Lime effects on the control of annual ryegrass and wild radish in low pH soils

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Acknowledgements

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- Bayer Crop science: supplied Sakura® and Velocity®
- Liebe Group
Background

• Anecdotal observations:
  – Hard to kill weeds in acid soils
  – Lime may enhance herbicide efficacy

• Lime reduced ryegrass and radish impact in a long-term lime trial demonstration (Gazey and Andrew)
What does lime do in soils and plants?

- Low soil pH means high soluble Al and Mn
- Lime releases Ca or Mg,
  - reverses soil acidity, reduces Al and Mn, ↑ soil pH

Ca??

- Participates in *uptake of other nutrients*
- Promotes plant cell elongation
- An essential part of plant cell wall
- *Participates in enzymatic and hormonal processes*
- Protects the plant against heat stress - *regulates stomatal opening*
Aims

- To examine the impact of lime and herbicides on the control of annual ryegrass or wild radish in low pH soils.
- **Hypothesis:** Application of lime should improve weed control and increase crop grain yield.
Methods
Methods

- **Main plots:** Lime @ 0, 1.25, 2.5, 5 t/ha applied in 2010 before sowing crop
- **Sub-plots:** 5 rates of herbicides
- **Design:** Split-plot design, 4 replications
- **Locations**
  - *Wild radish*: Eradu & Wongan Hills
  - *Annual ryegrass*: Wongan Hills and Merredin
Crop rotation for wild radish at Eradu and Wongan Hills

<table>
<thead>
<tr>
<th>Year</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crop</td>
<td>Wheat</td>
<td>Wheat</td>
<td>Lupin</td>
<td>Barley</td>
</tr>
<tr>
<td>Herbicide</td>
<td>Velocity®</td>
<td>Velocity®</td>
<td>Simazine (/Brodal + metribuzin)</td>
<td>Velocity®</td>
</tr>
</tbody>
</table>
Crop rotation and herbicides for annual ryegrass at Wongan Hills and Merredin

<table>
<thead>
<tr>
<th>Year</th>
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<th>2013</th>
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</tr>
<tr>
<td>Herbicide</td>
<td>Sakura®</td>
<td>Sakura®</td>
<td>Simazine (/Brodal + metribuzin)</td>
<td>Boxer Gold®</td>
</tr>
</tbody>
</table>
Herbicide rates (sub-plots) in wild radish and annual ryegrass

<table>
<thead>
<tr>
<th>Weeds</th>
<th>Herbicide</th>
<th>Rate 1</th>
<th>Rate 2</th>
<th>Rate 3</th>
<th>Rate 4</th>
<th>Rate 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual ryegrass</td>
<td>Sakura® (g/ha)</td>
<td>0</td>
<td>60</td>
<td>90</td>
<td>120</td>
<td>150</td>
</tr>
<tr>
<td></td>
<td>Boxer Gold® (mL/ha)</td>
<td>0</td>
<td>1000</td>
<td>1500</td>
<td>2000</td>
<td>2500</td>
</tr>
<tr>
<td>Wild radish</td>
<td>Velocity® (mL/ha)</td>
<td>0</td>
<td>250</td>
<td>350</td>
<td>500</td>
<td>670</td>
</tr>
</tbody>
</table>
Results

Soil pH
Effect of lime at 5 t/ha on the soil pH at Eradu (radish) in 2013 season

<table>
<thead>
<tr>
<th>Depth</th>
<th>Eradu- No lime</th>
<th>Eradu Lime</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 — 10 cm</td>
<td>5.05</td>
<td>5.92</td>
</tr>
<tr>
<td>10 — 20 cm</td>
<td>4.38</td>
<td>5.12</td>
</tr>
<tr>
<td>20 — 30 cm</td>
<td>4.35</td>
<td>4.55</td>
</tr>
</tbody>
</table>
Effect of lime at 5 t/ha on the soil pH at W Hills (radish) in 2013 season

![Bar chart showing soil pH at 5 t lime](chart.png)
Effect of lime at 5 t/ha on the soil pH at W Hills (ryegrass) in 2013 season

<table>
<thead>
<tr>
<th>Depth</th>
<th>WH (ryegrass)-No lime</th>
<th>WH (ryegrass)-Lime</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 — 10 cm</td>
<td>4.75</td>
<td>5.98</td>
</tr>
<tr>
<td>10 — 20 cm</td>
<td>4.23</td>
<td>4.45</td>
</tr>
<tr>
<td>20 — 30 cm</td>
<td>4.2</td>
<td>4.4</td>
</tr>
</tbody>
</table>
Lime effect on initial weed density
Effect of lime on wild radish density in 2013 season at Eradu and W Hills
Effect of lime on the density of barley grass and ryegrass at W Hills and Merredin in 2013
Herbicide effect on initial weed density
Effect of herbicides applied from 2010 to 2012 on the initial density of radish in 2013 season at Eradu and W. Hills

![Graph showing radish plants per m² at different velocity rates](image)
Herbicide effect on the density of barley grass and ryegrass at W Hills and Merredin in 2013

![Graph showing the effect of Boxer Gold® on grass density](chart.png)
Herbicide effects on final weed control
Effect of broadleaf herbicides in 2010 to 2013 on radish control in 2013 at Eradu and W Hills

![Graph showing radish control vs. Velocity® dosage for Eradu and W Hills]

Radish control (%)

0 100 200 300 400 500 600 700

Velocity® (ml/ha)

0 20 40 60 80 100

Radish (Eradu) - Blue
Radish (W Hills) - Red

97 100 100 100
98 99 100 100
Effect of grass herbicides applied from 2010 to 2013 on the control of barley grass and ryegrass in 2013

![Graph showing the effect of Boxer Gold® (mL/ha) on grass control (W Hills and Merredin).]
Grain yield

Lime effect
Effect of lime applied in 2010 on the grain yield of barley crop in 2013

- Eradu (radish)
- W Hills (radish)
Effect of lime applied in 2010 on grain yield of barley crop in 2013

![Graph showing grain yield (t/ha) for W Hills (grass) and Merredin (ryegrass) with lime application in t/ha.]
Herbicide effect on barley crop grain yield
Effect of broadleaf herbicides applied from 2010 to 2013 on the grain yield of barley crop in 2013
Effect of Sakura® and Boxer Gold® from 2010 to 2013 on grain yield of barley in 2013
Did lime influence grain yield in absence of herbicide?

Barley crop yield at Eradu radish site in 2013 in Zero Velocity® plots

<table>
<thead>
<tr>
<th>Lime (t/ha)</th>
<th>Grain yield (t/ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.34</td>
</tr>
<tr>
<td>1.25</td>
<td>1.52</td>
</tr>
<tr>
<td>2.5</td>
<td>1.83</td>
</tr>
<tr>
<td>5</td>
<td>1.66</td>
</tr>
</tbody>
</table>
Did lime interact with herbicides to enhance weed control?

No strong interaction effect of lime and herbicide on weed control was evident. However, relatively week interaction was observed in case of high density of wild radish.
Key messages

• Lime increased soil pH but the soil pH at the sub-soil layers was still below recommended pH level even 3 years after application.

• Lime reduced radish and grass weed density in all sites in 2013 but a small increase occurred in crop yield at 2 sites only.

• Herbicide was always effective on weeds and increased crop yield.

• However, a strong interaction of lime and herbicide was not evident.
Thank you

Questions?

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