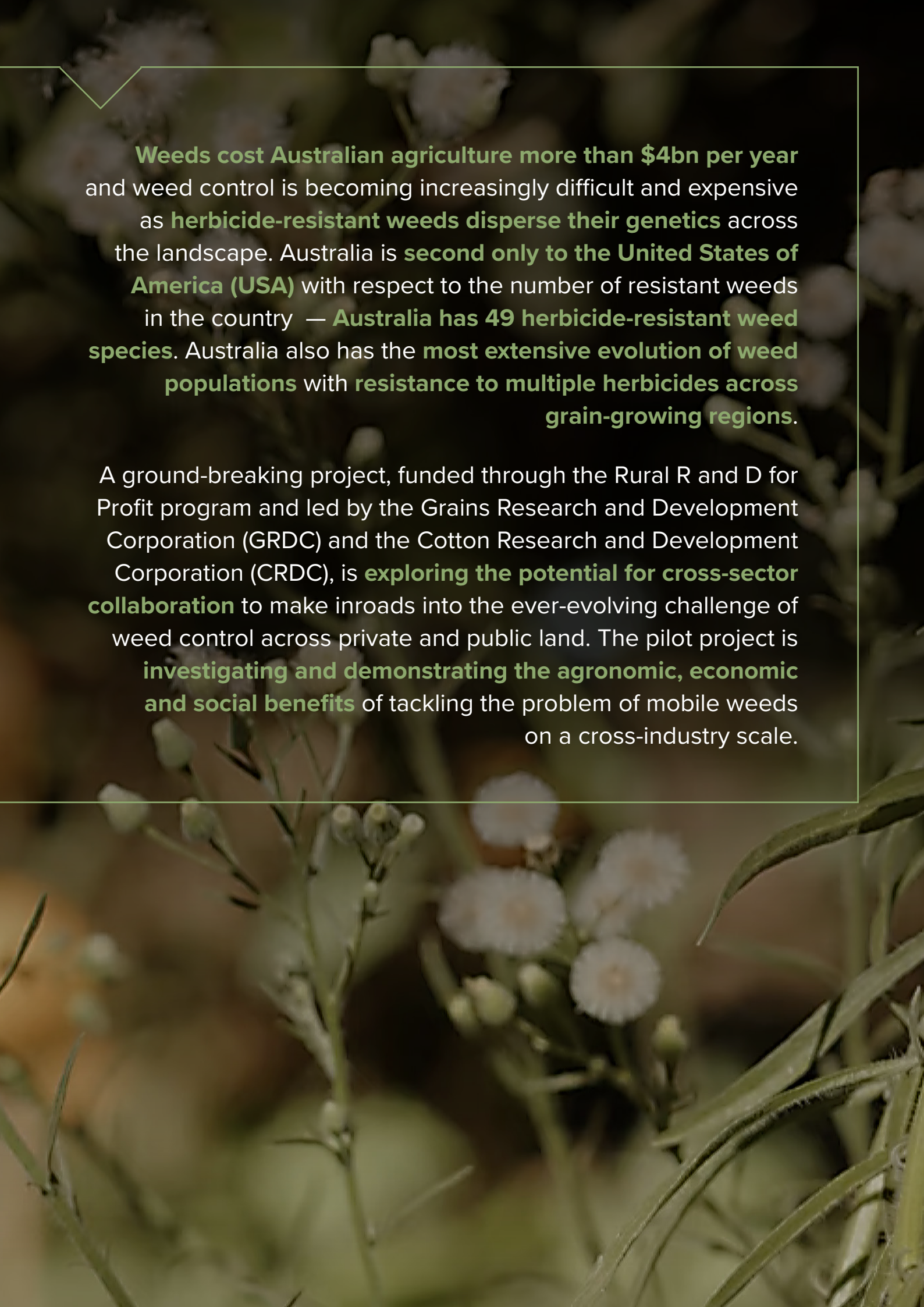
Area-wide management for cropping systems weeds

Australian Government
Department of Agriculture, Fisheries and Forestry

CRDC

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION



Weeds cost Australian agriculture more than $4bn per year and weed control is becoming increasingly difficult and expensive as **herbicide-resistant weeds disperse their genetics** across the landscape. Australia is **second only to the United States of America (USA)** with respect to the number of resistant weeds in the country — **Australia has 49 herbicide-resistant weed species**. Australia also has the **most extensive evolution of weed populations** with **resistance to multiple herbicides across grain-growing regions**.

A ground-breaking project, funded through the Rural R and D for Profit program and led by the Grains Research and Development Corporation (GRDC) and the Cotton Research and Development Corporation (CRDC), is **exploring the potential for cross-sector collaboration** to make inroads into the ever-evolving challenge of weed control across private and public land. The pilot project is **investigating and demonstrating the agronomic, economic and social benefits** of tackling the problem of mobile weeds on a cross-industry scale.

Gaining cross-sector insights

This transdisciplinary research project, involving 11 Australian research and industry organisations, set out to better understand the mobility of key weeds in cropping systems, their herbicide resistance status, the costs of managing herbicide-resistant weeds and the attitudes of a range of stakeholders to collaborative weed management approaches, such as area-wide weed management (AWM).

The team started by exploring how a diverse range of stakeholders perceive weeds and weed management across three cropping regions — Darling Downs, Queensland; Riverina, New South Wales and Sunraysia, Victoria (Figure 1). These regions were chosen for their diverse land-use types and distinct social dynamics.

From August to October 2020, the project team consulted with 84 weed management stakeholders, including: growers, agronomists, consultants, contractors, extension officers, biosecurity officers and public land managers from the pilot regions and other cropping regions across Australia.

This consultation revealed the three weeds of greatest concern to these stakeholders were (in order of concern): flaxleaf fleabane (*Conyza bonariensis*), annual ryegrass (*Lolium rigidum*) and feathertop Rhodes grass (*Chloris virgata*) (Figure 2).

When the project team delved more deeply into stakeholders' concerns, the issue of herbicide resistance and its spread across the landscape rose to the fore. Stakeholders were concerned about the mobility of herbicide resistance and the increased costs associated with its management. The findings from this consultation with stakeholders drove the key focus areas for the project in each region.

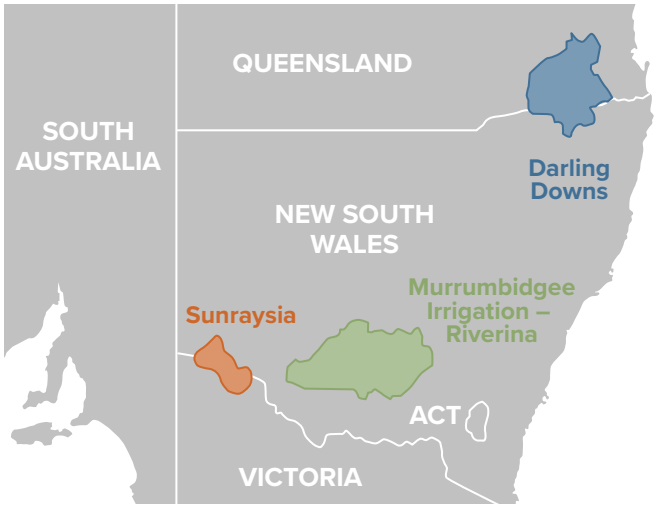


Figure 1. Project pilot regions

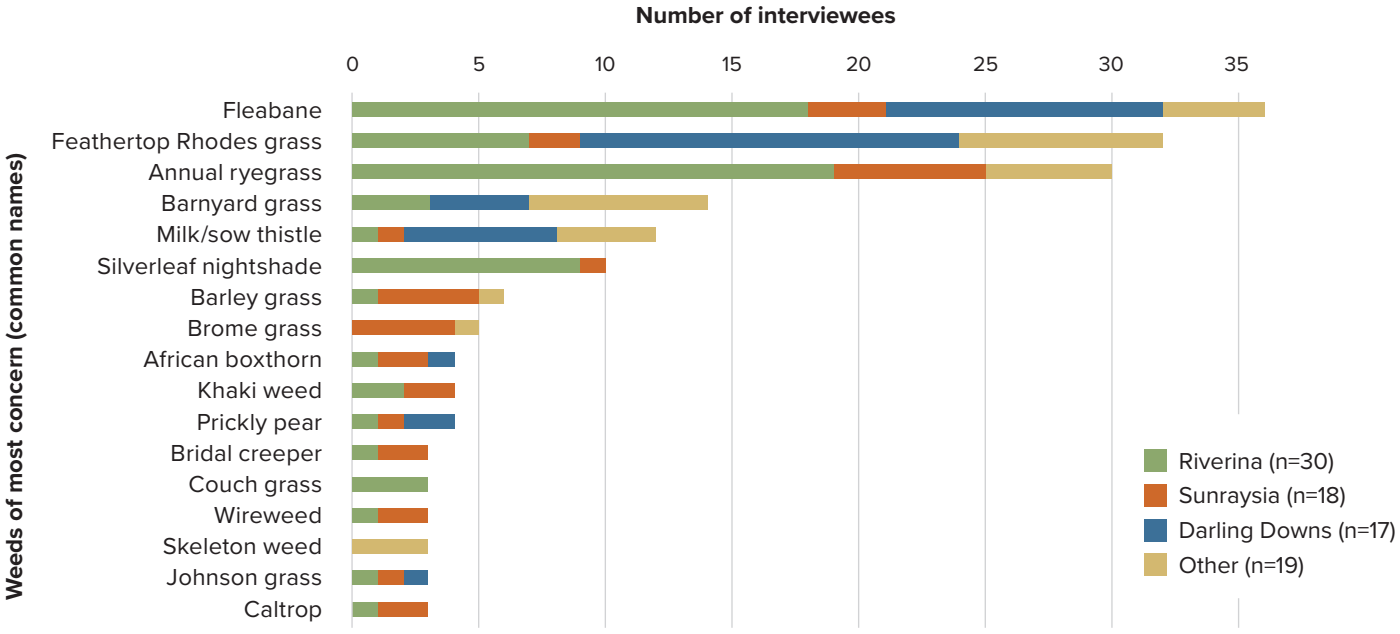


Figure 2. Weeds of most concern

Weed mobility and its role in herbicide resistance

Weed dispersion

Mobile weeds spread readily through seed and pollen — in wind, water and the movement of vehicles and agricultural machinery. Mobile weeds spread herbicide resistance as they carry their resistant genes across the landscape (Figure 3).

Weeds that can rapidly disperse across the landscape create ongoing problems for individual land managers — even when they are vigilant about weed control within their own boundaries. Highly mobile weeds more rapidly become shared problems, especially as increasing numbers of weed species are becoming resistant to key herbicides.

Some of Australia's most important agricultural weeds, including flaxleaf fleabane, annual ryegrass and feathertop Rhodes grass, have highly mobile seed or pollen. These weeds have the potential to become resistant to our most important herbicides.

Figure 3. Herbicide-resistant weeds spread across the landscape via wind, water and movement of vehicles and machinery.

How far do mobile weeds spread?

We know the movement of seed and pollen of mobile weeds spreads herbicide resistance, but the small size of seed and pollen make identifying the extent of weed movement challenging. This project used a 'population genetics' approach to assess the movement of three key weeds within and across each of the three regions. The weed species were selected based on high potential mobility and the concerns of growers in each region.

During 2020, the team collected 10 populations of each weed species in each region (flaxleaf fleabane from across the Riverina and Sunraysia, annual ryegrass across the Riverina, and feathertop Rhodes grass across the Darling Downs), across varying land uses, and explored the genetics of each population; looking for evidence of weed mobility.

Genetic variation across the regions

Annual ryegrass populations across the Riverina sites were similar, with little genetic differentiation between samples. This suggests high levels of weed dispersal has occurred across the region. Feathertop Rhodes grass populations sampled across the Darling Downs were also genetically similar, indicating high levels of movement in this weed species. This suggests herbicide resistance in annual ryegrass and feathertop Rhodes grass is moving widely across the landscape.

Fleabane populations within the Riverina, and between the Sunraysia and Riverina regions revealed surprising evidence of genetic variation. This suggests fleabane may be less mobile than its small, wind-dispersed seeds would suggest, although there was evidence of long-distance dispersal between the regions.

Weed mapping

Mapping resistance

The AWM project also examined the distribution of glyphosate-resistant weeds at a local scale across the three regions, for the three weeds of interest (fleabane, annual ryegrass and feathertop Rhodes grass).

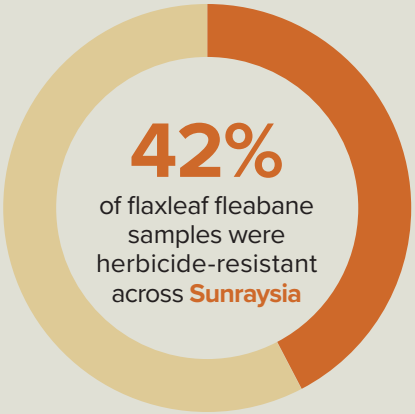
High frequencies of glyphosate resistance were identified across all weeds and districts (Figure 4) ranging from 42% of flaxleaf fleabane samples in the Sunraysia to 65% of annual ryegrass samples in the Riverina. Not only did resistance occur across the areas sampled, but it was present across multiple land uses — including farmland and non-farmland, such as roadsides and irrigation channels. These findings highlight the risk of herbicide resistance across multiple land uses and underscore the need for a landscape-scale approach to weed management.

Project findings **support a collaborative approach** to tackling the shared challenge of herbicide resistance.

Sunraysia

Flaxleaf fleabane

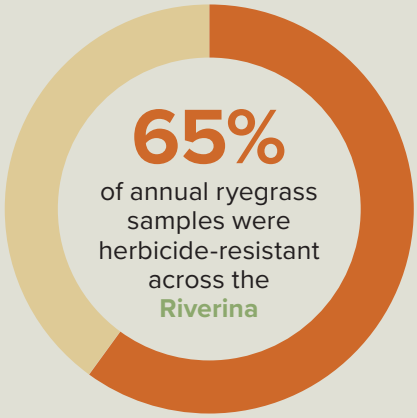
Glyphosate using Weedmaster ARGO at 2 L/ha



Riverina

Annual ryegrass

Glyphosate using Weedmaster ARGO at 1 L/ha



Darling Downs

Feathertop Rhodes grass

Glyphosate using Weedmaster ARGO at 2 L/ha

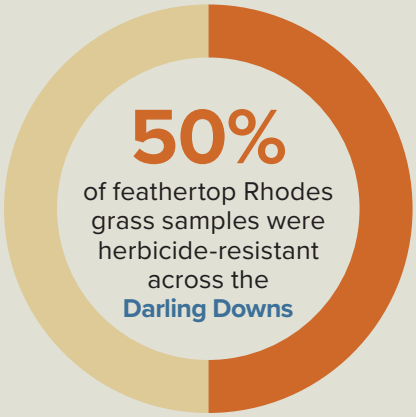


Figure 4. Frequency of herbicide-resistant plants across Sunraysia, Riverina and Darling Downs.

All plants killed Survived treatment

What is area-wide weed management (AWM)?

The Australian cropping belt has expansive areas where irrigated agriculture, horticulture and viticulture are neighbours to dryland cropping – in these interface zones weed problems and weed management are cross-industry issues.

Herbicide resistance management is often carried out by individual land managers, but their decisions have far-reaching impacts beyond the farm limits. Area-wide management (AWM) can reduce these impacts by supporting many land managers to cooperatively work towards a shared goal of reducing the spread of resistance.

Area-wide weed management offers a novel approach for tackling weeds on a landscape scale. It occurs when private and public land managers collaborate in their efforts to manage weeds to transcend industries, physical boundaries and notional responsibilities.

This does not mean cross-sector land managers use the same management tools to control weeds. Area-wide weed management is based on the premise that a shared understanding of the impacts of weeds and weed dispersal and the collective motivation to minimise weed-seed on a landscape scale, will have a greater impact on weeds than isolated efforts.

You can find an easy-to-understand explanation of area-wide weed management in this short, 2.5 minute animation on the CSIRO website at https://research.csiro.au/weed-awm/

How AWM can make an impact

The invasion of a new weed species or increasing herbicide resistance can be costly to rectify where weeds are not readily controlled by existing practices. Area-wide weed management can help coordinate surveillance and communicate information about new and emerging weed problems. A cross-sector, collaborative approach to weeds also supports the sharing of information about emerging weed management strategies to encourage improved preparedness and faster adjustment across growing regions with shared problems. Better weed control at the farm-level can help prevent costly incursions of mobile weeds at scale and avoid further spread across cropping regions.

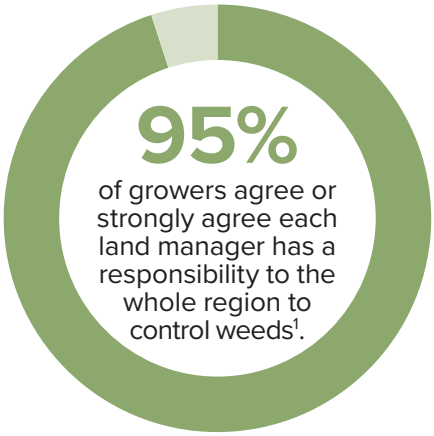
Attitudes to area-wide weed management

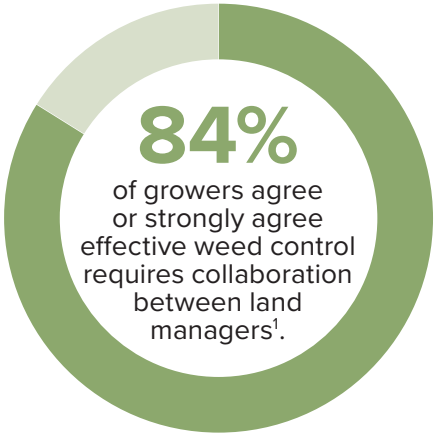
Although the initial interview with stakeholders identified shared concerns regarding key weed species and their management, few stakeholders (only 12 out of 84) had experience with AWM. The AWM project team surveyed more than 600 growers to:

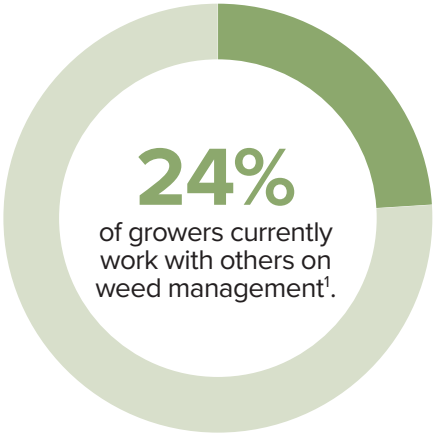
- better understand attitudes towards AWM across the three pilot regions
- identify factors that explain participation in individual and collective AWM
- identify social costs and benefits of AWM and related practices.

The results of the survey indicated growers who are less likely to currently engage in AWM of weeds are those who are less concerned about herbicide-resistant weeds spreading to neighbouring land, are unlikely to share information with other land managers about weeds or attend meetings about local weed issues.

Greater uptake of AWM of weeds requires increased awareness and education about the mobility of weeds, building new networks among growers and other key stakeholders, and developing AWM activities that are accessible to all land managers regardless of time and financial constraints.







[1]Results are drawn from the survey responses of 604 land managers from the Riverina, NSW (n=218), Sunraysia, Victoria (n=200), and the Darling Downs, Queensland (n=186).

Increasing system resilience through IWM

The project team investigated how integrated weed management (IWM) might play a role in AWM, help reduce costs and increase resilience to new weed problems.

The results indicate growers who invest in a diverse weed management strategy are likely to profitably manage existing weeds and reduce costs and risks from new weed and herbicide resistance introductions.

Practices likely to reduce the seed set of a new and potentially mobile weed can also improve landscape-scale control of the weed.

Managing herbicide resistance using IWM is likely to reduce the impact on whole-farm profit.

Image source: Ben White

Additional resources

Websites

CSIRO
research.csiro.au/weed-awm/

Videos

Taking and area wide management approach for cropping system weeds
https://www.youtube.com/watch?v=nP-bw4XOfs4

Beyond the fenceline: An area-wide approach to weed management
https://www.youtube.com/watch?v=4j9t-dg99wo

MSF Farm Talk podcast
https://omny.fm/shows/msf-farm-talk/farmer-attitudes-to-area-wide-management-of-weeds

This project is supported through funding from the Australian Government, Department of Agriculture, Fisheries & Forestry as part of its rural R&D for profit program, the Grains Research and Development Corporation and the Cotton Research and Development Corporation.

Research organisations

Grains Research and Development Corporation (GRDC)

Cotton Research and Development Corporation (CRDC)

AgriFutures Australia

CSIRO

University of Queensland

University of Adelaide

University of Wollongong

Partner organisations

Mallee Sustainable Farming

Millmerran Landcare Group

Irrigation Research & Extension Committee Inc

Toowoomba Regional Council