WA Herbicide Resistance Initiative (WAHRI)

- GRDC & ARC funded: multi-disciplinary research team
  From molecular resistance mechanisms to on-farm management
- Providing underpinning science
- Training is a key component (post-grad, under-grad, industry)
- Crucial that WAHRI interacts closely with the cropping industry
In 1970, all weeds were herbicide susceptible

In 2006, over 12 m Ha > 80% of all *Lolium* plants are multiple-resistant to at least the ALS & ACCase herbicides

High levels of resistance in *Raphanus*
**WAHRI 2007**

**Director**
Professor Stephen Powles

**Research Fellows/Associates**

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<tbody>
<tr>
<td>Dr Michael Walsh</td>
<td>Dr Qin Yu</td>
<td>Dr Roberto Busi</td>
<td>Dr Danica Goggin</td>
<td>Dr David Minkey</td>
<td>Dr Linh Nguyen</td>
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<tr>
<td>Resistance Management</td>
<td>Resistance Biochemistry</td>
<td>Resistance Evolution</td>
<td>Seed Dormancy Biochemistry</td>
<td>Extension</td>
<td>Molecular genetics</td>
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**PhD Students**

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<th>Name</th>
<th>Research Area</th>
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<tr>
<td>Shane Friesen</td>
<td>Resistance biochemistry</td>
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<td>Catherine Borger</td>
<td>Salsola biology</td>
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<td>Sudheesh Manalil</td>
<td>Resistance evolution</td>
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**Administration**

Robert Barrett-Lennard

**Grad Research Officer/Assistant**

Mechelle Owen
Roslyn Owen

**Visitors**

Dr Ibrahim Abdallah
Dr Martin Vila Aiub
Program 1

Resistance Evolution

1) Fitness costs of resistance mechanisms
   - multi-resistant ryegrass
   - clethodim-resistant ryegrass
   - target/non-target site resistant ryegrass

2) Inheritance of resistance

3) Resistance gene flow via pollen movement

4) Herbicide rates & resistance evolution

5) Resistance modelling
   - RIM, WRIM
   - Resistance population genetics modelling
Program 2
Resistance Mechanisms

**Lolium rigidum**
1) Molecular bases of paraquat & glyphosate resistances
2) Identifying cytochrome P450 genes
3) Mutations endowing ACCase & ALS resistance

**ARC Linkage with VABC**
2 post-docs: molecular biology of resistance

**ARC Discovery**
Molecular basis of *Lolium* dormancy

**Raphanus raphanistrum** (wild radish)
Biochemical/molecular basis of resistance

Dr Linh Nguyen
Program 3
Resistance Management

1) Agronomic management of resistance
   - identifying new herbicide options (KI 485)

2) Quantifying resistance across WA wheat belt
   - Lolium, Raphanus & Avena

3) Weed seed management at harvest
   - burning windrows
   - separation of weed seeds at harvest
   - weed seed destruction by novel methods

4) ARC Linkage with Kings Park
   - Buterolide role in cropping
Program 4
Extension & Economics

1) RIM for Australian cropping
2) Multi species RIM
3) Extension for improved management
4) WAHRI website
   http://wahri.agric.uwa.edu.au
Lolium target-site based resistance to ACCase-inhibiting herbicides

Mutations identified in CT domain:

\[ ^{1781} \text{Ile} \rightarrow \text{Leu} \text{ some Fop and Dim R} \]

\[ ^{2041} \text{Ile} \rightarrow \text{Asn} \text{ some Fop only R} \]

\[ ^{2027} \text{Try} \rightarrow \text{Cys} \]

\[ ^{2078} \text{Asp} \rightarrow \text{Gly} \]

\[ ^{2088} \text{Cys} \rightarrow \text{Arg} \]

\[ ^{2096} \text{Gly} \rightarrow \text{Ala} \]
Resistance gene identification requires genomics research & infra-structure - big $$$$.

- Resistance gene identification needs collaboration
- Challenge is gene identification in highly genetically diverse *Lolium & Raphanus*
- Much genomics research focussed on self-pollinated crops & Arabidopsis
P450 enzymes endow metabolism-based, non-target site herbicide resistance. New ARC grant with VABC will tackle identification of P450 genes.