

# Herbicide resistance and weed management in almonds

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# Dr Peter Boutsalis



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Peter Boutsalis grew up in Renmark, SA. His parents owned a vineyard/orchard property between 1970-1984. Peter has been involved in Herbicide Resistance for over 25 years. He graduated from The University of Adelaide in 1996 with a PhD investigating the first cases of broadleaf weed resistance to Group B herbicides in Australia. He was employed as a herbicide-weed biologist in Europe by an international company for almost a decade. Since 2005 he has been employed as a researcher with the University of Adelaide investigating the management of herbicide resistant weeds and investigating new mode of action herbicides. He also manages Plant Science Consulting, an Adelaide based company specialising in commercial Herbicide Resistance Testing and customized pot trials for the chemical industry.

# What is herbicide resistance?

“The *inherited* ability to survive and reproduce after exposure to a dose of herbicide lethal to normal individuals of that species”

Its not a weed species that was never controlled by a herbicide.

Selection is caused by herbicides, insecticides, fungicides, lawnmowers etc. that kill susceptible individuals leaving survivors (resistant) ones to reproduce and multiply

# Why does herbicide resistance occur?


- Using herbicides leads to resistance
- Using lower rates increases the onset of resistance
- Repeated use of the same mode of action or same active eg. there are about 90 paraquat containing products: Paradox 250, Agroquat 250, Gramoxone, Spraytop 250 etc.
- Survivors that are not controlled are allowed to set seed

# Herbicides are classified according to their mode of action: "how they kill weeds"


<b>GROUP A</b>	<b>Inhibitors of acetyl coA carboxylase (Inhibitors of fat synthesis / ACC'ase inhibitors)</b>
Aryloxyphenoxypropionates (Fops):	clodinafop (Topik <sup>®</sup> ), cyhalofop (Barnstorm <sup>®</sup> ), diclofop (Cheetah <sup>®</sup> Gold*, Decision <sup>®*</sup> , Hoegrass <sup>®</sup> , Tristar <sup>®</sup> Advance*), fenoxaprop (Cheetah <sup>®</sup> Gold*, Tristar <sup>®</sup> Advance*, Wildcat <sup>®</sup> ), fluazifop (Fusilade <sup>®</sup> , Fusion <sup>®*</sup> ), haloxyfop (Motsa <sup>®*</sup> , Verdict <sup>®</sup> ), propaquizafop (Correct <sup>®</sup> ), quizalofop (Targa <sup>®</sup> )
Cyclohexanediones (Dims):	butoxydim (Falcon <sup>®</sup> , Fusion <sup>®*</sup> ), clethodim (Motsa <sup>®*</sup> , Select <sup>®</sup> ), profoxydim (Aura <sup>®</sup> ), sethoxydim (Cheetah <sup>®</sup> Gold*, Decision <sup>®*</sup> , Sertin <sup>®</sup> ), tepraloxydim (Aramo <sup>®</sup> ), tralkoxydim (Achieve <sup>®</sup> )
Phenylpyrazoles (Dens):	pinoxaden (Axial <sup>®</sup> )

<b>GROUP M</b>	<b>Inhibitors of EPSP synthase</b>
Glycines:	glyphosate (Roundup <sup>®</sup> , Trounce <sup>®*</sup> , Illico <sup>®*</sup> , Arsenal Xpress <sup>®*</sup> )
<b>GROUP N</b>	<b>Inhibitors of glutamine synthetase</b>
Phosphinic acids:	glufosinate (Basta <sup>®</sup> , Liberty <sup>®</sup> )

# Herbicide resistant weeds in Australia

Grass weeds	MOA
Annual ryegrass ( <i>Lolium rigidum</i> )	A, B, C, D, J, L, M, Q
Wild oat ( <i>Avena</i> spp.)	A, B, Z
Barley grass ( <i>Hordeum</i> spp.)	A, B, L
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

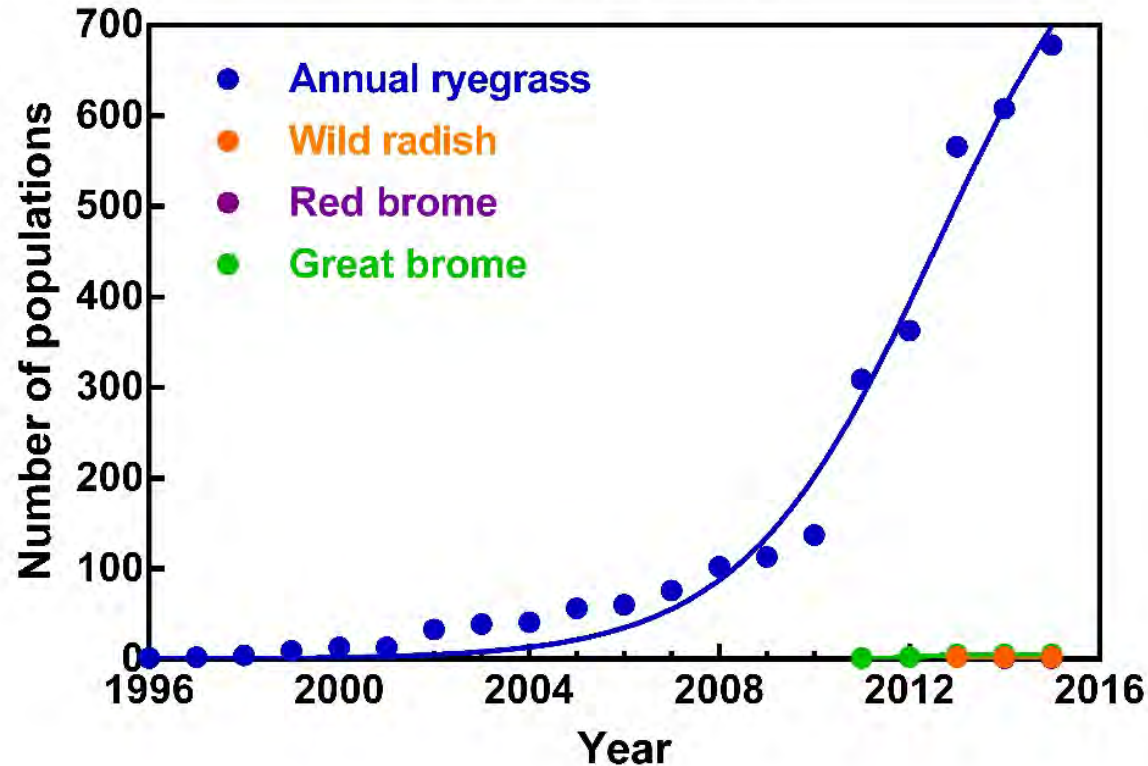


Broadleaf weeds	MOA
Wild radish ( <i>Raphanus raphanistrum</i> )	B, C, F, I, M
Flax-leaf fleabane ( <i>Conyza bonariensis</i> )	M, L 
Common sowthistle ( <i>Sonchus oleraceus</i> )	B, I, M
20 other broadleaf weeds	Resistant to 1 or 2 MOA

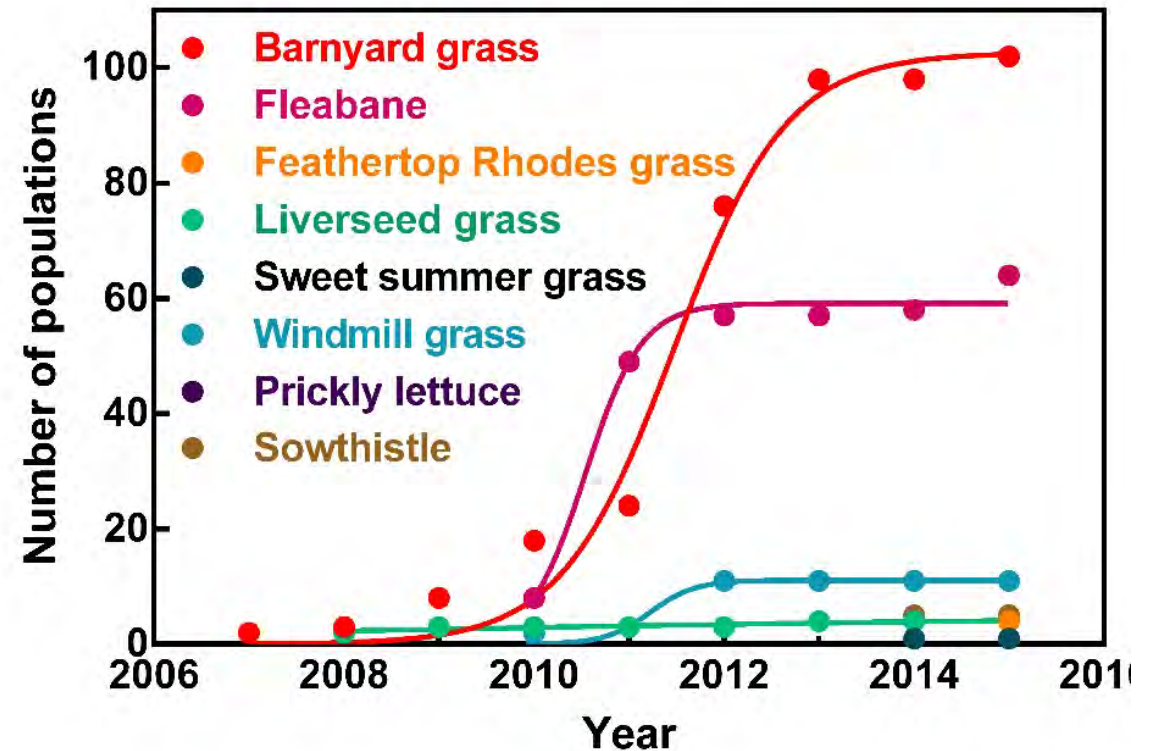


# Glyphosate resistant weeds in Australia- most are important in almonds

## Winter weeds



## Summer weeds



# Herbicides Weed Control in Almonds

<b>Mode of action &amp; Herbicides</b>	<b>Grasses</b>	<b>Dicots</b>
A* (Fops) eg. Verdict	yes	no
C- Simazine	yes	yes
D- Oryzalin	yes	yes
F- Zoliar	yes	Yes
G- Sharpen, Goal, Hammer	no	yes
K- Devrinol	yes	yes
L: Paraquat/diquat	yes	yes
M: Glyphosate	yes	yes

\*- registered?



# Protecting herbicides from resistance

- Use herbicides correctly- application, correct adjuvants
  - eg. Sharpen + MSO eg. Hasten (✓) not organosilicates (✗) or non-ionics (✗).
- Herbicides work better on young and healthy plants
- Use good quality herbicides not cheap imports with poor quality inbuilt components surfactants etc.
- Rotate your herbicides (MoA) even if they are working.
- Incorporate non-herbicide strategies to break the chemical cycle
- Resistance testing- don't use herbicides that don't work

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## Experts in Herbicide Resistance Testing

Submit a test 

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Choose a test to submit



Weed Resistance  
Seed Test



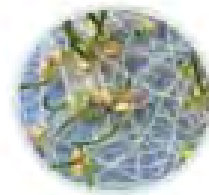
Weed Resistance  
Quick Test



Weed Viability  
Test



Crop Seed  
Quality Test



Clearfield and  
Triazine Test



# What can be tested?

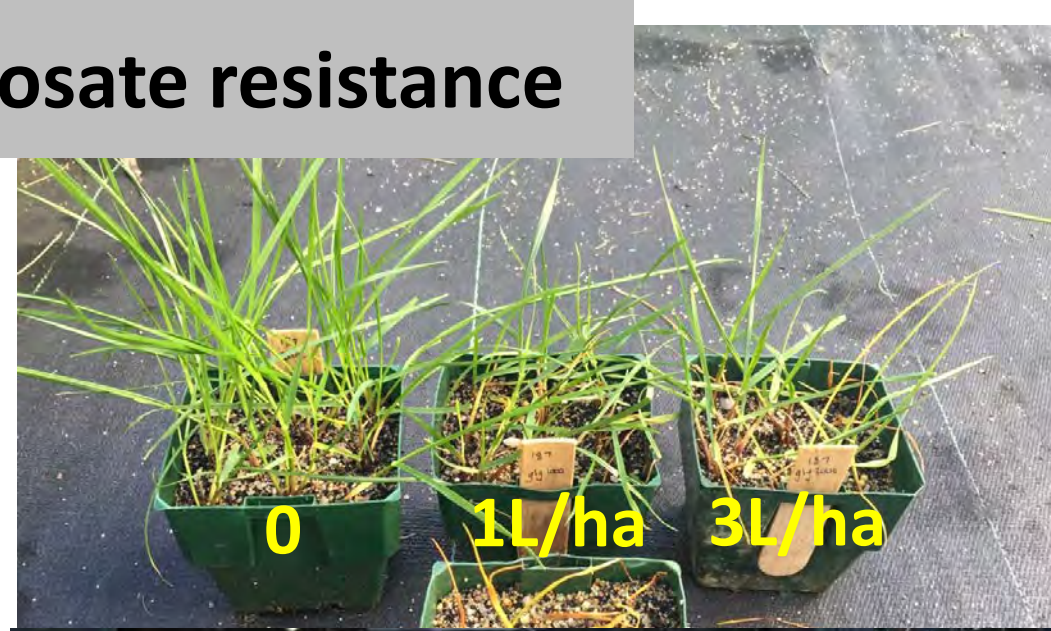
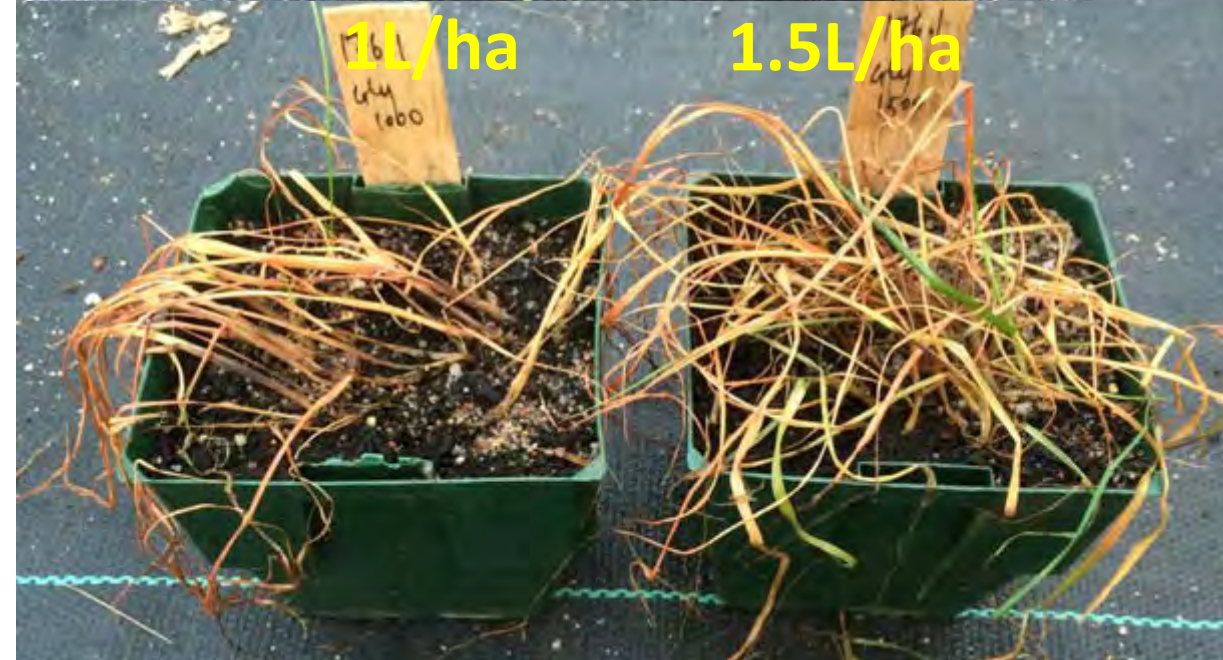
## Testing Plants



## Testing Seed



# Resistance Testing and Glyphosate resistance





- The End

