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Christine Brunel-Ligneau & Bayer colleagues

Merci, Danke, Thank you, Obrigado, Gracias, Tak, Tesekur ederim
32 years ago I joined the herbicide resistance battle

- 1983 Gif-sur-Yvette
  (30 km from Eiffel Tower)

- Herbicide Resistance in Plants. 1982. Editors: LeBaron & Gressel
What was my industry?
Our industry...

- Crop Protection, Farming, Agrichemicals, Research, Consulting, Business, Regulating, Agronomy, Herbicide, Consultant, Education, Communication
Food!

- Weeds threaten global food
- “Persistent food robbers over >10,000 years”
Our objective: MORE FOOD through less weeds, sustainably.
In a world full of weeds herbicides are superb tools for **MORE FOOD** less weeds.
Herbicides are available, effective, cheap & reliable.

- So easy to use
- So easy to OVERUSE
Resistance evolution

Any good weed control tool persistently used over large areas without diversity
HR weeds are global

Where persistent herbicide use without diversity!
BIG HR weed issues: USA, Brazil, Argentina, Canada, Australia

The five big global food (grain) exporters.
USA, Brazil, Argentina

- Big three global corn / soybean exporters – crucial to global food security

- BIG three adopters of GM glyphosate resistant crops

- US & Brazil have major herbicide resistant weed problems & Argentina at risk
USA = #1 in herbicide resistance

100 m ha field crops
70% GR

34 m ha glyphosate R weeds.
Weeds remember R to previous herbicides = MULTIPLE RESISTANT
Glyphosate resistant weeds have **tripled** $$$ herbicide spend for US corn & soybean growers

<table>
<thead>
<tr>
<th></th>
<th>Before Gly R</th>
<th>Now</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>$75 /ha</td>
<td>$200 /ha</td>
</tr>
<tr>
<td>Soybean</td>
<td>$75 /ha</td>
<td>$250 /ha</td>
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</tbody>
</table>
Glyphosate is redundant on “driver” weeds. Brazil & Argentina also!
BRAZIL 60 m ha field crops

HR weeds on 15 m ha (30%)
Argentina: 20 m ha soybean (99% GR) & 5 m ha corn (50% GR)

No published surveys of the extent of GR weeds

GR *Sorghum halepense* widespread in Salta Province and GR *Amaranthus palmeri* increasing
USA, Brazil, Argentina

• 148 million hectares of corn, soybean, cotton

• USA 34 million ha
• Brazil 15 million ha
• Argentina 1 million ha

= 50 million ha of the world’s best crop land infested with glyphosate resistant weeds & often multi-resistant = a threat to global food
30 m ha field crops
20 m ha HR weeds, esp. multi-R Lolium
Change needed now
Change is difficult
Forces against change & thus driving resistance “disaster”

- 50 years of successful herbicide weed control
- Strong belief that new herbicide solutions imminent
- Strong industry signals of pipeline of new herbicide / gene solutions
- Short term $$$$ driven decision making
- High % of rental crop land (US, Argentina)
- Upcoming period of lower grain prices
- Generic herbicide suppliers

- A **RR** generation used to easy herbicide weed control
- Diversity tactics perceived to be too difficult
- Growers do not “fear the weeds”
Change means confronting HOS
AIDS, SARS, MERS → HOS: A condition to be challenged
Herbicide Only Syndrome

HOS
• Herbicides are superb weed control tools, BUT multiple herbicide resistant weeds are telling us that herbicides ALONE are not sustainable

• DIVERSITY is the only sustainable way forward
The good news...

- Herbicides much more sustainable IF HOS replaced by diversity!
Diversity disrupts resistance evolution = sustainability
Diversity disrupts resistance evolution

Herbicide non-herbicide tools
Herbicide diversity & technology can disrupt R evolution

- New herbicides (non-metabolisable)
- Herbicide synergists & safeners
- Smart full-dose mixtures, sequences
- Genetic herbicides (RNAi)
- Herbicide restraint
Non-herbicide tools
Diversity & technology can confuse weeds

- Smart herbicide mixtures & synergy
- Smart crop rotation & agronomy
- Harvest weed seed control
- RNAi etc
- Precision agric & sprayers
- Robotics
- New technology

Need new herbicides!
BUT...

That’s taking things at face value!
There’s many layers to diversity

- Socio-economic
- Behaviour change
- Decision process (head vs. heart)
- Community influence (peer pressure)

Science & technology
Diversity needs communication

Science & technology

Socio-economic

Behaviour change

Decision process (head vs. heart)

Community influence (peer pressure)
Diversity needs communication

- More crop, less weeds - sustainably
- Traditional: Media releases, Articles
- People: Champion farmers
- Video
- Live: Workshops, Updates, Events, Presentations
- Digital: AHRI insight, Website
- Virtual: Diversity Era, Webinars
- Social: Twitter
- Models: RIM

Science & technology

- Socio-economic
- Behaviour change
- Decision process (head vs. heart)
- Community influence (peer pressure)
Food for a world with multiple HR weeds

Herbicides & other tools WILL continue IF all sectors ADOPT DIVERSITY.

The time to act is NOW.
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