F – E.

Rank	Weed species	Common name	F	E	I	Total score
1	*Arundo donax*	Giant reed	93	13	100.00	180.00
2	*Xanthium pungens*	Cockleburr	85	7	95.83	173.83
3	*Mikania micrantha*	Mile a minute	50	12	100.00	138.00
4	*Cardiospermum grandiflorum*	Grand balloon vine	50	14	100.00	136.00
5	*Passiflora rubra*	Red passionfruit	50	19	100.00	131.00
6	*Spathodea campanulata*	African tulip tree	50	21	100.00	129.00
7	*Psidium cattleianum*	Strawberry guava	50	12	85.00	123.00
8	*Sida rhombifolia*	Broom weed	99	8	30.00	121.00
9	*Clerodendrum chinense*	Honolulu rose	80	29	52.50	103.50
10	*Ludwigia octovalvis*	Willow primrose	77	25	46.67	98.67
11	*Sorghum bicolor subsp. drummondii*	Sudan grass	50	28	66.67	88.67
12	*Senna obtusifolia*	Sicklepod	15	17	87.50	85.50
13	*Phyllostachys bissetii*	Bisset's bamboo	50	33	68.33	85.33
14	*Hedychium coronarium*	White ginger	50	25	60.00	85.00
15	*Merremia peltata*	Peltate morning glory	15	32	100.00	83.00

Japanese Honeysuckle Project Back On Track

Some of the challenges we have encountered trying to develop biocontrol for Japanese honeysuckle (*Lonicera japonica*) have been strange, unexpected and downright unlucky! We last reported on this project in Issue 54 after seeking the help of Professor Austin Platt to hand-pair and rear the white admiral butterfly (*Limenitis glorifica*). But even the "master mater" was unable to get the butterflies to perform. Since then, two significant events have compromised the project. Firstly, the earthquakes that struck Christchurch in September 2010 affected the containment facility where populations of potential agents were being held. We had a stem-boring longhorn beetle (*Oberea shirahatai*) and an unnamed leaf-tying moth in containment and had begun host-testing them. We were getting good results but unfortunately both colonies were lost when the facility overheated.

Following this, the earthquake and tsunami in Japan 6 months later destroyed access to many of the collection sites used by our staff to source the insects and some of the sites were totally destroyed. In May 2011, the travel advisory recommended no travel north of Tokyo, which is where Quentin Paynter and Hugh Gourlay needed to go to restart the project. The unstable nuclear situation, in combination with the risk of ongoing aftershocks, meant it was not safe to undertake the work, and we decided to pause the Japanese honeysuckle project for a year. Because the work is seasonal, we needed to wait until June 2012 before another opportunity arose to collect and test Japanese honeysuckle agents.

The difficulties with rearing white admiral butterflies in captivity meant that host-range testing had to be done in Japan using field-collected eggs and larvae. Hugh and Quent were able to return safely to Japan in June this year and ship potential host plants from New Zealand to test the host specificity of the butterfly. The no-choice tests have now been completed and indicate that this species is sufficiently specific to honeysuckle to go ahead and apply for permission from the Environmental Protection Authority (EPA) to release the butterfly in New Zealand. As Quent reports, "New Zealand has no native plants in the Caprifoliaceae family and so gaining permission for their release should be relatively straightforward in light of the hurdles already encountered during this project." The butterfly did successfully rear through on Himalayan honeysuckle *(Leycesteria formosa),* which is also an invasive weed in New Zealand (so a bonus), but not on the mostly commonly grown ornamental *Lonicera* (*Lonicera nitida*), which appears to have leaves that are too tough for the first-instar larvae to chew on. Other ornamental climbing forms of honeysuckle grown in gardens here with softer leaves may be attacked by the white admiral given the testing results, but attack on other *Lonicera* species in Japan has rarely been recorded and is considered exceptional. If this attack does occur, home gardeners may not mind if it means having an attractive butterfly in residence. These and other issues will be addressed in the EPA application, which will be prepared soon.

White admiral adult.

Hugh and Quent also collected some of the other potential control agents for Japanese honeysuckle. Twenty cocoons of the leaf-feeding sawfly (*Zaraea lewisii*) were collected and are now in containment in Lincoln while we wait for them to mature. We have learnt that they remain as prepupae for a long time and may need to be kept for up to 2 years before they will pupate, so it may be some time before we know if we will be able to successfully work with this species.

Some adult stem-boring beetles were collected again and have been caged on mature honeysuckle plants in the Lincoln containment facility. The inoculated plants have been busy creating plenty of sawdust so it is hoped that plenty of beetles emerge in due course to begin host testing in 2013. The leaf-tying moth has been tentatively identified by research associate John Dugdale as *Allotalanta* sp. or *Scaeosopha* sp. and it appears to be a new moth species for Japan. Eggs of the moth have been successfully reared through in containment and their offspring have been used to set up no-choice host specificity tests. "The preliminary results indicate that the moth is specific to the Caprifoliaceae family of plants but more extensive testing will be required to confirm this," says Quent. This testing will be undertaken in 2013.

Watch a video about this project (http://www.youtube.com/landcareresearch)

CONTACT: Quentin Paynter
paynterq@landcareresearch.co.nz

Buddleia Takes a Beating

Buddleia weevil adults, larvae and feeding damage.

The impact of the buddleia leaf weevil (*Cleopus japonicus*) continues to impress with some buddleia (*Buddleja davidii*) bushes being completely defoliated. Many people are beginning to notice and comment on the dramatic and widespread damage, especially in the Central North Island. Toni Withers and Michelle Watson from Scion in Rotorua have found that most damage occurs in the autumn following the main egg-laying period in late summer. They have also looked at the rate of weevil dispersal from the original release sites. Toni says, "It is very important that the weevils invade newly planted pine forests quickly and give the pines a chance to gain some height." Buddleia can withstand repeated attacks from defoliators and it is important that enough weevils hang around until the next growing season to keep up the pressure on the plants. "We are starting to see evidence of sustained control, with some large woody plants having died as a result of 2–3 seasons of repeated defoliation," said Toni. Forestry companies are reporting a lot of damage to plants, equivalent to what you would expect from herbicide application. Toni adds, "If this level of impact continues, this biocontrol agent could have positive economic implications for the long-term management of buddleia in forestry and natural areas in New Zealand."

Scion is developing a case study to quantify the economic and environmental benefits versus the historical costs of releasing this agent. The case study will make predictions based on whether the weevil is achieving 25%, 50%, 75% or 100% control of existing buddleia populations. Simon Fowler from Landcare Research supports this approach and agrees that more analysis needs to be done to demonstrate how cost-effective successful weed biocontrol really is (see the article on page 2 of Issue 61).

Regional councils and forestry companies are now successfully introducing the weevil to other sites throughout the Central North Island. So far, the weevils have established at every site that they have been released at. Scion is keen for people to report back on the presence and performance of the weevil, especially any new outbreaks. So keep an eye out for adults in old seed heads and new flower buds next spring or look for damage on the leaves from the slug-like larvae.

CONTACT: Toni Withers
toni.withers@scionresearch.com

Summer Activities

Summer is a busy time for many biocontrol agents. Some activities you may need to schedule include:

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

- Check release sites for feeding shelters made by caterpillars webbing together leaves at the tips of stems. Caterpillars makes 'windows' in the leaves where they have eaten the green tissue away, leaving behind sprinkles of black frass, and the leaves may be turning brown. Small caterpillars are olive-green in colour and become darker, with two parallel rows of white spots as they mature. We would be very interested to hear if you find any severe damage to boneseed foliage.
- Caterpillars can be harvested if you find them in good numbers. Cut off infested boneseed tips and wedge them into plants at new sites. Aim to shift at least 500 caterpillars to sites where scale insects and invasive ants are not known to be present.

Broom gall mite (*Aceria genistae*)

- Summer is a good time to check plants at release sites for galls, which look like deformed lumps and range in size from 5 to 30 mm across. They will probably be fairly close to the release point. Occasionally galls can be found on broom that are not made by the gall mite, but these are much less dense.
- Because the mites are showing much promise, but are expected to disperse quite slowly, it will be important to plan a comprehensive redistribution programme once you have good numbers. Note that October–November is the best time for harvesting and redistribution, when mite

numbers are building inside the galls. However, it may still be possible to successfully move the galls around in December if the weather is not too hot and dry. Aim to shift at least 50 galls, and tie them onto plants in bunches of 10 galls per plant at the new site so the tiny mites can shift across.

Broom leaf beetles (*Gonioctena olivacea*)

- Check sites where beetles have been released for three or more years for signs of establishment. The adults are 2–5 mm long and females tend to be goldish-brown while males have an orangey-red tinge, although colouration can be quite variable. These beetles can be quite hard to find so it is best to use a beating tray. The adults lay eggs over a period of 3–4 months, starting in spring, so you may also be able to find the greyish-brown larvae feeding on the leaves or shoot tips.
- It is probably still a bit soon to find enough beetles to be able to begin harvesting and redistribution just yet.

Broom seed beetle (*Bruchidius villosus*)

- Beetles can be harvested and redistributed while they are still inside mature brown pods but avoid green ones as the beetles will not be completely developed. Cut infested branches and wedge them into bushes at the new site. A period of hot weather can cause pods to ripen rapidly, so once the first ones have started to burst, don't delay.

Gorse soft shoot moth (*Agonopterix ulicetella*)

- Check release sites now as by late November, early December the caterpillars are quite large but have not yet pupated. Look inside webbed or deformed growing tips for dark brown or greyish-green caterpillars. 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.
- Redistribute caterpillars by harvesting infested branches or even whole bushes.

Green thistle beetles *(Cassida rubiginosa)*

- Check release sites for windows eaten into the leaves made by the adults and larvae. Adults are well camouflaged, being green, so it may be easier to spot the larvae, which have a distinctive protective covering of old moulted skins and excrement, and prominent lateral and tail spines.
- If you find beetles in good numbers then make plans to harvest adults next spring.

Hieracium gall midge (*Macrolabis pilosellae*)

- Check 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.

Tradescantia leaf beetle (*Neolema ogloblini*)

- Check the older release sites for signs of the beetles, such as notches in the edges of leaves caused by adult feeding or leaves that have been skeletonised by larvae. You may see the dark metallic bronze adults but they tend to drop or fly away when disturbed. It may be easier to spot the larvae, which have a distinctive protective covering over their backs. Young larvae are gregarious and may be seen in packs forming feeding fronts. Older larvae feed individually. The white, star-shaped pupal cocoons may be visible on damaged foliage. We would be very interested to hear if you find any sign of the beetles.
- We would not expect you to find enough beetles to be able to begin harvesting and redistribution just yet.

Tradescantia stem beetle (*Lema basicostata*)

- Given that the first release only went out last autumn it may well be far too early to find the stem beetle at release sites this summer, but there is no harm in taking a look! The black knobbly adults also tend to drop or fly away when disturbed so may be hard to spot. They chew elongated windows in the upper surfaces of leaves and sometimes consume entire leaves. The larvae are inside the stems so look for signs of their feeding (collapse and necrosis of stems) and brown frass.
- We would not expect you to find enough beetles to be able to begin harvesting and redistribution just yet.

Woolly nightshade lace bug (*Gargaphia decoris*)

- Check release sites by examining the undersides of leaves for the adults and nymphs, especially on leaves showing signs of bleaching or black spotting around the margins.
- We expect the lace bugs might be slow to disperse so if good numbers are present it would be worth collecting some to release in other areas. Always wear gloves when handling woolly nightshade foliage to avoid any health issues. Cut leaf material infested with adults and/or nymphs and wedge or tie this material firmly into new woolly nightshade plants so the lace bugs can move across. We recommend that you shift at least 1000 individuals to each new site at any time during the warmer months.

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Editor: Lynley Hayes
Any enquiries to Lynley Hayes

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