Science For A Better Life

Role of Consultants in Preserving Insecticidal Technology

November 8, 2012| Tunica, MS

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Agenda/
Content

- Integrated technology pipeline
- Threats
- Successes and failures
- Consultant role

BioScience – our growth strategy


Traits


Seeds


Seed treatment


Agrochemicals


Plant health


Harvest aids & diagnos-tics


Down-stream

An integrated approach to crop protection

Integrated Crop Platforms – focusing on our customer's needs

Cotton: A complete offering for customers & more value per seed bag sold

Shifting the focus to integrated cotton products and solutions

Bayer CropScience

A Strong Trait Pipeline

Cotton

- GlyTol (Herbicide Tolerant)
- GlyTol + Liberty Link (Dual Herbicide Tolerance)
- GlyTol + Liberty Link + Bollgard® II (Dual Herbicide Tolerance, Dual Insect Resistance)
- WideStrike (Insect Resistant)
- GlyTol + Liberty Link + TwinLink (Dual Herbicide Tolerance, Dual Insect Resistance)
- GlyTol + Multiple Insect Resistance

Oilseeds

- Winter hybrid oilseed rape (Europe)**
- Canola hybrids (Herbicide tolerant) – Australia
- Yield enhancement**
- InVigor + Genuity™ Roundup Ready® (Dual Herbicide Tolerance)
- Oil Quality**

Rice

- Submergence Tolerance**
- Brown plant hopper + Gall Midge Resistance**
- Salinity Tol.**
- Liberty Link (Herbicide Tolerant)

Soybeans

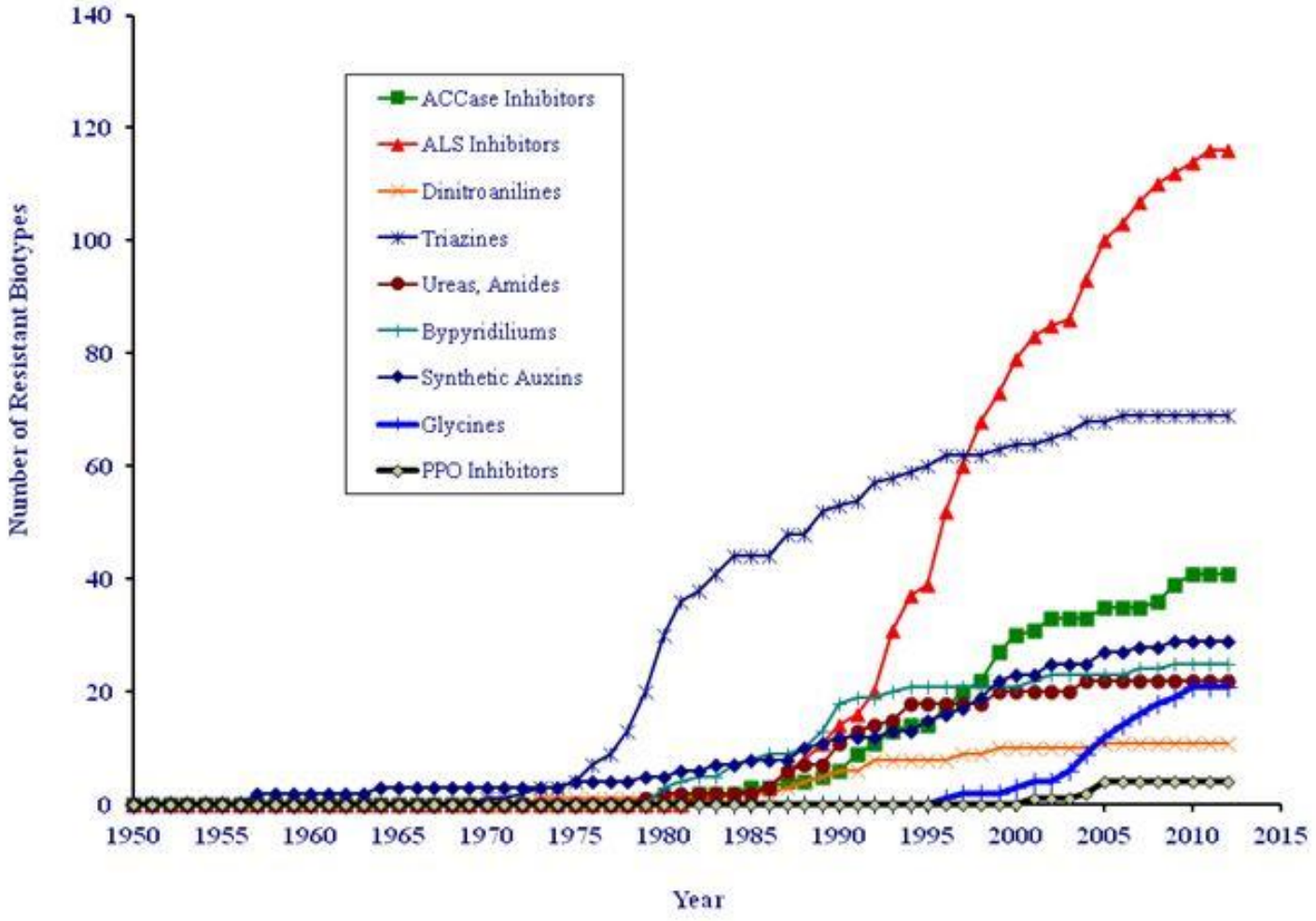
- Liberty Link (Herbicide Tolerant)
- GlyTol + HPPD (Dual Herbicide Tolerance)
- GlyTol + HPPD + Liberty Link (Triple Herbicide Tolerance)

Expected Launch*	2011	2012	2013	2014	2015	2016

* Product launches are subject to regulatory approvals

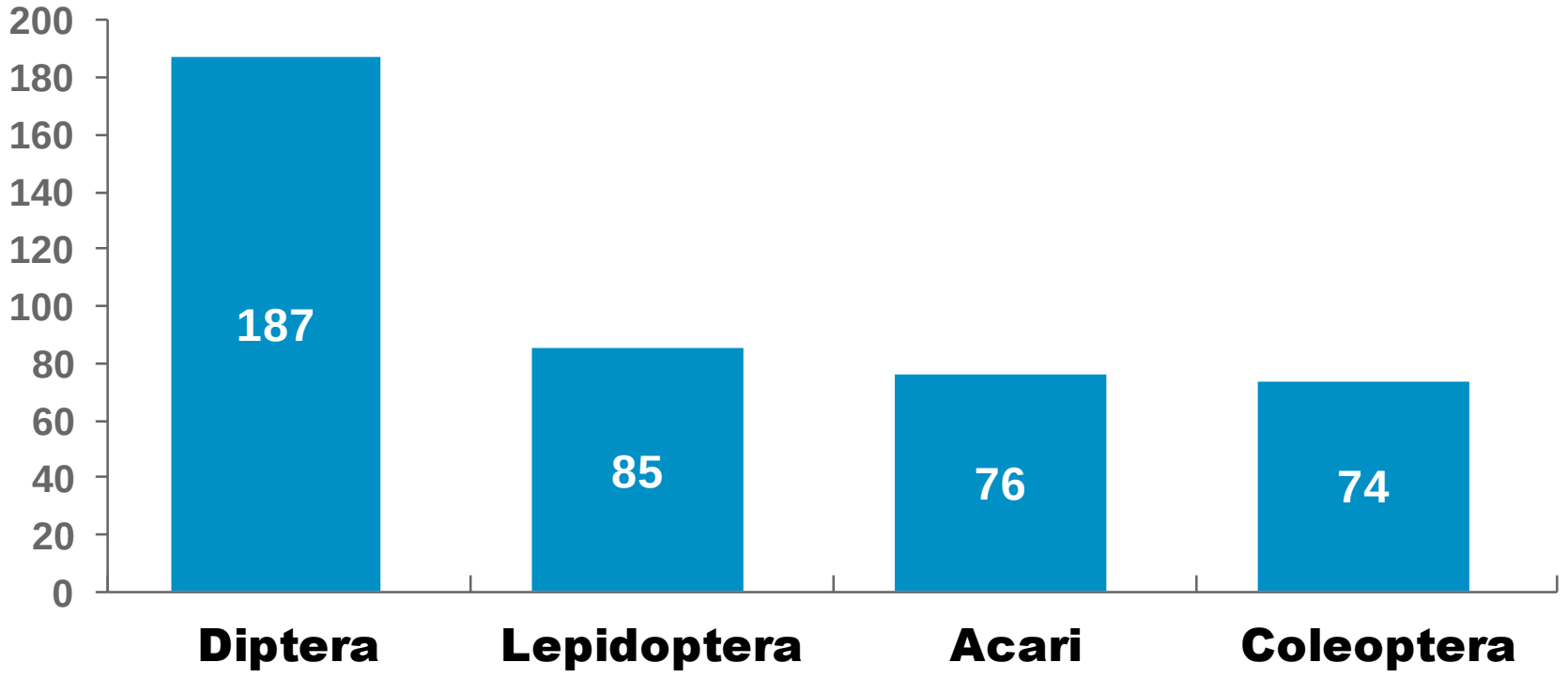
WideStrike™ is a trademark of Dow AgroSciences LLC, Genuity™, Roundup Ready® and Bollgard®II are trademarks of Monsanto Company

Resistant Weed Species



Source: Ian Heap

Resistant Arthropod Species

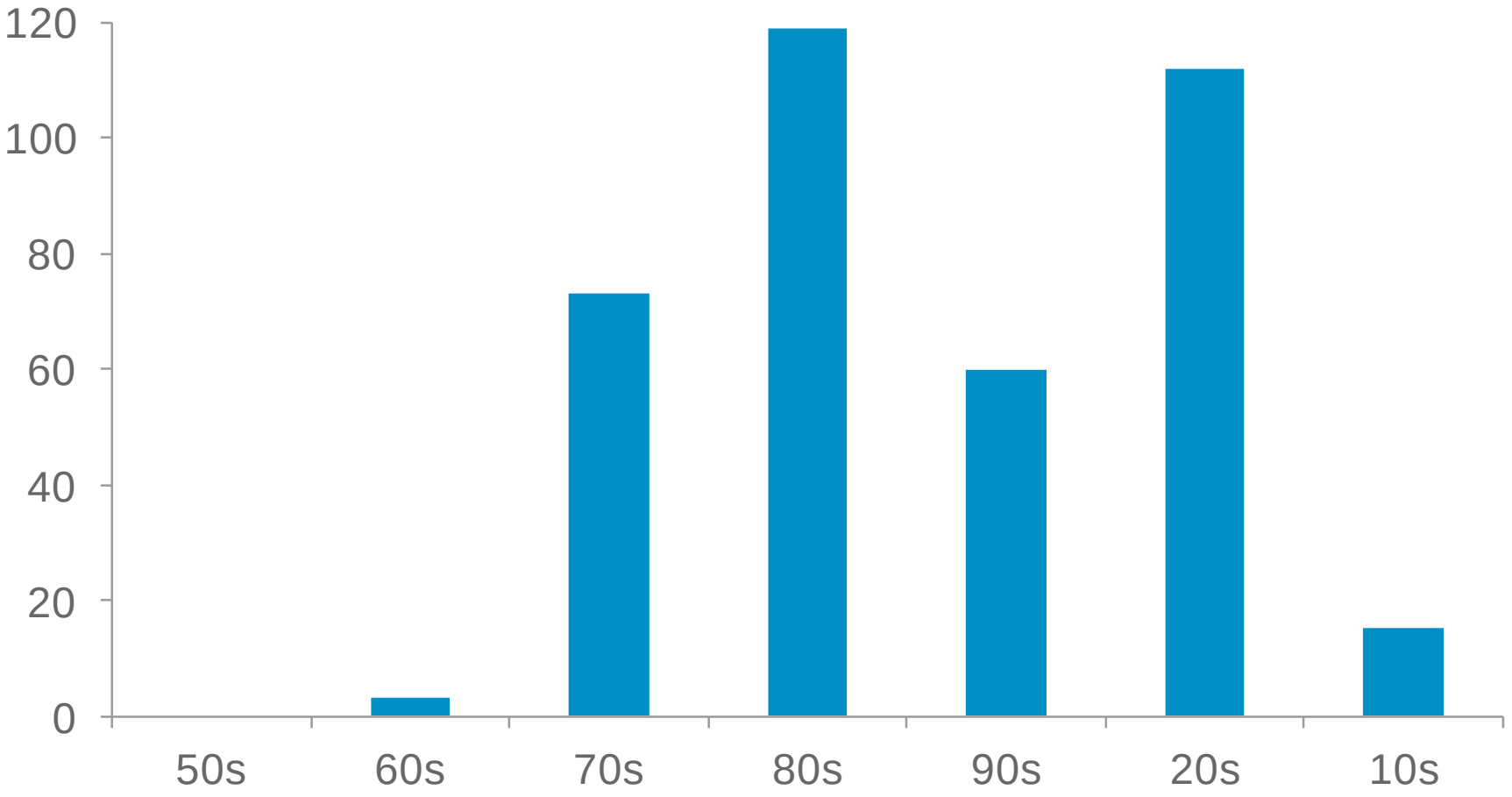


Whalon, M, et al. 2008 Analysis of Global Pesticide Resistance

553 Arthropod Species are resistant, 306 agriculturally important

Resistant Plant Disease Species

FRAC. http://www.frac.info/frac/publication/anhang/List-of-resistant-plant-pathogens_2012.pdf



Tarnished plant bug

Constant battle

- Multiple MOA resistance
  - OP's
  - Pyrethroids
  - Cyclodienes
  - Carbamates

Global Bt Crops Resistance Picture

Field-Relevant	Cry1Ab maize in South Africa	*Busseola fusca*
	Cry1F maize in Puerto Rico	*Spodoptera frugiperda*
	Cry1Ac cotton in Gujarat India	*Pectinophora gossypiella*
	Cry3Bb1 corn in Iowa	*Diabrotica virgifera virgifera*
No evidence of field relevance	Cry1Ab maize in USA	*Ostrinia nubilalis* *Diatraea grandiosella*
	Cry1Ac cotton in USA	*Heliothis virescens* *Helicoverpa zea* *Pectinophora gossypiella*
	Cry1Ac cotton in China	*Helicoverpa armigera* *Pectinophora gossypiella*
	Cry1Ac cotton in Australia	*Helicoverpa armigera* *Helicoverpa punctigera*
	Cry2Ab cotton in Australia	*Helicoverpa armigera* *Helicoverpa punctigera*

Lessons from 17 Years of Bt Crop Use….

- High dose/refuge strategy can effectively delay resistance
- Pyramids of toxins reduce resistance risk/refuge size
- Functionally monophagous pests present the greatest challenges

Lessons learned (cont.)

- Polyphagous pests must be managed at the agro-ecosystem level in intensive agricultural systems
- Small and very large farms pose the greatest challenges with compliance with IRM and refuge requirements
- Resistance must be defined in the both the laboratory and the field

Lessons learned (cont.)

- Objective of IRM is to delay resistance, not prevent it
- Sustainable Bt crops = IPM + IRM + research pipeline

The high dose/refuge strategy can effectively delay resistance

Example: Pink bollworm in Southwestern USA

- Monophagous pest
- High resistance risk
- Very high Bt cotton deployment rates
- Major gene/intensive resistance isolated in 1997
- 70-80% compliance with planting of 5%/20% refuges
- Intensive monitoring: bioassays and molecular

The high dose/refuge strategy can effectively delay resistance

…..if refuges are adequate.

Cases of field-relevant resistance

Cry1Ab maize in South Africa	*Busseola fusca*
Cry1F maize in Puerto Rico	*Spodoptera frugiperda*
Cry1Ac cotton in Gujarat India	*Pectinophora gossypiella*

- ✓ All cases with low/no compliance with refuge requirements

Gujarat, India. Pink bollworm emergency hole on single-gene (Cry1Ac) cotton

EPA Requirements for TwinLink

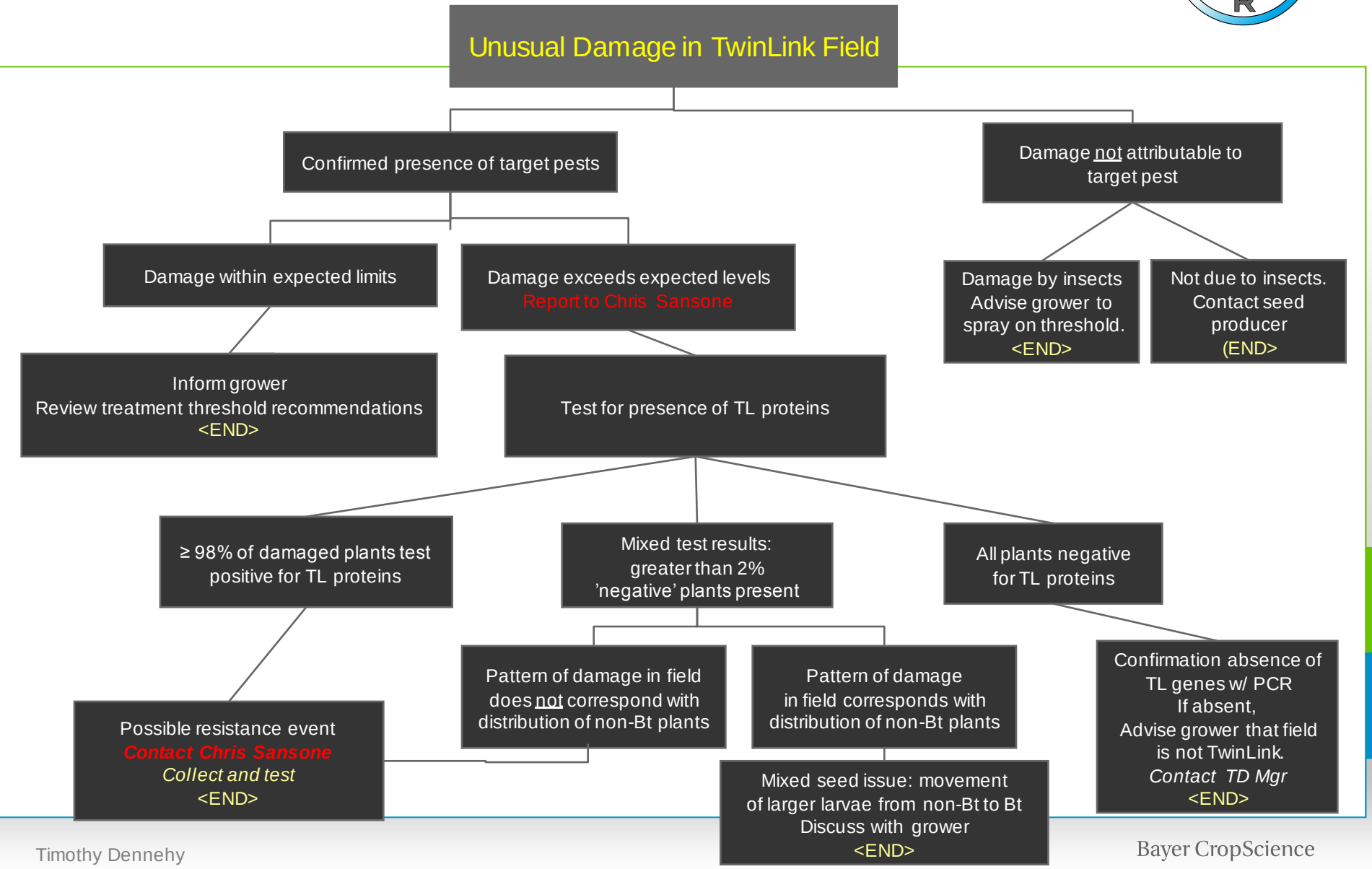
BCS must ....

Monitor resistance, including:

- *Surveying and testing insects for potential resistance*
- *collection of information from growers about events that may indicate resistance.*

If a substantiated resistance incident occurs, Bayer CropScience must report this to EPA, do follow-up investigations and submit and execute a plan to remediate the problem.

Responsibilities and Reporting Expectations



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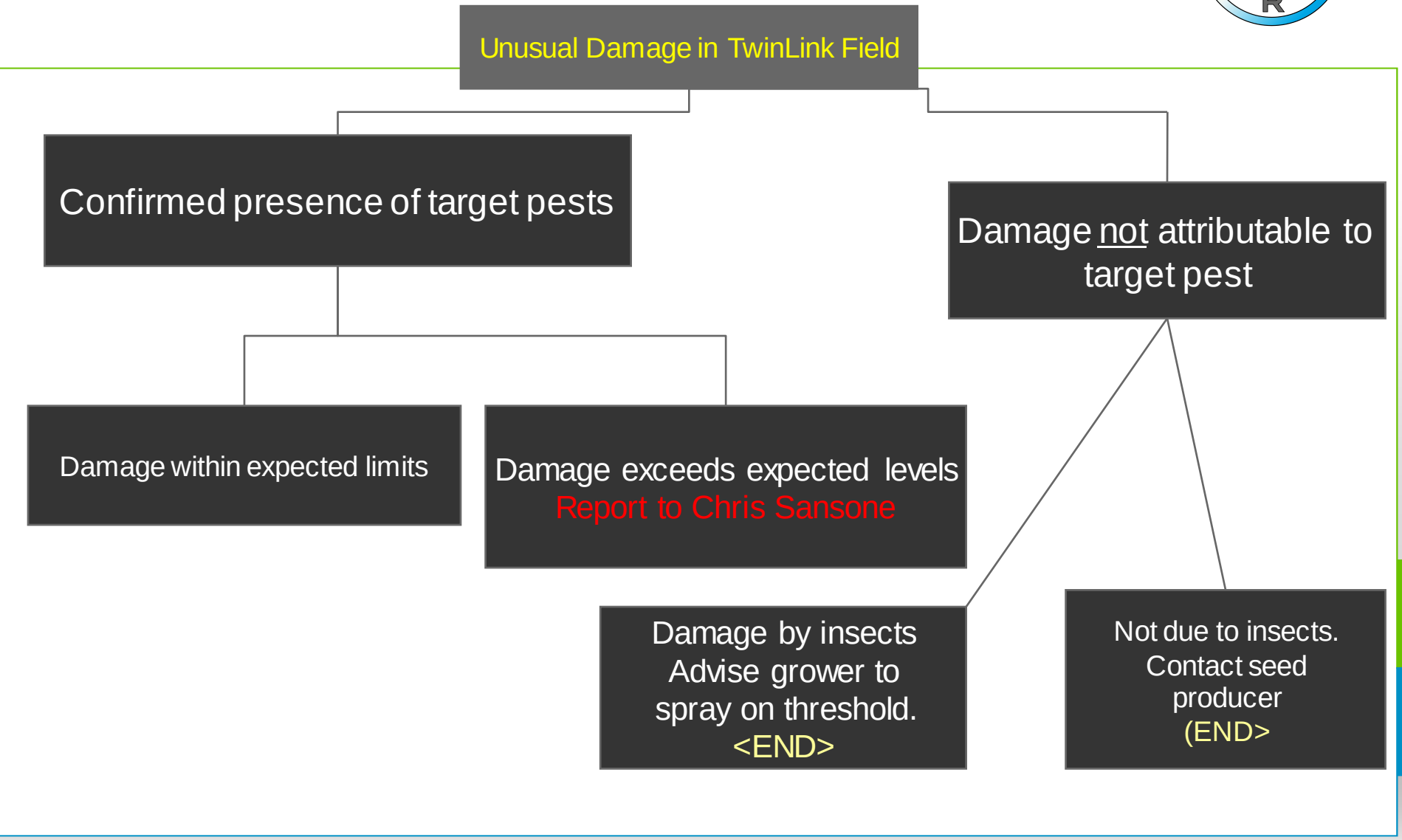
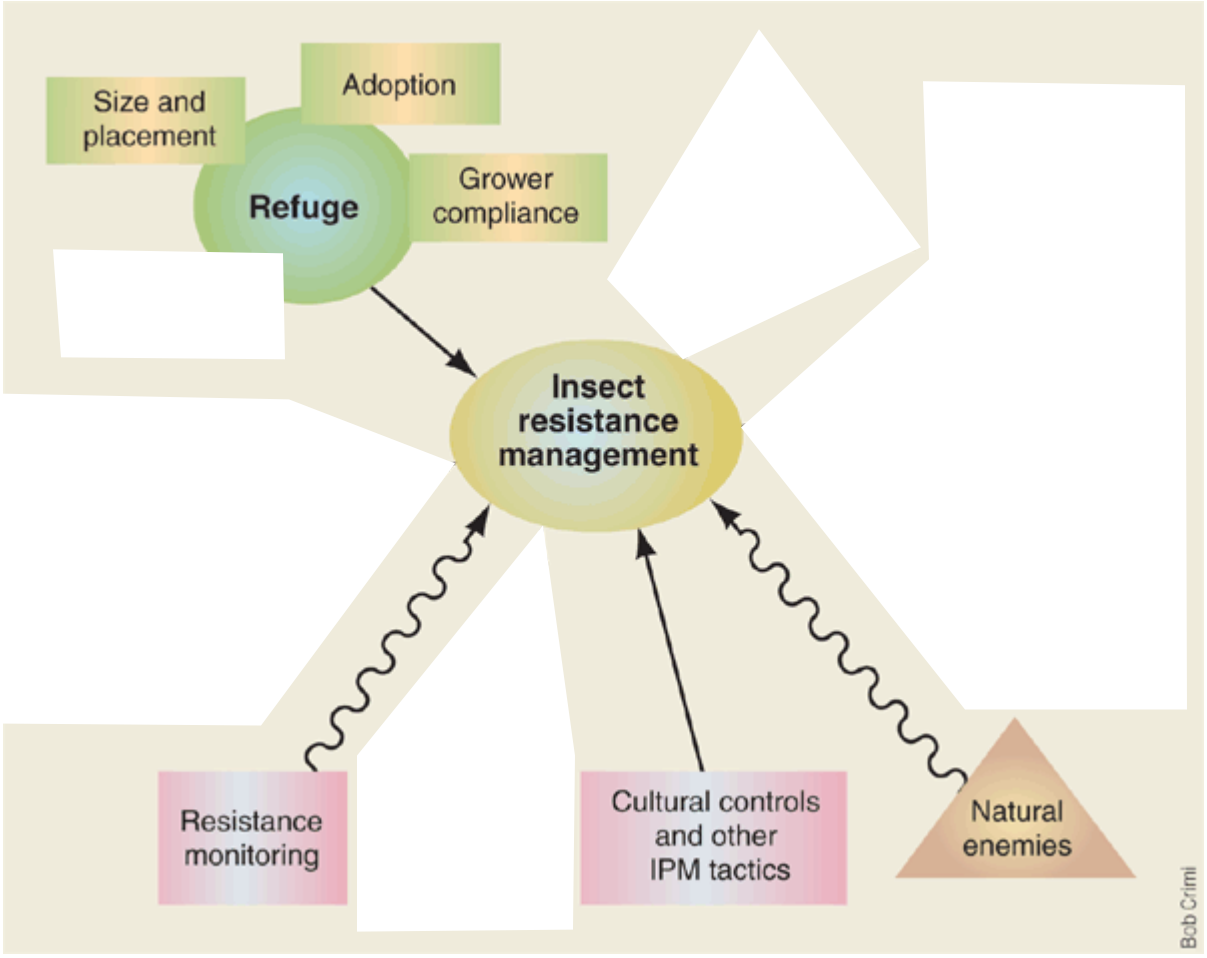


Integrated Pest Management

- System or strategy
- Utilizes all methods of pest suppression
- Tactics used are compatible
- Maintain pests below economically damaging level
  - Should be environmentally sound

Consultant Role with Insecticides

Consultant Role with Insecticidal Proteins



Consultant Role with IPM

From: P. Ellsworth,
University of Arizona

LET'S GET THINGS DONE AND … PROPEL FARMING'S FUTURE

- Stay up to date
- Understand the broader issues
- Educate your 'clients'
  - ✓ Producers, universities, industry

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