Biocontrol of weeds in native ecosystems

Quentin Paynter

paynterq@landcareresearch.co.nz

LANDCARE RESEARCH
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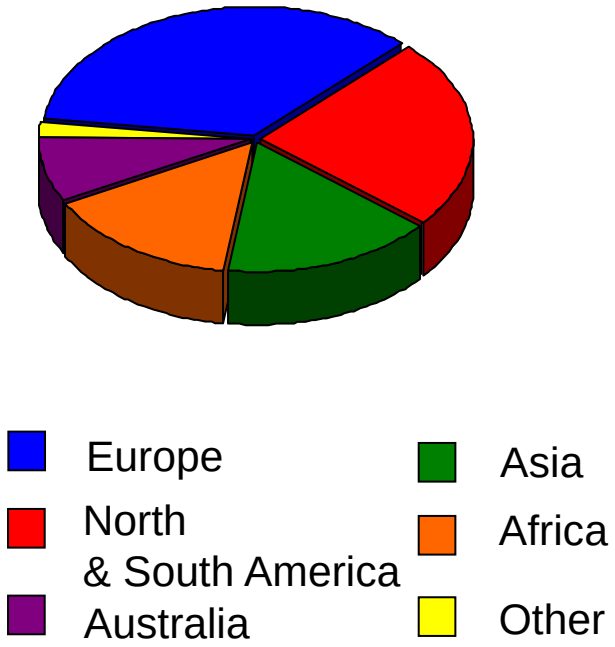
Invasive plants in NZ

Since 1769, >25,000 exotic plant spp. introduced (90% deliberately) from all over the world

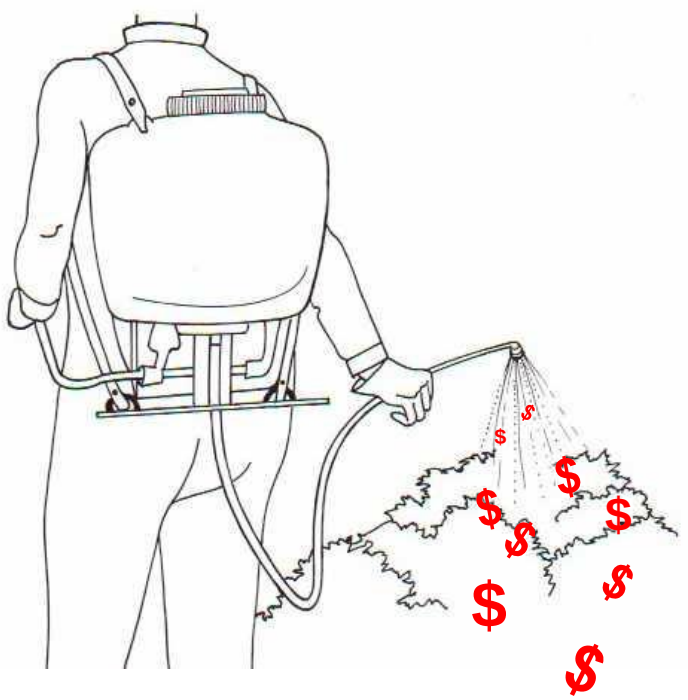
Naturalized seed plant spp. (2200) already outnumber native spp. (1900) & number is growing

328 spp. listed as environmental weeds in DOC ‘consolidated list’



The Cost

- Pastoral weeds cost ~$1.1 billion/yr (2005).
- Ecosystem service losses ~$2.52 billion/yr (2008).
- DOC & regional councils spend ~$18m/yr to reduce biodiversity losses from weeds but are failing to contain many weed populations.

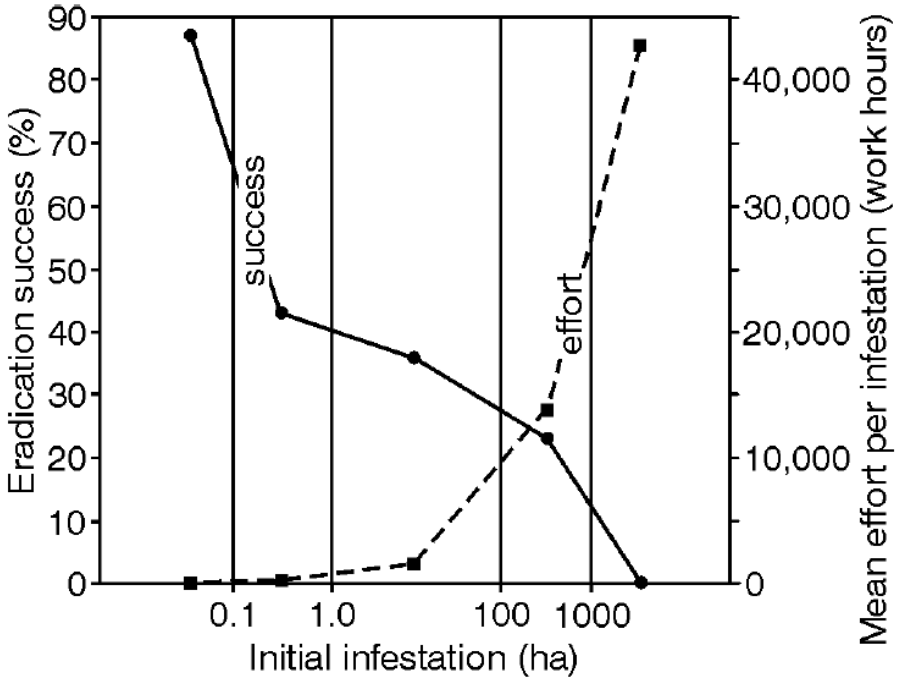


Weed Biocontrol in NZ

Eradication of naturalised weeds rarely feasible: need to minimise harmful impacts

Herbicides &/or mechanical control often not cost-effective or unsustainable in sensitive native ecosystems

Landcare Research is the lead provider of classical weed biocontrol in NZ – we end up with the weeds that are too intractable to be controlled by other means!

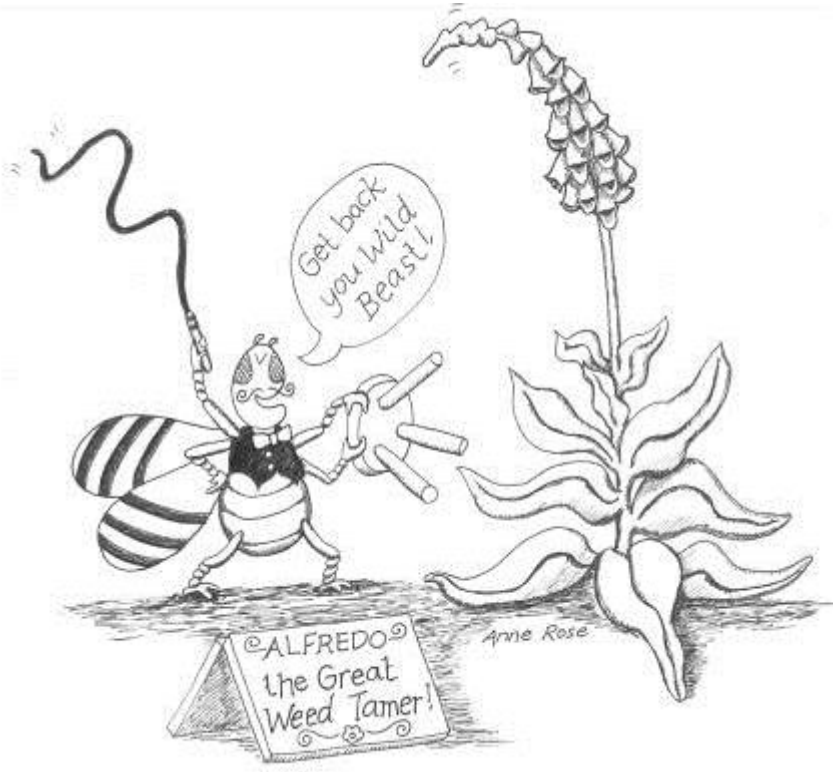


Rejmánek, M & Pitcairn, MJ 2002. When is eradication of exotic pest plants a realistic goal. *Turning the tide: the eradication of invasive species*, 249-253.

Data: California Dept. Food & Ag.

What is Biological Control?

" A technique used worldwide where we attempt to restore the balance between a weed & the environment by reuniting it with some of its key natural enemies."



Isn’t biocontrol risky?

Weed biocontrol safety record

Stringent host-range testing required to demonstrate weed biocontrol agents are adequately host-specific to gain EPA approval for release in NZ

Testing highly reliable e.g. no-choice starvation test (where an agent is confined on a test plant & either feeds or starves to death) is virtually infallible!

Weed biocontrol safety record

NZ: ~90 yr history & no significant non-target attack on native or economically important exotic plants[1,2]

Worldwide: 512 weed biocontrol agents released only 4 (0.8%) have serious non-target impacts: all on plants & in same genus as the target weed & *all predictable* (lower standards of biosafety in past – their release would not be allowed today[3])

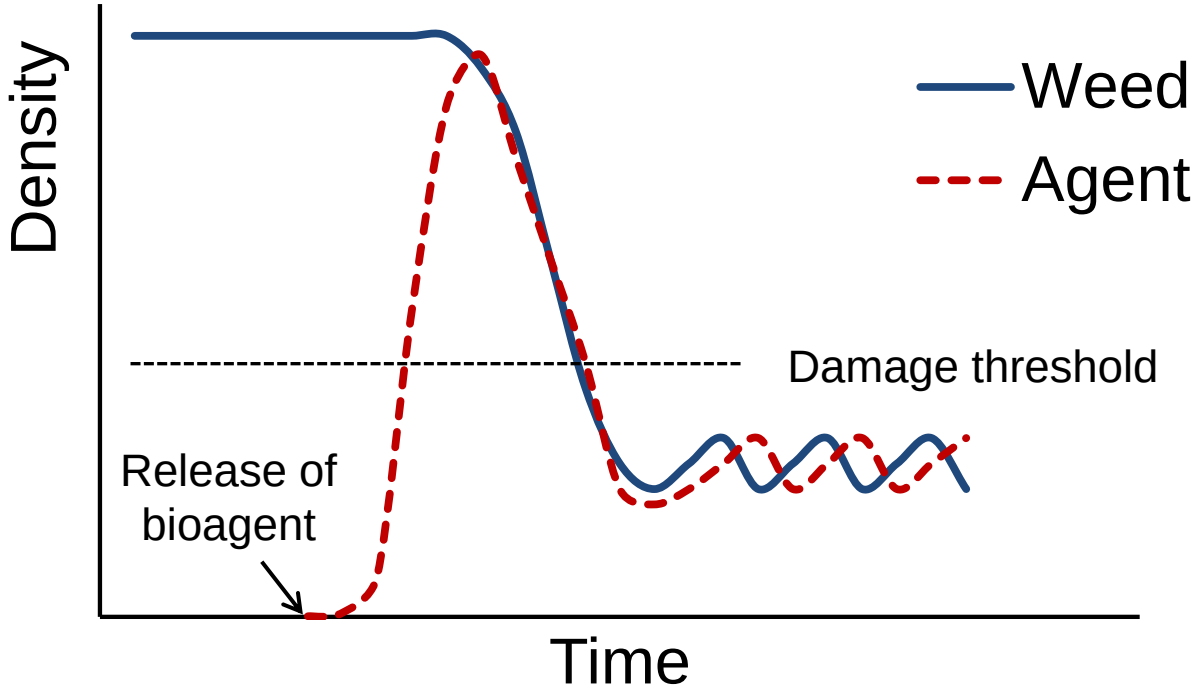
Host-range testing has been improved to reduce potential risks still further. Potential benefits exceed risks[1,2]

[1]Paynter et al. 2004 *NZ Plant Prot.* **57** 102-107
[2]Fowler et al. 2012. *J. Appl. Ecol.* **49** 307-310
[3]Suckling DM & Sforza, RFH 2014. *PloS one*, **9**, e84847

Biocontrol Pros & cons

- Selective & no health risks
- Sustainable: after initial investment, can provide long-term control at no cost
- Agents disperse naturally to control inaccessible weed infestations
- BUT no guarantees of success & slow vs instant results of herbicide
- Not all weeds suitable targets (e.g. kiwifruit)
- Weeds never eliminated totally

A successful biocontrol programme should progress like this:



Success rate

~1/3 of programmes so successful other control options are no longer required;

~1/2 are partially successful (e.g. biocontrol effective in some habitats, but not in others)

~1/6 are failures (no impact)[1]

We are working on improving success rate/cost-effectiveness!

[1]Paynter et al. 2012 *J. Appl. Ecol,* **49**, 1140-1148.

90 year history in NZ

Early programmes targeted pasture weeds: 1st major success St John's wort *Hypericum perforatum* in 1940s

Recent NPV calculated for SJW beetle introduction is between $140m & $1,490 m (Benefit: cost ratios between 10:1 & 100:1)

Benefits of SJW programme, have more than paid for all weed biocontrol programmes undertaken in NZ to date!

Ragwort

Jacobaea vulgaris

Ragwort

- Economic evaluation of the impact of the ragwort flea beetle has begun.
- Current annual saving in herbicide use alone for the dairy industry estimated to be NZ$41m.
- Potential for this figure to be increased by a further $20m if the plume moth (released 2005) controls remaining ragwort stands.

Taking on Environmental weeds:

Entyloma geratinae & mist flower *Ageratina riparia*[1]

1 yr after 1998 release of white smut fungus

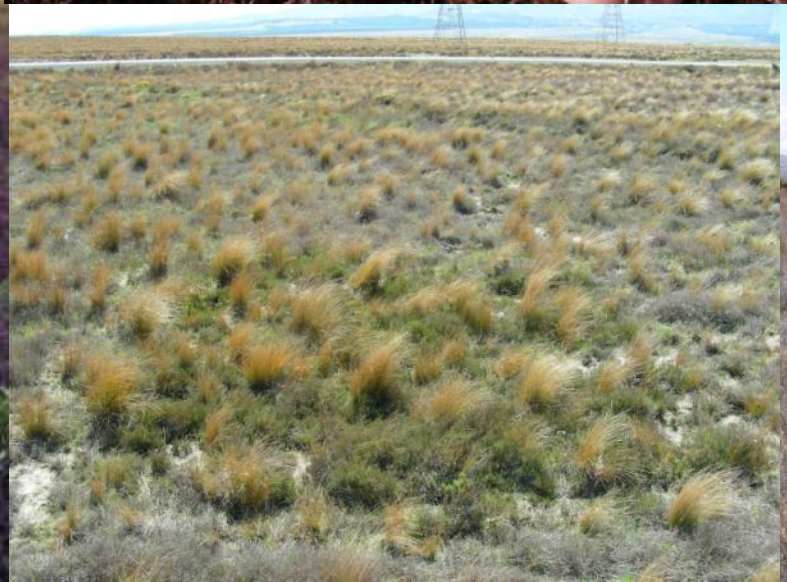
Mist flower declined by 98% & replaced by native plants[1]

Hebe acutiflora status changed from 'endangered' to 'range restricted'

3 yrs after fungus released

[1]Barton *et al.* (2007) *Biological Control*, 40, 370-385

Heather *Calluna vulgaris*



Current Targets

- Alligator weed
- Banana passionfruit
- Boneseed
- Chilean needle grass
- Darwin’s barberry
- Field horsetail
- Japanese honeysuckle
- Lagarosiphon
- Lantana
- Moth plant
- Old man's beard
- Pampas
- Privet
- Tradescantia
- Tutsan
- Wild ginger
- Woolly nightshade

Tradescantia

Tradescantia fluminensis

In NZ, mats >200gm^{-2} (dry weight) prevent native forest regeneration

NZ biomass 116-3999 gm^{-2}; 83% samples > 200gm^{-2}

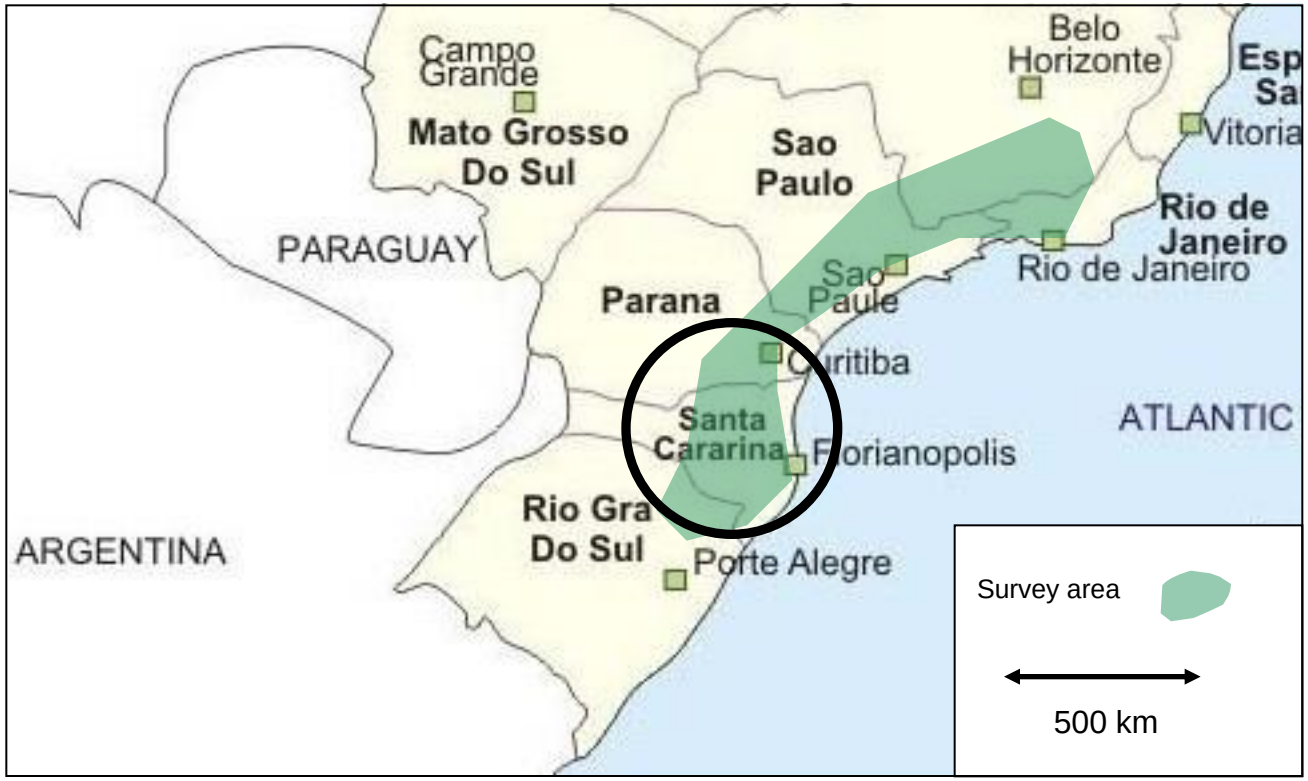
Brazil biomass 46-296 gm^{-2}; 12% samples > 200gm^{-2}

If difference is due to natural enemies in Brazil, then good prospects for biocontrol!

Dense mat of *Tradescantia* in Waipu Gorge

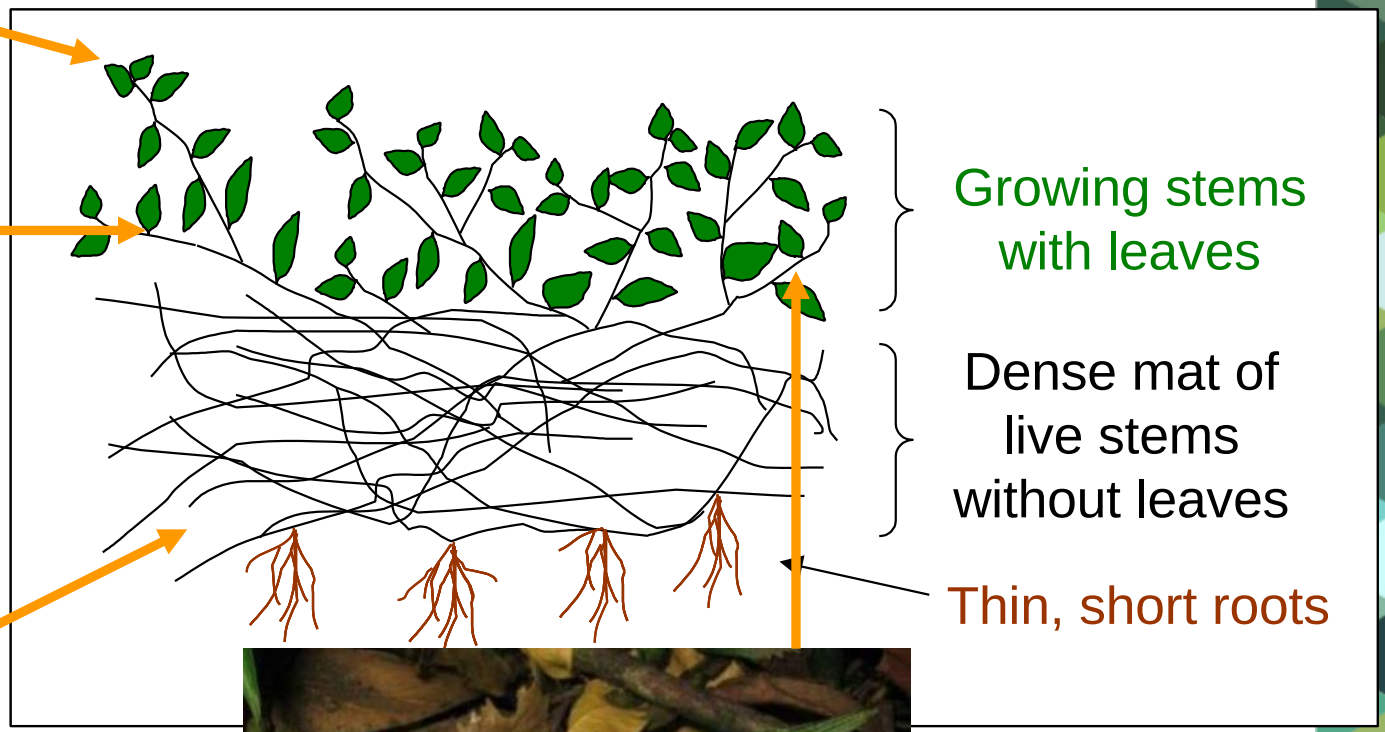
Natural enemy surveys in Brazil

- Some work near Rio de Janeiro & São Paulo, but most surveys in uplands of Paraná, Santa Catarina & Rio Grande do Sul (good ecoclimatic match to NZ).

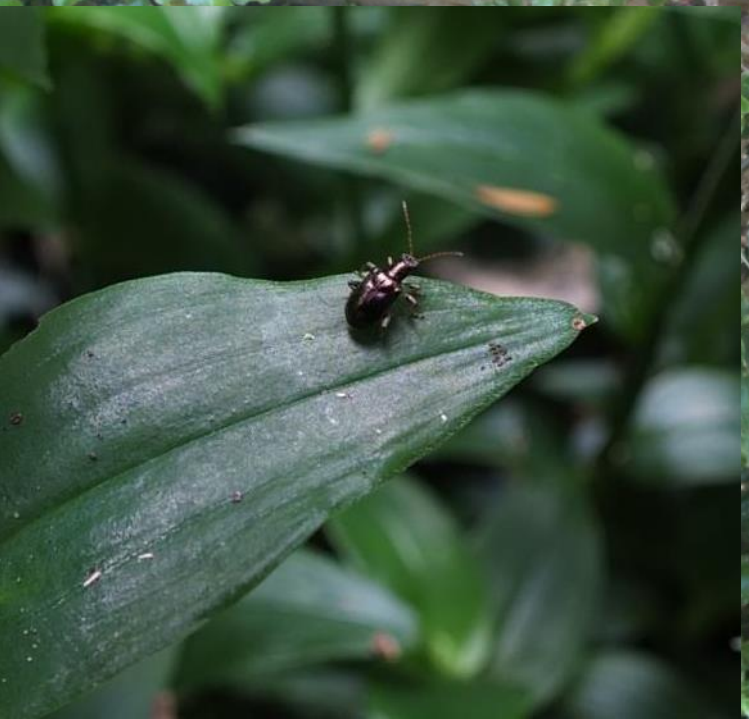


Tradescantia grows best on the slopes of the Brazilian Highlands plateau at altitudes between 600 – 900 m

4 agents approved for release by EPA, expected to complement each other.



Neolema ogloblini
released 2011



Lema basicostata
released 2012

Neolema abbreviata
released 2012

Japanese Honeysuckle

Lonicera japonica

Woolly Nightshade (*Solanum mauritianum*)

Chinese Privet (*Ligustrum sinense*)

Projects in development…

Moth Plant
(*Araujia hortorum*)

Pampas
(*Cortaderia spp*.)

Wild Ginger (*Hedychium* spp.)

Information Sources

- Information on our website: www.landcareresearch.co.nz/science/plants-animals-fungi/plants/weeds/biocontrol
- "The Biological Control of Weeds Book" www.landcareresearch.co.nz/publications/books/biocontrol-of-weeds-book
- Quarterly Newsletters http://www.landcareresearch.co.nz/publications/newsletters/biological-control-of-weeds