You can follow my talk here: www.zeetings.com/sakura
EVOLUCIÓN Y MANEJO DE LA RESISTENCIA A HERBICIDAS

Roberto Busi, Herbicide Technology, University of Western Australia
Weeds can be the biggest problem

![Bar chart showing potential loss in major crops (%)](Oerke 2006)

- Pathogens
- Viruses
- Animal pests
- Weeds

Weeds can result in a loss of up to 40% in major crops. Oerke (2006)
IMPACT OF WEEDS ON AUSTRALIAN GRAIN PRODUCTION

The cost of weeds to Australian grain growers and the adoption of weed management and tillage practices

Rick Llewellyn, CSIRO
David Ronning and Michael Clarke, AgEconPlus
Allan Mayfield, Allan Mayfield Consulting
Steve Walker, UniQuest, University of Queensland
Jackie Ouzman, CSIRO

March 2016
Report for Grains Research and Development Corporation

GRDC Grains Research & Development Corporation

FIGURE 1 The total cost of weeds (revenue loss plus expenditure) to Australian grain growers is estimated at $3,318 million.

Cost
3.3 billion pa

Llewellyn 2016
Weed Species Resistance to Multiple Herbicide Sites of Action

<table>
<thead>
<tr>
<th>Weed Species</th>
<th>Number of Sites of Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lolium rigidum</td>
<td>13</td>
</tr>
<tr>
<td>Echinochloa crus-galli var. crus-galli</td>
<td>10</td>
</tr>
<tr>
<td>Poa annua</td>
<td>9</td>
</tr>
<tr>
<td>Eleusine indica</td>
<td>8</td>
</tr>
<tr>
<td>Lolium perenne ssp. multiflorum</td>
<td>8</td>
</tr>
<tr>
<td>Alopecurus myosuroides</td>
<td>7</td>
</tr>
<tr>
<td>Avena fatua</td>
<td>7</td>
</tr>
<tr>
<td>Echinochloa colona</td>
<td>7</td>
</tr>
<tr>
<td>Amaranthus palmeri</td>
<td>6</td>
</tr>
<tr>
<td>Amaranthus hybridus (syn:...)</td>
<td>6</td>
</tr>
<tr>
<td>Amaranthus tuberculatus (=A. rudis)</td>
<td>6</td>
</tr>
<tr>
<td>Amaranthus retroflexus</td>
<td>5</td>
</tr>
<tr>
<td>Ambrosia artemisiifolia</td>
<td>5</td>
</tr>
<tr>
<td>Conyza canadensis</td>
<td>5</td>
</tr>
<tr>
<td>Kochia scoparia</td>
<td>5</td>
</tr>
</tbody>
</table>
Greater use of pre-em herbicides in response to resistance

Ref: P Newman 2013
Pre-em herbicides incorporated at seeding (zero-till)
2012: New herbicide Pyroxasulfone
Field study: selection at high dose
100M seeds 4X treated : no resistance
Pyroxasulfone low dose selection

MR (Parent)  1st  2nd  3rd

Trifluralin resistant  2007  2008  2009
Resistance to pyroxasulfone

![Graph showing survival (%) against pyroxasulfone g ha\(^{-1}\)](image)

- **Selected progeny**
- **Unselected parent**

Survival (%) axis:
- 0%
- 20%
- 40%
- 60%
- 80%
- 100%

Pyroxasulfone g ha\(^{-1}\) axis:
- 0
- 100
- 200
- 300
- 400
Cross-resistance: prosulfocarb & triallate

Selection with pyroxasulfone
Cross resistance patterns

- Trifluralin
- Pyroxsulfone
- Napropamide
- Prosulfocarb + SMOC
- Metazachlor
- Dimethenamid
Resistance mechanism early studies

Synergist: P450 inhibitor (OP insecticide)

Cabinet sprayer

- **R** Herbicide only
- **R^+** Synergist + herbicide
- **S** Herbicide only
Trifluralin resistance reversed (-70%)
Phorate + pyroxsulfone (-40%)
Pyroxasulfone metabolic resistance

- More rapid decrease of $^{14}$C-labelled pyroxasulfone in resistant ryegrass
- Pyroxasulfone metabolism likely is GST-mediated

Ref: Busi and Powles et al., unpublished
GST confers pyroxasulfone resistance

GST-1

**Population**

![Graph showing transcript level (2^-ΔCt) for GST-1 in different populations.](image)

*Untreated*

**Pyroxasulfone**

![Comparison of untreated and pyroxasulfone-treated plants.](image)

USA  JAPAN
Pyroxasulfone selection led to cross-resistance to other $K_3/N$

Pyroxasulfone resistance is metabolic (GST?)

Not reversed by phorate (NOT P450)
Extension message for agronomists

FULL DOSES

Rotate BETWEEN the boxes

Trifluralin

Pyroxasultone
Prosulfocarb
Triallate

Propyzamide
Extension message for agronomists

FULL DOSES

Rotate BETWEEN the boxes

Trifluralin
Pyroxasulfone
Prosulfocarb
Triallate

Propyzamide

What about mixtures?
Modelling: mixtures delay resistance

1 = Trifluralin; 2 = Prosulfocarb; 3 = Pyroxasulfone; 4 = Propyzamide

Ref: Busi, Renton and Powles, unpublished
Future herbicides for ryegrass (2020)

Survival (%) vs. Experimental herbicide for Wheat and Ryegrass.
Herbicides are the current best tools to control weeds.

Pre-em herbicides are under pressure (know how and use them with care!)

Metabolic cross-resistance traits anticipate herbicide use

Mix and rotate at full dose (synergists? only promising)
Can this work be useful to farmers?
Are you a farmer?

Are you an agronomist?

Do you think herbicide resistance is a problem?

Is it useful to test for field resistance?
Two centres provide herbicide resistance testing

- Southern Australian ‘wheat-belt’
- 25 M ha

$1000 and 10 weeks
First experiments:

7DAT was encouraging

BUT NOT ENOUGH!
Keep monitoring...
7 DAYS

Prosulfofocarb
7 DAYS: Great!! 😍

-> Time consuming

-> OK for 3 herbicides

-> Statistical power? 😐

(5 seedlings tested)
Pyroxasulfone (Yamato)
<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Resistance detected</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glyphosate</td>
<td>YES</td>
</tr>
<tr>
<td>Paraquat</td>
<td>YES</td>
</tr>
<tr>
<td>Triallate</td>
<td>YES</td>
</tr>
<tr>
<td>Trifluralin</td>
<td>YES</td>
</tr>
<tr>
<td>Prosulfocarb</td>
<td>YES</td>
</tr>
<tr>
<td>Pyroxasulfone</td>
<td>YES</td>
</tr>
<tr>
<td>Clethodim</td>
<td>YES</td>
</tr>
</tbody>
</table>
AHRI kit for rapid resistance detection (5 DAYS)

Farmers / agronomists will sample fields and test weeds
Real-time demos to farmers
Weed seeds collected in March-April
Correlation work in progress...
Conclusions

- A new test for rapid resistance detection (patent pending);
- This AHRI test could be highly adopted (work in progress);
- Agronomists / growers will make informed decisions and own the data;
- Resistance will be managed more effectively.
You have received 118 responses.

1. Are you a farmer?
   - Yes: 33%
   - No: 67%

2. Are you an agronomist?
   - Yes: 89%
   - No: 11%

3. Do you think herbicide resistance is a serious issue in Argentina?
   - Yes: 57%
   - No: 3%

4. Would a rapid and simple test for resistance be useful to farmers/agronomists?
   - Agree: 59%
gracias por invitarme aquí
gracias por invitararme aquí
gracias por invitarme aquí
gracias por invitarme aquí
gracias por invitarme aquí
gracias por invitarme aquí
gracias por invitarme aquí
gracias por invitarme aquí
Preguntas???