

Development of biological control of *Polygala myrtifolia*

A strategic approach to evaluate potential candidates



A report prepared for the
Glenelg Hopkins Catchment Management Authority

Contact and business

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Aim

To develop effective biological control of *Polygala myrtifolia* on public and private land in Victoria

Background

General

Polygala myrtifolia is naturalised across southern Australia with extensive infestations in Victoria around Melbourne, and in South Australia on the Eyre Peninsula. Isolated and expanding populations are widely scattered in coastal New South Wales, eastern Tasmania and south-west Western Australia. Dense infestations of *P. myrtifolia* disrupt ecological processes in native coastal vegetation and threaten biodiversity values. The species increases vegetation flammability and fire intensity due to increased biomass, and alters geomorphological processes by increasing sediment retention, particularly on sandy coastal soils. A broad range of vegetation communities are susceptible to invasion by *P. myrtifolia* in southern Australia, where environmental impacts effect or have the potential to affect numerous vulnerable or endangered species or communities (Groves *et al.* 2003). In coastal vegetation, *P. myrtifolia* may displace *Acacia longifolia* (Andrews) Willd. subsp. *sophorae* (Labill.) and *Leucopogon parviflorus* (Andrews) Lindl., structurally dominant woody species in a range of coastal vegetation associations (Arnold 1981). *Polygala myrtifolia* is host to the Cucumber Mosaic Virus in Europe and New Zealand, an important viral pathogen of crop and ornamental plants (Tessitori *et al.* 2002, Cardin and Onesto 2005, Freeman and Aftab 2006). It is unknown whether CMV is present on *P. myrtifolia* in Australia. Mechanical and chemical control techniques suppress *P. myrtifolia*, but are generally only successful when applied to small areas where regular follow-up treatments can be implemented.

In Australia, few phytophagous arthropods occur on *P. myrtifolia*, and herbivory damage is low to negligible which contributes to the species success as an invasive weed. In contrast, phytophagous (plant-feeding) species can cause substantial damage to *P. myrtifolia* in its native range of South Africa. Six phytophagous species have potential for classical biological control (Adair and Naser 1996). *Polygala myrtifolia* was recently (2018) accepted as a target for biological control in Australia by the Australian Invasive Plants and Animals Committee following national consultation and liaison with the Australian horticultural industry. This form of control is considered the only effective long-term management option in natural areas for this species.

Biological Control

- Classical biological control uses phytophagous organisms from the native range of the host plant to control or suppress the same host in an area where it has been introduced and is problematic.
- Extensive surveys in South Africa between 1998 and 2004 found 28 phytophagous species from *Polygala myrtifolia* in South Africa and six have potential as biocontrol agents in Australia.
- Further field surveys are not required.
- *Polygala myrtifolia* is accepted nationally as a target for biocontrol and host specificity evaluation can proceed.
- Host specificity evaluation tests the feeding range and impact of selected potential agents and evaluates their suitability for release in Australia.
- Evaluation methods commence with using no-choice feeding trials of species closely allied to the pest species and others that are of economic and ecological importance.
- Testing can be undertaken in the country of origin, South Africa, or in quarantine in Australia.
- Approval for release is a rigorous and carefully planned process that requires national consensus.
- As *Polygala* has horticultural importance, *Polygala* species and cultivars utilized by the industry are a priority for evaluation, together with selected Australian native *Polygala* species.
- The majority of Australian native *Polygala* are annuals from arid areas in central and northern Australia and are highly unlikely to be at risk from South African insects found on *P. myrtifolia*.
- The perennial and native *Polygala japonica* is vulnerable in Victoria, but more common in eastern Australia and is a key species to include in host specificity evaluation.
- A tiered host-testing and evaluation program is suggested to reduce investments risks.

Strategic importance

- *Polygala myrtifolia* forms intractable infestations in areas of biodiversity significance in western Victoria, including the Bellarine and Mornington Peninsulas, and SE South Australia.
- The potential for expansion is considerable and active invasion occurs over much of its range in Australia, particularly western Victoria .
- Biological control is the only viable option for suppression for larger scale infestations.

Proposal

A three stage research program designed to evaluate the host specificity of potential biological control agents for *Polygala* is presented. Each of the phases can be treated as stop-go points for evaluation and assessment for future investment decisions.

Phase 1

Preliminary host testing to determine susceptibility of key horticultural and Australian native species

Introduction

Preliminary host testing utilizes a small selection of key species closely related to *Polygala myrtifolia* to provide an initial indication of host specificity of potential biological control agents.

Agents that demonstrate unacceptable feeding damage or development capability on important related species can be removed for further evaluation therefore reducing project costs. Species indicating specificity can proceed to more detailed evaluation using a full host-test list that will include a broad range of economically and ecologically important plants.

Methods

- Preliminary host testing would be completed in South Africa, thereby avoiding expensive quarantine costs in an Australian facility.
- Tests can be completed in a basic facility where water, shade and a work area is available.
- Select and secure test plants for testing in South Africa. Ten *Polygala* species or cultivars including the native *P. japonica* would be utilized. Plants will need to be sourced, stabilised and prepared for testing several months before preliminary host testing commences and will entail determining the germination requirements of native *Polygala* and *Comesperma*.
- Establish a potted population of the western Cape form of *P. myrtifolia* for agent rearing.
- Identify and secure source populations of *Diaphorina petteyi* (Hemiptera: Psyllidae), *Aceria myrtifoliae* (Acari: Eriophyiidae), *?Coryphodema sp.* (Lepidoptera: Cossidae), *Duffyoemida barkeri* (Coleoptera: Cerambycidae), *Dasineura sp.* – shoot tip galler (Diptera: Cecidomyiidae), and *Uredo polygalae* (Uredinales).
- Depending on availability, all or a selection of species will be evaluated in one season
- Complete host tests within 4 months (October- February)

Outcome

- Key agents identified to progress to full host specificity evaluation
- Rearing methodology determined for key agents
- High risk test plants evaluated.
- On completion, project will be in a strong position to attract support funding

BIOLOGICAL CONTROL OF BLACKBERRY

Duration

- 4 months

Location

- Western Cape, South Africa

Cost estimate

Costs are agency dependent. Cost estimate below uses the Australis Biological costing model.

Accommodation (4 months)	Western Cape (within range of <i>P. myrtifolia</i>)	\$15000
Car Hire	Medium sedan	\$8000
Fuel		\$2500
Flights		\$4100
Materials	Bug dorms, ethanol, vials, sample tubes, tools, LED light, dissecting tools, slides, pith, pins, esky, potting materials	\$1600
Plants	Nursery stock	\$800
Salary	100 working days @\$400/day	\$40,000
Total		\$72,000

Skill requirements

- Entomology, pathology, knowledge of South Africa and *P. myrtifolia*

Alternative suppliers

- Agriobiosciences (DEDJTR) in quarantine facilities at Bundoora. Agricultural Research Council, South Africa – Vredenburg Campus.

Mandatory precursor

A precursor to the above stage requires the location of seed material of Australian native Polygalaceae and development of germination and growing conditions. This needs to be perfected before undertaking field work in South Africa.

Plants need to be found, collected and stored for export. Australian Polygalaceae are mostly annuals and are not normally cultivated. Very little is known about their cultivation requirements. Collections trips to central Australia and coastal NSW are required to secure suitable material. Several collections trips would be required.

Budget

Approx. \$10000k required for collection of target material and experimentation of germination requirements. Results would be published as an article in the Society for Growing Australian Native Plants.

Phase 2

Full host specificity testing and evaluation of candidate agents

Introduction

BIOLOGICAL CONTROL OF BLACKBERRY

Agents that demonstrate sufficient specificity in preliminary testing (Phase1) can be considered for full testing using a nationally agreed test list and protocol.

The full test list will include around 30-50 species of commercial and ecological importance. As most plants will be more distantly related to *Polygala myrtifolia* than those used in Phase 1, the probability of non-target attack is small to remote.

Host tests lists are developed by consultation with all national stakeholders.

Methods

- Prepare and submit an application for host-test approval to Australian Department of Agriculture and all key national stakeholders. The process will include consultation with the nursery industry on suitable test species.
- Source test plants and assemble for testing in South Africa.
- Source or regenerate culture material of candidate agents used in Phase 1 testing.
- Run and evaluate host testing of candidate agents.
- Prepare final report on host evaluation
- Realistically, only one agent per season could be completed, providing strong source cultures can be established and maintained. The number of seasons needed to complete evaluation will depend of the number of agents recommended in Phase 1 of the project.

Outcome

- Full host specificity and risk evaluation completed for key candidate agents
- Candidate agents identified for Phase 3 – application for release.

Duration:

- 4-5 months

Location:

- Most testing could be completed in South Africa under non-quarantine conditions as the majority of test species are freely available in commercial nurseries or can be collected from the wild.
- A small number of species may need to be tested under quarantine conditions in Australia, if they are considered mandatory and not available in South Africa. Alternatively, test plant material could be imported into South Africa and tested under quarantine conditions. Approval for importation and permission to utilize South African laboratory facilities would need to be secured. The latter option is likely to be cheaper than utilizing Australian facilities.

Cost estimate:

- The bench costs of utilizing quarantine facilities in Australia and South Africa are not available for this project proposal. Project endorsement and license to operate requires negotiation with the respective agencies. Estimated bench fee costs in a South African facility are \$AUS 50,000-\$80,000 for part-time use over 2-3 months. Non-quarantine host-test evaluation is estimated at \$65-\$70,000, based on Phase 1 costing structure.
- Costs are agency dependent
- One agent may be completed in one season subject to availability of source materials.
- The project could be undertaken using a Post Graduate student at the University of Cape Town under supervision of South African and Australian scientists

Phase 3

Preparation for release of potential biological control agents

Introduction

Approval for release of biological control agents is tightly regulated and requires consensual approval from all State agriculture and environment departments, as well as potential stakeholder industries. The process is co-ordinated through the Federal Department of Agriculture. The application requires detailed documentation of justification for biological control, the methods and results of host specificity testing, risk analysis, and potential for suppression of the host. Evidence of consultation with stakeholder industries where potential conflict of interest could occur is mandatory. An application for release general takes around one month to prepare by a qualified practitioner.

Methods

- Assemble data and prepare application into standard DoA format
- Consult and seek endorsement from stakeholder industries prior to submission
- Submit and respond to queries or requests for further information

Outcome

- Agent approved for release in Australia

Duration:

- 1-2 months

Location:

- Location independent

Cost estimate:

- Approx \$20-30,000
- Costs are dependent of the agency or individual tasked with preparation

Skill requirements:

- Strong writing skills
- Knowledge of the biological control protocols
- Access to test results and data
- Knowledge of *Polygala myrtifolia*
- Strong negotiating skills

Funding summary

Biological control of <i>Polygala myrtifolia</i>			
	Cost estimate	Duration (yrs)	Location
Phase 1	\$65,000	0.4	South Africa
Phase 2	\$150,000 (max) per agent	0.6	South Africa
Phase 3	\$30,000	0.2	Australia

Risk Analysis

BIOLOGICAL CONTROL OF BLACKBERRY

	logistics	deliverance	outcome	capability	remediation
Phase 1	L	M	M-H	L	Prepare in South Africa before preliminary host testing commences. Secure support roles using network of affiliations
Phase 2	M	M	M	L	Commence exploratory negotiations with South Africa in early stages of project
Phase 3	L	L	M	L	Liaise with garden industry stakeholders extensively

H= high risk, M=moderate risk, L=low risk

Logistics= capacity to implement the program

Deliverance= capacity to deliver within the indicated time frame

Outcome= potential to deliver favourable results

Capability= capacity to secure qualified personnel to complete project tasks

Remediation=actions that may reduce risk profile

Costing structures

Polygala is not just a Victorian problem. The same impacts experienced in Victoria occur in South Australia and have potential to develop in Tasmania, New South Wales and Western Australia. Victoria has traditionally led the development of biological control of *Polygala* and has funded research since 1998.

Victoria would be justified in investigating cost sharing arrangements with other state agencies and stakeholders that have or may benefit from development of biological control of *Polygala*. This can be pursued through the Victorian representative on the Australian Invasive Animal and Plant Committee or by negotiating with other key stakeholders. Victoria is currently lacking a lead agency to co-ordinate future development of biological control of *P. myrtifolia*.

Recommendations

- Establish a consortium of agencies interested in developing biological control of *P. myrtifolia* willing to enter cost sharing arrangements (e.g. City of Greater Geelong, Barwon Coast, Corangamite CMA, PIRA (South Australia)).
- Identify a lead agency for development of biological control of *P. myrtifolia*
- Acknowledge the commitment and support provided by City of Greater Geelong and Barwon Coast which pioneered work on assessment of biological control of *P. myrtifolia*
- Identify funding opportunities to support or contribute to a biocontrol program
- Prepare and commence with Phase 1. Use results of Phase 1 as a stop-go point.

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