WHAT'S NEW IN

Biological Control of Weeds?

Issue 56 May 11

Lagarosiphon
Rohan Wells

What's Inside?

Landcare Research
Manaaki Whenua

Tradescantia Leaf Beetle Released

The first biocontrol agent to attack tradescantia (*Tradescantia fluminensis*) has been released in New Zealand. It has taken a lot of time and effort to get the tradescantia leaf beetle (*Neolema ogloblini*) to this point (see *Tradescantia Beetles out of Containment*, Issue 55), so it was with a great sense of satisfaction that the first release was made by Auckland Council staff in March. Releases of 300 adult beetles have since also been made in Northland, Bay of Plenty, Waikato and Manawatu-Wanganui. More releases are planned for next spring.

The leaf beetle has not been released as a biocontrol agent anywhere else in the world so we are looking forward to seeing how the beetles settle in. "We are not sure whether adult beetles continue to lay eggs over the cooler months or just slow down and become less active," said Lindsay Smith. If the beetles continue to breed it will increase the speed at which the population grows. We will look for signs of establishment in the spring. Adult feeding damage is quite noticeable as they tend to eat notches in scattered leaves over a wide area. Larvae skeletonise whole leaves sequentially along a stem and if several are feeding in the same area, the damage will be obvious.

This project is funded by the Department of Conservation, National Biocontrol Collective (including the Auckland Council) and the Ministry of Science and Innovation under the Beating Weeds programme.

Alastair Jamieson

Auckland Councillor Sandra Coney helps to make the first release of the leaf beetles.

CONTACT: Chris Winks
(winksc@landcareresearch.co.nz)

Earthquake Update

Just when we thought things were settling down in February the earth moved for us again. Lincoln was largely spared this time, but the Central Business District, Eastern Suburbs and Port Hills of Christchurch were hit hard. Lincoln staff were able to return to work the following week once services were restored, and Landcare Research has been hosting staff from other organisations who lost their premises. The Invertebrate Containment Facility lost power for a time, but changes made to the operating system after the first earthquake-induced meltdown meant that there were no losses in the facility. Thanks to everyone who again sent messages of support. It has been a trying time for Lincoln staff and will continue to be for some time, especially for those with damaged homes. It will take many years to rebuild Christchurch but we are optimistic of having an even better, safer, more sustainable, people-friendly place to live.

Come to the Biosecurity Bonanza

The Biosecurity Bonanza is back! Again you will be able to learn not only about the latest weeds research being undertaken by a range of agencies in New Zealand but also about mammalian pests (there will be concurrent sessions). There will also be a chance to discuss some hot topics with scientists and other practitioners.

When: 8 June 2011

Where: Hotel Grand Chancellor Auckland Airport Hotel (3 km from the airport)
Corner Kirkbride & Ascot roads, Airport Oaks, Auckland

What: Free workshop with catering provided, limited to 150 people. To view the agenda or secure a place visit www.landcareresearch.co.nz/news/conferences/biosecuritybonanza/registration.asp
Note that if you do not have computer access, you can register by phoning Andrea Airey on 03 321 9618. If you can't make it this time, we hope to be able to offer the Biosecurity Bonanza again in 2012, mostly likely in the South Island or Wellington.

Hope to see you there!

Biosecurity Bonanza

Prospects for Targeting Aquatic Weeds

Biocontrol appears to be underutilised as a method of controlling aquatic weeds in New Zealand, but has great potential. To date, only one aquatic weed here, alligator weed (*Alternanthera philoxeroides*), has been targeted in this way with some success. The use of biocontrol for aquatic weeds warrants further investigation not just because herbicide application in freshwater habitats is expensive and becoming increasingly unacceptable to many, but also because it has proven to be highly successful overseas. While recently investigating what kinds of weeds make the best targets, we found that aquatic species do seem to be more susceptible to biocontrol than terrestrial weeds.

There are rather a lot of exotic aquatic weeds in New Zealand that need to be controlled. Fifty-two aquatic species have naturalised and become weeds so far and this is not including wetland species that are normally flooded for only part of their life cycle. We have previously developed a scoring system to improve prioritisation of targets for weed biocontrol (see *Deciding Which Weeds to Target for Biocontrol*, Issue 48), and have now applied this to aquatic species. The system uses measures of the weed's impacts (its importance), amenability to biocontrol (how feasible it is to target) and the likely effort (or cost) required to implement a biocontrol programme, to come up with scores.

Paul Champion from NIWA was extremely helpful, providing us with a list of aquatic weeds and scores from NIWA's Aquatic Weed Risk Assessment Model (AWRAM). The model scores a weed's potential impact in New Zealand and was developed by NIWA to improve border control for potential aquatic weeds. Many aquatic weeds currently have limited distributions in New Zealand, and biocontrol is often most suitable against weeds that are too widespread or too difficult to be controlled using conventional measures. For this reason, species that are targets for eradication on a national level (e.g. National Interests Pest Response (NIPR) species and those included in Regional Pest Management Strategies (RPMS)) were discounted as suitable targets for biocontrol. This left 38 species to be assessed.

The calculated biocontrol impact scores indicate that most aquatic weed species in New Zealand are likely to be good targets for biocontrol. Some are already the focus of biocontrol programmes elsewhere. "Of the 38 species under consideration, biocontrol agents have been released against seven worldwide and their impact has often been substantial," said Quentin Paynter, who wrote the report (see table). Surveys looking for potential biocontrol agents in the weed's native range have been conducted for oxygen weed (*Egeria densa*), lagarosiphon (*Lagarosiphon major*), water purslane (*Ludwigia peploides* subsp. *montevidensis*), and common reed (*Phragmites australis*). The surveys indicate that promising agents exist for all four species.

The final ranking scores indicate that purple loosestrife (*Lythrum salicaria*) is ranked first despite having a relatively low weed importance score. Its ranking is raised due to the successful biocontrol programme in Canada and the United States where plant biomass was reduced by 81%. This gave purple loosestrife a maximum biocontrol impact score combined with a very low effort score, because native range surveys and host-range testing have already been performed. Lagarosiphon got the second highest ranking – it has a high AWRAM score, promising agents have been identified in its native range, and the biocontrol impact is predicted to be high. Oxygen weed is ranked third, above parrot's feather (*Myriophyllum aquaticum*), even though the latter has been successfully controlled by a beetle (*Lysathia* sp.) in South Africa. Parrot's feather is ranked lower than might be expected due to the risk of non-target attack as there are five indigenous *Myriophyllum* species in New Zealand. Hornwort (*Ceratophyllum demersum*) was ranked fifth, despite being the second most important weed by AWRAM score. "The difference is due to the lack of previous research into biocontrol of hornwort, meaning that a programme would have to start from scratch, thus increasing costs and the uncertainty of success," said Quentin.

Having identified the best targets for biocontrol, the next step is to check with those working on aquatic weed control that the most important weeds have been identified and scored correctly. "We excluded weeds that are eradication targets. While purple loosestrife is believed to be beyond eradication, I think it may be ranked too high because its distribution is currently quite limited," warned Quent. Lagarosiphon also has the potential to change rank depending on the values of interested parties. This is because the weed has some uses: it provides habitat for aquatic fauna, large patches increase sedimentation (which is helpful in some areas), it can coexist with native aquatic plants in some areas, and it is one of the few plants that can withstand the conditions in some fresh waters, so its removal would further degrade the habitat. Biocontrol agents released against lagarosiphon may spread to areas where it is valued for these reasons which would need to be taken into account.

We also need to ensure we understand the effects of removing an aquatic weed. There are examples of terrestrial weeds being removed only to be replaced by another weed species and this may happen in the aquatic environment too. Although, the slower rate of removal by biocontrol, than mechanical or chemical control methods, gives less aggressive plants more of a chance to get established.

Another thing to consider is the best kind of agents to use on aquatic weeds. In Europe, leaf beetles and weevils have been the most successful agents. Fungal pathogens have not been used much, but they might be suitable to attack emergent species, and the use of indigenous pathogens as mycoherbicides shows some promise. In New Zealand most aquatic weeds spread vegetatively so biocontrol agents that attack flowers or fruit are unlikely to have a significant impact. However, biocontrol agents that attack stems and/or roots also have the potential to increase stem fragmentation, which may in turn facilitate weed spread, as well as cause problems for clogging intakes for power generation.

Keeping these things in mind, biocontrol of aquatic weeds in New Zealand has the potential to be very successful. The prospects for the biocontrol of lagarosiphon and oxygen weed, look very promising. Hornwort, arguably our most serious aquatic weed, is also a promising target, although initiating a biocontrol programme against it will be more expensive since it would be starting from scratch. Other targets look quite do-able, but might require a greater investment to yield results. We plan to organise a workshop later this year to share our findings with those who manage aquatic pests and float [pun entirely intentional!] the idea of activating an aquatic biocontrol programme for New Zealand.

This work was funded by Landcare Research's Capability Fund.

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

The world wide biocontrol status of the most serious aquatic weeds in New Zealand to date

Target weed	Biocontrol status worldwide	Where	Notes
Alternanthera philoxeroides (alligator weed)	Controlled in warm sites, generally poor control of terrestrial growth.	Several countries including NZ, Australia, USA	Agents include leaf-feeding beetle (*Agasicles hygrophila*) and moth (*Arcola malloi*). Agents to attack the weed on land and in cooler climates are being sought.
Egeria densa (oxygen weed)	Native range surveys and host range testing of a potential agent performed.	Nothing released	Leaf-mining fly *Hydrellia* sp. looks promising.
Eichhornia crassipes (water hyacinth)	Variable success. Control often excellent where the weed is not subjected to regular removal.	Many countries including USA, Australia, China, eastern Africa	Agents are weevils (*Neochetina eichhorniae* and *N. bruchi*).
Hydrilla verticillata (hydrilla)	Reduced weed biomass by 66%, despite parasitism on flies.	USA	Agents are leaf-mining flies (*Hydrellia pakistanae* and *H. balciunasi*).
Lagarosiphon major (lagarosiphon)	Native range surveys indicate promising agents exist.	Nothing released	Leaf-mining fly (*Hydrellia* sp.), leaf-feeding and shoot-boring weevils (cf. *Bagous* sp.) look promising.
Ludwigia peploides subsp.montevidensis (water purslane)	Native range surveys & preliminary testing indicate promising agents exist.	Nothing released	Weevils (*Tyloderma* sp. and *Auluetes bosqui*) and flea beetle (*Lysathia flavipes*) look promising.
Lythrum salicaria (purple loosestrife)	81% reduction in weed biomass.	USA	Agents are beetles (*Galerucella calmariensis* and *G. pusilla*).
Myriophyllum aquaticum (parrot's feather)	60% reduction in weed cover in 3 years.	South Africa	Agents are a flea beetle (*Lysathia* n. sp.) and stem-boring weevil (*Listronotus marginicollis*). Five indigenous *Myriophyllum* spp.in NZ.
Phragmites australis (common reed)	Native range surveys indicate promising agents exist.	Nothing released	Range of lepidoptera and a fly (*Platycephala planifrons*) look promising. Targeted for eradication in NZ.
Pistia stratiotes (water lettuce)	40-90% reduction in cover.	Australia, North America, South Africa	Agent is a leaf-mining weevil (*Neohydronomus affinis*). Targeted for eradication in NZ.
Salvinia molesta (water fern)	> 95% reduction in cover in Australia and South Africa.	Australia, PNG, Namibia, South Africa	Agents is a leaf-feeding weevil (*Cyrtobagous salviniae*). Targeted for eradication in NZ.

A New Pathogen to Tackle Blackberry

Blackberry rust (*Phragmidium violaceum*) has been attacking blackberry in Australia and New Zealand for more than 20 years, but the weed continues to be a problem in both countries. The difficulty is that while the rust can cause severe disease on many of the *Rubus* taxa known as blackberry, its efficacy is limited by climatic, genetic and taxonomic factors. The introduction of eight new strains of blackberry rust to Australia in 2006 may improve biocontrol of blackberry there and perhaps also, with time and favourable winds, in New Zealand (see *Blackberry to Come under Additional Strain*, Issue 44). However, the addition of the new strains will not alter the environmental preferences of the rust, which does not do well in areas with low rainfall (< 750 mm per year), in shade, or on plants that are under stress from other factors (e.g. high or low temperatures). Therefore, additional biocontrol agents are needed to bring this thorny pest back into line.

Other natural enemies of blackberry are believed to have potential as biocontrol agents, but need further evaluation. These include the fungus that causes purple blotch disease (*Septocyta ruborum*), an eriophyid mite (*Eriophyes rubicolens*) and several other insects. These potential agents are currently being studied by the Victorian Department of Primary Industries (DPI), in collaboration with the CSIRO, at Montpellier, France.

Three important characteristics are needed for a successful biocontrol agent for blackberry. Firstly, an ability to reduce the crown and cane density enough so that it can no longer restrict the movement of people and stock; secondly, the ability to operate across the broad range of habitats (to be active in environments unfavourable to the rust in particular); and finally, the ability to act persistently both within and between seasons. The purple blotch disease ticks all of these boxes: it is capable of killing canes and whole plants; has a broad climatic range; and is systemic (i.e. it attacks the whole host plant) which means it should persist within the plant tissues between seasons. The purple blotch disease gets an additional tick because in its home range it attacks many of the different *Rubus* species that are known to be weedy.

Research at Montpellier determined the genetic diversity of purple blotch disease in its native range and revealed that, like the blackberry rust, different isolates of this rust also vary in their ability to infect different *Rubus* species. We are hopeful that highly damaging strains might exist that will attack weedy blackberry but not berry crops. While it has been possible to observe infection under the microscope using small pieces of stem and detached leaves, applying spores of the pathogen to whole potted blackberry plants has not yet resulted in any disease symptoms. There are several possible reasons for this but Dr Robin Adair, the DPI scientist leading this project in Australia, suspects that incompatibility between the plants tested and the fungal isolates applied to them may be the main reason. Robin was interested to hear recently that the purple blotch disease had been found attacking boysenberry and youngberry crops at Riwaka (near Motueka, Tasman District) in the South Island of New Zealand. "This gives us an opportunity to perfect our whole-plant inoculation procedures," explained Robin. "If we collect the rust from a diseased plant, and grow new plants from cuttings of that host, then we know that we have a compatible host–pathogen pair. We can then trial whole-plant inoculation techniques knowing that incompatibility will not be a problem."

Dr Robin Adair

Symptoms of *Septocyta ruborum* infection on a cane of youngberry in New Zealand.

Dr Robin Adair

Australian berryfruit growers inspecting canes for pathogens which will be used to develop molecular identification tools.

Robin and his team are keen to understand the biology, ecology, and host range of purple blotch disease in New Zealand because we have a similar climate to parts of Australia and also have similar weedy *Rubus* species. Therefore, the project has a number of new objectives. These are to determine the genetic origin of the purple blotch disease strain/s found in New Zealand by comparing them with isolates in Europe and the USA, and explore the genetic diversity of the fungus here. Also the field host range of the fungus in New Zealand will be determined by surveying wild blackberry populations for disease symptoms, particularly populations that are growing close to infected commercial cane berry crops. Finally whole-plant inoculation procedures will be developed as mentioned above.

Surveys for symptoms caused by purple blotch disease on wild blackberry (i.e. stem cankers and stem die-back) have already started. Robin made many collections from sites across the South Island in October 2010 and March 2011, and another survey is planned for May 2011. Canes of wild blackberry often exhibit symptoms similar to those caused by purple blotch disease but so far it has not been possible to isolate the pathogen from these diseased tissues. “It appears other pathogens, insects, sunlight damage and herbicides can cause symptoms on canes that look very similar to those caused by purple blotch disease and that has made it impossible to detect the fungus with the naked eye in the field,” reported Robin. Therefore, a molecular approach is being developed with specific markers for purple blotch disease, and other pathogens that infect *Rubus* species, being designed by DPI scientists. These will be applied to DNA extracted from canes showing symptoms similar to those caused by purple blotch disease. Landcare Research is lending a helping hand by providing facilities at their molecular lab in Lincoln. DNA was extracted there before being sent to Australia. Plant & Food Research is also helping the project by providing land for the field experiments and laboratory assistance for producing inoculum for experiments.

The taxonomy of blackberry species that are invasive in Australasia is something of a mess, so molecular studies will be crucial to attempts to find the right pathotypes of purple blotch disease to improve blackberry control. Some of this extracted blackberry DNA has been donated to a Landcare Research project, led by Gary Houliston, that aims to begin to identify the genetic and morphological species of blackberry present in Southland. Specimens of blackberry collected during Robin’s surveys have also been lodged with the Allan Herbarium at Lincoln. In future, commercial cane berry growers in both Australia and New Zealand should also benefit from this research programme. Purple blotch disease reduces yields of boysenberry and youngberry in New Zealand, particularly when they are grown on poorly drained soils. This project should reveal how the fungus infects these plants, which should help berry growers to better manage this disease. Berry industry assistance for the research programme is being provided in both New Zealand and Australia, and will continue to be critical to the success of the project.

Ultimately, the aim of this project is to identify pathotypes of purple blotch disease that are specific to the most invasive blackberry taxa present in Australia, and which are likely to be useful for New Zealand too. Blackberry has been a serious problem in both countries for more than 100 years, but hopefully a solution may soon be at hand.

This project is funded by the Victorian DPI and the Rural Industries Research and Development Corporation (RIRDC). The funds for studying blackberry in Southland are provided by Envirolink.

CONTACT: Jane Barton
(Jane.Barton@ihug.co.nz)

Jatropha: a Useful Biofuel Crop or a Weed in the Making for Samoa?

The Government of Samoa through the Scientific Research Organisation of Samoa (SROS) is investigating the production of biodiesel and is proposing to expand its current research work on coconut biofuels to include *Jatropha curcas* (henceforth jatropha), a shrub native to Mexico and Central America that can produce a high-quality biodiesel fuel. SROS is currently considering a 60-acre plot (c. 24 ha) on Upolu as a potential area for planting jatropha and is also proposing to promote planting in villages throughout Samoa.

Biofuels can potentially reduce reliance on fossil fuels but are controversial due to fears of competition between food and energy crops driving up food prices, and environmental degradation if natural areas are cleared to grow biofuel crops, or if the crops become invasive weeds. The International Union for Conservation of Nature (IUCN) wishes to ensure that any adverse impacts resulting from jatropha cultivation are avoided and recently asked Quentin Paynter to assess what the risks to Samoa might be.

"Fears that the recent promotion of biofuel crops could contribute to a new generation of invasive weeds are not unfounded. For example, 89% of New Zealand's environmental weeds were deliberately introduced and when I reviewed the jatropha literature I found weed risk assessments (WRA) had already been done for Australia, Hawai'i, Florida and Italy – and they all scored 'reject'," said Quent.

The WRA scores a plant species on traits that are associated with invasiveness. If the total is greater than 6 a plant is predicted to become invasive and should be rejected for importation; <1 is not predicted to become invasive and therefore accepted. Intermediate scores of 1–6 indicate that further evaluation is necessary before a prediction is possible. Even though the WRA correctly identifies harmful invaders about 90% of the time, there is a high rate of false positives, where plants are falsely identified as weeds. Relatively few introduced plants actually become invasive (e.g. only around 2% of plants introduced to New Zealand, see table over page).

"Despite the high number of false positives, the WRA was shown to be cost-effective for Australia, but only for the nursery industry. Ornamental plants have a relatively low value and there are many non-weedy alternatives," said Quent. "I am doubtful though that the WRA is cost-effective for potentially much more valuable crops." For example the highly valuable crop canola (*Brassica napus*) has not become a significant weed in Australia but would have been rejected if the WRA system was operational at the time of importation. "The predicted export value of canola to Australia is A$708 million this year. You would have to exclude a lot of weed species to make up for that kind of a mistake!" So to prevent the majority of weed invasions without potentially impinging on economic development, it may be worth importing certain plants that fail the WRA, provided there is robust economic justification for taking the risk that they may become invasive.

Further investigation revealed that jatropha has a long (>260 year) history of introduction worldwide. Although the plant has been listed as a weed in countries as diverse as Australia, South Africa, India, Brazil, Fiji and parts of Caribbean, there is scant evidence to suggest it has any significant impact on primary production or the environment where it has naturalised. For example, it was imported into Queensland more than 100 years ago, and while it has formed small thickets its impact is localised and relatively minor. In Samoa, jatropha is not considered invasive, despite herbarium records dating back to 1893 and it being widely planted (mainly in the 1990s) as a support for vanilla vines. Moreover, most vanilla plantations were subsequently abandoned. A survey by Samoa's Ministry of Natural Resources and Environment found that jatropha has not spread from these plantings into surrounding bush. "My guess is that the climate does not quite suit jatropha and it cannot keep pace with better adapted rainforest species. More work would be needed to confirm this, but we do know that in its native range jatropha

R. K. Henning. Source: www.jatropha.org

Jatropha plant as part of a hedge near Falan, Mali.

prefers tropical monsoon or savannah climates and is largely absent from fully humid equatorial zones with similar climates to Samoa," said Quent, "Indeed, when I conducted a WRA for Samoa, jatropha scored 'evaluate', rather than reject."

Despite this, Quent remains cautious: "Even though it has been well behaved for over 100 years we cannot be totally certain that jatropha will not become invasive in Samoa because some introduced plants exhibit initially slow 'lag-phases' before their populations explode and planting more jatropha may accelerate this process." A number of mechanisms have been postulated as potential causes of prolonged lag-phases, including Allee effects: a phenomenon in which small populations struggle to survive until they pass a threshold size. For example, dispersal may be limited until fruit production reaches a threshold that attracts fruit-feeders and pollination is often inefficient when distances between individuals are large and patches are small. Mutualists may be important too: for example, broom (*Cytisus scoparius*) would not be invasive in New Zealand without its introduced bee pollinators. In the case of jatropha, most of these mechanisms can be ruled out: jatropha is not pollinated by specialists and can set seed through apomixis (reproduction without fertilisation) and selfing; its fruits are not dispersed by frugivores. Some factors, such as genetic changes over time potentially resulting in increased invasiveness, cannot be discounted. However, jatropha does not appear to be a major ecosystem 'transformer' weed anywhere overseas, despite a long history of introductions. This, together with the low probability that naturalised populations are currently being limited by Allee effects, suggests that its potential impact in Samoa is likely to remain relatively minor.

Quent also considered the potential social impacts of planting jatropha. Current diesel imports into Samoa are estimated to be 40 million litres per year and, initially, the most feasible way to replace some diesel imports would be to use a B10 blend (i.e. 90% diesel mixed with 10% biodiesel). This would require 4 million litres of biofuel to be produced each year. Given the range of jatropha yields overseas, this should require planting jatropha on about 1,800 – 9,100 ha (or 0.6 – 3.1% of the total land area of Samoa). Due to the rocky volcanic nature of Samoan soils, much of the country is unsuitable for growing food crops, but could support jatropha cultivation. It has been estimated that there is about 15,000 ha of underutilised land suitable for growing biofuel crops. "This means that a target of 4 million litres of jatropha biofuel each year, without impacting on land of high conservation value, grazing or the production of other crops, may be realistic," said Quent, who added that "estimating the social costs, in terms of competition with crop plants is a hard task because it is difficult to estimate how big an incentive there will be for Samoan farmers to plant jatropha without knowing how profitable a crop it is likely to be". Quent has recommended that the planned plantation on Upolu should proceed so that yield and profitability under Samoan conditions can be determined. "This information is required before widespread planting can be recommended, so I do not recommend more widespread plantings at this stage."

This project was funded by IUCN.

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

Hypothetical example to illustrate the problem of false positives

	Predicted invasive species	Predicted non-invasive species	Totals
True invasive species	18	2	20
True non-invasive species	98	882	980
Totals	116	884	1000

This hypothetical example (adapted from Smith, Lonsdale & Fortune 1999), assumes 20 out of 1,000 introduced plant species will become invasive weeds and that the WRA correctly identifies invasive and non-invasive species with 90% reliability. The rate of false negatives (where an invasive species is incorrectly identified as a non-invasive species) is low (2/884 = 0.23%), but for every 18 invasive species correctly identified, 98 non-invasive species are incorrectly identified as invasive (rate of false positives = 98/116 = 84.5%).

www.landcareresearch.co.nz

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

Thanks to: Christine Bezar
Layout: Cissy Pan

Contributions: Jane Barton

ISSN 1173-762X (Print) ISSN 1173-8784 (Online)