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factsheet

Biological control of weeds: impact evaluation

A leafhopper on a bridal creeper leaf.
Photo: CSIRO

Background

Biological control (biocontrol) of weeds has been an Australian success story for over 80 years, since the drastic decline of prickly pear over vast areas of eastern Australia following the introduction of the *Cactoblastis* caterpillar in the 1920s. However, biocontrol does not necessarily means wiping out the weed—rather reducing it till it no longer has a significant cost or ecological impact.

One of the great advantages of biocontrol is that, compared to other control methods, it is low cost—the main expense being in finding, testing and releasing the control agent. But for this method to be effective and low cost at the same time, the impact of the control agent must be carefully monitored after release to determine if it is doing the job and was a good choice for biocontrol, ie impact evaluation.

What is the issue?

Scientists test the chosen biocontrol agent carefully (usually an insect but sometimes a rust fungus or other pathogens) in the laboratory or in the field in its native range before it is released to be sure that it targets the right weed, causes severe damage to it and does not attack other plants (see factsheets on Agent selection and Host testing). However this can only give a general indication of how effective the agent will prove once released into the field where conditions can and do vary greatly (see factsheet on Release and establishment).

Therefore there is a need to test the effectiveness of the control agent after it has become established and has had time to work on the target weed. This is known as post-release impact evaluation. It assesses how the agent has affected the target weed and how this, in turn, has benefited other plant communities, pastures and ecosystems as well as society and the economy at large.

On farm or in the environment, this assessment provides information to help fine-tune control of the target weed and make it more effective, sometimes in combination with other control techniques. At the national level it helps to demonstrate the value of the investment in the biocontrol program, justifying further biocontrol research.

Field trial to measure the impact of the bridal creeper rust.
Photo: CSIRO

Key principles

The recommended approach to evaluation is to set a series of performance benchmarks and measure the extent to which the control agent succeeds in attaining them. For example, a possible benchmark may be to reduce the weed population by 25 % over 10 years.

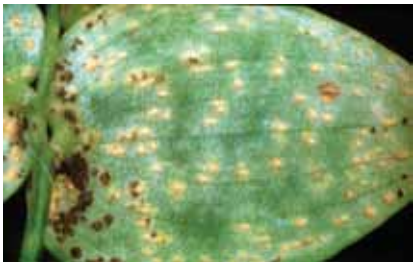
Measurements typically include agent survival, weed numbers and density, and the size of the weed seedbank, but they should also include native species diversity, crop or pasture yields, and other ecosystem characteristics.

Economic benefits of the control program are calculated by comparing the situation after release with the likely damage or additional costs that would have been sustained by farmers or land managers had there been no control. Costs of the program are usually clear, whereas it may take some time for benefits to emerge.

Ecological impact evaluation

Ways to measure the impact of a biocontrol program include:

Photopoints: the simplest and cheapest is to photograph the same selected sites over time to identify changes taking place in the target weed population and other vegetation.



The rust fungus infecting a bridal creeper leaf.
Photo: CSIRO

Historical comparisons: can provide an indication as to whether biocontrol has caused changes in weed populations.

Stakeholder surveys: useful for monitoring impacts of biocontrol over a wide area.

Quantitative: involves taking measurements at several sites over many years before and after agent release and provides good data to indicate the impact of biocontrol.

Plot comparisons: estimates the impact of biocontrol by comparing plots where the control agent is present and absent; cannot be used for agents which disperse widely.

Correlation: studies which correlate levels of damage to the weed, including reduced weed densities, with biocontrol agent abundance.

Agent exclusion: experiments where the agent is deliberately excluded (with cages or use of chemicals) and results compared to plots where it is present.

Demographic modelling: helps to clarify the likely future impact of the agent on the target weed.

...case study

Impact of biocontrol agents on bridal creeper

Bridal creeper (*Asparagus asparagoides*) is an aggressive climbing vine that smothers large areas of native vegetation and threatens irrigated orchards in southern Australia. A leaf hopper, a rust fungus and a leaf beetle have been released to control it.

Post-release impact evaluation focussed on measurements of weed cover, number of shoots and fruits, and biomass per ground area. Researchers measured the creeper's growth for up to 3 years before control agents were released, giving them a good basis for comparison. Six to 7 years later they found a drastic decline in bridal creeper populations at most sites across Australia, due mainly to the effects of the fungus. Other trials in Western Australia showed a decline in the creeper from 50 % ground cover to 10 % within 15 months of the rust fungus being released. In most sites there was also a return of native vegetation.

For further information, contact Louise Morin: louise.morin@csiro.au.

Other considerations

Where post-release impact evaluation of biocontrol agents indicates that they have only been partly successful at reducing the target weed, their integration with other control methods (eg spraying, grazing, tillage, fire or other biocontrol agents) may improve overall control. The aim of this integrated weed management is to identify the best combination of methods to manage the target weed.

Using photopoints to measure the impact of a rust fungus on bridal creeper.
Photos: Peter Turner

Further information

Carson, W.P., Hovick, S.M., Baumert, A.J., Bunker, D.E. and Pendergast, T.H. (2008). Evaluating the post-release efficacy of invasive plant biocontrol by insects: a comprehensive approach. *Arthopod-Plant Interactions* **2:**77–86.

CRC for Australian Weed Management (2008). *Best practice guide: impact evaluation of weed biocontrol agents.* CRC for Australian Weed Management, Adelaide.

Spafford Jacob, H. and Briese, D.T. (eds) (2003). *Improving the selection, testing and evaluation of weed biological control agents.* Technical Series No. 7, CRC for Australian Weed Management, Adelaide.

For further information visit the following websites:

CRC for Australian Weed Management
www.weedscrc.org.au

Weeds in Australia
www.weeds.gov.au

Australian Quarantine and Inspection Service
www.daffa.gov.au/aqis

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