

Herbicide Resistance

With Peter Boutsalis



**Hort
Innovation**
Strategic levy investment

RMCG

**ONION
FUND**

THE ONION PROJECT

Dr Peter Boutsalis

Involved in herbicide resistance since 1989

Plant Science Consulting

Commercial herbicide resistance testing

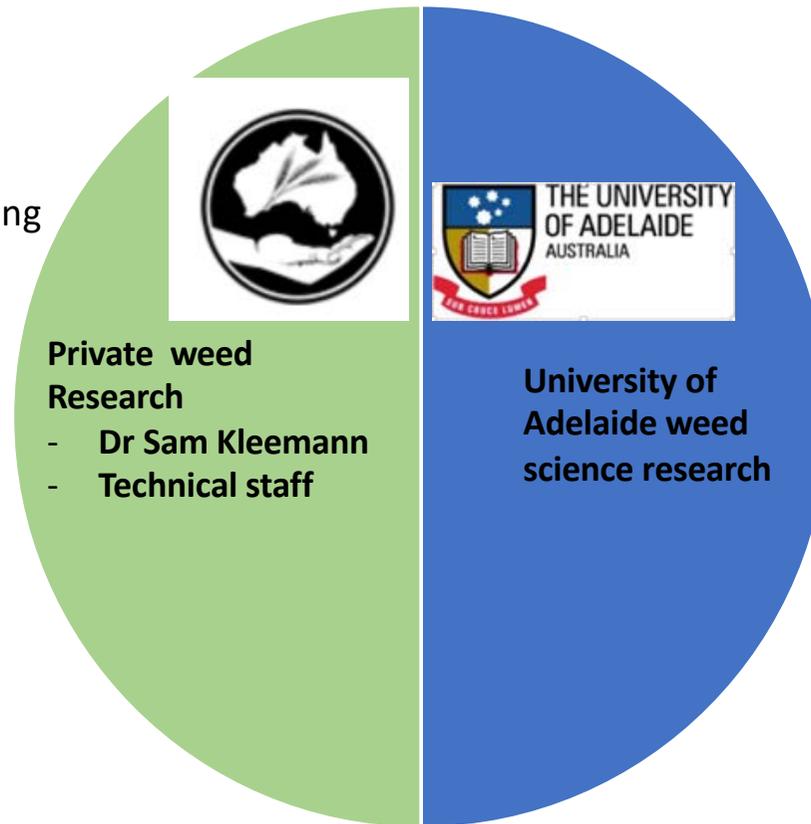
- Seed testing
- Quick Test

Customised pot trials

Grain Quality testing

Weed Viability testing

Clearfield testing



The University of Adelaide

National weed resistance surveys

Field Trials

- Management of resistant weeds
- Seedbanks

Pot trials

- Confirming resistance
- Genetics
- Weed biology- emergence
- Genetics

Lab studies

- Mechanisms of resistance
 - Biochemistry
 - Molecular biology

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Outline

- Principles of herbicide resistance
 - Frequency of resistance: how common are resistance genes before herbicides were sprayed?
 - Selection pressure: Herbicide intensity & weed numbers
- Multiple resistant annual ryegrass
- Herbicide resistance
- Post-emergent herbicides
- Pre-emergent herbicides
- Resistance testing: identify reasons why weeds have survived

What is herbicide resistance?

- Resistance is:

“The *inherited* ability of an individual to survive and reproduce after exposure to a lethal dose of herbicide”

- Resistance is not:

- Weed escapes from herbicide applications
- Species that were never controlled by that herbicide

Herbicide resistant weeds in Australia

Grass weeds	Modes of Action (MoA)
Annual ryegrass (<i>Lolium rigidum</i>)	A, B, C, D, J, L, M, Q
Winter grass (<i>Poa annua</i>)	B, C, D, M, Z
Wild oat (<i>Avena</i> spp.)	A, B, Z
Barley grass (<i>Hordeum</i> spp.)	A, B, L, M
Brome grass (<i>Bromus</i> spp.)	A, B, M
Feathertop Rhodes grass (<i>Chloris virgata</i>)	M
Windmill grass (<i>Chloris truncata</i>)	M
14 other grass species	Resistant to 1 or 2 MOA
Broadleaf weeds	
Wild radish (<i>Raphanus raphanistrum</i>)	B, C, F, I, M
Flax-leaf fleabane (<i>Conyza bonariensis</i>)	M, L
Common sowthistle (<i>Sonchus oleraceus</i>)	B, I, M
20 other broadleaf weeds	Resistant to 1 or 2 MOA



Frequency of Resistance

- Resistance is naturally present in weed populations at low frequencies
- The frequency of resistant individuals will vary between species
- → resistance occurs quickly for some species eg. ryegrass

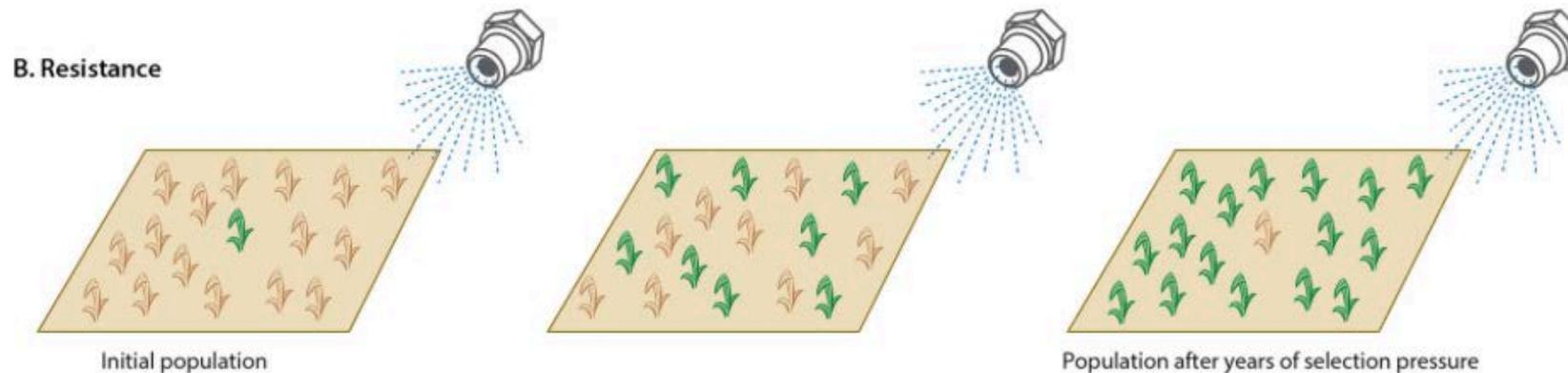


More weeds exposed to herbicides = > chance of resistance
(in 20ha field)

Plant Density	Plants	Resistant Individuals
1 m ⁻²	200,000	0.2
10 m ⁻²	2 million	2
100 m ⁻²	20 million	20
1000 m ⁻²	200 million	200

Resistance starts with Selection pressure

- Mechanisms of resistance naturally occur.
- Herbicides kill susceptible plants.
- Resistant plants survive, set seed and resistance starts

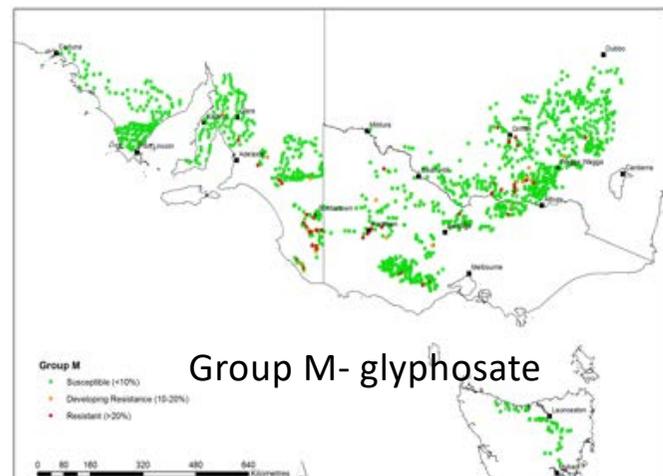
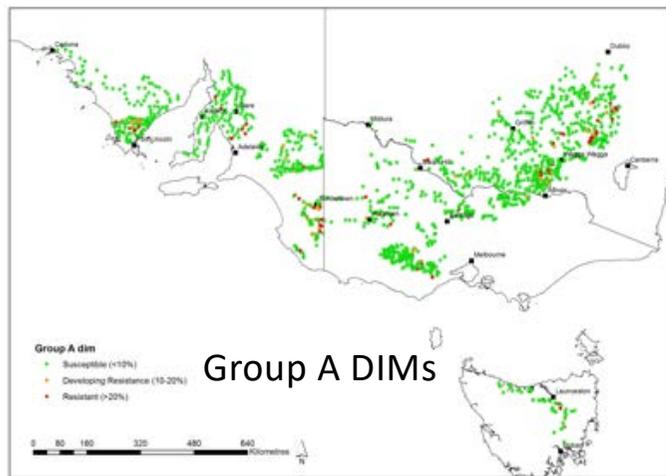
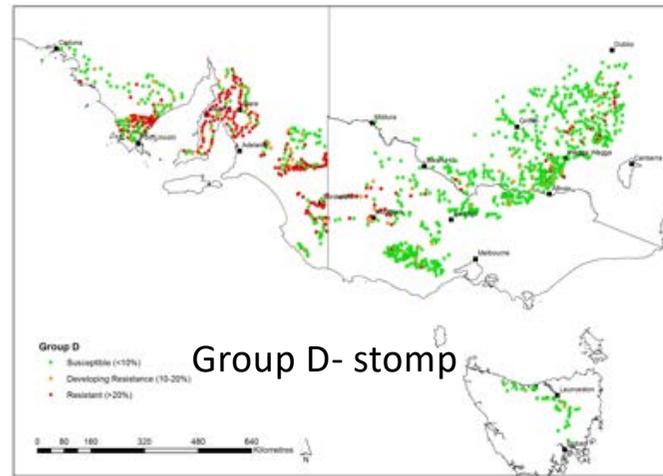
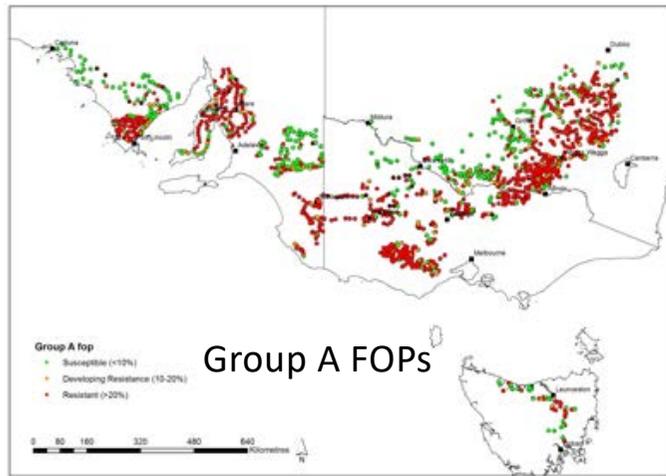


Lots of resistance in annual ryegrass

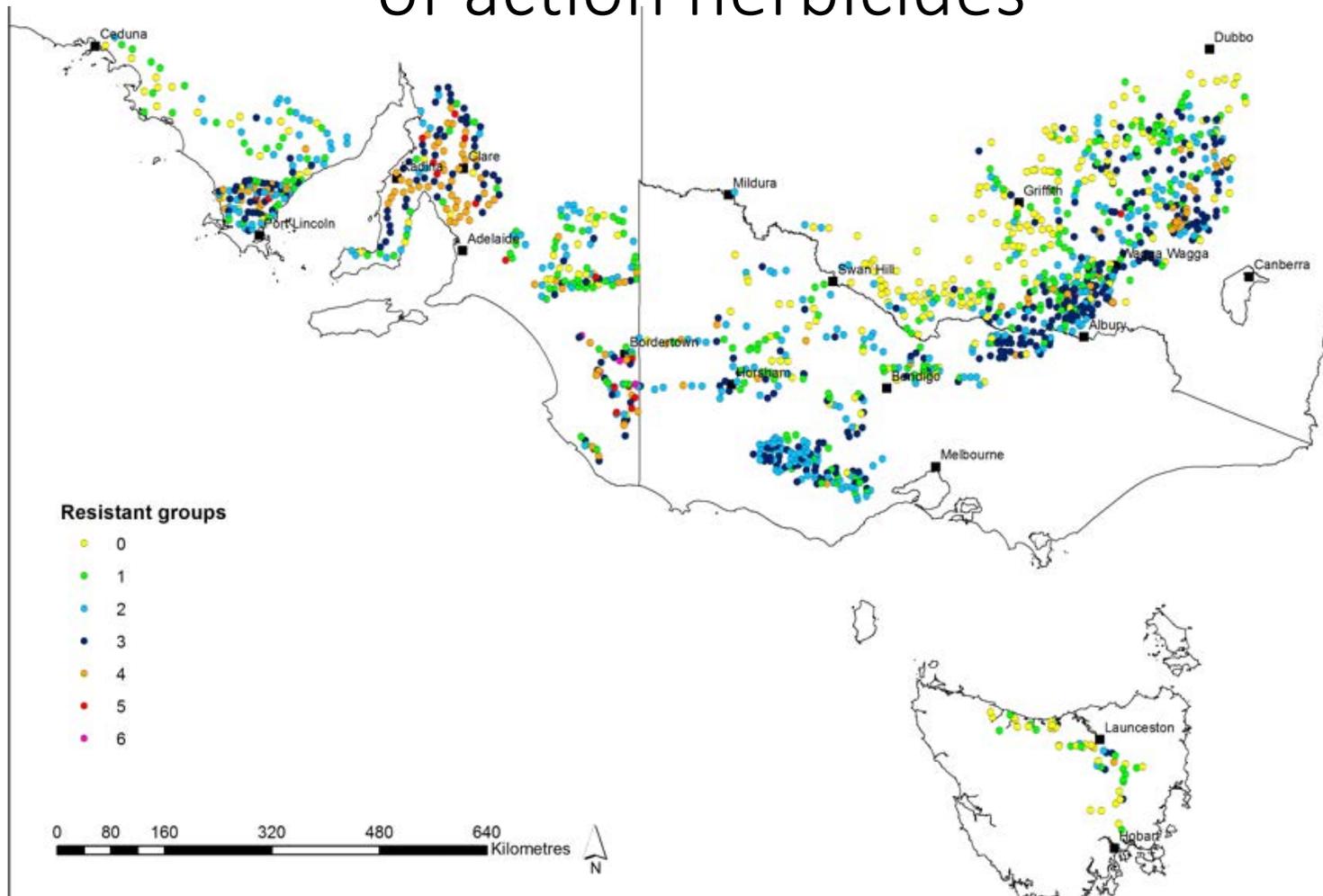
- Ryegrass is the biggest challenge
- Ryegrass is resistant to most herbicides
- What's present in your paddock?
 - Cropping history
 - Herbicide history/ records
- Without resistance testing high risk of herbicide failure.
- In photo a \$400 test could have prevented a \$500,000 loss



Resistance in annual ryegrass- GRDC random weed surveys



Multiple resistance in ryegrass to different mode of action herbicides



Factors that increase herbicide resistance

- Repeated use of the same herbicide eg. glyphosate
- Rotating similar herbicides, eg. Targa, Fusilade, Clethodim
- Low rates or 'reduced kill rate' fast tracks resistance:
 - Poor application → sub-lethal effects
 - Stressed/ large weeds → sub-lethal effects
 - Poor quality herbicides → sublethal
 - Reduced efficacy: poor quality herbicides, adjuvants, water etc.



Planning an onion crop

- Limited herbicide choices for weed control in onions
- Use Herbicide resistance testing to identify effective herbicides
- Use Herbicide resistance testing to identify ineffective herbicides
- Use effective herbicides to control weeds eg. ryegrass
- Choose area that has low weeds
- Can take several seasons
 - mechanical weed control
 - non-selective herbicides
 - → leave no survivors to contaminate with fresh seed



Post-emergent herbicides used in onions

GRASS WEED HERBICIDES: Group A's

- **FOPs:** eg. Targa, Fusilade
- **DIMs:** eg. clethodim eg. Select, Platinum etc.
- → all have the same Mode Of Action

BROADLEAF WEED HERBICIDES

- Group G eg. Goal (oxyfluorfen)- broadleaf weeds
- Group R: Asulam- broadleaf weeds
- Group C: Cyanazine, ioxynil, linuron, methabenzthiazuron



Residual herbicides in onions

→ control grass & broadleaf weeds

- Group D eg. pendimethalin (Stomp), Dacthal (chlorthal)
- Group J eg. ethofumesate (Matrix, Trammat)
- Group K eg. propachlor (Ramrod)

→ Very important to use to reduce selection pressure on ryegrass



Herbicide Resistance Testing

The image shows six potted grass plants arranged in two rows of three. The top row consists of three plants that are lush, green, and densely packed with long, narrow leaves. The bottom row consists of three plants that are significantly smaller, sparser, and appear to be struggling or dying, with many leaves missing or broken. This visual comparison illustrates the results of herbicide resistance testing.

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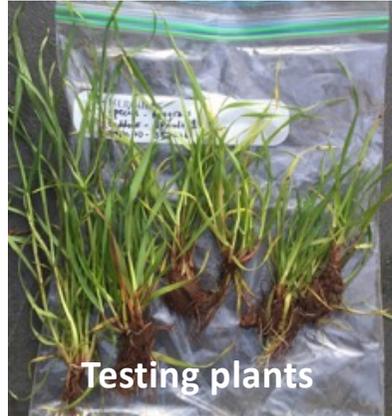
Herbicide failure?
Resistance?
Conduct testing



What can be tested?



Testing seedlings from field



Testing plants



Seed from soil



Testing Seed



Testing wild radish from the field



Testing seed from grain sample

Ryegrass

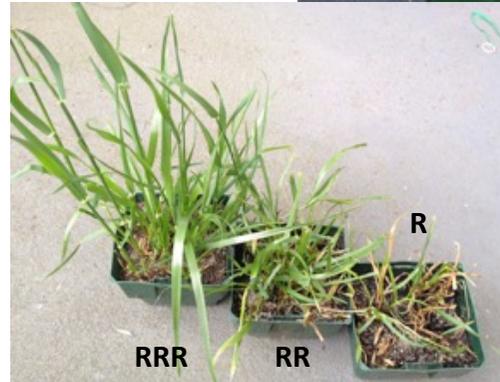
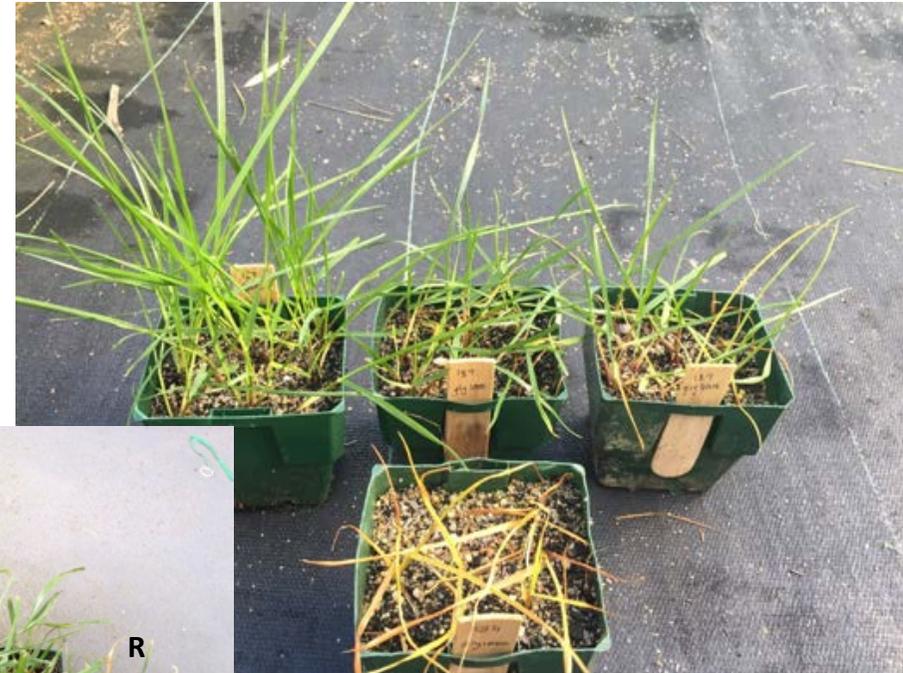
Wild
oats

Wild radish



Opportunities from resistance testing:

Herbicide	Product Rate	Herbicide Group	Farmer sample	
			Survival (%)	Rating
Glyphosate 540	1 L/ha	M	85	RR
Glyphosate 540	2 L/ha	M	30	RR
Glyphosate 540	4 L/ha	M	0	S
Basta	4 L/ha	N	0	S
Amitrole	6 L/ha	Q	80	RR
Gramoxone	2 L/ha	L	0	S
Stomp	8 L/ha	D	0	S



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Experts in Herbicide
Resistance Testing

Submit a test 

Returning client login

Email

Login

[Forgot password? Click here](#)

Why test?

- To determine the failure was due to resistance
- To determine which other herbicides might still be effective (resistance pattern)

Choose a test to submit



Weed Resistance
Seed Test



Weed Resistance
Quick Test



Weed Viability
Test



Summary:

→ Herbicide resistance complicates weed control!

- Don't use the same herbicides continuously
- Rotate modes of action
- Test to determine if weeds are resistant

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