



Cacti biocontrol in the South Australian Arid Lands

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Key words: cacti; biocontrol; cochineal; arid

Abstract

All Opuntoid cacti species in Australia are introduced and are Weeds of National Significance (WONS) and declared under the Landscape South Australia Act 2019 (except *O. ficus-indica*). Significant time, money and effort has been spent trying to control infestations using herbicide and physical removal. Despite this, Opuntoid cacti have resisted control efforts and continued to infest rangelands.

Since 2016, with the support of Biosecurity Queensland (Queensland Department of Primary Industries), we have developed an Opuntoid cacti biocontrol program. The biocontrol agent we use is cochineal, species of mealybugs that are cactus specific. As a result, we have biocontrol agents that assist in controlling 12 of the 15 species of Opuntoid cacti found in the SAAL LB region (Map of infestation locations included). Cochineal has been a game changer in helping to get on top of some of the worst infestations of Opuntoid cacti in our region. Before and after photos in this paper demonstrate how successful this biocontrol has been.

Biosecurity Queensland have provided cochineal species, that SAAL LB previously didn't have, that were suited to many species of Opuntoid cacti in our region. In return, we have provided samples of cactus and cochineal that they have used to further develop their Opuntoid cacti biocontrol program through trials and DNA testing of cochineal.

The SAAL LB have also been supported by the Port Augusta City Council who agreed to house the SAAL LB Cochineal Nursery on their Australian Arid Lands Botanic Garden site. The Cochineal Nursery was established in 2021 and breeds four species of cochineal, which work on six species of cacti. Cochineal from this facility has been used on infestations on numerous properties in SAAL and other Landscape Boards.

Introduction

Many cacti are invasive species globally, posing a risk to native species via competition, impeding access to natural areas, and causing harm to animal and humans due to physical attributes such as sharp spines. In Australia, Opuntoid cacti in particular, are Weeds of National Significance (WONS), with many declared species under the Landscape South Australia Act 2019 (except *O. ficus-indica*),

requiring control. Opuntoid cacti are mainly found in low rainfall areas, such as the South Australian Arid Lands Landscape Board (SAAL LB) region which covers more than half of South Australia, and shares borders with three other States: New South Wales, Queensland and the Northern Territory. The vastness of this region with inaccessible terrain and a sparse population, poses a challenge to the logistics of implementing chemical control and follow-up treatments. Biocontrol is an effective management tool for cacti and entails the use of a plants' natural enemies to control populations in introduced ranges. There are several varieties of *Opuntia* species present in our region, including Wheel cactus (*Opuntia robusta*), Prickly pear (*O. stricta*), Engelmann's cactus (*O. engelmannii*), Devil's rope (*Cylindropuntia imbricata*), jumping cholla (*Cylindropuntia prolifera*), Coral cactus (*Cylindropuntia fulgida* var. *mamillata*) and Red-flowered prickly pear (*Opuntia elatior*) for which there are effective biocontrol agents available.

Methods

The SAAL LB initiated an Opuntoid cacti biocontrol program in 2016. The biocontrol agents we use are collectively called cochineal (*Dactylopius* sp.), of which there are several species of mealybugs belonging to the genus *Dactylopius*. Research has identified which *Dactylopius* species to release on targeted cactus species (see table 1). Biosecurity Queensland's Cacti Biocontrol Research program has provided support through the provision of suitable cochineal that the SAAL LB didn't previously have, but that were suited to many species of Opuntoid cacti in our region (e.g. Jumping Cholla (*Cylindropuntia prolifera*) and Coral cactus (*Cylindropuntia fulgida* var. *mamillata*)).

In return, we provided samples of local cactus plants and cochineal that they have used to further develop their Opuntoid cacti biocontrol program through trials and DNA testing of cochineal.

Another aspect to ensure the success of any biocontrol program, is the mass-rearing of suitable agents to ensure a smooth supply-demand cycle. This involves distribution of cochineal to new plant populations infield, and collection and replenishing of fresh plant material for agents to feed on. In partnership with the local Port Augusta City Council, a cochineal nursery was established at the Australian Arid Lands Botanic Garden property in 2021.

Results

Cochineal has been a game changer in helping to get on top of some of the worst infestations of Opuntoid cacti in the SAAL LB region. (See Fig. 1 for an example of a Before and after image that demonstrates how successful biocontrol has been). We now have cochineal released against 12 of 15 Opuntoid cacti present in the region. In the 2023-2024 financial year alone, cochineal was released at 23 sites in the SAAL LB region, targeting seven cacti species. Thirteen of these were new release sites (see Table 1).

This cochineal nursery is crucial to the success of the biocontrol program, four strains are bred at the facility that are specific to six cacti species found in region: Wheel cactus (*Opuntia robusta*), Red-flowered prickly pear (*Opuntia elatior*), Engelmann's cactus (*Opuntia engelmannii*), Devil's rope cactus (*Cylindropuntia imbricata*), Coral cactus (*Cylindropuntia fulgida* var. *mamillata*) and Jumping cholla (*Cylindropuntia prolifera*). cochineal. Cochineal from this facility has been used on infestations on numerous properties in the SAAL LB and other Landscape Board regions. Maintaining the nursery to ensure adequate stock is a shared responsibility amongst many SAAL LB staff (See Fig.2 below).

Table 1. Cochineal release across different Districts in the SAAL LB region in the 2023-2024 Financial year

Cactus Species	Cochineal species	District	Release Date
<i>O engelmannii</i>	<i>Dactylopius opuntiae</i> Mexican lineage	GR	03-Aug-23
<i>O engelmannii</i>	<i>Dactylopius opuntiae</i> Mexican lineage	GR	04-Sep-23
<i>C imbricata</i>	<i>Dactylopius tomentosus</i> Imbricata biotype	NEP	28-Sep-23
<i>O elatior</i>	<i>Dactylopius opuntiae</i> Mexican lineage	Kin	29-Sep-23
<i>O engelmannii</i>	<i>Dactylopius opuntiae</i> Mexican lineage	PA-Q	29-Sep-23
<i>C fulgida var. mamillata</i>	<i>Dactylopius tomentosus</i> Cholla biotype	Kin	05-Oct-23
<i>C fulgida var. mamillata</i>	<i>Dactylopius tomentosus</i> Cholla biotype	M-O	06-Oct-23
<i>C. prolifera</i>	<i>Dactylopius tomentosus</i> Californica biotype	M-O	06-Oct-23
<i>C fulgida var. mamillata</i>	<i>Dactylopius tomentosus</i> Cholla biotype	Kin	14-Oct-23
<i>C imbricata</i>	<i>Dactylopius tomentosus</i> Imbricata biotype	NF	24-Oct-23
<i>C fulgida var. mamillata</i>	<i>Dactylopius tomentosus</i> Cholla biotype	M-O	30-Oct-23
<i>C. prolifera</i>	<i>Dactylopius tomentosus</i> Californica biotype	M-O	30-Oct-23
<i>O. engelmannii</i>	<i>Dactylopius opuntiae</i> Mexican lineage	GR	10-Nov-23
<i>O. stricta</i>	<i>Dactylopius opuntiae</i> - USA lineage	PAQ	17-Nov-23
<i>O. stricta</i>	<i>Dactylopius opuntiae</i> - USA lineage	PAQ	20-Nov-23
<i>C. imbricata</i>	<i>Dactylopius tomentosus</i> Imbricata biotype	PA-Q	29-Nov-23
<i>C. prolifera</i>	<i>Dactylopius tomentosus</i> Californica biotype	NF	01-Nov-23
<i>O. robusta</i>	<i>Dactylopius opuntiae</i> Mexican lineage	NF	13-Nov-23
<i>C. prolifera</i>	<i>Dactylopius tomentosus</i> Californica biotype	NF	04-Dec-23

<i>O. elatior</i>	<i>Dactylopius opuntiae</i> Mexican lineage	Kin	02-Feb-24
<i>O. robusta</i>	<i>Dactylopius opuntiae</i> Mexican lineage	NEP	23-Feb-24
<i>C. proliferata</i>	<i>Dactylopius tomentosus</i> Californica biotype	NF	16-May-24
<i>O. robusta</i>	<i>Dactylopius opuntiae</i> Mexican lineage	NEP	13-Jun-24



Fig. 1 Fountain Spring in the Flinders Ranges, before (LEFT) in 2008, and in 2018 (RIGHT), 10 years after cochineal release against prickly pear cactus.



Fig. 2 Cochineal Nursery, established at the Australian Arid Lands Botanic Garden in January 2021, as a joint project between SA Arid Lands Landscape Board and the Port Augusta City Council.

Discussion

The SAAL LB prides itself in harnessing partnerships that benefit the landscape, and this is evident through the delivery of many collaborative natural resource management projects in the region, possible through a combination of internal (levy) and external (project) funding. The SAAL LB Opuntoid cacti biocontrol

program is a prime example of this. This project has been a success so far, due to the building and maintaining of partnerships, including with landowners, volunteers, and other stakeholders who participate in collaborative planning and also distribution and spread of cochineal.

For example, landholders and volunteers were engaged to map out control work that had already been completed and the scale of remaining cactus infestations, coming up with a plan of when and where to use cochineal versus chemical control. This led to the Northern Flinders Opuntia control strategy and bringing a group like this together allowed for better cross-property collaboration. Volunteers made up of 4WD, bushwalking and cycling clubs have also played a crucial role in spreading cochineal in the North Flinders for over a decade (~4,000 hours of volunteer hours annually).

Biocontrol agents are able to establish and spread by themselves infield, reducing time, effort and capacity required. Human-aided spread of agents can enhance the success of such programs, which have minimal costs involved. However, biocontrol should not be viewed as a stand-alone "golden ticket" and is often required to be used as a management tool in conjunction with other treatment methods *e.g.* herbicide control. Integrated pest weed and animal management reaps benefits, and biocontrol can be used for example, in reducing populations sizes to a more manageable level for a targeted chemical control program to reduce costs.

The Opuntoid cacti biocontrol program is directly linked to at least three SAAL LB Board priorities; Sustainable land management, Protecting and enhancing biodiversity, and People and partnerships. It is envisaged that this program will expand in future years to include a more structured post-release monitoring protocol, and collection of more in-field population data to demonstrate its effectiveness over time.

Acknowledgements

Queensland Department of Primary Industries Port Augusta City Council

Staff, volunteers and landholders in the SAAL LB region

References

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