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factsheet

Biological control of weeds: selection of agents

Background

Australian scientists have been in the vanguard of weed biological control (biocontrol) since the success with prickly pears in the 1920s. Since then, the science and on-ground implementation of biocontrol has evolved enormously. However, there are still some critical issues that need to be addressed. One of these is agent selection, an essential stage in a biocontrol program.

Weed biocontrol programs typically involve the introduction of many agents, although control often results from the impact of only one or two of these. Prior prediction of which agent will be successful has proved difficult but continuing research is underway to improve this process.

Issue

Biocontrol of this kind involves the deliberate introduction of a living organism into an environment where it has not previously occurred, with the intention that populations will establish and thrive in the new location. This is not a trivial matter and proper safeguards are essential. In particular, potential adverse economic or environmental impacts must be greatly outweighed by the benefits. As there is always a risk of unforeseen consequences from every new introduction, however slight, it is important to choose only the most efficacious agents for further testing thus reducing the number of introductions and program costs and improving the success rate.

Unfortunately, the biotic environment into which the agent is released is radically different from its native range, for example with regard to predators and parasites. It can thus be difficult to predict whether the agent will develop and maintain sufficiently large populations in the new location. It is also a challenge to predict the level of damage to the target weed and whether it will achieve the desired weed management outcomes. Research on these issues is on-going.

Simulated herbivory trials on prickly acacia.
Photo: K Dhileepan

Tingid adults and nymphs.
Photo: K Dhileepan

Key principles

In Australia, the deliberate release of new biocontrol agents requires permits from the Australian Government quarantine and environment protection agencies. Their decision includes consideration of the results from host-specificity tests (see factsheet on *Biological control of weeds: host testing*).

Successful biocontrol requires the released agents to cause sufficient damage to reduce the target weed population to a level where it no longer causes economic, environmental or social harm.

Agent selection starts with correctly identifying the target weed and confirming its area of origin. Detailed searches are then undertaken in this area for all insects, mites and diseases attacking the target weed. This initial list of candidate agents can be very large (> 300 species). These candidates are then prioritised for exhaustive host-range testing prior to release, using data from the literature and field and laboratory studies to identify those most likely to be damaging and host-specific.

An adult tingid bug on cat's claw creeper. Based on experimental results, this bug has now been introduced into Australia to help control the weed.
Photo: K Dhileepan

Herbivory trials on cat's claw creeper to determine plant vulnerabilities.
Photo: K Dhileepan

Guidelines

Criteria for success: explicit performance targets, such as the required level of reduction in weed population to reduce impact, are used to guide the agent selection process. This may require detailed studies and modelling to quantify the current and potential negative impacts of the weed that biocontrol is seeking to address, and to identify the causes of invasions.

Plant identification: molecular methods are used to clarify the taxonomy of the target weed and determine the genetic variation present, and match these to varieties in the native range to ensure an agent – host match.

Plant vulnerabilities: experimental and modelling approaches are used to understand the plant demography and response to damage, in order to determine which type of damage (eg to roots or leaves) will have most impact and therefore which kind of agent will be most successful.

Agent characteristics: comprehensive knowledge of potential biocontrol agents is gathered during detailed native-range studies of the plant and its natural enemies. These investigations, together with laboratory studies and modelling, assist in predicting the potential distribution, abundance and impact of the potential agents in the new country, which is then used in the agent prioritisation process.

...case study

How best to manage cat's claw creeper

Cat's claw creeper (*Macfadyena unguis-cati*) is an invasive vine in gullies and rainforest in coastal eastern Australia. The plant spreads through wind-blown seed and regenerates after damage from huge underground root tubers which make control both difficult and expensive. The biocontrol program for this weed started in 2002 with surveys in South America. Experiments in Australia showed that damage to root tubers results in vigorous regrowth and production of more tubers, and does not reduce the plant population. However, damage to shoots and leaves was found to cause a significant reduction in plant growth and also reduce the size of the underground tubers. Based on these results, two leaf-feeding insects were selected for testing and have been introduced into Australia.

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Other considerations

Post establishment, predictions regarding abundance, climatic range and impact on the weed can be checked against actual events (see *Best practice guide: Impact evaluation of weed biological control agents*).

Further information

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

Raghu, S. and van Klinken, R.D. (eds) (2006). Refining the ecological basis for agent selection in weed biological control. Special issue. *Australian Journal of Entomology* **45**.

Raghu, S., Dhileepan, K. and Treviño, M. (2006). Response of an invasive liana to simulated herbivory: implications for its biological control. *Acta Oecologica* **29**:335–45.

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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