BIOCONTROL AGENTS FOR WEEDS IN NEW ZEALAND

A QUICK REFERENCE

What Is Biocontrol and How Does it Work?

Invasive species pose a serious and increasing threat to all New Zealand ecosystems. Biological control (biocontrol) is an important tool for managing serious, widespread, intractable weeds and some have already been successfully controlled in New Zealand in this manner. This pamphlet is a quick guide to biocontrol agents currently available for weeds in New Zealand.

Biocontrol uses one living organism (usually insects or fungi) to control another. The natural enemies of weeds are studied carefully, and tested to ensure they will not damage desirable plants or cause unexpected problems if introduced to New Zealand. The Environmental Risk Management Authority only allows the introduction of biocontrol agents if stringent criteria are met in relation to risks and benefits. The safety record of biocontrol of weeds in New Zealand is excellent.

Once new biocontrol agents have been approved for release Landcare Research undertakes mass rearing programmes so they can be released widely as quickly as possible. Because of the costs involved large organisations, rather than individuals, fund the development and release of weed biocontrol agents. Once numbers build up to harvestable levels at release sites biocontrol agents are made available by these organisations free of charge. **Therefore if you want weed biocontrol agents you should register your interest with biosecurity staff at your regional council.**

What to Expect

Biocontrol agents do not eliminate weeds, because they can never find or kill every plant. Rather, a successful biocontrol attack is likely to result in smaller, weaker plants that are less likely to spread and can be more easily outcompeted by other plants. Infestations may be reduced to a level that we can live with, or eliminate effectively and economically by other means.

If biocontrol is successful and the weed becomes increasingly rare then its associated biocontrol agents will also reduce in number accordingly. If conditions conducive to the weed occur it might outbreak again, especially if it has a seedbank, but the biocontrol agents should eventually be able to overcome it again.

Biocontrol is rarely a quick fix because it takes many years, or even decades, for suitable agents to be found, tested, approved, reared, released and established, and then for agents to spread and become common and be able to achieve damaging levels.

The impact of biocontrol agents is likely to vary throughout New Zealand, and from year to year, and usually several biocontrol agents are required to have a significant impact on a weed. Biocontrol has the greatest impact when used in conjunction with good land management practices.

For Further Information

For details about how to recognise if weed biocontrol agents are already present on a weed or for advice on handling, collection, and management see:
www.landcareresearch.co.nz/research/biocons/weeds/
or contact Lynley Hayes

Landcare Research
PO Box 40
Lincoln 7640
New Zealand
email: hayesl@landcareresearch.co.nz
Ph (03) 321 9694
Fax (03) 321 9998

Prepared on behalf of the National Biocontrol Collective by Landcare Research.

Landcare Research
Manaaki Whenua

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Broom (*Cytisus scoparius*)

Broom Gall Mite (*Aceria genistae*)

First released in 2008 with widespread releases made since then. Establishing well and showing promise. Mite feeding causes buds to develop into deformed lumps. Galls formed on successive years' growth result in stunting, reduced flowering, and sometimes death of small bushes.

Broom Leaf Beetle (*Gonioctena olivacea*)

Widespread releases began in 2008 and establishment looks promising. Adults and larvae feed on the leaves and stems. Heavy feeding reduces the growth rate of broom. In conjunction with the shoot moth, sometimes completely defoliates broom plants in Europe.

Broom Psyllid (*Arytainilla spartiophila*)

Becoming common in many parts of the country. Adults and nymphs suck sap out of new growth in spring. When populations are high damage to new growth can be severe. Outbreaks are still not common and predation may be limiting impact.

Broom (*Cytisus scoparius*)

Broom Seed Beetle (*Bruchidius villosus*)

Now common in many parts of the country. Each larva destroys one seed as it develops inside a pod. Can destroy as much as 80–90% of seed. Also attacks tree lucerne (*Cytisus proliferus*) seeds to a lesser extent.

Broom Shoot Moth (*Agonopterix assimilella*)

First released in 2008 and establishment success unknown. Difficult to rear so limited releases to date. Caterpillars feed on the leaves and sometimes kill off stem tips and small branches by ringbarking. In conjunction with the leaf beetle, sometimes completely defoliates broom plants in Europe.

Broom Twig Miner (*Leucoptera spartifoliella*)

Accidental introduction. Now common throughout most of the country. Larvae feed in the stems during the cooler months. Outbreaks causing severe damage have become common in the South Island. Growth and flowering is reduced, and branches and whole bushes may die.

Alligator Weed (*Alternanthera philoxeroides*)

Alligator Weed (*Agasicles hygrophila*)

Commonly found almost everywhere alligator weed occurs. Adults and larvae feed on foliage growing above water, especially around the edges of weed mats. Can cause considerable damage and each year successfully control the weed in many lakes and ponds. Not effective in flowing water that is regularly flooded, in areas that get frosted, or on terrestrial infestations.

Alligator Weed Moth (*Arcola malloi*)

Patchily established in Northland and Auckland. Caterpillars feed inside the stems causing them to collapse. Can cause considerable damage and each year successfully control alligator weed in some lakes and ponds. Effective under similar conditions as the beetle, but can attack terrestrial infestations to a limited extent.

Other Agents

Additional agents for alligator weed are currently being sought to strengthen the attack.

University of Bahia Blanca

Californian Thistle (*Cirsium arvense*)

Californian Thistle Gall Fly (*Urophora cardui*)

Established but rare since grazing animals eat galls produced as a result of larval feeding inside growing tips. Galling reduces nutrients available for growth, and terminal galls stop bud production and reduce stem height.

Californian Thistle Leaf Beetle (*Lema cyanella*)

Only established at one site near Auckland, but renewed efforts to establish the beetle more widely are likely. Adults and larvae feed on the leaves and stems and can severely defoliate plants. Also damages Scotch (*Cirsium vulgare*) and winged thistles (*Carduus tenuiflorus*).

Green Thistle Beetle (*Cassida rubiginosa*)

First releases made in 2007 with widespread releases made since then. Establishing well and showing promise. Adults and larvae eat windows in the leaves and at high densities can severely defoliate plants. Likely to attack all thistles to some extent.

Blackberry (*Rubus fruticosis* agg.)

Blackberry Rust (*Phragmidium violaceum*)

Released against blackberry in Australia. Self-introduced to New Zealand and common. Heavily infected leaves fall prematurely, weakening the plant and reducing growth. Impact is variable because the 18 species called 'blackberry' range from highly susceptible to resistant. More effective control may be achieved if additional strains recently released in Australia also self-introduce.

Boneseed (*Chrysanthemoides monilifera monilifera*)

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

First released in 2006 and widespread releases made in 2007. Establishment has been confirmed at some sites in the North Island. Caterpillars feed on the foliage, especially the tips, and can severely defoliate plants. Growth, seed production and vigour are reduced and plants may be killed.

Other Agents

A rust (*Endophyllum osteospermi*) is being tested to see if it might be suitable for release. Infected plants become deformed, reducing growth, seed production and vigour, and some die.

Californian Thistle (*Cirsium arvense*)

Thistle Stem Miner (*Ceratapion onopordi*)

First release made in 2009. Difficult to rear so limited releases to date. Larvae feed in the stems and roots, which kills plants or reduces their competitive ability. Likely to also attack nodding thistle (*Carduus nutans*), Scotch thistle, variegated thistle (*Silybum marianum*), and possibly other thistles to a lesser extent.

Common Diseases

A number of fungal pathogens have been accidentally or self-introduced and are quite common. Damaging outbreaks sometimes occur. White soft rot (*Sclerotinia sclerotiorum*) causes the stems to turn yellow and wilt and eventually rot. Californian thistle rust (*Puccinia punctiformis*) causes plants to look yellowish and stunted, and they are covered in yellow, orange or brown spores. Phoma leaf blight (*Phoma exigua* var. *exigua*) causes plants to look yellowish and later turn brown as they die, and attacks a range of thistles.

AgResearch are exploring the potential of other pathogens found in a recent survey.

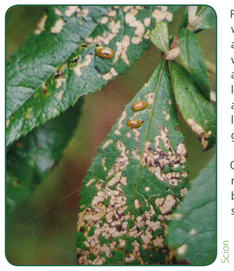
Bridal Creeper/Smilax (*Asparagus asparagoides*)

Bridal Creeper Rust (*Puccinia myrsiphylli*)

Released against bridal creeper in Australia. Self-introduced to New Zealand and now commonly found here. Stems, shoots, leaves and fruit are attacked. Damage is often severe with plants completely defoliated and dying back prematurely. Looks likely to provide good control of this plant. In Australia studies have shown above- and below-ground biomass are significantly reduced.

Buddleia (*Buddleja davidii*)

Buddleia Leaf Weevil (*Cleopus japonicus*)



First released by Scion in 2006 with widespread releases in 2007 and appears to be establishing well and showing promise. Adults and larvae feed on the surface of leaves resulting in a windowed appearance. Heavily damaged leaves fall prematurely, and plant growth may be stunted.

Other agents for buddleia may be released in future if funding can be found and they prove to be suitable.

Scion

Gorse (*Ulex europaeus*)

Gorse Colonial Hard Shoot Moth (*Pempelia genistella*)

Released widely but currently only established in Canterbury and still rare. Caterpillars live in communal webs and cause dieback by feeding on the foliage and flowers during warmer months.

Gorse Pod Moth (*Cydia succedana*)

Widespread and common everywhere gorse occurs. Caterpillars feed on seeds inside the pods. With the seed weevil can destroy most spring seed. Destroys some autumn seed. Also attacks broom and some other closely related exotic legumes to a lesser extent.

Gorse Seed Weevil (*Exapion ulicis*)

Commonly found almost everywhere gorse occurs. Each larva destroys one seed as it develops inside a pod. With the pod moth can destroy most spring seed.

Gorse Soft Shoot Moth (*Agonopterix umbellana*)

Common in the South Island but still rare in the North Island. Caterpillars feed on the new growth in the spring. Some damaging outbreaks seen.

Gorse (*Ulex europaeus*)

Gorse Spider Mite (*Tetranychus lintearius*)

Commonly found on gorse in most places but tend to come and go. Live in communal webs. Adults and juveniles suck on foliage, reducing growth and flowering, but rarely stay on bushes long enough to kill them

Gorse Thrips (*Sericothrips staphylinus*)

Becoming more common throughout New Zealand. Adults and juveniles suck on foliage which becomes blotchy-looking. Prefers new growth, but will feed on older, harder growth during winter. When present in good numbers, reduces growth and flowering and may kill seedlings.

Native Insects

A stem-mining moth (*Anisoplaca ptyoptera*) and lemon tree borer (*Oemona hirta*) commonly attack gorse in the South Island and North Island respectively. Tunnelling by the larvae can result in ringbarking of stems leading to dieback, and near ground level can kill plants. Both also attack broom to a lesser extent.

Echium (*Echium plantagineum*)

Echium Leaf Miner (*Dialectica scalariella*)

Released against Paterson's curse (*Echium plantagineum*) in Australia. Self-introduced and becoming common on several *Echium* species here. Larvae feed inside the leaves. Has little impact in Australia; impact here unknown.

Heather (*Calluna vulgaris*)

Heather Beetle (*Lochmaea suturalis*)

Established, but not yet widespread, in Tongariro National Park and Rotorua. Larvae and adults feed on the foliage. When present in large numbers can severely defoliate plants causing them to turn reddish-brown and die. Some damaging outbreaks have occurred.

Hemlock (*Conium maculatum*)

Hemlock Moth (*Agonopterix alstromeriana*)

Self-introduced and common on hemlock throughout the country. Caterpillars feed on the foliage and can reduce large plants to bare stalks. Flowers are also eaten, reducing seed production. Severe damage to hemlock has been seen at many sites.

Hawkweeds (*Hieracium lepidulum & Pilosella spp.*)

Hieracium Crown Hover Fly (*Cheilosia psilophthalma*)

Limited releases to date and establishment not confirmed. Further releases will be made if funds become available. Larvae stunt growth by feeding in the centre of rosettes, at the base of stolons, in the leaves and leaf axils, and stolon tips.

Hieracium Gall Midge (*Macrolabis pilosellae*)

Established at sites in both Islands, becoming common at some. Larval feeding causes galls to form in the crown, stolon tips, leaf axils and flowerheads. Plants are stunted and likely to produce fewer flowers and stolons.

Hieracium Gall Wasp (*Aulacidea subterminalis*)

Only established at sites in the South Island so far and becoming common at some. Larvae feed in the stolon tips over summer causing woody galls to form. Galls reduce vegetative reproduction by limiting stolon elongation so fewer daughter plants are produced at the tips.

Hawkweeds (*Hieracium spp.*)

Hieracium Plume Moth (*Oxyptilus pilosellae*)

Only one release to date and not thought to have established. Further releases will be made if funds become available. Caterpillars damage plants by grazing on the central buds, root crowns, and leaves and stolons. Heavily damaged plants produce fewer flowers and may die.

Hieracium Root Hover Fly (*Cheilosia urbana*)

Limited releases to date and establishment not confirmed. Further releases will be made if funds become available. Larvae feed underground externally on the roots, which stunts plant growth.

Hieracium Rust (*Puccinia hieracii* var. *piloselloidarum*)

First noticed here in 1995 and now widespread. Mouse-ear hawkweed populations vary in susceptibility so two additional strains were released. Suppresses growth, but impact appears minimal. Performs best under moist conditions but impact can be most severe when infection is followed by drought.

Mexican Devil Weed (*Ageratina adenophora*)

Mexican Devil Weed Gall Fly (*Procecidochares utilis*)

Commonly found wherever the weed occurs. Larvae feed in the buds and the plant forms gall tissue around them. Plants are shorter with reduced vigour. Galling may be limited by parasitism.

Mist Flower (*Ageratina riparia*)

Mist Flower Fungus (*Entyloma ageratinae*)

Commonly found almost everywhere the weed occurs. Causes leaves to fall prematurely. Under favourable conditions also invades stem tissue and causes dieback of shoots. Plants can be heavily defoliated over wide areas. Mist flower has declined enormously since this fungus was released.

Mist Flower Gall Fly (*Procecidochares alani*)

Well established and becoming common. Larvae feed on the buds and the plant forms gall tissue around them. Plants are shorter with reduced vigour. May prove to be limited by parasitism.

Nodding Thistle (*Carduus nutans*)

Nodding Thistle Crown Weevil (*Trichosirocalus horridus*)

Becoming common throughout much of the country. Larvae feed in the crown which often kills plants; survivors are stunted. Thistles have been reduced at many release sites. Attacks other thistles, especially Scotch (*Cirsium vulgare*) and cotton (*Onopordum acanthium*) thistles to a lesser extent.

Nodding Thistle Gall Fly (*Urophora solstitialis*)

Becoming common throughout much of the country. Larval feeding in the flowerheads reduces seed production. Tends to be outcompeted by the receptacle weevil for the first flowers. Also attacks plumeless thistle (*Carduus acanthoides*).

Nodding Thistle Receptacle Weevil (*Rhinocyllus conicus*)

Common throughout the country. Larval feeding in the flowerheads reduces seed production. Destroys most seed produced by first flowers, but less effective on later flowers. Also attacks other thistles to a lesser extent.

See also Californian thistle agents as some attack nodding thistle.

Old Man's Beard (*Clematis vitalba*)

Old Man's Beard Leaf Fungus (*Phoma clematidina*)

Showed initial promise but believed to have died out. A weaker strain causes minor damage late in the season and has little impact.

Old Man's Beard Leaf Miner (*Phytomyza vitalbae*)

Common on old man's beard wherever it occurs. Larvae feed inside the leaves. Heavily damaged leaves fall prematurely. Impact limited by parasitism.

Old Man's Beard Sawfly (*Monophadnus spinolae*)

Released widely in early 2000s but establishment is looking unlikely. Another attempt to establish it may be made in future. Larvae feed on the leaves and in large numbers can do considerable damage.

Other Agents

Trials are underway in Europe to see if a beetle (*Xylocleptes bispinus*) might be suitable. Larvae attack stems, which often die as a result, and can kill significant portions of the plant. A bud gall-forming mite (*Aceria vitalbae*) will be studied when funds permit.

Ragwort (*Jacobaea vulgaris*)

Cinnabar Moth (*Tyria jacobaeae*)

Occurs patchily throughout the country, but seems to be slowly increasing its distribution. Is more common some years and may be limited by parasitism. Caterpillars feed on the leaves and flowers and can totally defoliate plants. Damaged plants usually regrow unless subject to additional stresses.

Ragwort Crown-Boring Moth (*Cochylis atricapitana*)

Limited releases made in 2006/07 but establishment not looking promising. In summer caterpillars mine stems, which reduces flowering in young stems and tends to kill older stems. Also kill seedlings in cooler months by attacking root crowns.

Ragwort Flea Beetle (*Longitarsus jacobaeae*)

Common on ragwort nearly everywhere it occurs. Larvae feed on the roots and crowns of rosette plants. Heavily infested plants die and survivors produce fewer flowering stems. Has reduced ragwort to very low levels in many areas.

Ragwort (*Jacobaea vulgaris*)

Ragwort Plume Moth (*Platyptilia isodactyla*)

Released widely from 2006-10 and establishing readily. Caterpillars can severely damage the roots and crowns. As few as 2–3 larvae can kill a plant. Survivors produce fewer flowers and seeds. Well adapted to wet climates. Has already reduced ragwort in many places where it is not able to be controlled by the flea beetle.

Ragwort Seedfly (*Botanophila jacobaeae*)

Only established in the central North Island. Larvae feed inside the flower heads and destroy seeds. Early flowerheads are often attacked but during peak flowering most seeds escape attack, so does not contribute to ragwort control.

Other insects

A number of other insects are commonly seen on ragwort but seldom do much damage. Larvae of a stem-mining fly (*Melanagromyza senecionella*) and a blue stem borer (*Patagonoides farinaria*) feed inside the stems. Magpie moth caterpillars (*Nyctemera annulata*) and a leaf miner (*Phytomyza syngenesiae*) damage the foliage.

Saint John's Wort (*Hypericum perforatum*)

Greater St John's Wort Beetle (*Chrysolina quadrigemina*)

Widely established, difficult to tell apart from *C. hyperici*. Adults and larvae defoliate the plants heavily so flowering and seed production is suppressed. Has helped to successfully control the plant in many areas.

Lesser St John's Wort Beetle (*Chrysolina hyperici*)

Widely established, difficult to tell apart from *C. quadrigemina*. Attacks the plant in a similar way, and larvae can destroy new spring growth almost as soon as it is produced. Has helped to successfully control the plant in many areas.

St John's Wort Gall Midge (*Zeuxidiplosis giardi*)

Only established in the northern South Island. Larval feeding in leaf buds causes the leaves to grow together. Plants are stunted, with reduced vigour.

Scotch Thistle (*Cirsium vulgare*)

Scotch Thistle Gall Fly (*Urophora stylata*)

Becoming common in some areas. Larval feeding in the flowerheads reduces seed production. Impact unknown but some high levels of infestation have been seen.

See also Californian and nodding thistle agents as some also attack Scotch thistle.

Tradescantia (*Tradescantia fluminensis*)

Tradescantia Leaf Beetle (*Neolema ogloblini*)

First released in March 2011. The larvae skeletonise the leaves by feeding on epidermal tissue, while adults are leaf-edge feeders. Capable of inflicting high levels of damage to tradescantia.

Other Agents

It is hoped permission to release two other beetles will be granted by ERMA in 2011. Larvae of one of these damages the stems (*Lema basicostata*) and the other damages the growing tips (*Neolema abbreviata*). Adults of both damage the leaves. An application to release a fungus (*Kordyana brasiliense*) is expected to be made in the near future.

Woolly Nightshade (*Solanum mauritianum*)

Woolly Nightshade Lace Bug (*Gargaphia decoris*)

Releases began in late 2010 and there are already promising signs of establishment. Adults and nymphs feed on the leaves which can result in premature leaf fall and a reduction in flowering and fruiting. If attack is severe plants may die.

Future Agents

Projects to develop biocontrol programmes for weeds are ongoing. Within the next year agents for Chilean needle grass (*Nassella neesiana*), Darwin's barberry (*Berberis darwinii*), lantana (*Lantana camara*), and moth plant (*Araujia hortorum*) are likely to be approved for release. Within the next 3 years it is hoped that agents for banana passionfruit (*Passiflora* spp.), Japanese honeysuckle (*Lonicera japonica*), and wild ginger (*Hedychium* spp.) will become available.

Other weeds for which biocontrol may be developed in the future include African club moss (*Selaginella kraussiana*), Chilean flame creeper (*Tropaeolum speciosum*), pampas (*Cortaderia* spp.), privet (*Ligustrum* spp.), and tutsan (*Hypericum androsaemum*). Decisions about which weeds to target are made by the National Biocontrol Collective (comprised of regional councils nationwide and the Department of Conservation), who are also key funders of this work. Other major funders include the Ministry for Science and Innovation, and community groups which are often substantially supported by the MAF Sustainable Farming Fund.