Global Herbicide Resistance Action Committee

CropLife INTERNATIONAL

Global HRAC Member Companies.

HERBICIDE RESISTANCE ACTION COMMITTEE

Our Members:	Our Staff:
Arysta LifeScience BASF Bayer CropScience Corteva Agriscience™, Agriculture Division of DowDuPont FMC Syngenta Crop Protection Sumitomo Chemical Company	**Chair** *Mark Peterson - Corteva* **Secretary/Treasurer** *Roland Beffa – Bayer* **Communications Lead** *Julia Fellmann, Syngenta*

Working Groups:

HERBICIDE RESISTANCE ACTION COMMITTEE

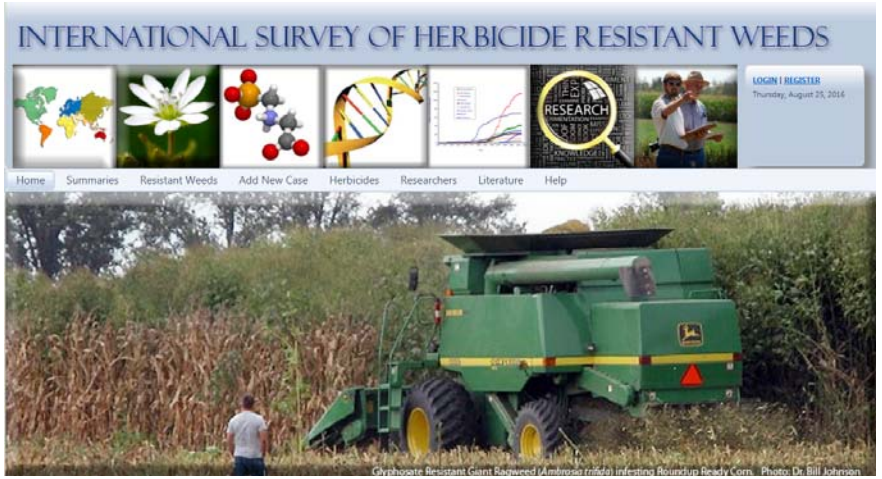
Auxin	HPPD	Communications	Issues Engagement	MOA Classification	PPO
Terry Wright	Roland Beffa	Julia Fellmann	Harry Strek	Rex Liebl	John Pawlack

Key objectives for Working Groups:

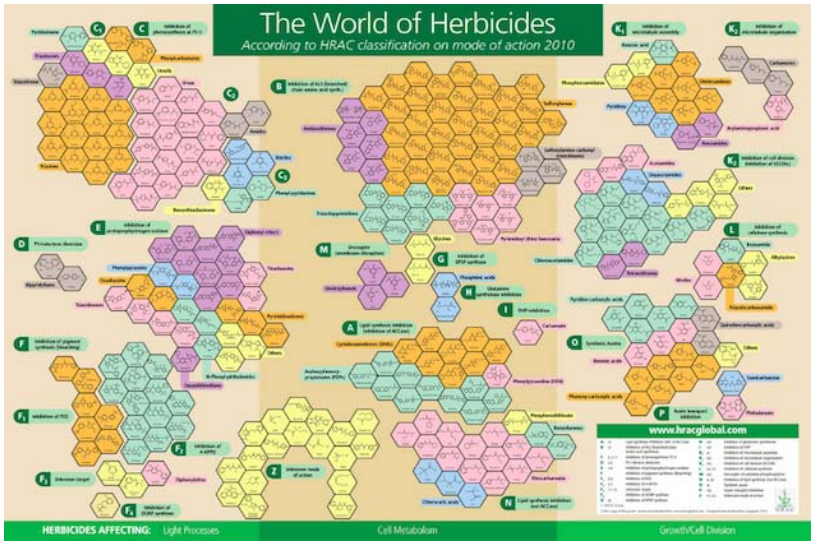
- Consolidate and communicate information for specific MOAs
- Monitor research
- Support intellectual dialogue
- Customize BMPs for a given MOA
- Address specific resistance topics (e.g. Monitoring)

Global HRAC Initiatives and Activities

- Disseminate information on resistant weeds:
  - The International Survey of Herbicide Resistant Weeds
  - HRAC Website
  - Seminars and Symposia
- Build recommendations:
  - Working groups
  - Testing protocols
- Mode of Action Classification:
  - Poster
  - Online tool
  - Coordination with other entities



www.weedscience.org



www.hracglobal.com

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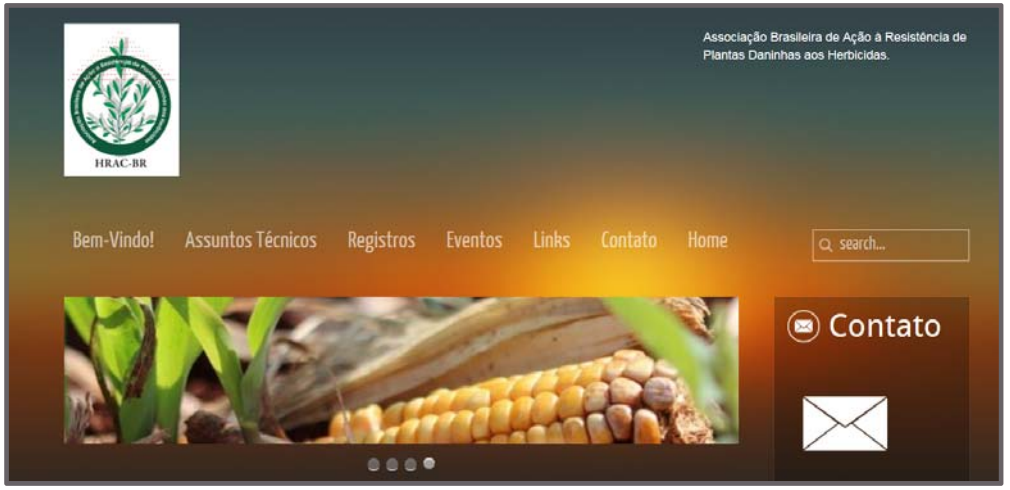
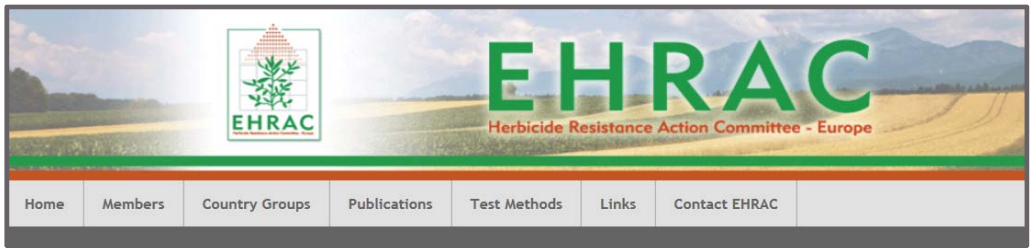
Regional/Country HRAC Objectives and Actions

- Education materials, seminars, symposia
- Research collaborations
- Collection of information on resistant weeds
- Development of Best Management Practices



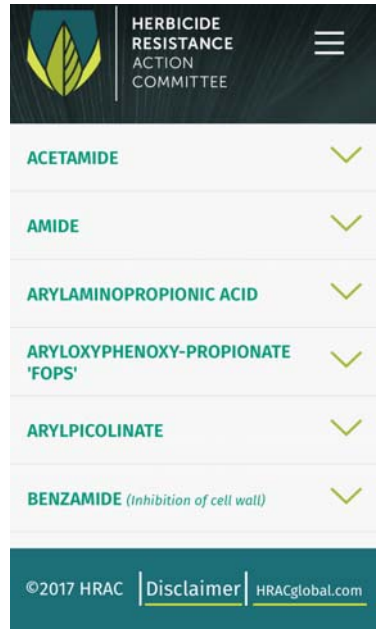


New Resistance cases in Europe

Country	Weed species	First Year	Active ingredient	Site of Action	Crop
Germany	*Bromus sterilis*	2017	propoxycarbazone	ALS (B/2)	wheat
Greece	*Lolium rigidum*	2017	glufosinate	Glutamine synthase inhibitor (H/10)	grapes, olives, orchard
Hungary	*Sorghum halepense*	2017	Foramsulfuron / nicosulfuron	ALS (B/2)	Corn
Serbia	*Sorghum halepense*	2017	Fenoxaprop, fluazifop, haloxyfop,. …	ACCase (A/1)	Soybean
Ukraine	*Echinochloa cruss-galli*	2017	Imazamox, penoxulam	ALS (B/2)	Rice

2018 Activities and Accomplishments

- Continued engagement with local/regional HRACs
- MOA Classification Working Group completes updates and revisions
- Herbicide MOA app
- PPO Working Group initiated
- Auxin Working Group sponsored review paper
- Review of resistance testing methods in progress
- Survey of HRAC stakeholders completed



MOA mobile app


Review

SCI

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(wileyonlinelibrary.com) DOI 10.1002/ps.4823

Weed resistance to synthetic auxin herbicides

Roberto Busi,[a] Danica E Goggin,[a] Ian M Heap,[b] Michael J Horak,[c] Mithila Jugulam,[d] Robert A Masters,[e*] Richard M Napier,[f] Dilpreet S Riar,[e] Norbert M Satchivi,[e] Joel Torra,[g] Phillip Westra[h] and Terry R Wright[e]

Auxin Resistance Review

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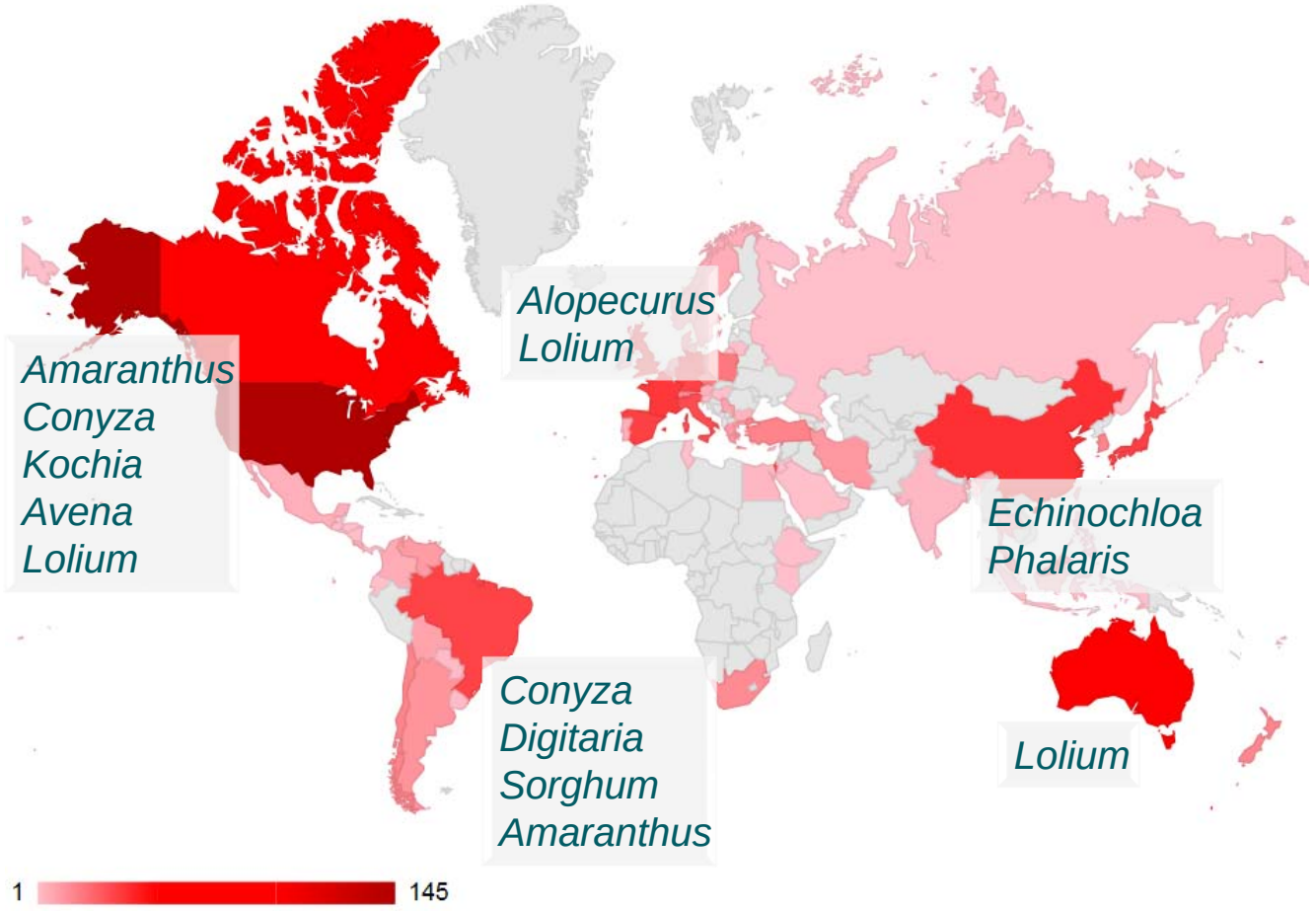
Industry Perspective of How to Meet the Herbicide Resistance Challenge

Mark A. Peterson, Global HRAC Chair

Herbicide Resistant Weeds Globally



Number of herbicide-resistant species by country

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Challenges of Herbicide Resistance

Undermines sustainability
Hurts our customers
Limits return on investment

Challenges to Resistance Management

Technical
Economic
Societal

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How Does Industry Meet These Challenges?

Technical

- Develop new technologies (small and large companies)
- Evaluate integrated programs
- Study resistant weeds to understand mechanisms

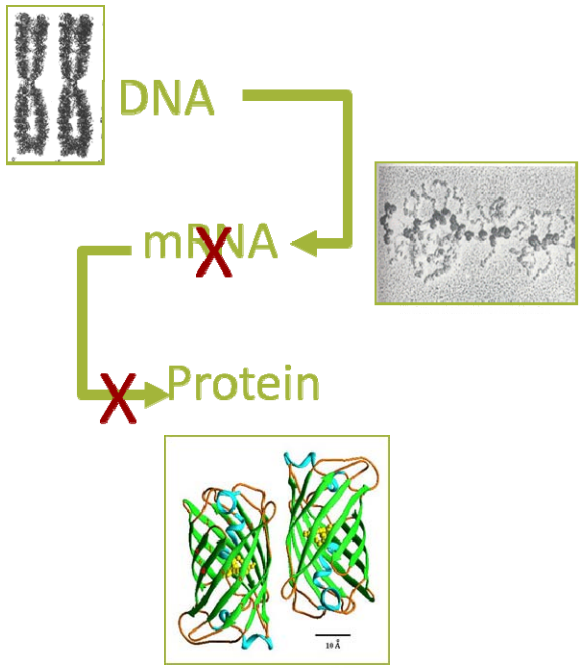
Economic and Societal

- Education
- Stewardship programs
- Incentives

How Does Industry Meet These Challenges? Develop new technologies

Biotechnology

- Gene insertion (adding new DNA)
- Gene editing (manipulating existing DNA)
- Manipulation of transcription (e.g. RNAi)



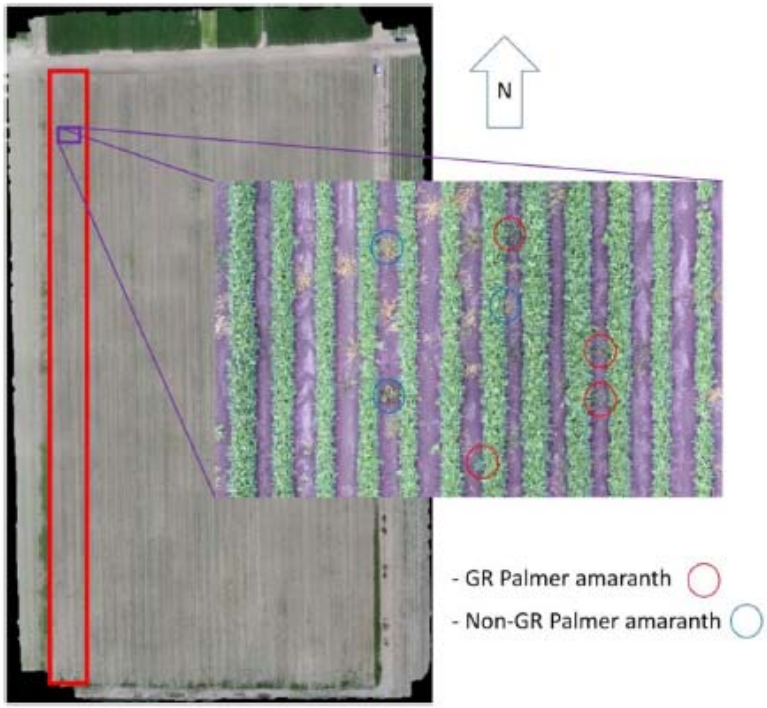
- **These technologies offer significant promise**
- **Societal and political acceptance issues are limiting the potential**
- **Uncertainty of market access can cause companies to reconsider investments**

Robotic weeding

- Possibly starting to come of age
- John Deere recently acquired Blue River Technology
- Most devices are currently focused on plant-selective spraying (www.seeandspray.com)
- Could non-chemical means be incorporated in the future?

Precision Weed Management

- UAV-mounted sensor technology
- Faster detection of resistant weeds
- Potential to incorporate spot-control devices



Huang, et al. Weed Tech. 2017

Other Alternative Management Tools

- How can technology change crop competitiveness?
- Which companies can bring these technologies forward?

Selective fertilization with phosphite allows unhindered growth of cotton plants expressing the *ptxD* gene while suppressing weeds

Devendra Pandeya[a,1], Damar L. López-Arredondo[b,1], Madhusudhana R. Janga[a], LeAnne M. Campbell[a], Priscila Estrella-Hernández[b], Muthukumar V. Bagavathiannan[c], Luis Herrera-Estrella[d,2], and Keerti S. Rathore[a,c,2]

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Summary

- Weeds are evolving
- Our thinking must evolve as well
- The Industry needs to work cooperatively and inclusively in some areas
- Public and Private weed scientists as well as farmers need to be open to new ideas and new methods of weed control

Thank You!

Contact us at hracglobal.com