The New biocontrol solutions for sustainable management of weed impacts to agricultural profitability project aims to improve the long-term profitability of primary producers affected by the target weeds by developing novel biocontrol solutions that will reduce recurrent costs of control.

The target weeds are: African boxthorn, cabomba, prickly acacia, sagittaria, silverleaf nightshade, fleabane, sowthistle, mother-of-millions, giant rat’s tail grass and ox-eye daisy.

Weeds threaten Australia’s natural environment and rural industries. They displace native species, contribute significantly to land degradation, and reduce agricultural productivity.

AgriFutures Australia, through the Australian Government Rural R&D for Profit Program is working with departments of agriculture in NSW, Queensland and Victoria, and the CSIRO to develop new biocontrol agents to target 10 weed species that are significant on a national level — weeds that are difficult to control with current methods and have substantial impacts across agriculture sectors.
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Why biocontrol?
Successful targeted and integrated biocontrol programs deliver long-term solutions to soil, water and natural resource management problems.

Australia has been a world leader in weed biocontrol since the prickly pear success of the 1930s, with average benefit–cost ratios on R&D investment in the order of 23:1.

Weed biocontrol programs involve: identifying new effective agents (Phase 1), assessing the risk and efficacy of such agents (Phase 2), followed by approval for release in Australia, mass-rearing, large-scale release and redistribution of these agents (Phase 3).

The New biocontrol solutions for sustainable management of weed impacts to agricultural profitability project specifically targets Phases 1 and 2. When Phase 3 is supported and agents approved for release, the anticipated outcomes from the project will reach nation-wide.

The project brings together biocontrol expertise from four Australian and multiple international research agencies to support the development of these new agents.

Why these weed species?
Consultation with industry stakeholders identified and prioritised 10 target weed species. The criteria included addressing significant impacts across multiple industry sectors and the likelihood of successful control.

The target weeds impact cropping (fleabane, sowthistle, silverleaf nightshade), pasture (African boxthorn, mother-of- millions, ox-eye daisy, giant rat’s tail grass, prickly acacia) and water resources (cabomba, sagittaria), and collectively their impacts cost Australian agriculture more than $400 million/year.

Approval process and next steps
Approval for the release of biocontrol agents requires thorough assessment of impact and risks. This includes a detailed evaluation of the risks of the proposed release (including host-specificity testing), including pest status across each state, possible implications of the weed’s biological control for affected industries and public consultation.
African boxthorn (*Lycium ferocissimum*)

DNA extracted from African Boxthorn samples from Australia revealed all local specimens to be *Lycium ferocissimum*, with no evidence of hybrids. There are several *Lycium* species in South Africa and significantly more genetic diversity within *L. ferocissimum* in Africa than Australia.

Ongoing work is determining the closest genetic match in South Africa for the Australian populations; candidate agents will be sourced from these populations.

Two accessions of the promising rust fungus, *Puccinia rapipes*, have been imported into Australia. Cultures on living plants have been established in quarantine and pilot studies to develop efficient inoculation methods for host specificity testing are underway.

Two leaf-feeding insects (*Cletia* sp. and *Cassida distinguenda*) show promise and colonies have been established in South Africa. Testing is examining the risk these insects pose to species in the genera *Lycium*, *Solanum* and *Capsicum*.

Pending successful results, the insects will be imported into an Australian quarantine facility for continued host-specificity testing.

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Cabomba (*Cabomba caroliniana*)

Surveys in Argentina to assess field specificity of potential biological control agents for cabomba, such as *Hydrotmetes notans*, continue to show that the promising weevil occurs only on this highly invasive aquatic weed.

A colony of *H. notans* is being established in Argentina, where the insect will be screened against three species of cabomba, and up to six species in the family *Nymphaceae*.

Adults from a population of *H. notans* from the wetlands along the border of Paraguay and Argentina have been imported into Australia and a colony of weevils is in the process of being established under quarantine conditions.

A draft test list of plants for assessing the risk *H. notans* may pose to non-target species in Australia has been developed.

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Fleabane (*Conyza bonariensis*)

Close to 500 samples of fleabane have been obtained from the native (South America) and invaded (Australia) ranges for genetic analyses.

Analysis of the samples collected in Australia indicate two distinct genetic groups, suggesting Australia has had multiple introductions of fleabane.

A total of 245 herbarium samples from countries spanning the native range of fleabane have been obtained and are awaiting DNA sequencing and analyses. This comparative analysis will identify locations likely to prove most profitable for candidate biological control agents.

Surveys in Brazil have identified up to a dozen insect species of interest and with the exception of a rootworm, none appear to occur on other non-target species.

These species are being identified and a root-feeding beetle and scale insect are being cultured in Brazil for further evaluation.

After identification, and preliminary host-specificity testing in southern Brazil, candidate agents will be imported for risk assessment in quarantine laboratories in Australia. A draft test list for this risk assessment has been compiled. These species have been collected and are being propagated to build up seed reserves in anticipation of host-specificity testing.

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Giant rat’s tail grass (*Sporobolus* sp.)

The *Sporobolus* leaf smut, *Ustilago sporoboli-indici*, found on giant rat’s tail grass (GRT) during one of the surveys in Queensland is having a significant impact on the invasive grass species. Infected plants are stunted, void of seedheads and easily pulled out of the ground. Early indications suggest this pathogen could be an excellent biocontrol agent for GRT in Australia. Infested leaf smut plants growing at the Ecosciences Precinct, Brisbane have a number of infected shoots with sterile inflorescences and leaf dieback. The pathogenicity of the leaf smut will be tested on other *Sporobolus* species and key grass crops and pastures. A climate model will be used to highlight areas in South Africa climatically similar to areas in Australia where GRT species are found. Field surveys have yielded more than 50 insects and pathogens, with at least two insects (the stem-galling wasp *Tetramesa* sp. and another eurytomid wasp, *Eurytoma* sp.) showing potential as biological control agents. Impact studies in the field indicate *Tetramesa* sp. significantly reduces height, survival and reproductive output of GRT. If this insect is suitably host specific, it is likely to be a damaging agent. Laboratory cultures of both wasps, collected at two sites in the Limpopo Province, are being established at Rhodes University, South Africa. Field host range studies at 14 field sites involve *Tetramesa* sp., among other potential candidates.

Mother of millions (*Bryophyllum* spp)

Following a severe cyclone season in Madagascar during early 2017, the location and collection during late 2017 of the two potential biological control agents for mother of millions — the stem-boring weevil (*Osphilia tenuipes*) and the root-feeding flea beetle (*Rhembastus* sp.) — was successful. Both agents have been imported and established in quarantine in Australia. A PhD student in Madagascar, Tahina Rajaonera, will be studying the impact and host range of *O. tenuipes* and *Rhembastus* sp. under open-field conditions.

Developmental threshold experiments with *O. tenuipes* are ongoing. These trials will allow for degree-day models to be developed, which in turn will inform how many generations the weevil could complete at each invaded locality in Australia. Field monitoring sites have been established by NSW DPI at Wee Waa and at Turrawarri in NSW. Field sites will be established by QDAF in Queensland during 2018.

Ox-eye daisy (*Leucanthemum vulgare*)

Replicated no-choice feeding trials examining feeding damage and development of the potential biological control agent *Dichrorampha aeratana* on ox-eye daisy have shown no effect on the species of Asteraceae tested. These test species included several ornamentals Asteraceae, a native Brachysome and lettuce. Developmental threshold studies for *D. aeratana* were delayed due to adult moths from the culture not laying fertilised eggs. This issue has now been resolved. During trials overseas, CABI Switzerland recently discovered that a rhizome-feeding weevil (*Chypholeconus trisulcatus*) has a greater effect on growth of ox-eye daisy than *D. aeratana*. As a result, NSW DPI is negotiating with CABI Switzerland for the opportunity to carry out testing in Switzerland on both *D. aeratana* and *C. trisulcatus*. In preparation, seed from several native Australian Anthemidae have been sent to CABI for cultivation. Field monitoring sites have been established by NSW DPI at Kosciusko National Park and Mongarlo (NSW), as well as Mount Hotham (Victoria). At these sites, plant population data were recorded and soil samples collected to determine the viable seed bank component.
Sagittaria (Sagittaria platyphylla and S. calycina)

A phylogenetic ‘tree’ showing the relationship between weevil larvae with the potential for use as biological control agents for sagittaria, collected in the USA during 2015, has been developed using genetic analysis.

Laboratory trials have commenced with crown-boring weevil (Listronotus sordidus) under day lengths and climatic conditions for Darwin (NT), Cape York (Queensland) and the Riverina (NSW) to determine effects on fecundity and larval development.

Testing of the crown-boring weevil showed larval damage in all tested plant species at high and low water levels, with no larvae developing to adults on plants growing at high water levels.

Prickly acacia (Vachellia nilotica)

In addition to previous surveys carried out in Senegal during October 2017, a native range survey was conducted in Ethiopia during November and December 2017 to identify and source biological control agents for the high-invasive prickly acacia.

Two gall mites found on prickly acacia in Ethiopia have been imported into Australia for identification.

A gall thrip (Acaciothrips ebneri), two gall mites (Aceria spp.) and a stem-galling fly (Notomma mutilum) from Senegal have been identified as prospective biological control agents.

Stem galls of N. mutilum collected from Senegal have been imported into quarantine at the Ecosciences Precinct, Brisbane for colony establishment and host specificity testing.

Silverleaf nightshade (Solanum elaeagnifolium)

The Foundation for the Study of Invasive Species (FuEDEI), Argentina, has surveyed and collected silverleaf nightshade samples in Argentina. No prospective agents have been recorded from these surveys, however it is early in the growing season and surveys are still underway.

The FuEDEI has targeted a high-priority area in southern Buenos Aires with intensive surveys during January 2018. In anticipation that agents will be found, test plants of commercially-important species have been grown.

Prospective control agents will be tested for host specificity in Argentina to rule out any clearly unsuitable options before potential agents are imported to Australia.

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Sowthistle (Sonchus oleraceus)

Bioclimatic modelling suggests the southern European edge of common sowthistle's native range could be the best option in the pursuit of enemies best adapted to the climatic distribution of the weed in Australia.

Of the 40 or more insects found so far on sowthistle during field surveys in France, Italy, Portugal and Morocco, two gall insects (Cystiphora sonchi, Tephritis formosa) appear to have the most potential due to their apparent host specificity.

To date, field observations of these species show them to be restricted to plants in the genus Sonchus. Colonies of these insects have been established in the CSIRO European Laboratory in France.

Of the six species of fungi found associated with sowthistle in Europe, an unidentified rust fungus looks to be the most promising candidate agent at this stage. Culturing of this fungus on sowthistle plants is underway to enable identification and the study of its host specificity.

Preliminary host-specificity tests with these insect and fungal pathogen species will start at the CSIRO European laboratory in France in early 2018.

If the candidate agents pass these initial tests, they will be imported to Australia for further risk assessment in quarantine. A draft proposed test list for this assessment has been compiled.

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Research organisations

CSIRO
Sowthistle, African boxthorn, cabomba, fleabane

DEDJTR
Silverleaf nightshade, sagittaria

QDAF
Prickly acacia, giant rat’s tail grass, mother-of-millions

NSW DPI
Mother-of-millions, ox-eye daisy, giant rat’s tail grass

Partner organisations

PIRSA
SEQ Water
GRDC
Ravensthorpe Shire
USDA
Goulburn Murray Water
Murrumbidgee Irrigation
Coleambally Irrigation
Goulburn Broken Catchment Management Authority
North Queensland Dry Tropics
Wyong Shire
Murray Local Land Services
Murrumbidgee Landcare
Central Murray County Council
NSW Office of Environment and Heritage
NSW National Parks and Wildlife Service
NSW Biocontrol Taskforce
Bundaberg Council
North West Local Land Services
Gladstone Council
HQ Plantations

This project is supported by funding from the Australian Government Department of Agriculture and Water Resources as part of its Rural R&D for Profit program

Learn more
agrifutures.com.au/weeds-biocontrol