Diversified Weed Management for glyphosate resistant biotypes in Europe

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2014 Integrated Weed Management is facing a crossroads of priorities...

Mitigation of climatic change (1 l diesel = 2,68 kg CO$_2$ dir. emissions)

Lowest footprint per unit of food

Economic sustainability of farming


Country herbicide reduction targets?

Soil conservation and biodiversity
BIOTYPES OF GLYPHOSATE RESISTANT *Lolium spp.* ★ AND *Conyza spp.* ★ HAVE BEEN CONFIRMED IN EUROPE
# TIERED APPROACH TO GLYPHOSATE RESISTANCE MANAGEMENT FOR MAIN WEEDS

<table>
<thead>
<tr>
<th>Weed population with low herbicides resistance risk (18,000 taxa*)</th>
<th>Any of the 206 species with biotypes resistant to herbicides other than glyphosate</th>
<th>Any of the 28 species with biotypes resistant to glyphosate somewhere</th>
<th>Lolium spp. and/or Conyza spp. present in the area</th>
<th>Lolium spp. and/or Conyza spp. resistance to glyphosate confirmed</th>
</tr>
</thead>
</table>
| Integrated Weed Management:  
• Choice of sustainable weed control program to minimize CO₂ emissions. | Integrated Weed Management:  
• Choice of weed control program to minimize CO₂ emissions  
• Potential use of glyphosate to control resistant weeds. | Diversified Weed Management:  
• Herbicide a.i. rotation. | Diversified Weed Management:  
• Scouting for presence  
• Herbicide a.i. rotation  
• Scouting for weed control and seed reduction. | Diversified Weed Management:  
• Effective post herbicides +  
• Mechanical control or  
• Follow up with other effective herbicides  
• Scouting for seed reduction. |
A reference case: 12 years of glyphosate resistant *Lolium* in Castellón (E. Spain)
Association between density of *Lolium* in heads/m² and herbicide use in 55 citrus fields of Castellón (Atanackovic et al, unpublished, 2013)
Association between density of *Lolium* in heads/m² and herbicide use in 55 citrus fields of Castellón (Atanackovic *et al.*, unpublished, 2013)
Lolium is not the only weed.
Mowing is appropriate for grassed alleys, but needs to be repeated for satisfactory *Lolium* control.
Tillage helps under dry conditions in alleys or in annual crops.)
CHEMICAL OPTIONS: Efficacy (% control) of herbicide sequences and tank mixes for control of glyphosate resistant *Lolium spp.* in TNV (average of 5 field trials in Iberia, 2013)

- Tank mix with glyphosate 1.8 kg/ha) at tillering
- Sequence at tillering following gly early post
CHEMICAL OPTIONS: Estimated cost in €/ha of herbicide sequences and tank mixes for control of glyphosate resistant *Lolium spp.* in TNV (20 €/ha application cost in Iberia)

- Tank mix with glyphosate (1,8 kg/ha) at tillering
- Sequence at tillering following gly early post
## Risks for the Sustainability of Integrated Weed Management

<table>
<thead>
<tr>
<th>Management Option</th>
<th>Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herbicide use in cropping system</td>
<td>LOW &gt; 2 modes of action</td>
</tr>
<tr>
<td></td>
<td>MODERATE 2 modes of action</td>
</tr>
<tr>
<td></td>
<td>HIGH 1 mode of action</td>
</tr>
<tr>
<td>Weed control in cropping system</td>
<td>Cultural, mechanical and chemical</td>
</tr>
<tr>
<td></td>
<td>Cultural and chemical</td>
</tr>
<tr>
<td></td>
<td>Chemical only</td>
</tr>
<tr>
<td>Same mode of action per season</td>
<td>Once</td>
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<tr>
<td></td>
<td>More than once</td>
</tr>
<tr>
<td></td>
<td>Many times</td>
</tr>
<tr>
<td>Cropping system</td>
<td>Full rotation</td>
</tr>
<tr>
<td></td>
<td>Limited rotation</td>
</tr>
<tr>
<td></td>
<td>No rotation</td>
</tr>
<tr>
<td>Resistance status to mode of action</td>
<td>Unknown</td>
</tr>
<tr>
<td></td>
<td>Limited</td>
</tr>
<tr>
<td></td>
<td>Common</td>
</tr>
<tr>
<td>Weed infestation</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
</tr>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Control in last 3 years</td>
<td>Good</td>
</tr>
<tr>
<td></td>
<td>Declining</td>
</tr>
<tr>
<td></td>
<td>Poor</td>
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<tr>
<td>Proper usage (rate / timing)</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Unsure</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>
Resistance risk analysis for glyphosate in Europe (2014)

- Low proportion of herbicide suppliers with high stewardship commitments
- Over 30 years of continued use
- Occurrence of resistant species
- Frequency of repeated use
- Herbicide risk (EPPO PP standard 1/213)

- Perennial crops
- Arable crops
Stewardship and communications on glyphosate resistance:

- Literature and mass media may help, but **product labels are the most reliable way to reach the end user.**
- Resistance statements are now included in Roundup® labels for Belgium, France, Germany, Ireland, Italy, Netherlands, Portugal, Slovakia, Spain and UK.
- Glyphosate labels in **Portugal** include the sentence “Repeated application of the same herbicide in the same area over several years may lead to development of resistance in species previously susceptible. To avoid development of resistances, it is recommended, whenever possible, to use herbicide mixtures or rotation with herbicides acting differently from glyphosate.”
- Roundup® labels in **Spain** are including the following sentence in the label “Some biotypes of *Coryza* and *Lolium* have been identified as resistant to the recommended rates of glyphosate. The areas with these biotypes must be properly managed –before these weeds produce seeds- using other types of registered herbicides, or by mechanical or cultural practices. Please check with your distributor or a Monsanto representative for further information.
- But we also have in Spain over 100 glyphosate formulations sold by **other companies**, and we do not have evidence on how resistance stewardship is being addressed...
GENERAL RECOMMENDATIONS

✓ Use an effective and registered herbicide product at the right rate and at the right time. For information on rates, timing or conditions, consult the herbicide product label.

✓ Indicate, at least on the product label, the weeds where weed resistance is most likely.

✓ For the high risk weeds (*Lolium*, *Conyza*...), combine with other effective herbicides or cultural practices (e.g. tillage, mowing or crop rotation) where appropriate.

✓ Control weed escapes to prevent weeds from setting seeds.

✓ Adopt good crop hygiene practices to prevent seed spread.

✓ Report any incidence of repeated non-performance on a particular weed to the local manufacturer representative.
**Lolium spp. in perennial crops**

1. Use Roundup® at rate to get 100% control (early tillering)
2. Scout treated fields 3-6 weeks after application to detect **escapes unrelated to spray coverage** (picture below left)
3. If escaped *Lolium* is dense and growing in the alleys, explore its potential use to feed livestock from nearby farmers
4. Spray eventual weed escapes in late fall-winter with registered effective herbicides such as those including flazasulfuron, clethodim, cycloxidim or quizalofop
5. Shallow tillage could be used in March when most of the weed seeds have germinated and provided there is no risk damage to the crop or to irrigation facilities
6. If some *Lolium* weed escapes are still alive in April, **minimize seed production** by spot spraying with registered effective herbicides such as glufosinate, or by two mowings in early May and June.
Conyza spp. in perennial crops

1. Use Roundup® at label rate and early rosette stage (January-February), preferably under cool temperatures.
2. Scout treated fields 3-6 weeks after application to detect **escapes unrelated to spray coverage** (picture left).
3. Spray areas with uncontrolled Conyza with registered effective herbicides such as flazasulfuron (best early postemergence), **amitrol** (also helping to control *Malva*), **MCPA** (such as with Fusta™) or fluroxipir.
4. If there are new emergencies after the previous treatment has been applied in February, a repeat application in May—preferably changing the active ingredient—might be appropriate to **avoid seed production**.
5. Shallow tillage is another potential option to be used in March when most of the weed seeds have germinated and provided there is no risk damage to the crop or to irrigation facilities.
6. Diversify the herbicide mechanisms of action to be applied in consecutive years.
PROPER DISSEMINATION OF DIVERSIFIED WEED MANAGEMENT / IWM IS AS IMPORTANT AS THOROUGH KNOWLEDGE OF OPTIONS
PROPER DISSEMINATION OF DIVERSIFIED WEED MANAGEMENT / IWM IS AS IMPORTANT AS THOROUGH KNOWLEDGE OF OPTIONS

Thank you!

Mechanical, Chemical, Biological and Cultural Management Options

Management Diversity

Cultural

Mechanical

Biological

Chemical