The New biocontrol solutions for sustainable management of weed impacts to agricultural profitability project is a $13 million, five-year project, managed by AgriFutures Australia, which aims to improve the long-term profitability of primary producers affected by the target weeds through the development of novel biocontrol solutions that will reduce recurrent costs of weed 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.
Collaboration harnesses critical mass

The global network of collaborations that underpin the *New biocontrol solutions for sustainable management of weed impacts to agricultural profitability* project spans more than 21 Australian organisations and 18 international partnerships.

This ambitious approach is successfully harnessing an unsurpassed global foundation of knowledge, skills, experience and resources along the discovery-to-delivery pipeline to deliver fast-tracked, rigorously tested biological control solutions to support Australian agricultural production systems.

The project is utilising a well-recognised and highly credentialled team of researchers, whose critical mass and strong local and international collaborations are yielding benefits not only for this project, but for future weed control initiatives across Australia.

Integrated model finds widespread support

The integrated multi-weed and multi-agency model developed for this project is strongly supported by the research community and financial participants.

Researchers are finding the approach is bringing a host of benefits, ranging from invaluable access to local expertise, facilities, knowledge and networks, to critical support in navigating the minefield of regulatory administration that governs the international transfer of biological material.

A recent review of the project identified that several core financial participants would invest in a similar project in the future. They indicated the integrated multi-agency, multi-weed project framework provides better efficiencies and enhanced outcomes for research, development and extension (RD&E) compared with stand-alone projects. The model also provides a lower risk profile for project investors.

Looking ahead

With the myriad of benefits on offer, there is strong support for the continuation of the project and for the development of a ‘next-step, phase-three’ project, which will take successful outcomes from the current project through to the broader agricultural community by large-scale release and distribution of the agents.

There is also widespread support for projects of this nature to be developed for other weed species.
Biocontrol of weeds
Spring 2018 update

African boxthorn (Lycium ferocissimum)
Researchers from CSIRO, Canberra are collaborating with teams of researchers from Rhodes University and the Plant Protection Research Institute, South Africa in the search for suitable biocontrol agents to add to the weed control toolbox for African boxthorn species across Australia. South African collaborators have undertaken more than 50 native range surveys across Eastern Cape and Western Cape to identify prospective agents. These surveys confirmed a single candidate pathogen and several insects had potential as control agents. Meanwhile, back in Australia, local collaborations across all Australian bioregions affected by African boxthorn have seen landholders support the research team in collecting plant samples to help researchers determine the genetic diversity of local Lycium species. In addition, local councils (e.g. Shire of Ravensthorpe, WA) have also co-invested in the work, which offers clear benefits in helping them to manage African boxthorn. At a research level, the CSIRO team is working closely with the University of Queensland to undertake the molecular research related to this project.

Cabomba (Cabomba caroliniana)
The Fundación para el Estudio de Especies Invasivas (Argentina) and Fundación Moises Bertoni (Paraguay) have been integral in helping the CSIRO research team survey the native range of cabomba and have been facilitating the import of the potential weevil agent into Australia. On home turf, the CSIRO research team is working closely with SEQWater (and their affiliated water asset managers), Noosa Landcare and several impacted landholders to monitor cabomba infestations. This project has a close collaboration with QDAF researchers (Joe Vitelli and Tobias Bickel), who are working on registering a new herbicide for use in freshwater systems; the biocontrol and herbicide work are being developed concurrently as components of an integrated weed management (IWM) system for the water asset managers.

Fleabane (Conyza bonariensis)
A collaborative international effort including researchers from Fundación para el Estudio de Especies Invasivas (Argentina); Universidade Regional de Blumenau (Brazil) and Universidad Nacional de Colombia (Colombia) is supporting the CSIRO team to identify suitable agents for the bioccontrol of fleabane in Australia. With information generated by CSIRO’s Australian National Herbarium, from plant genetic material collected by regional grower groups in each of the GRDC grain growing regions, international teams have been undertaking native range surveys of fleabane infestations to find candidate biological control agents. These surveys have identified up to a dozen insect species of interest and the CSIRO team has been working closely with their South American colleagues to carry out the initial host-specificity testing process, which facilitates the import of agents into Australia. This complex network of relationships is vital in ensuring a rigorous and efficient process to both identify suitable agents and undergoes the necessary testing protocols to manage the risks associated with the discovery-to-delivery biocontrol R&D pipeline.

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Giant rat’s tail grass (Sporobolus spp.)

A combination of local and international efforts is yielding early results in the battle against giant rat’s tail grass.

A collaboration with the Rhodes University, South Africa is carrying out native range surveys at more than 100 sites across Eastern Cape, Kwa-Zulu Natal, Mpumalanga and Limpopo Provinces, to seek out additional potential control agents.

To date these surveys have have yielded more than 50 insects and pathogens, with at least two insects showing potential as biological control agents.

Support from Rhodes University, in the form of laboratory cultures of four priority species, all stem-galling wasps, is building the case for further investigation.

Surveys across Queensland by QDAF researchers are having a significant impact on the invasive grass species.

QDAF researchers at the Brisbane Pathogen (BRIP) herberia are currently testing the pathogenicity of the leaf smut on other Sporobolus species and key grass crops and pastures.

The herberia is one of three in Australia that constitute the National Collection of Fungi.

Field trials at multiple sites are assessing the impact of a range of control options on giant rat’s tail grass and results will be incorporated into a best practice management manual.

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Mother-of-millions (Bryophyllum spp.)

Local and international collaborations on the mother-of-millions project have optimised efficiencies, with concurrent efforts in Australia being supported by background research in Madagascar, paving the way for an efficient technology transfer when the time comes.

Project lead Andrew McConnachie, NSW DPI, explained that the collaboration with the experienced QDAF team has allowed investigation of two agents (a stem-boring weevil at NSW DPI’s Orange facility and a hitherto unidentified root-feeding flea beetle at QDAF’s Brisbane facility) concurrently.

A partnership with the University of Antananarivo, Madagascar has seen PhD student Tahina Rajaonera (pictured) join the project team to study the impact and host range of the agents under open-field conditions in their native range.

The relationships developed in Madagascar, and the data collected by Tahina, are critical to navigating the regulatory processes required to transfer the agents between countries if they prove fit for purpose.

The relationships developed and nurtured during the project also pave the way for future research opportunities.

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Ox-eye daisy (Leucanthemum vulgare)

Australian researchers are piggy-backing on more than 10 years of research into biocontrol agents for ox-eye daisy by joining forces with the Centre for Agriculture and Bioscience International (CABI), Switzerland.

According to project lead Andrew McConnachie, NSW DPI, local researchers are benefiting from a vast body of existing work carried out by Swiss researchers for the US and Canada.

Instead of starting from scratch, Australian researchers have a bank of test data to draw from, which will fast-track the progress of local biocontrol efforts.

Additional benefits have been realised when local researchers had difficulty growing biological cultures under local quarantine conditions and were able to draw on the expertise and resources of CABI to progress trials and testing in their laboratories, while local researchers got on top of the challenge.

Local collaborations with National Parks teams in NSW and Victoria have also been critical in securing long-term field trial sites in which to progress investigations in Australia.

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AgriFutures Biocontrol of Weeds
Biocontrol of weeds
Spring 2018 update

Sagittaria (Sagittaria platyphylla and S. calycina)

According to Sagittaria project leader and researcher Raelene Kwong, relationships with international collaborators such as the US Army Corps of Engineers, offer administrative knowledge, local knowledge and networks and access to equipment and expertise.

Local collaborators provide regulatory advice and help the Australian team negotiate the administrative requirements for agent collection, which can be time consuming, and in some cases, an administrative nightmare!

Local knowledge is also critical to finding weeds in their native range and helping researchers gain access to private land.

Access to laboratories and expertise in the US and South Africa has been invaluable to Raelene’s team in terms of being able to rear insects to ensure a clean culture is obtained before shipment to the AgriBio labs in Victoria, Australia.

Collaborators are usually specialists in their field and provide support with both agent and host plant species identification.

They also can conduct genetic analyses to help determine where the Australian weed populations originated from the native range.

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Prickly acacia (Vachellia nilotica)

Collaborations spanning Africa have seen native range surveys carried out across Ethiopia (Adama, Arba Minch, Awasa, Awash, Debre Birhan, Dessie, Harar, Mille, Shewa Robit regions), Nigeria (Borno, Adamawa, Kano and Kaduna), and Senegal (Bambre, Kaolack, Ndioum Wadi, Podol and Senegal River Valley) to identify and source biological control agents for the highly-invasive prickly acacia.

Three prospective agents have been collected from surveys in Senegal and Ethiopia and further investigations into the candidate agents are exploring host specificity across Australia and Africa.

Gall mites sourced from Senegal have been exported to a specialist gall mite taxonomist in Turkey for identification.

Institutes supporting the Australian research into potential biological control solutions to prickly acacia include the Ethiopian Forest Research Centre Addis Ababa; Dr Sebahat Ozman Sullivan and Ondokuz Mayis University, Samsun, Turkey; Senegalese Institute of Agricultural Research (ISRA), Centre National de Recherche Agronomique (CNRA), Bambre, Senegal; Agricultural Research Council - Plant Protection Research Institute Pretoria, South Africa.

The collaborations occuring in the project are paving the way for future collaborative research for host specificity testing of prickly acacia biocontrol agents.

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Silverleaf nightshade (Solanum elaeagnifolium)

The failure during host testing of a promising biocontrol agent identified in an earlier project has meant a redoubling of effort to find suitable candidates for silverleaf nightshade control.

Surveys for agents are being conducted in Argentina and Texas — two areas identified as the likely origins of the weed in Australia.

Silverleaf nightshade is widely distributed in cropping areas and workshops were held across NSW and Victoria with stakeholders from: Deakin University, NSW DPI, Hay Shire Council, Hunter Local Land Services (LLS), Murrumbidgee Irrigation, Riverina LLS, RENWA, Murray LLS, Central Murray LLS, Murrumbidgee Council, Murray Irrigation, NSW National Parks and Wildlife Service, Goulburn Broken CMA, Goulburn Murray Water, NT Dry Tropics, Parks Victoria, farmers and spray contractors.

The NSW and Victorian workshops have focused on engaging stakeholders in silverleaf nightshade-infested areas, and updating them on research findings and new research directions.

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Photo credit: John Heap, PIRSA
Sowthistle (Sonchus oleraceus)

Regional grain grower groups across each of the GRDC grain growing regions have provided CSIRO’s Australian National Herbarium with plant genetic material enabling researchers to undertake genetic studies to pinpoint the regions of origin of the genotypes of sowthistle of interest to Australian producers.

Researchers at CSIRO Monpellier (France) have undertaken native range field surveys in France, Italy, Spain, Portugal and Morocco and are facilitating the import of agents into Australia.

Colonies of these candidate insects have been established in the CSIRO European Laboratory in France under conditions to support development to adult stage.

Preliminary host specificity testing is underway on a number of potential agents and additional agents have been prioritised for testing.

Project leaders are also mentoring a PhD student who is working on a project that could add value to the risk analysis component of the sowthistle biocontrol research efforts.

Using community ecology, advanced genomics and food web models to compare the network of interactions between plants and insects associated with sowthistle in Europe and Australia, the project may shed light on how biocontrol could function in a real-world setting, helping researchers to better anticipate benefits and risks.

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

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Learn more
agrifutures.com.au/weeds-biocontrol