

Using population genetics to understand weed movement in the context of area wide management



James Hereward, Sonia Graham, Chris Preston, Christina Ratcliff, Rick Llewellyn





Article

Opportunities to Manage Herbicide Resistance through Area-Wide Management: Lessons from Australian Cropping Regions

Kaitlyn Height , Sonia Graham , Rebecca Campbell, Gina Hawkes, Silja Schrader, Louise Blessington and Scott McKinnon

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ghawkes@uow.edu.au (G.H.); silja@uow.edu.au (S.S.); louise.blessington@anu.edu.au (L.B.);
scottmck@uow.edu.au (S.M.)

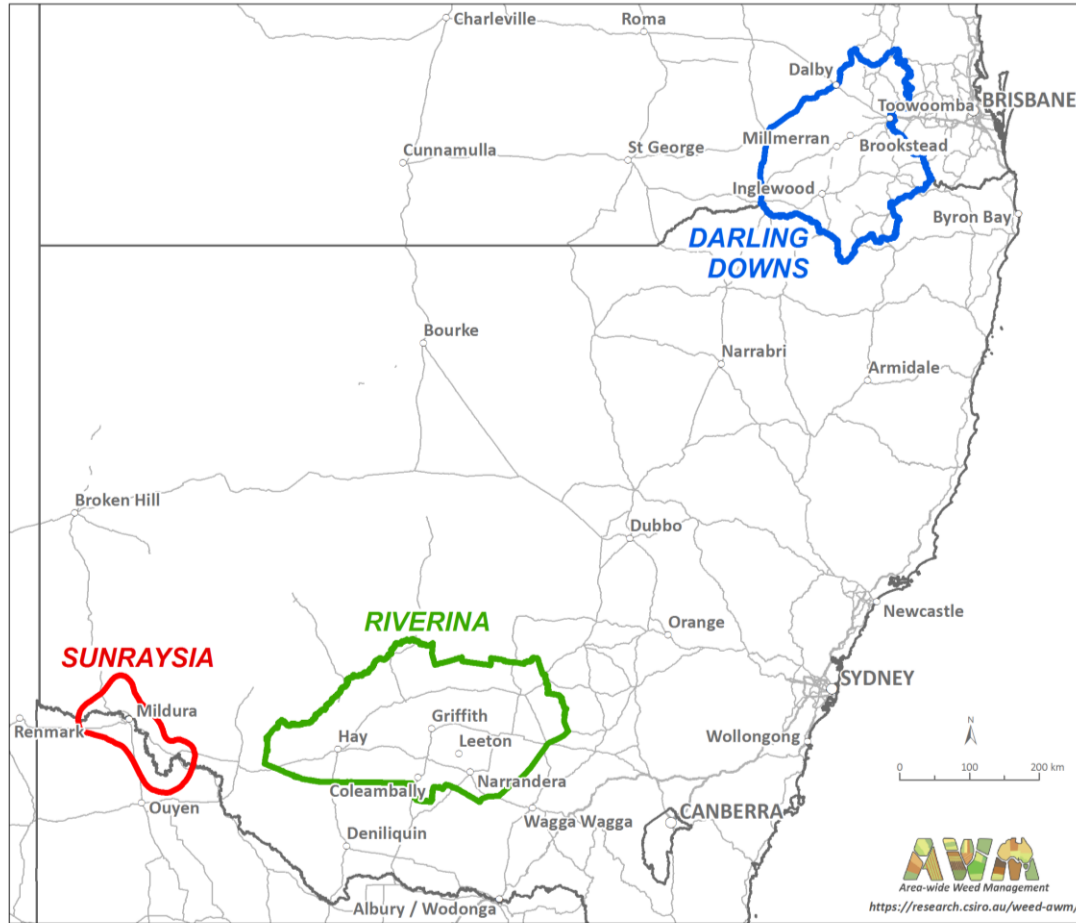
* Correspondence: kheight@uow.edu.au

Spread of resistance is a major concern and potential driver of AWM

Growers worried about resistance spreading to neighbours property



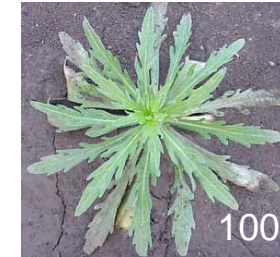
2020 sampling



Darling Downs



Sunraysia

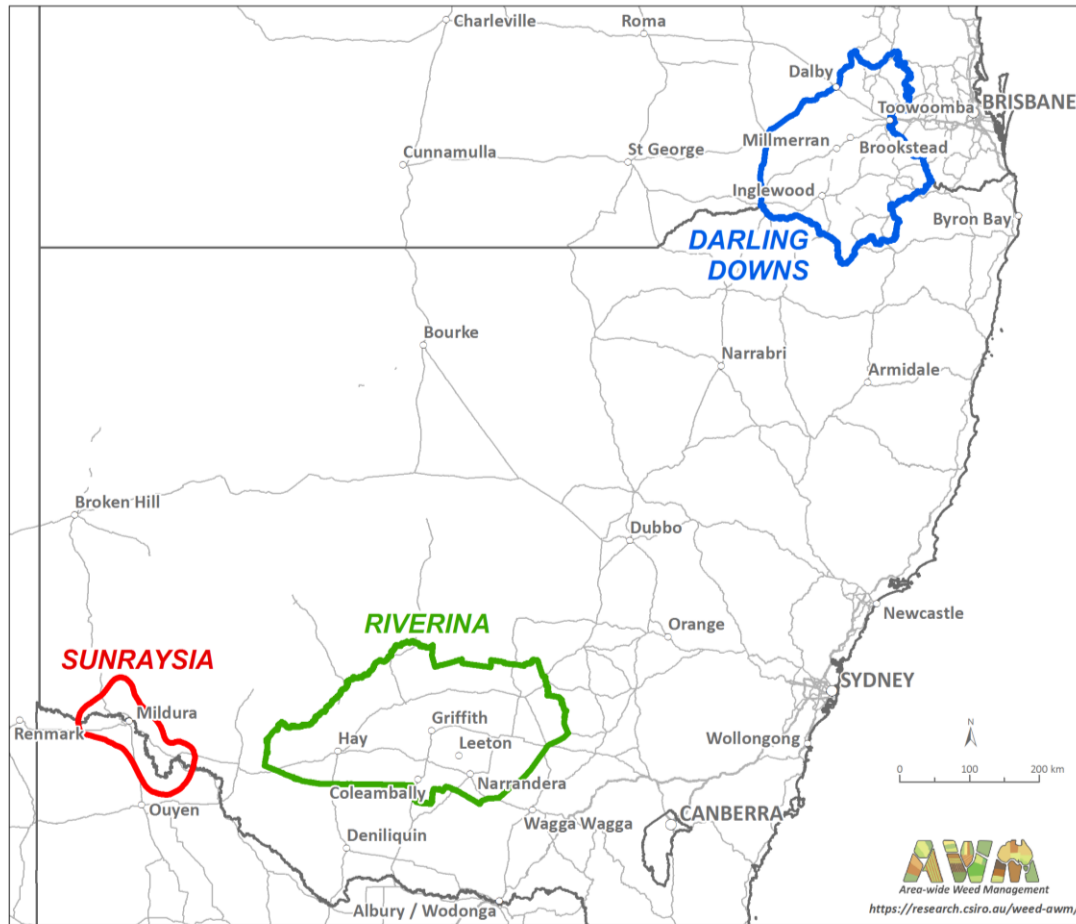


Riverina





2021 sampling



Darling Downs



Sunraysia



Riverina





Fleabane



Conyza bonariensis

Glyphosate
resistant across
QLD by 2018
(first detected 2006)

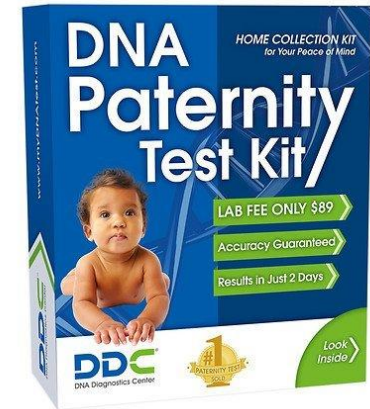
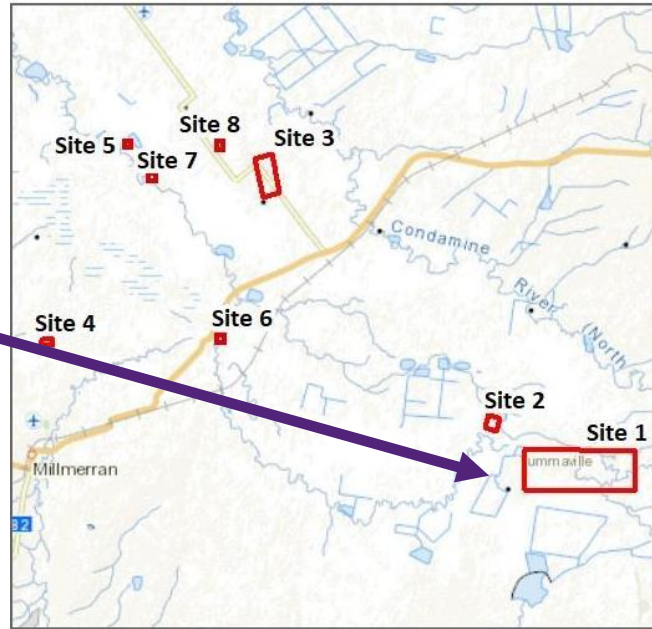
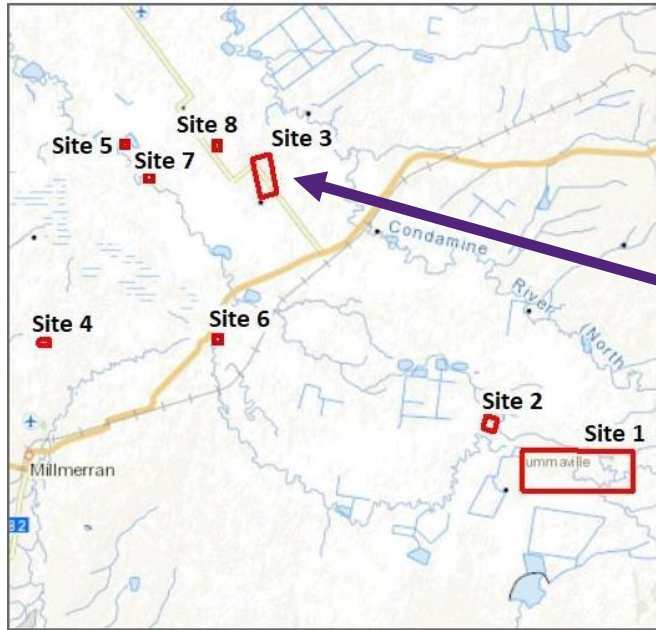
Annual Ryegrass



Lolium rigidum

2020

2021





SITE: 8A
DATE: 8-5-2020
LAT: 34.33606
LONG: 146.09279
WP: 168
Need: FB

SITE: 6A
DATE: 22-5-2020
LAT: 34.26349
LONG: 146.16058
WP: 201
Need: FB

SITE: 8A
DATE: 8-5-2020
LAT: 34.33943
LONG: 146.09024
WP: 182
Need: FB

SITE: 6A
DATE: 22-5-2020
LAT: 34.26399
LONG: 146.15997
Need: FB

SITE: 8A
DATE: 8-5-2020
LAT: 34.33842
LONG: 146.09079
WP: 181
Need: FB

SITE: 3
DATE: 20-5-20
LAT: 32.75679
LONG: 151.32177
WP: 011
Need: FB

SITE: 5
DATE: 20-5-20
LAT: 32.75679
LONG: 151.32177
WP: 011
Need: FB

SITE: 5
DATE: 20-5-20
LAT: 32.75679
LONG: 151.32177
WP: 011
Need: FB



THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA

CREATE CHANGE





AWM 1

AWM 2

AWM 3

AWM 4

AWM 5

AWM 6

AWM 7

AWM 8

AWM 9

AWM 10

AWM 11

AWM 12

AWM 13

AWM 14

AWM 15

AWM 16

AWM 17

AWM 18

AWM 19

AWM 20

AWM 21

AWM 22

AWM 23

AWM 24





THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA

CREATE CHANGE





Fleabane



Conyza bonariensis

V. low rates of outcrossing

Annual Ryegrass

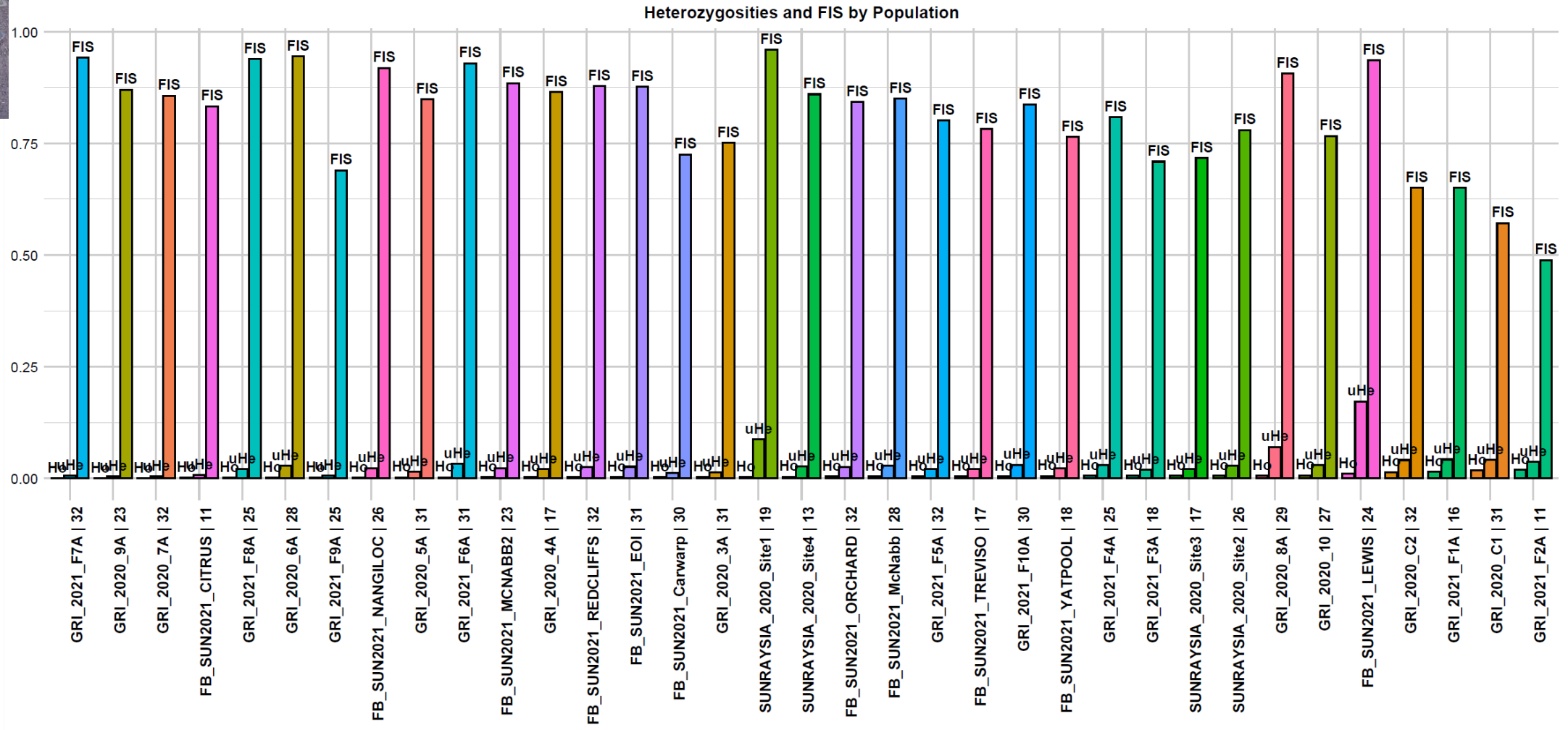


Lolium rigidum

Obligate outcrossing

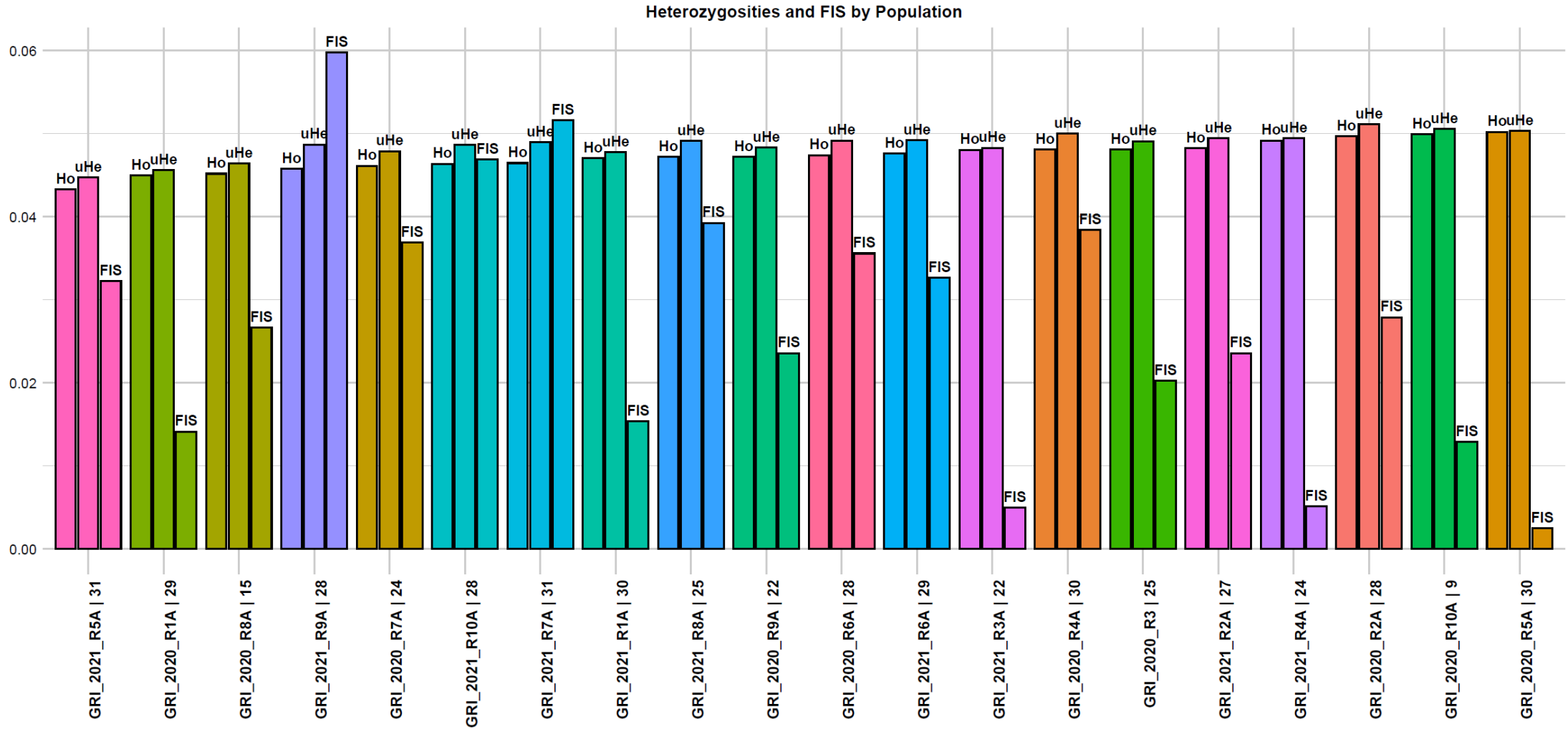


Fleabane





Ryegrass





[Home](#) > [Euphytica](#) > Article

Breakdown of self-incompatibility in perennial ryegrass at high temperature and its uses in breeding

Review Article | Published: January 1992

Volume 64, pages 65–69, (1992) [Cite this article](#)

[P. W. Wilkins](#) & [D. Thorogood](#)

 260 Accesses  31 Citations [Explore all metrics](#) →

Summary

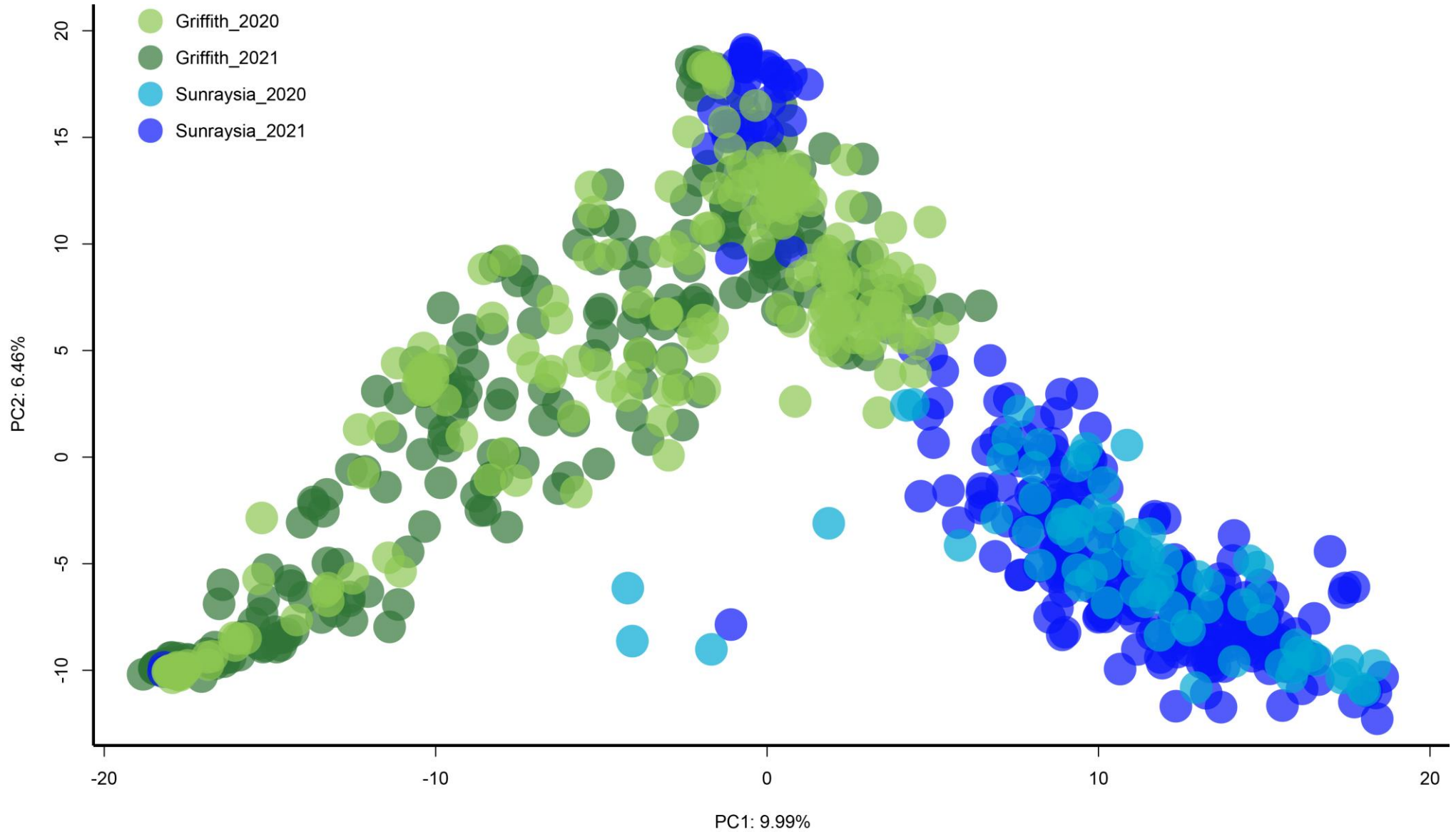


Hexaploid - mapped to genome



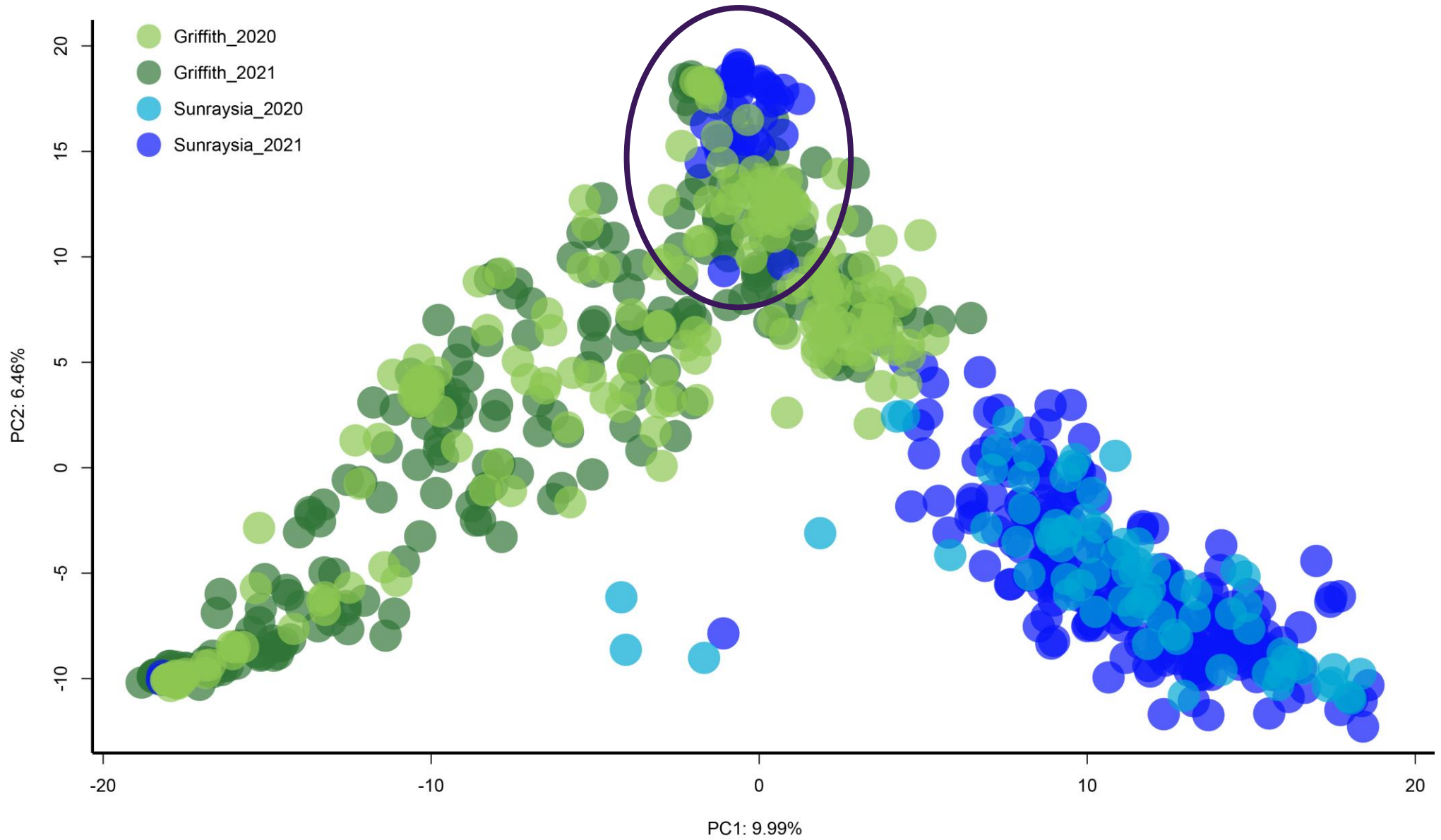


Fleabane
2020 and 2021



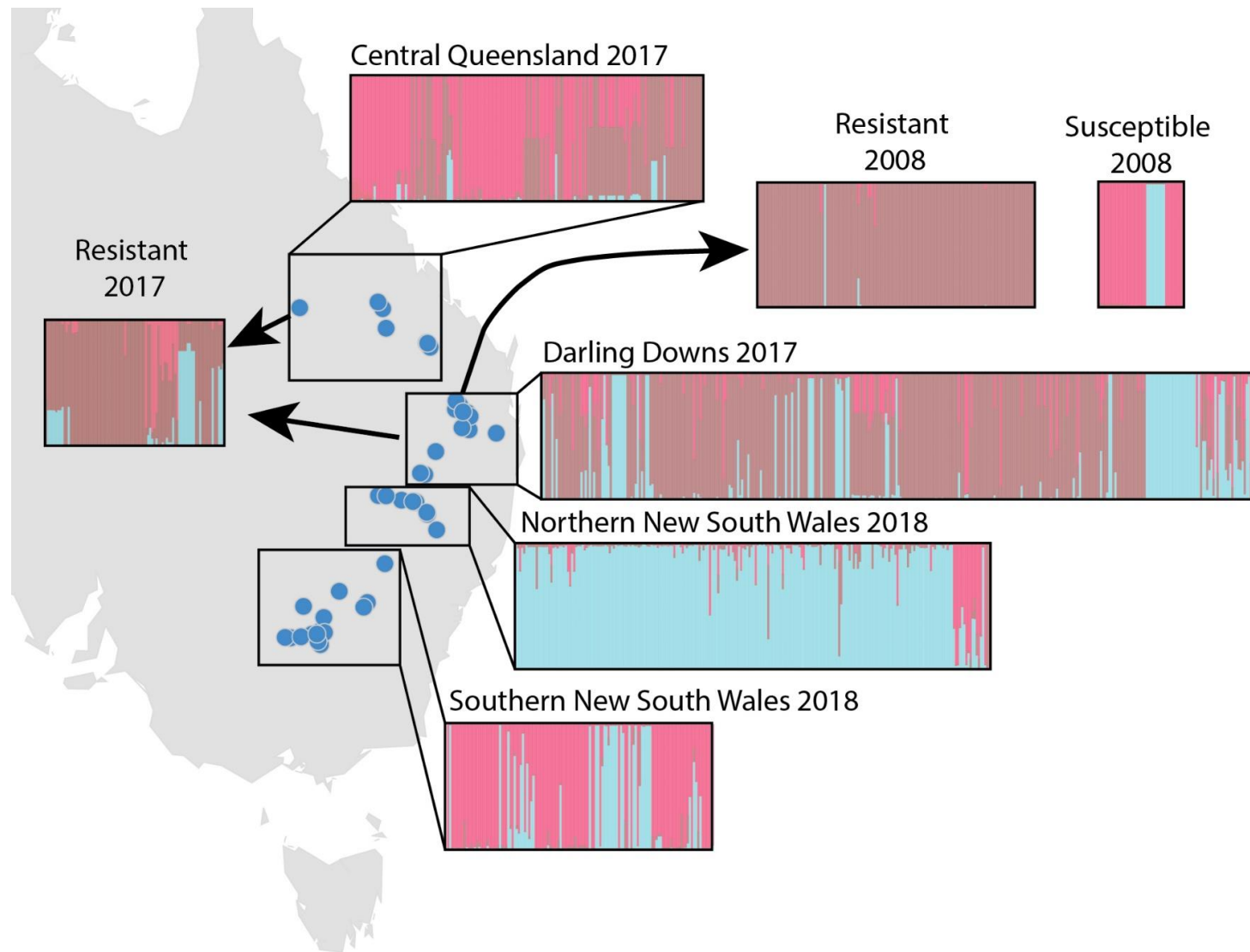


Fleabane
2020 and 2021





Fleabane
CRDC
Project
UQ1501



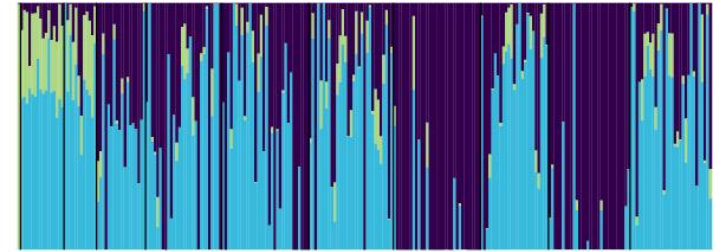
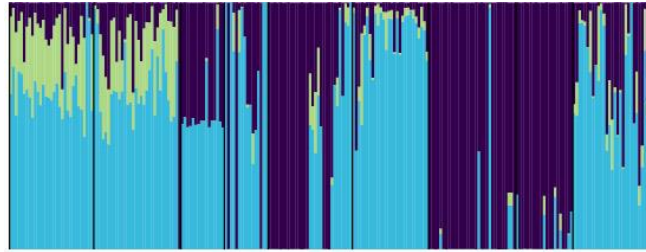


Fleabane
2020 and 2021

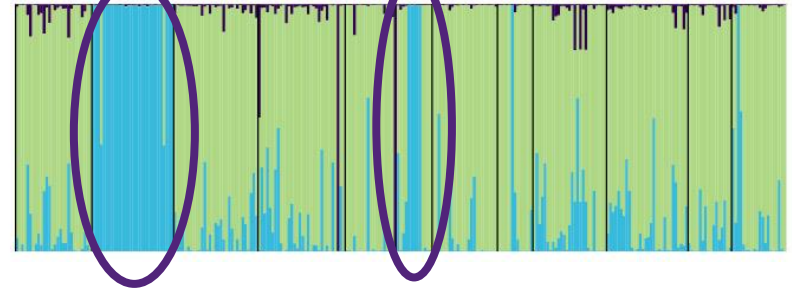
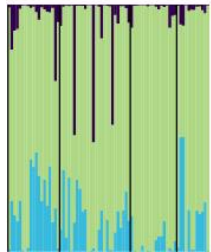
2020

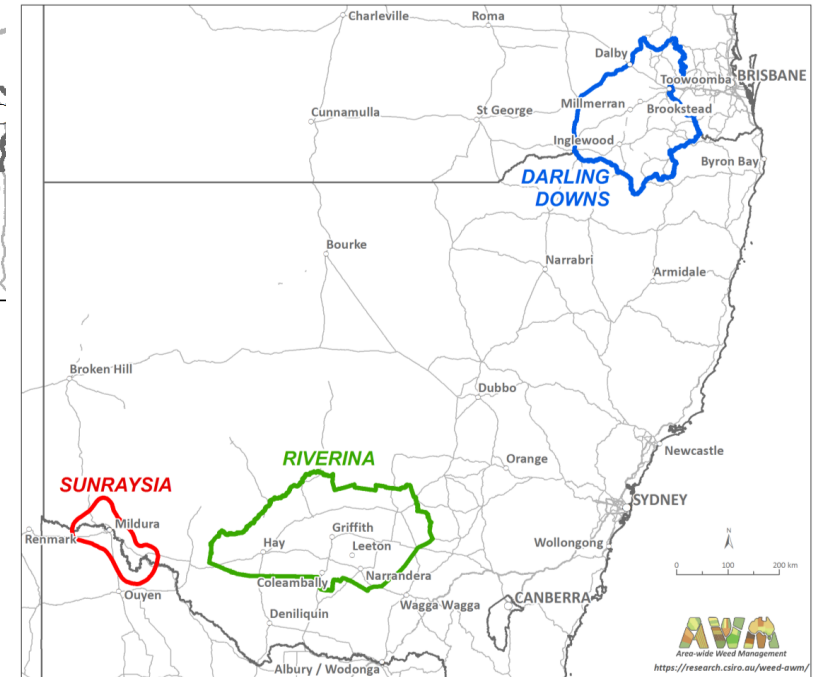
2021

Riverina



Sunraysia







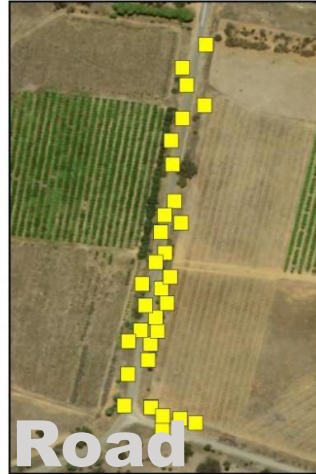
Fleabane Griffith 2020

Riverina Fleabane Sites

■ Sample Location

INTERNAL USE ONLY
not for general distribution

Site 1



Site 2



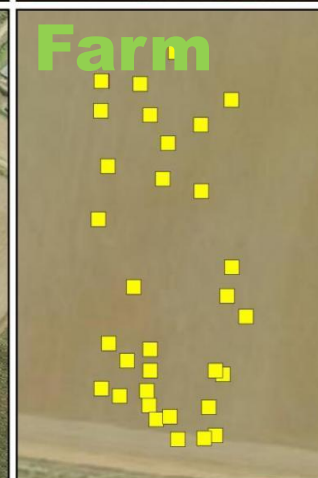
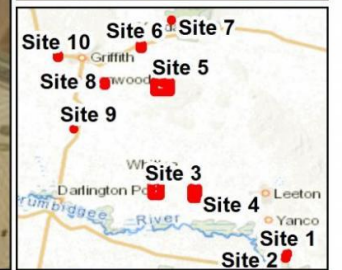
Site 3



Site 4



Site 5



Site 6

Site 7

Site 8

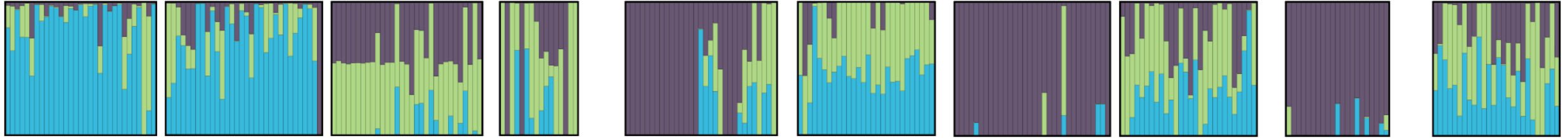
Site 9

Site 10

Source Data:
NSW Imagery: © Department of Finance, Services & Innovation 2018
Overview: © Department of Customer Service 2020

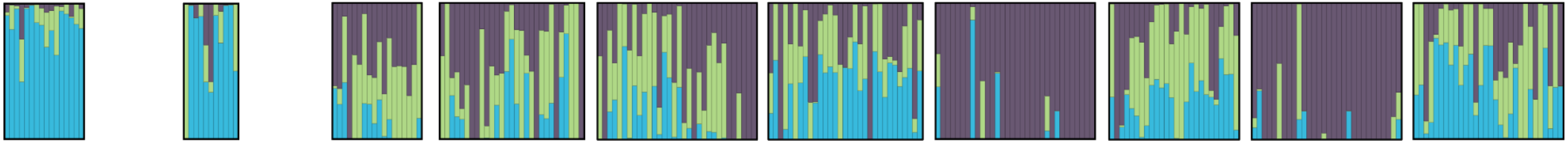


Riverina 2020



Site 1 Site 2 Site 3 Site 4 Site 5 Site 6 Site 7 Site 8 Site 9 Site 10

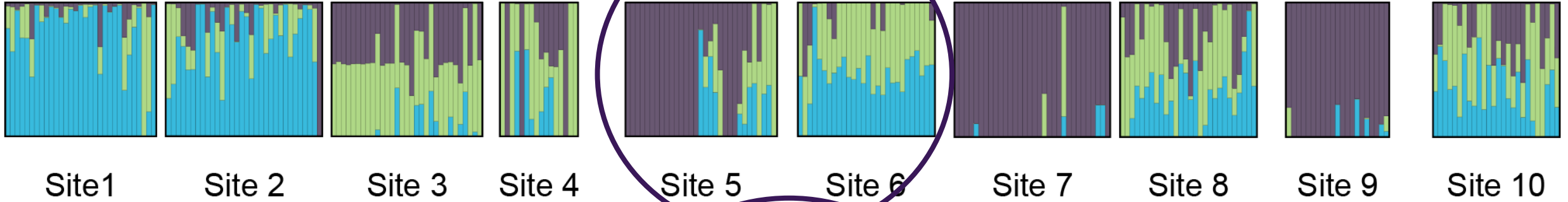
Riverina 2021



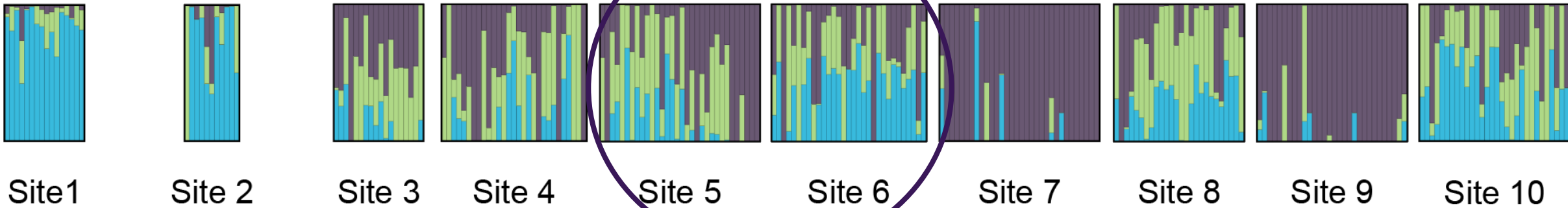
Site 1 Site 2 Site 3 Site 4 Site 5 Site 6 Site 7 Site 8 Site 9 Site 10



Riverina 2020



Riverina 2021





Riverina Fleabane 2020

- 2020 Genetic Sampling Site
- Glyphosate using Weedmaster ARGO at 2 L/ha
 - Survived Treatment 64%
 - All Plants Killed 36%

Samples were collected from roadsides and paddocks



Source(s): © Commonwealth of Australia (Geoscience Australia) 2016.



Riverina Fleabane 2021

- 2021 Genetic Sampling Site
- Glyphosate using Weedmaster ARGO at 2 L/ha
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Source(s): © Commonwealth of Australia (Geoscience Australia) 2016.





Fleabane





Fleabane

	MLG.50	MLG.127	MLG.158	MLG.182	MLG.238	MLG.246	MLG.258	MLG.267	MLG.288	MLG.292	MLG.314	MLG.401	MLG.413	MLG.414	MLG.418	MLG.493	MLG.512	MLG.535
GRI_2020_5A	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	13	1	1
GRI_2020_7A	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	18	0	3
GRI_2020_C1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRI_2020_C2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRI_2020_3A	0	0	0	0	0	0	0	0	8	7	0	0	0	0	0	0	0	0
GRI_2020_4A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRI_2020_6A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRI_2020_9A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
GRI_2020_10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUNRAYSIA_2020_Site1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUNRAYSIA_2020_Site2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUNRAYSIA_2020_Site3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
SUNRAYSIA_2020_Site4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRI_2021_F1A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRI_2021_F2A	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
GRI_2021_F3A	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
GRI_2021_F4A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRI_2021_F8A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRI_2021_F9A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRI_2021_F6A	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
GRI_2021_F7A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
GRI_2021_F5A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
GRI_2021_F10A	0	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	0	0
FB_SUN2021_McNabb	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FB_SUN2021_Carwarp	0	0	0	0	0	0	2	0	0	0	0	2	2	2	0	0	0	0
FB_SUN2021_EOI	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FB_SUN2021_ORCHARD	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0	0	1	0
FB_SUN2021_REDCLIFFS	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
FB_SUN2021_MCNABB2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FB_SUN2021_CITRUS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FB_SUN2021_LEWIS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FB_SUN2021_NANGILOC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FB_SUN2021_TREVISIO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
FB_SUN2021_YATPOOL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GRI_2020_8A	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
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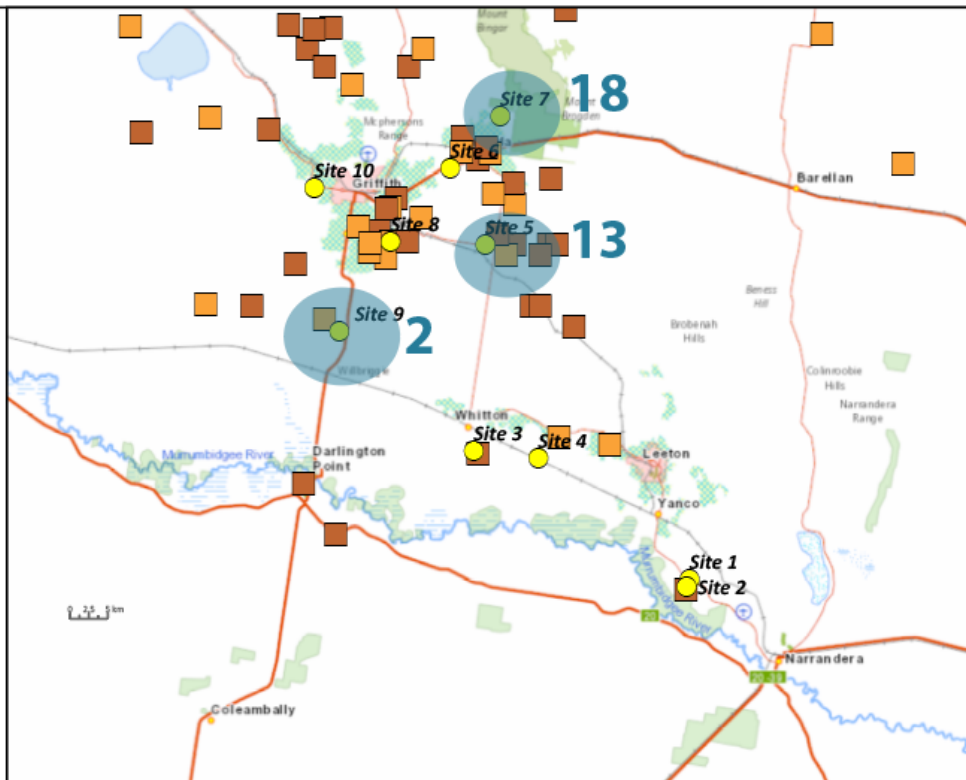


MLG 493

Riverina Fleabane 2020

- 2020 Genetic Sampling Site
- Glyphosate using Weedmaster ARGO at 2 L/ha
 - Survived Treatment 64%
 - All Plants Killed 36%

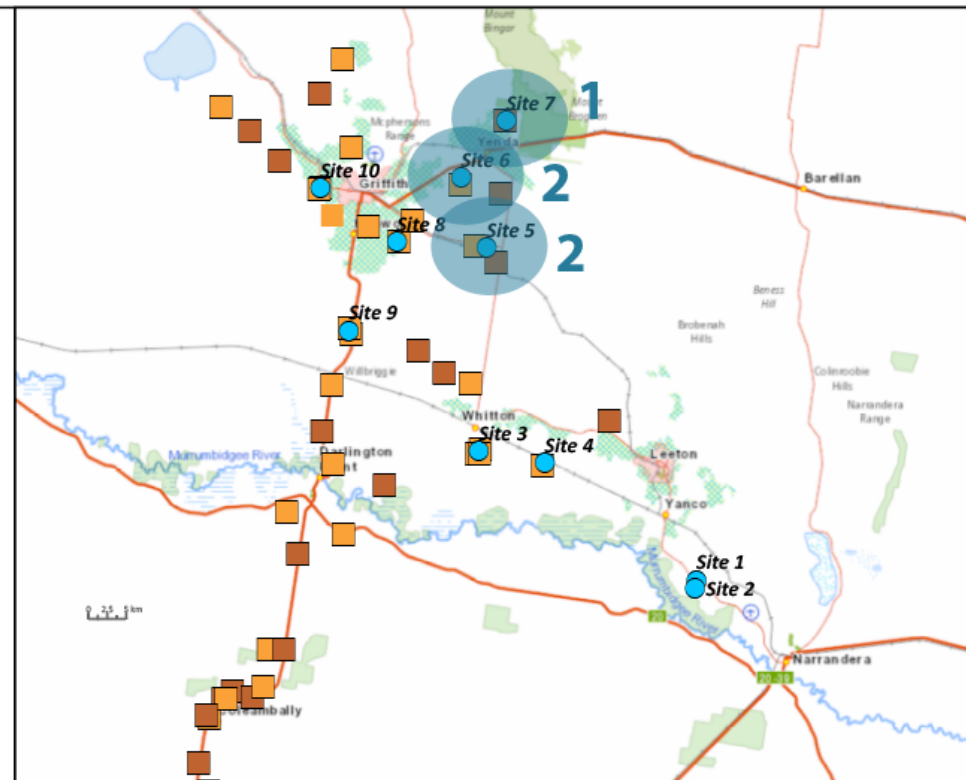
Samples were collected from roadsides and paddocks



Riverina Fleabane 2021

- 2021 Genetic Sampling Site
- Glyphosate using Weedmaster ARGO at 2 L/ha
 - Survived Treatment 37%
 - All Plants Killed 63%

Samples were collected from roadsides and paddocks



This project is supported through funding from the Australian Government Department of Agriculture, Water and the Environment as part of its Rural R&D for Profit program and the Grains Research and Development Corporation and the Cotton Research and Development Corporation.



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34km

One detected in Sunraysia 2021



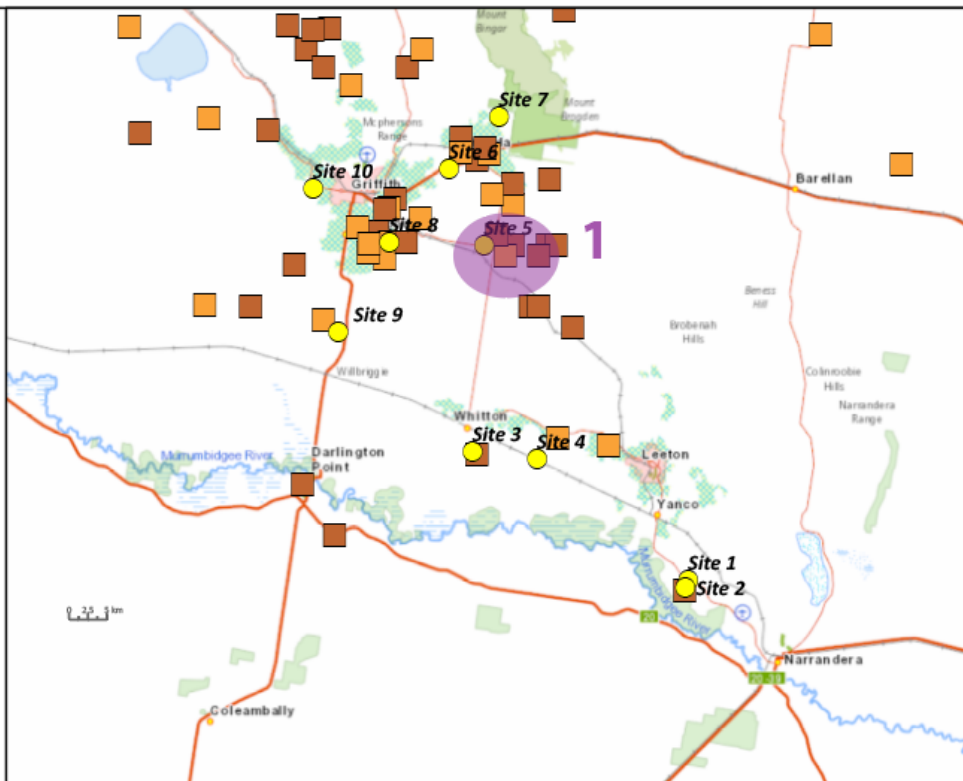
MLG 267

Riverina Fleabane 2020

2020 Genetic Sampling Site

Glyphosate using Weedmaster ARGO at 2 L/ha
Survived Treatment 64%
All Plants Killed 36%

Samples were collected from roadsides and paddocks



AWM
Area-wide Weed Management
<https://research.csiro.au/weed-awm/>
Source(s): © Commonwealth of Australia (Geoscience Australia) 2016.



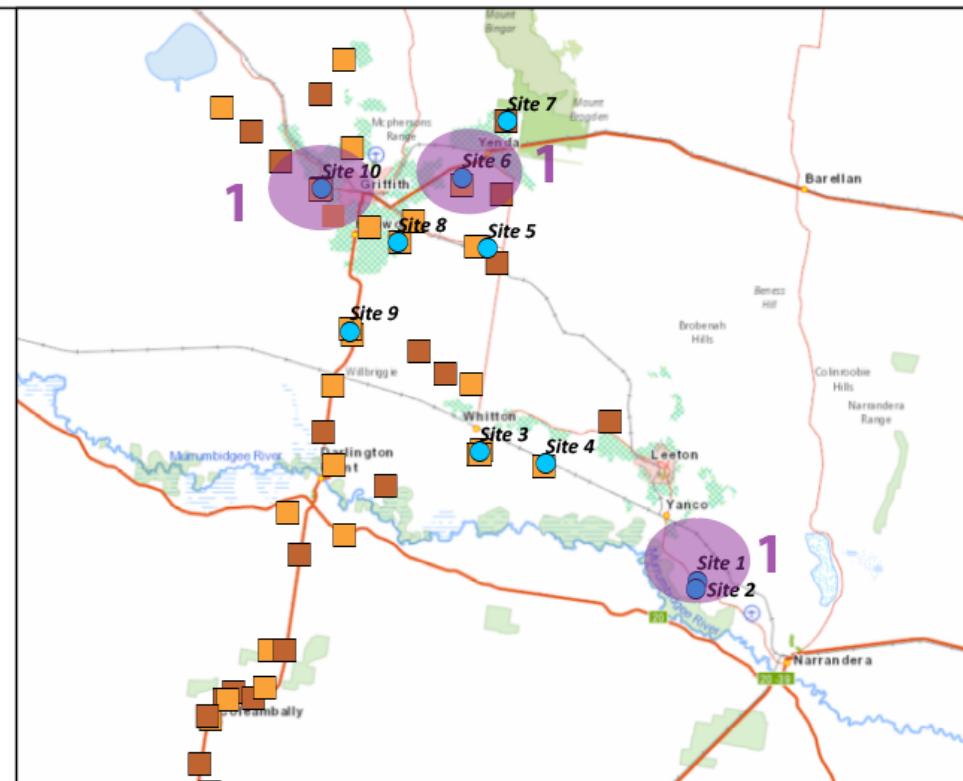
This project is supported through funding from the Australian Government Department of Agriculture, Water and the Environment as part of its Rural R&D for Profit program and the Grains Research and Development Corporation and the Cotton Research and Development Corporation.

Riverina Fleabane 2021

2021 Genetic Sampling Site

Glyphosate using Weedmaster ARGO at 2 L/ha
Survived Treatment 37%
All Plants Killed 63%

Samples were collected from roadsides and paddocks



AWM
Area-wide Weed Management
<https://research.csiro.au/weed-awm/>
Source(s): © Commonwealth of Australia (Geoscience Australia) 2016.



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71km

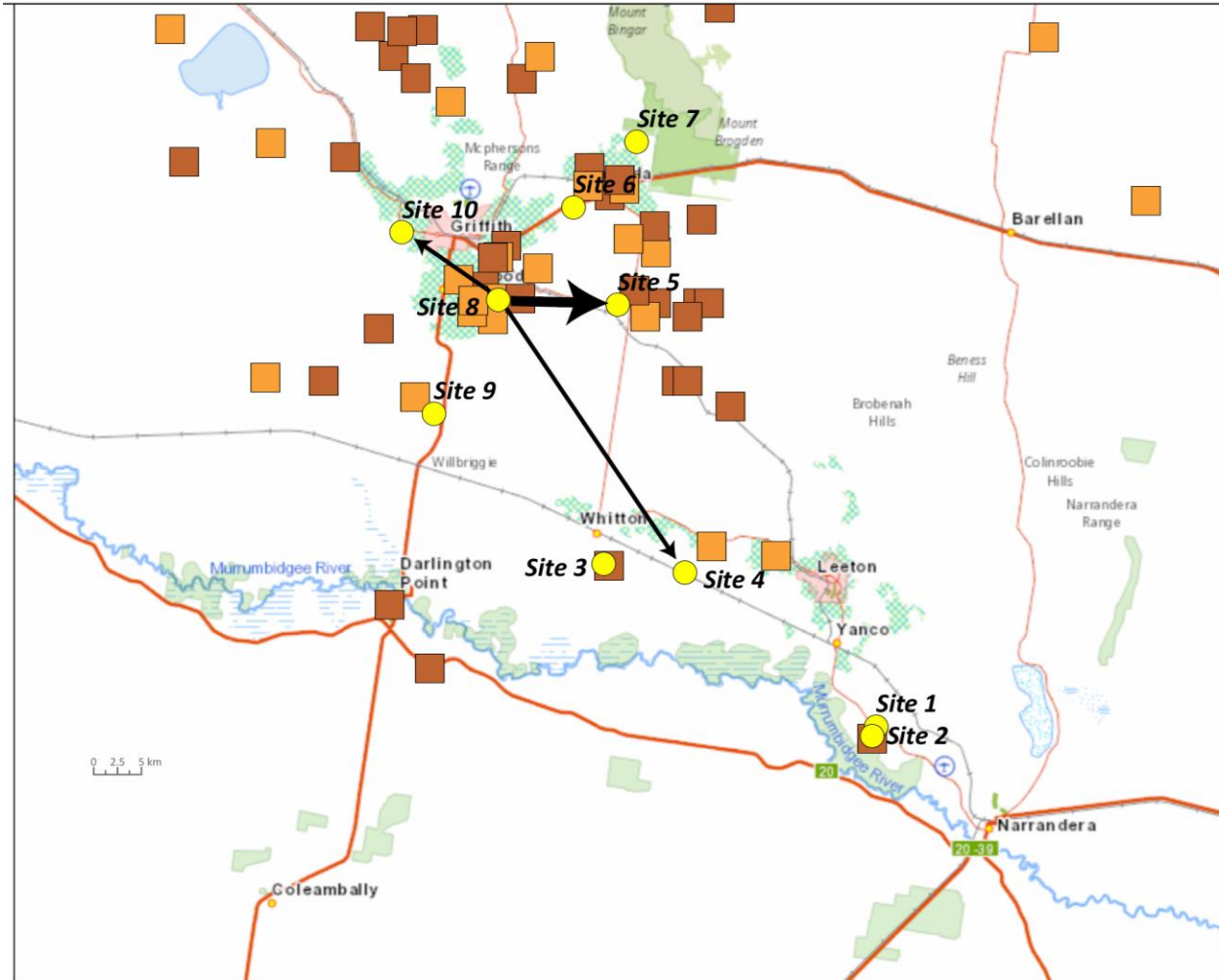


Fleabane





Fleabane



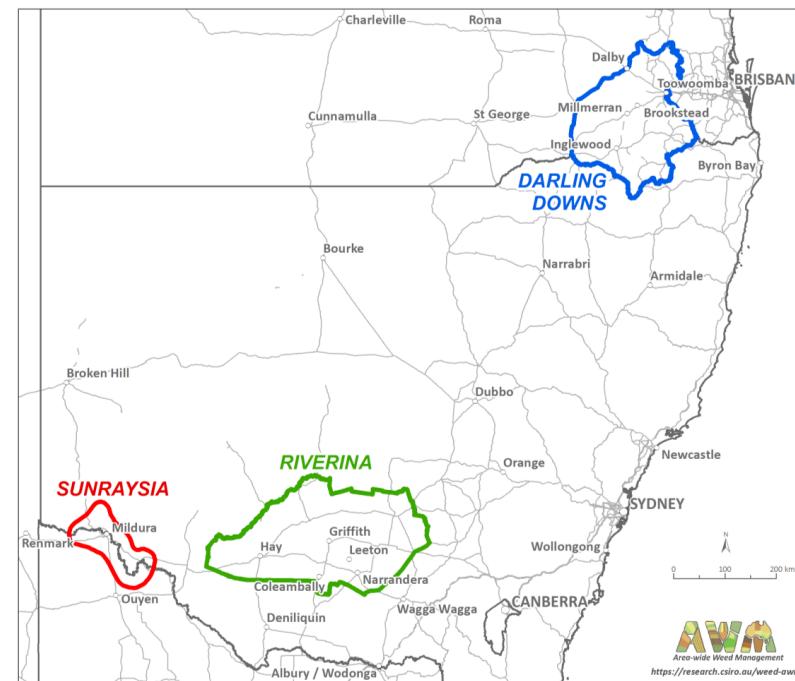
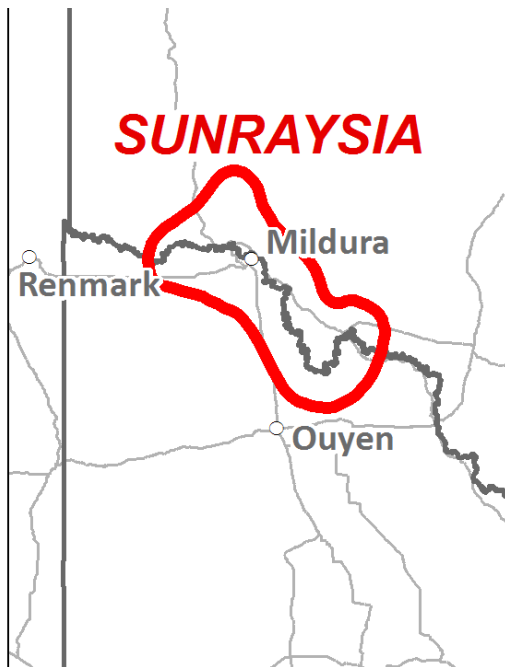
offspring site (2021)	parent site (2020)
site10	site8
site1	site1
site1	site1
site3	site3
site3	site3
site3	site3
site4	site8
site5	site8
site5	site5
site5	site5
site5	site8
site5	site8
site5	site8
site8	site8



36km



This project is supported through funding from the Australian Government Department of Agriculture, Water and the Environment as part of its Rural R&D for Profit program and the Grains Research and Development Corporation and the Cotton Research and Development Corporation.





Fleabane

**Sunraysia
Fleabane
2020 & 2021**

- 2020 Genetic Sampling Site
- 2021 Genetic Sampling Site

Glyphosate

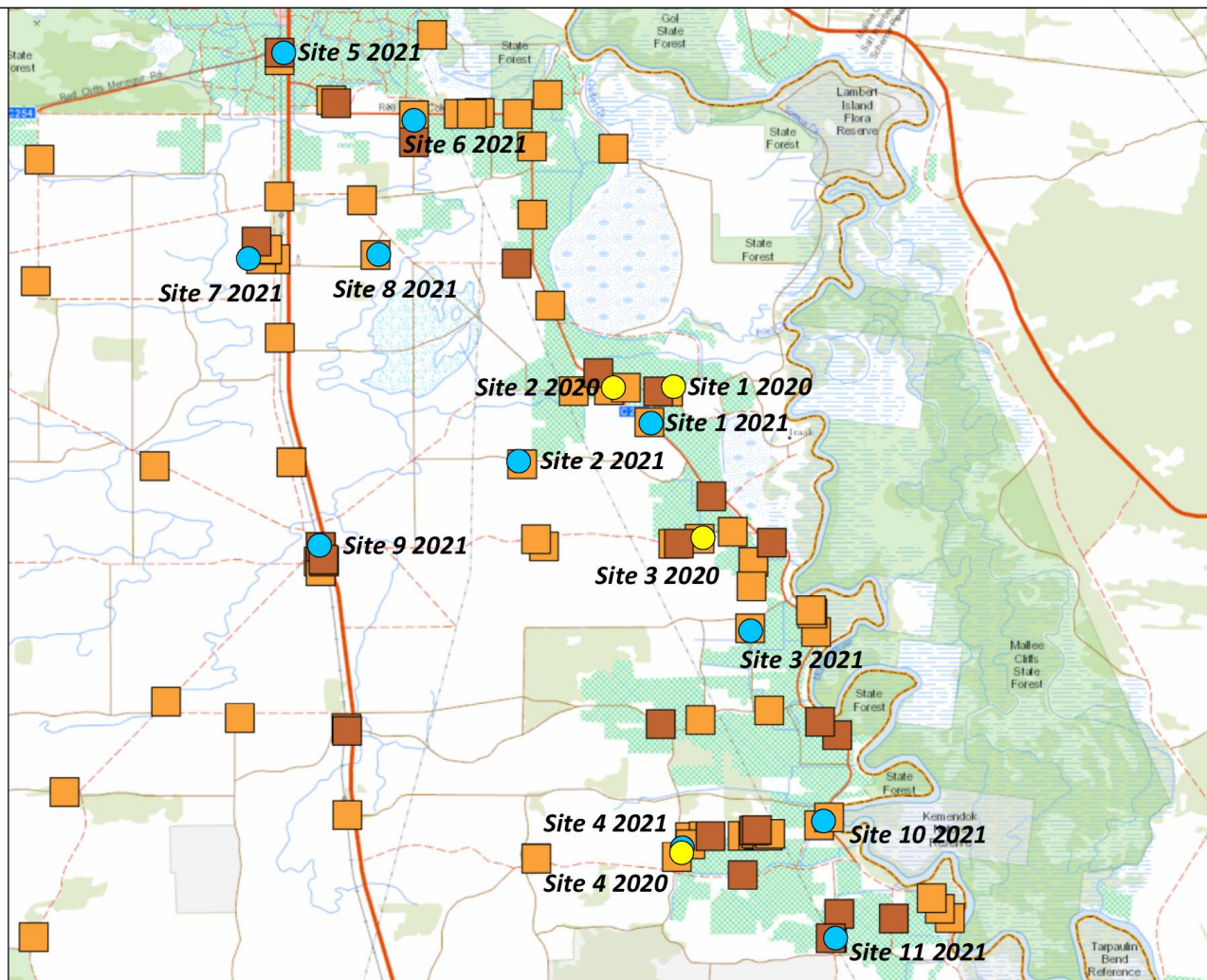
using WeedMaster ARGO at 2 L/ha

- Survived Treatment 23%
- All Plants Killed 77%

Samples were collected from roadsides and paddocks

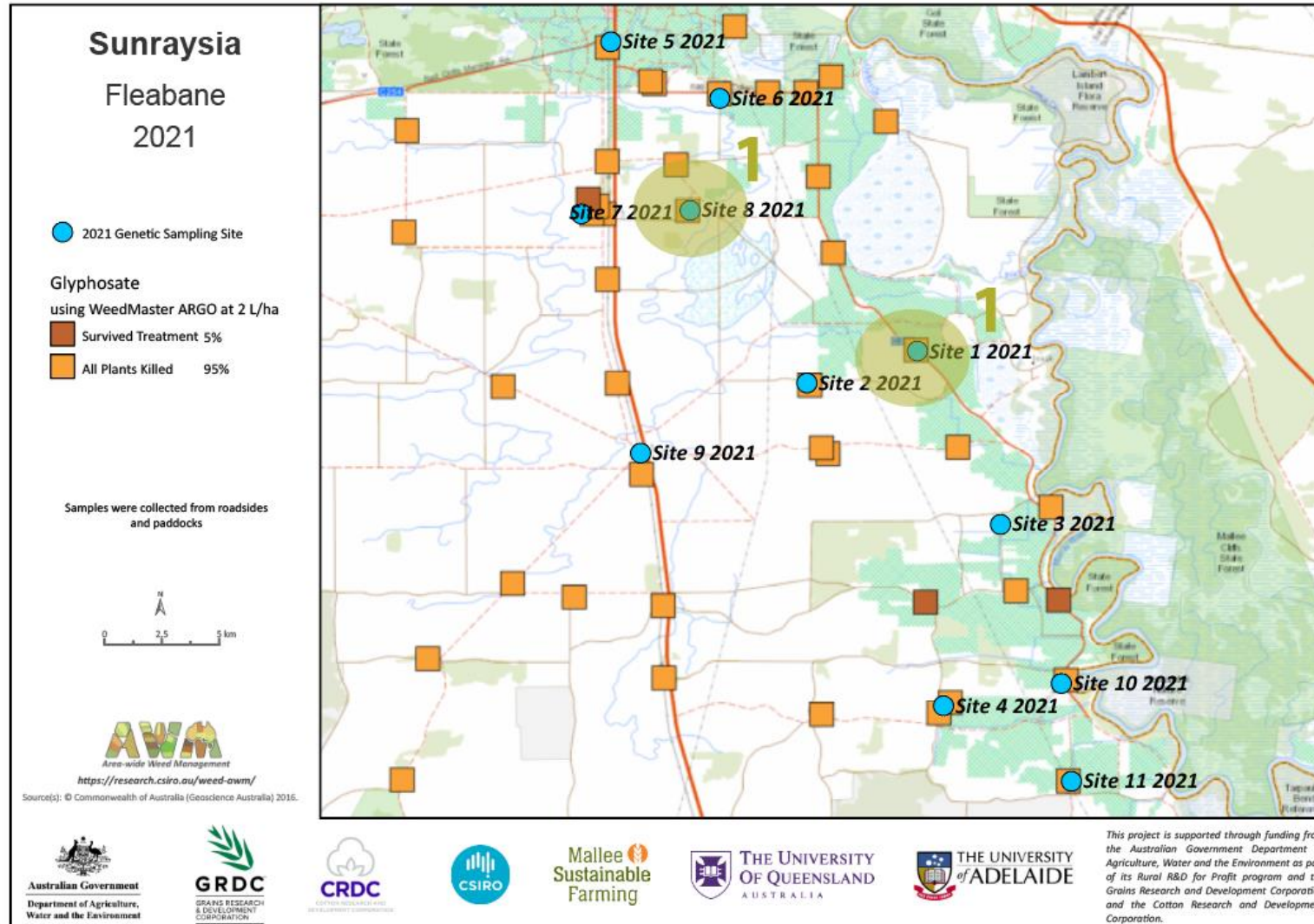


Source(s): © Commonwealth of Australia (Geoscience Australia) 2016.



This project is supported through funding from the Australian Government Department of Agriculture, Water and the Environment as part of its Rural R&D for Profit program and the Grains Research and Development Corporation and the Cotton Research and Development Corporation.

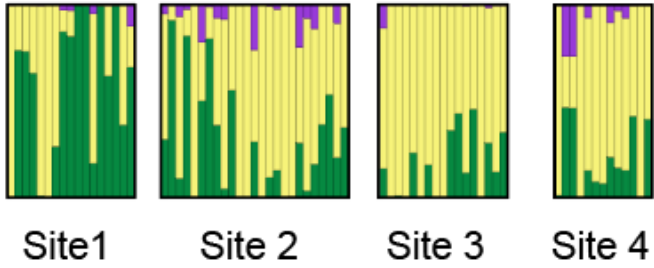
MLG238



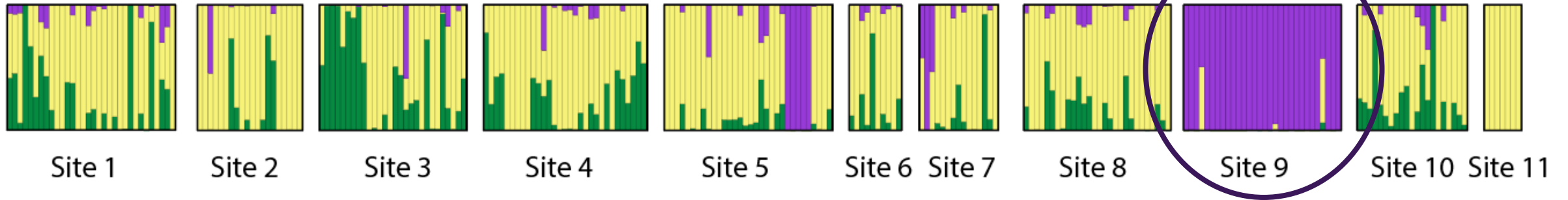
12km



Sunraysia 2020

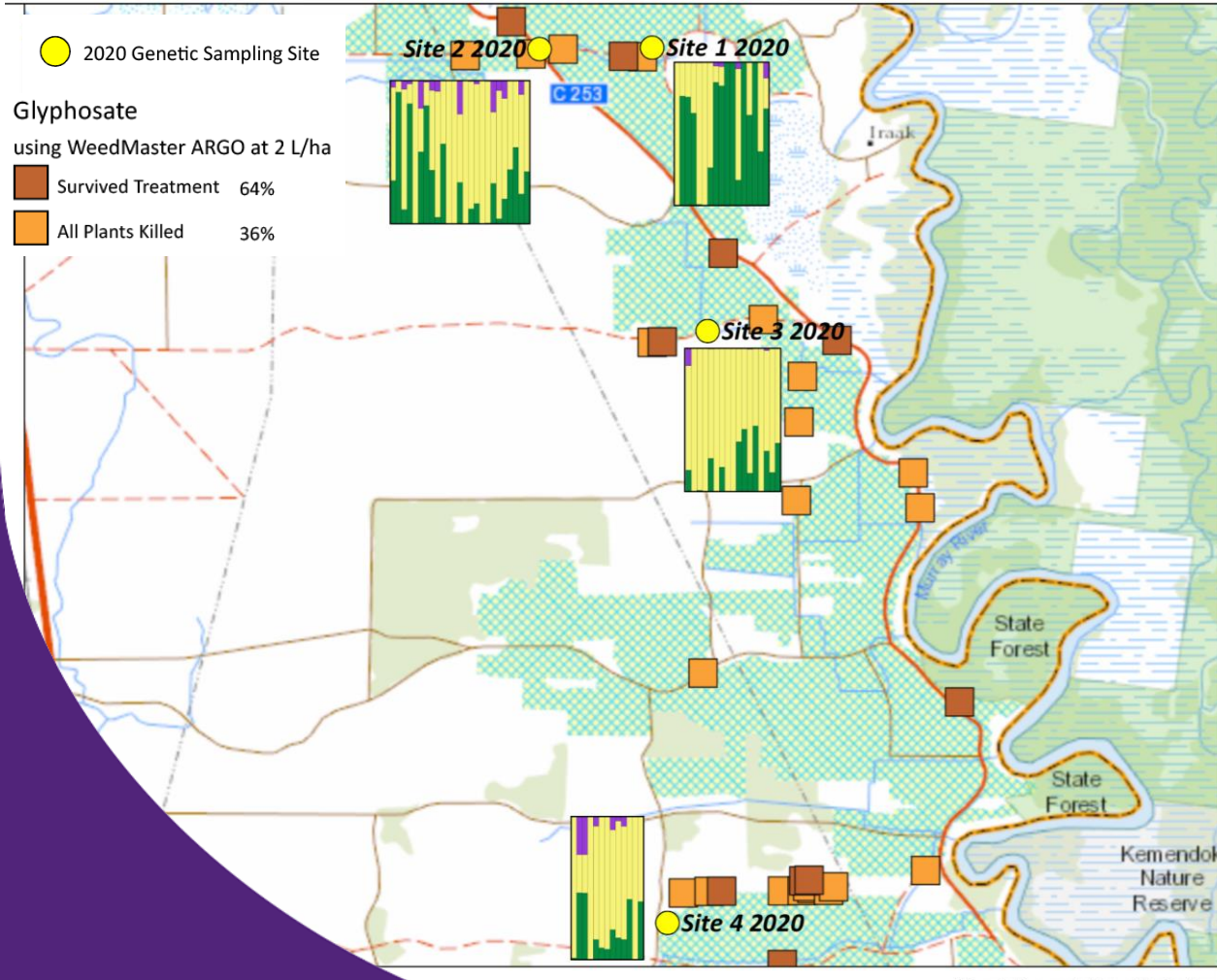


Sunraysia 2021

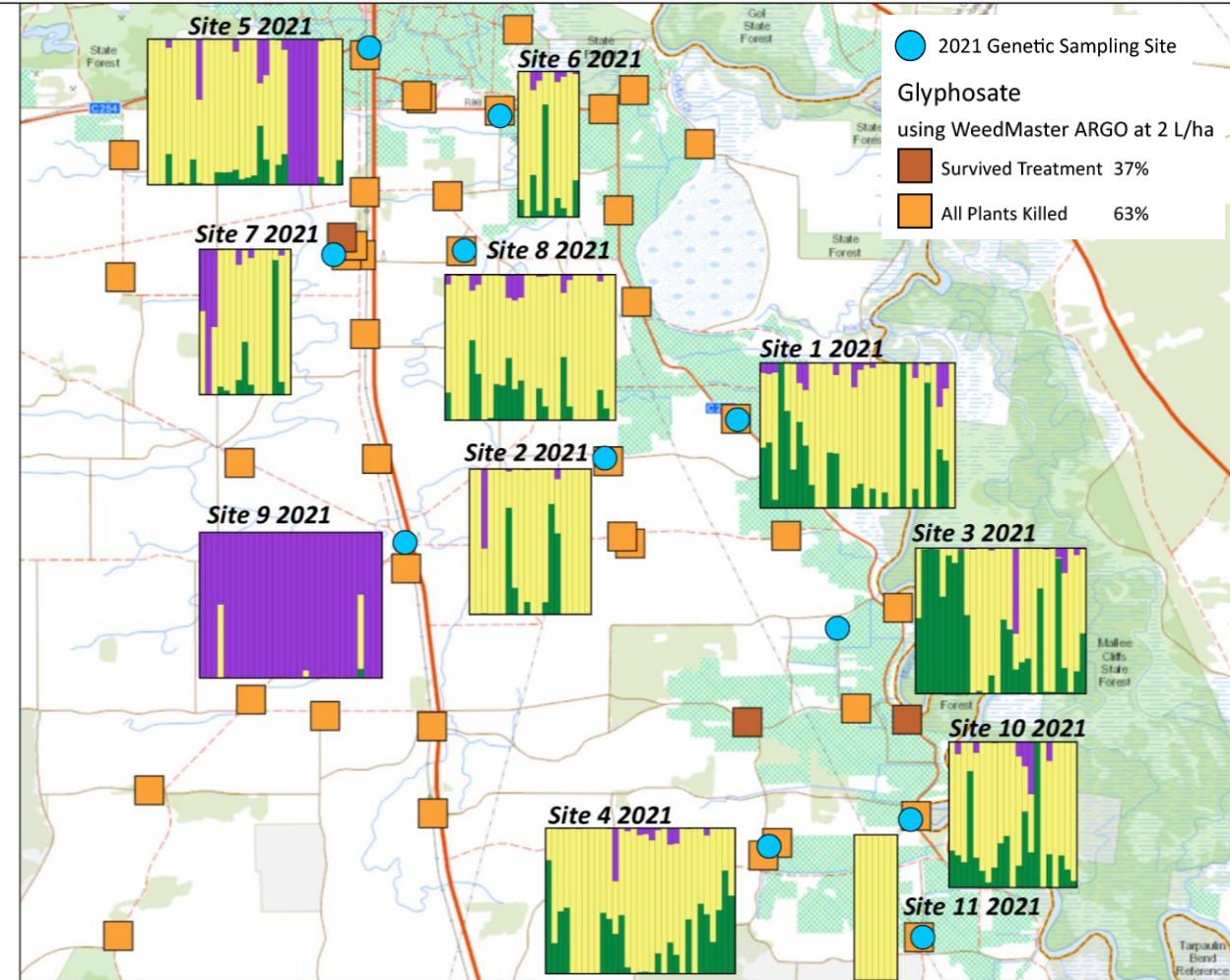




Fleabane 2020

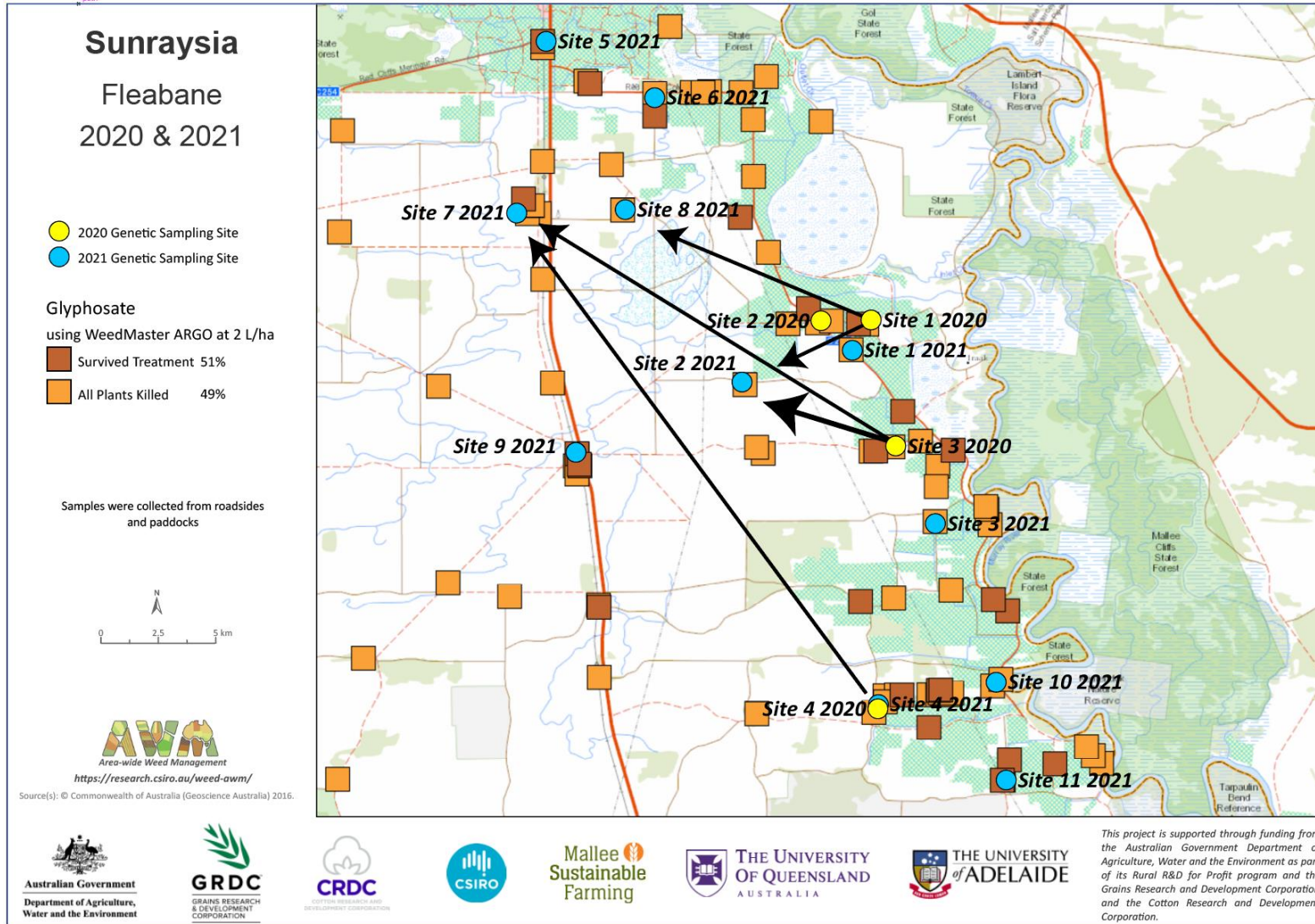


Fleabane 2021





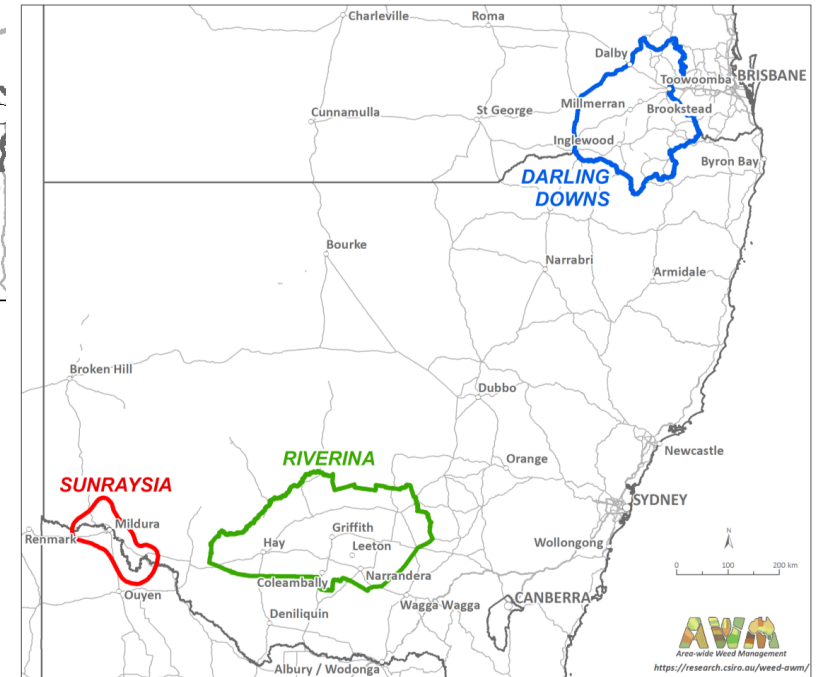
Fleabane
Sunraysia
2020



offspring site (2021)	parent site (2020)
Site4	site4
Site4	site4
Site8	site1
Site2	site1
Site2	site3
Site2	site3
Site1	site1
Site7	site3
Site7	site4

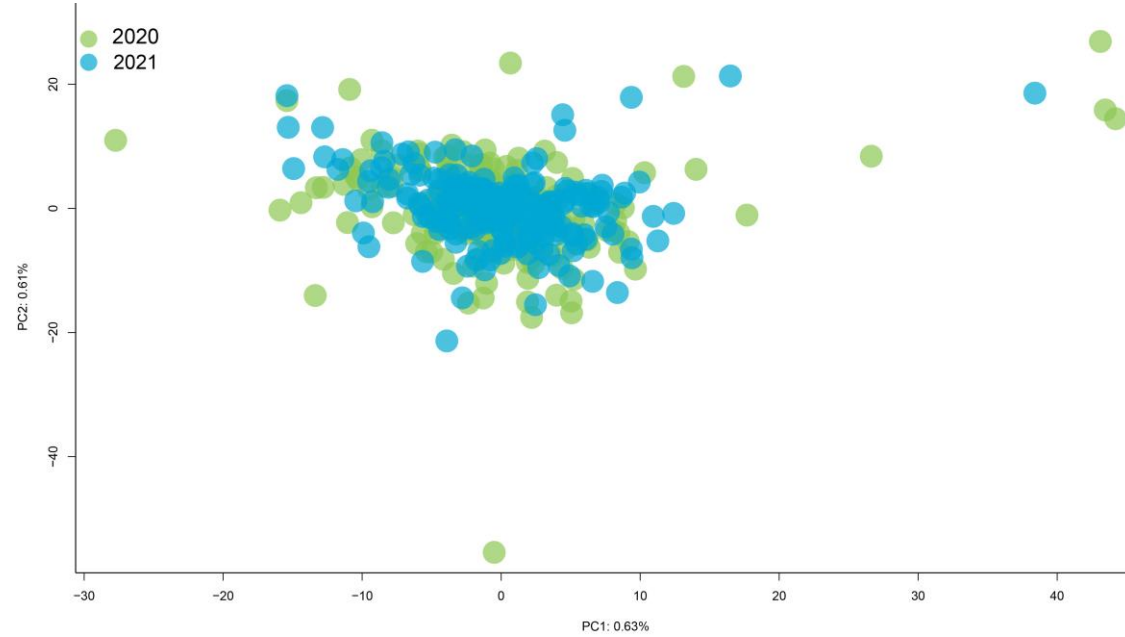


25km

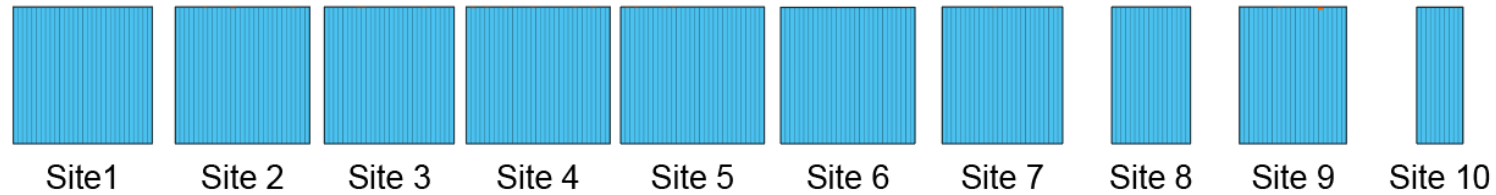




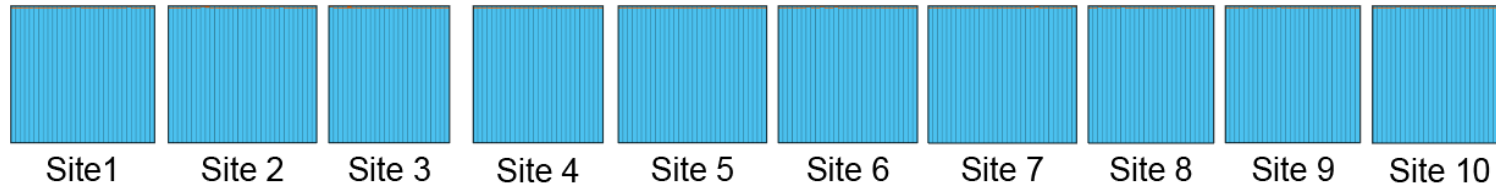
Ryegrass Riverina 2020 and 2021

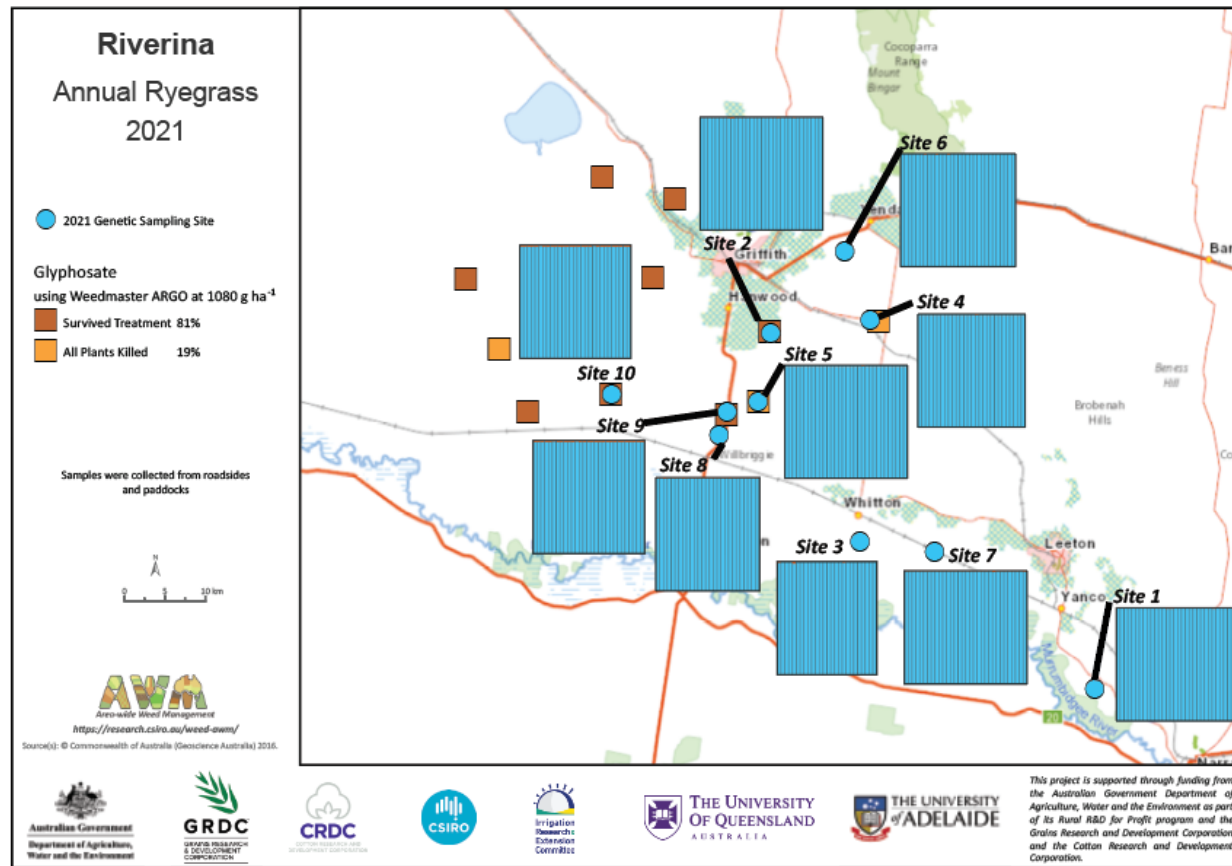
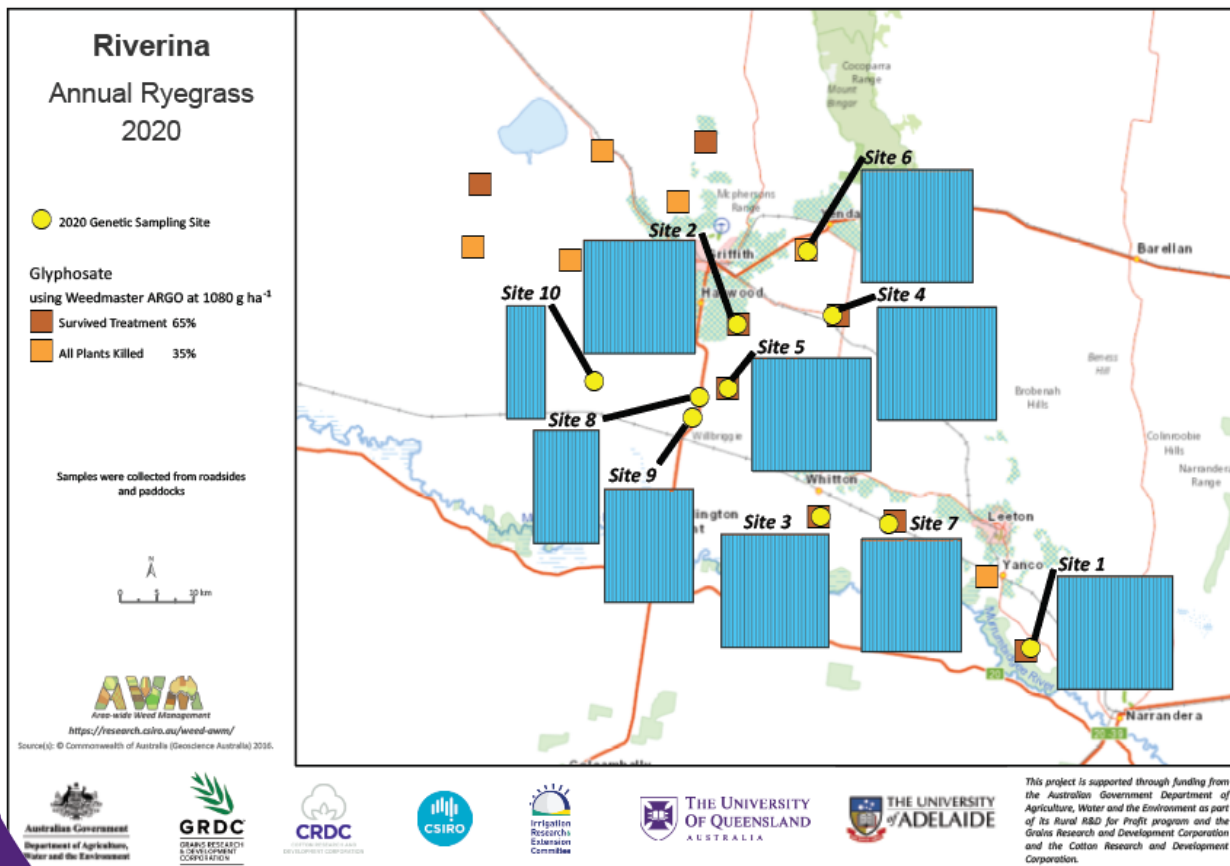


2020 season



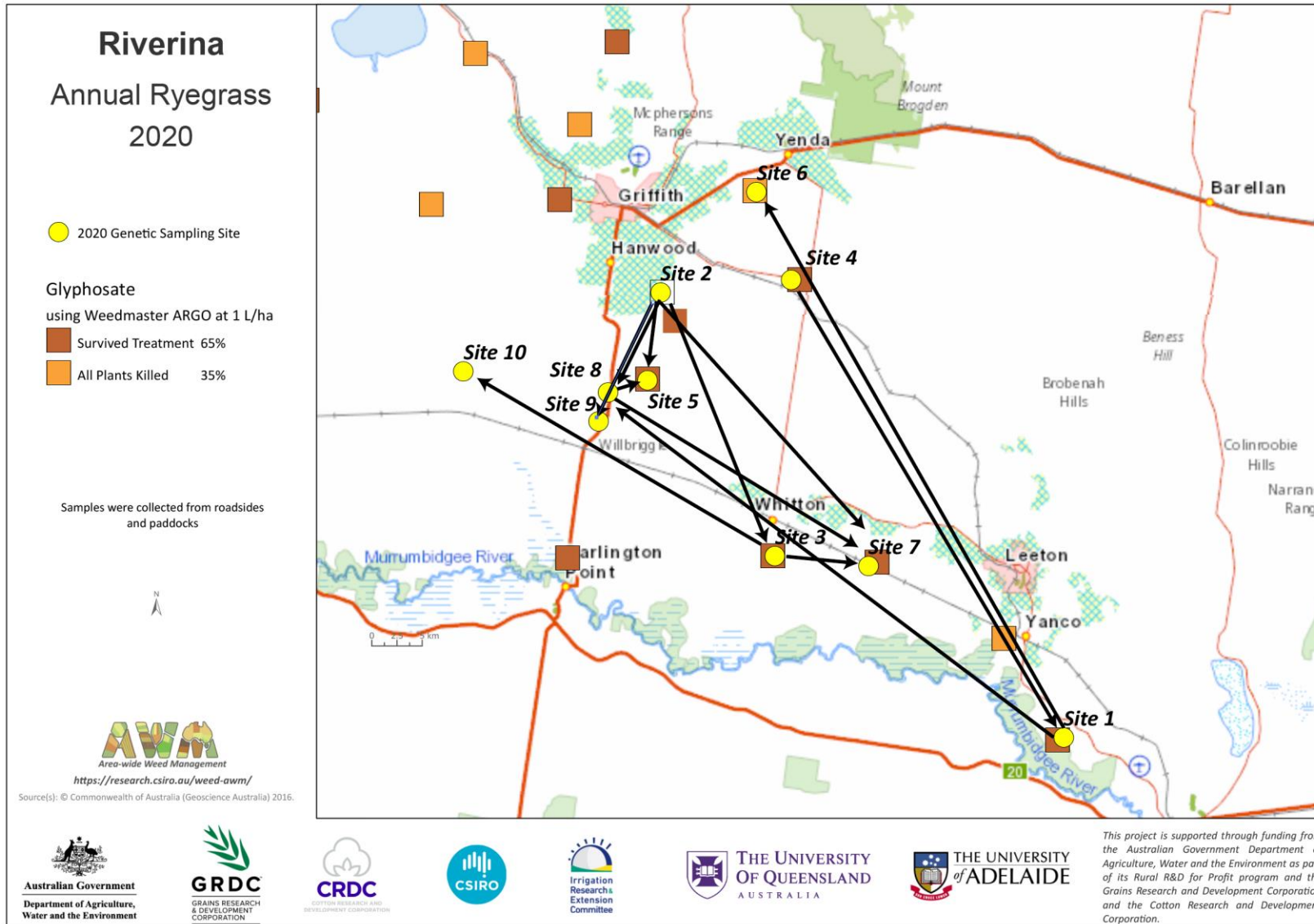
2021 season







Ryegrass Riverina 2020 and 2021



offspring site (2021)	parent site (2020)
site10	site3
site1	site4
site3	site2
site4	site4
site4	site4
site4	site4
site5	site2
site5	site8
site5	site8
site6	site1
site7	site7
site7	site3
site7	site7
site7	site8
site7	site7
site7	site2
site8	site2
site8	site1
site9	site2



62km



62km



36km



25km



71km



12km



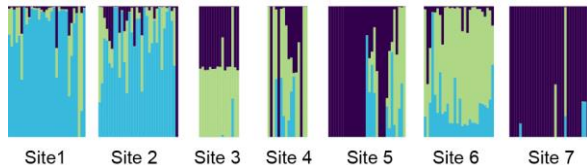
2020



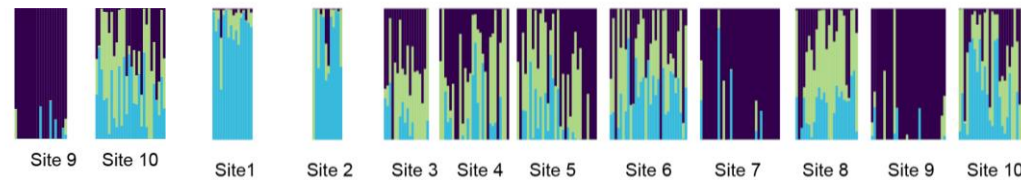
2021



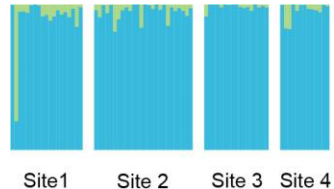
2020



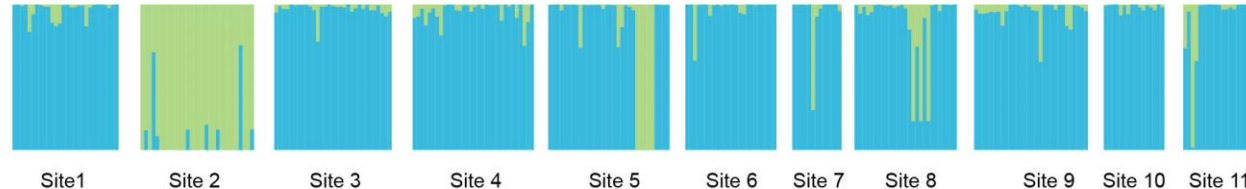
2021



2020



2021





Coordinated control of highly mobile weeds likely to reduce spread of herbicide resistance



Thank You!

