How to control herbicide resistant weeds with innovative herbicide strategies?

Amali Welgama
School of Health and Life Sciences

Supervisors:
A/Prof. S. Florentine, A/Prof. Bhagirath Chauhan, Dr. Jason Brand, Dr. Nimesha Fernando, Prof. Martin Westbrook
Herbicides

- The use of chemical weed control has become necessary in today’s agriculture.

- Ease and convenience of use, less labour requirements and the quick results of chemical herbicide application have made this the most popular approach among farmers.

- Herbicide Mode of Action (MOA) : the way in which the herbicide controls susceptible plants

- 19 herbicide MOA groups (crop life, 2017)
But..

- Continuous use of the same herbicide for a long period of time $\rightarrow$ herbicide resistant weeds

Evolution of herbicide resistance in a weed population (Martin et al., 2000)
Herbicide resistant weeds (HRW)

- A plant’s evolved capability to survive the herbicide and complete its life cycle in a previously herbicide susceptible weed population (Heap, 2014)

- 48 herbicide resistant weed species in Australia (Heap, 2017)
Herbicide resistant weeds

Narrow safety margins between the weed and crop

Selection pressure on weeds

Use of different herbicides

Weed control using that particular herbicide MOA

Herbicide Tolerant Crops

Weed control using a particular herbicide MOA
Herbicide Tolerant Crops (HTC)

• Developing novel herbicide tolerant traits in plants using mutagenesis or non-mutagenesis methods

• Allows a wide range of herbicide options for farmers

• Can the HTC prevent HRW evolution?
  • **NO!** Weeds may evolve resistance to the whole herbicide MOA
New molecules to deal with herbicide resistant weeds?

• The release of new herbicides to the market has not occurred for three decades (Davis and Frisvold, 2017).

• This situation has made the farmers cognisant of the upcoming challenge of sustainable use of herbicides where an increasing number of weeds can no longer be dealt with by use of existing herbicides.
Research approach

HTC

Herbicide MOA combinations

Sustainability of HTC

Control herbicide resistant weeds

Sustainability of existing and future herbicides
Study species

HTC Faba bean  
(*Vicia faba*)

Wild radish  
(*Raphanus raphanistrum*)

Annual ryegrass  
(*Lolium rigidum*)

Herbicides MOA: Group B & Group C
Approach

- Group B
- Application rate
- Application time
- Group C
Step 1: Best growth stage for group B herbicide application on Faba bean

- **Imazamox + Imazapyr**
  - PSPE
  - 4 node stage
  - 8 node stage
  - Flowering stage

- **Imazethapyr**
  - Resistant
  - Susceptible
Step 2. To check the flexibility of Faba bean genotype to different rates of group C herbicides

<table>
<thead>
<tr>
<th>4 node stage</th>
<th>Metribuzine</th>
<th>R 1</th>
<th>R 2</th>
<th>R 3</th>
<th>R 4</th>
<th>R 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>FB Resistant</td>
<td>Susceptible</td>
<td>R 1</td>
<td>R 2</td>
<td>R 3</td>
<td>R 4</td>
<td>R 5</td>
</tr>
</tbody>
</table>
Group B

Application rate

Application time

Group C
Step 3. Best growth stage for group B herbicide application to control Wild radish/Annual ryegrass

- **Imazamox + Imazapyr**
  - 2 leaf stage: Susceptible
  - 1 node stage: Susceptible
  - 2 node stage: Susceptible
  - Flowering stage: Susceptible

- **Imazethapyr**
  - 2 leaf stage: Susceptible
  - 1 node stage: Susceptible
  - 2 node stage: Susceptible
  - Flowering stage: Susceptible
Herbicide combination
Observations
PBA Bendoc proved to be tolerant to both herbicides at all the application timings than PBA Samira
Group B application timing on Ryegrass
Group B application timing on Wild radish
Management implications

• This project will benefit not only the agricultural and weed management authorities but also will directly be beneficial for the local farmers and agronomists.

• It will also provide new leads for future research options in making weed herbicide control more beneficial and sustainable in agricultural system generally.
Reference


Hashem, A, Bowran, D, Piper, T & Dhammu, H 2001a, ‘Resistance of wild radish (Raphanus raphanistrum) to acetolactate synthase-Inhibiting herbicides in the Western Australia wheat belt’, Weed Technology, vol. 15, pp. 68-74.


thank you