

Directions in Global Research and Development for Crop Protection Products

Presentation at APVMA Future Forum

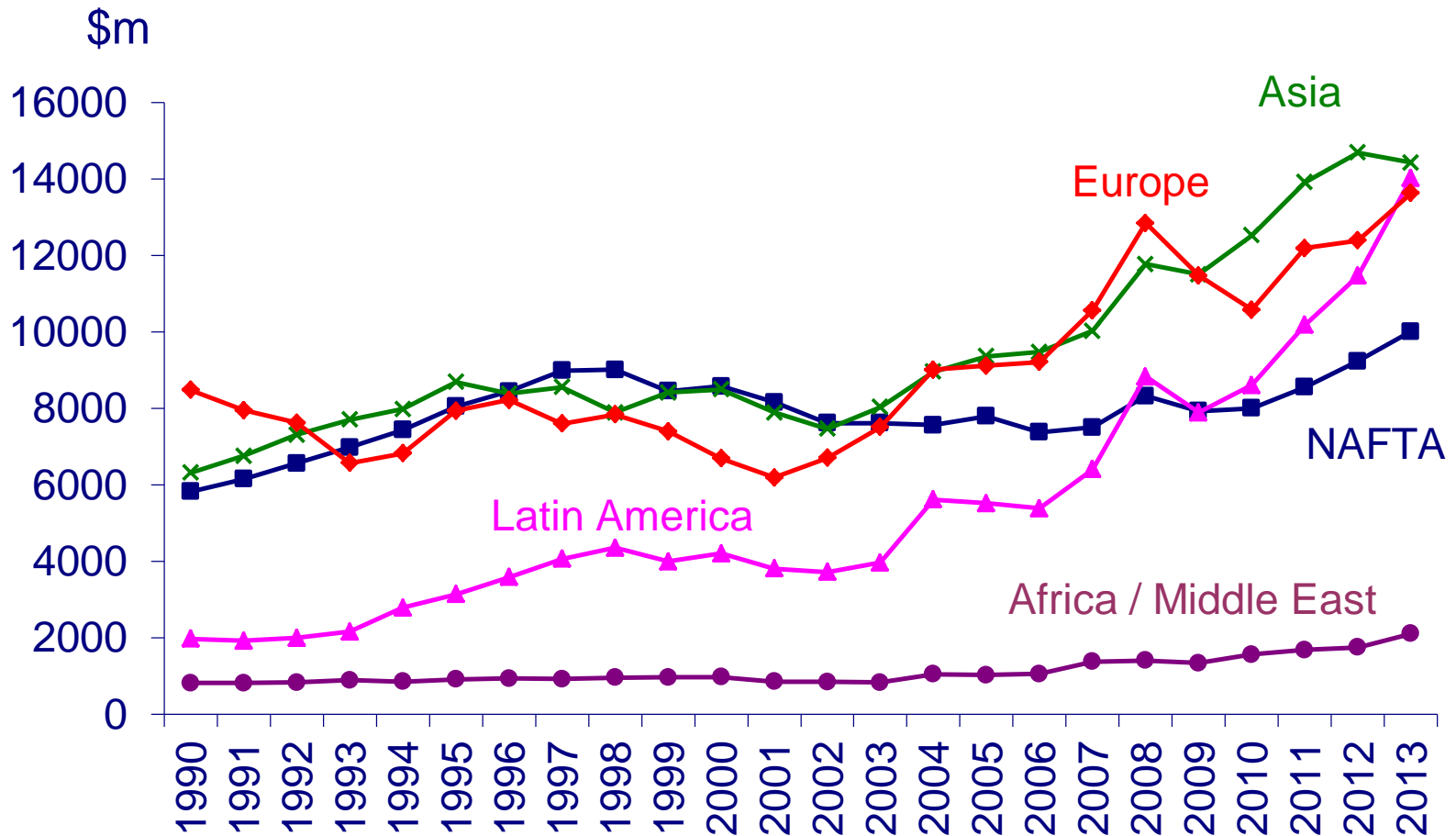
Canberra, Australia

5th November 2014



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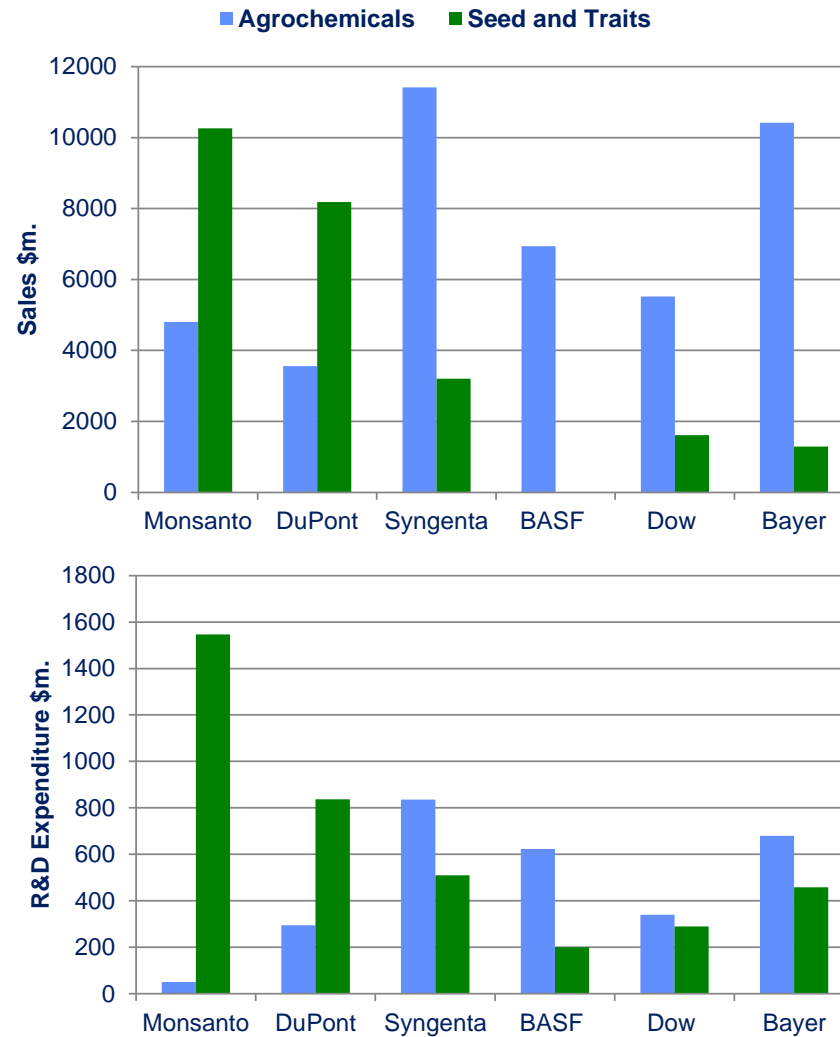
Regional Crop Protection Market Development



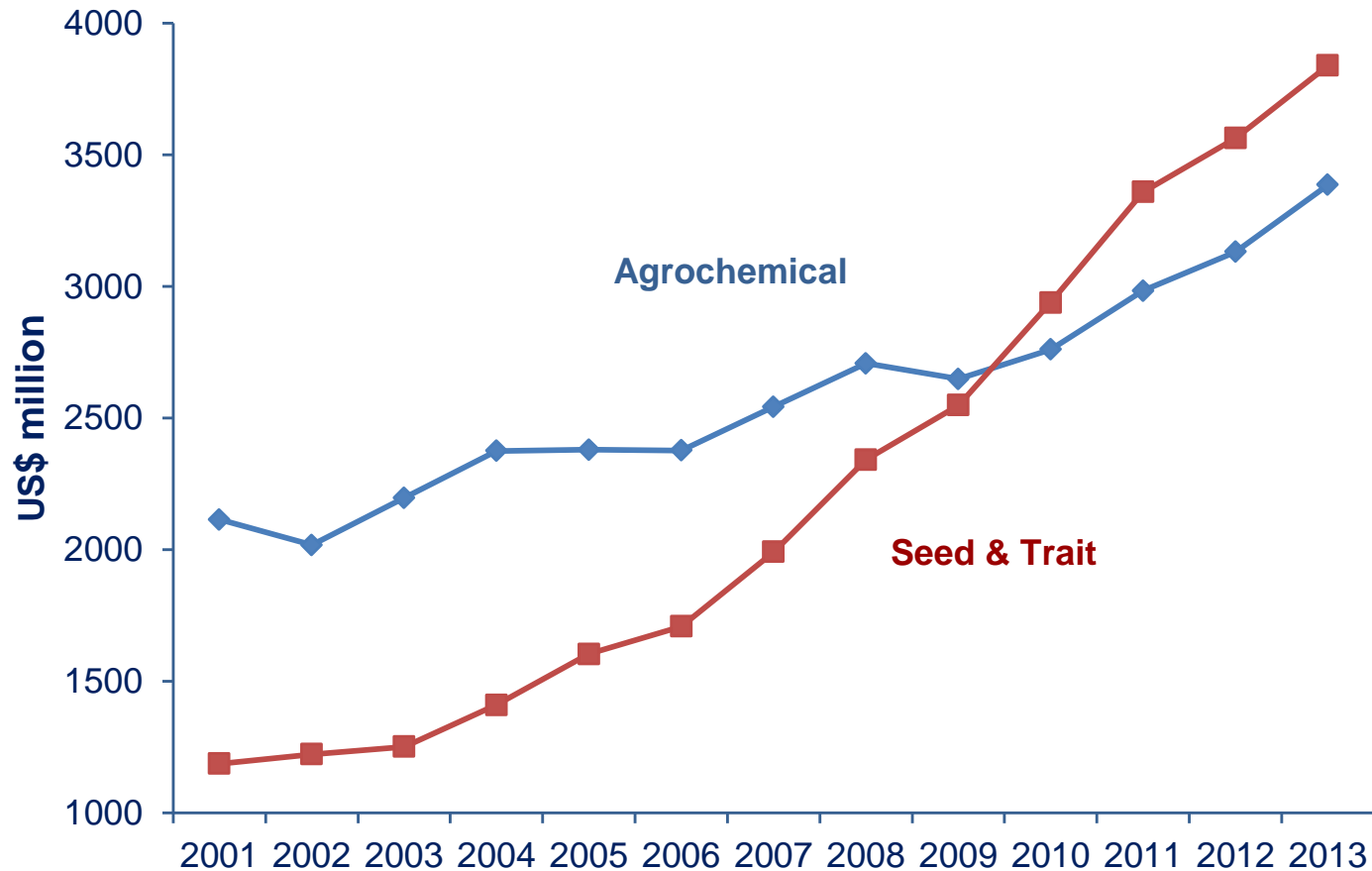
Factors Affecting Agrochemical R&D Expenditure

- Industry Consolidation
 - Fewer companies involved
- Shift in R&D expenditure to seeds and GM traits
- Increasing cost of new active ingredient R&D
- More companies seeking to licence in product candidates
- Harsh regulatory environment, particularly in the EU
- Increasing focus on biologicals
- Rise in expenditure to defend off patent molecules
 - Development of defining technologies
 - Formulations
 - Seed Treatments

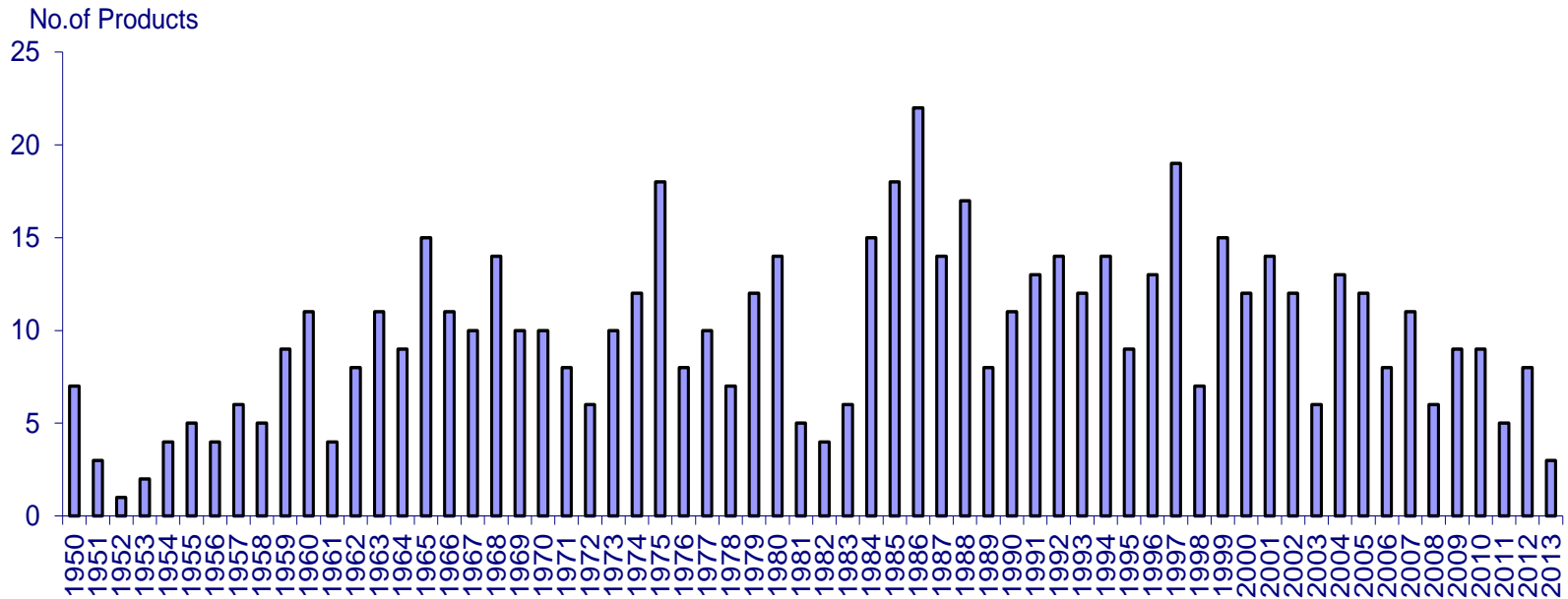
Company Sales and R&D Expenditure 2013



R&D expenditure of Leading Agrochemical Companies

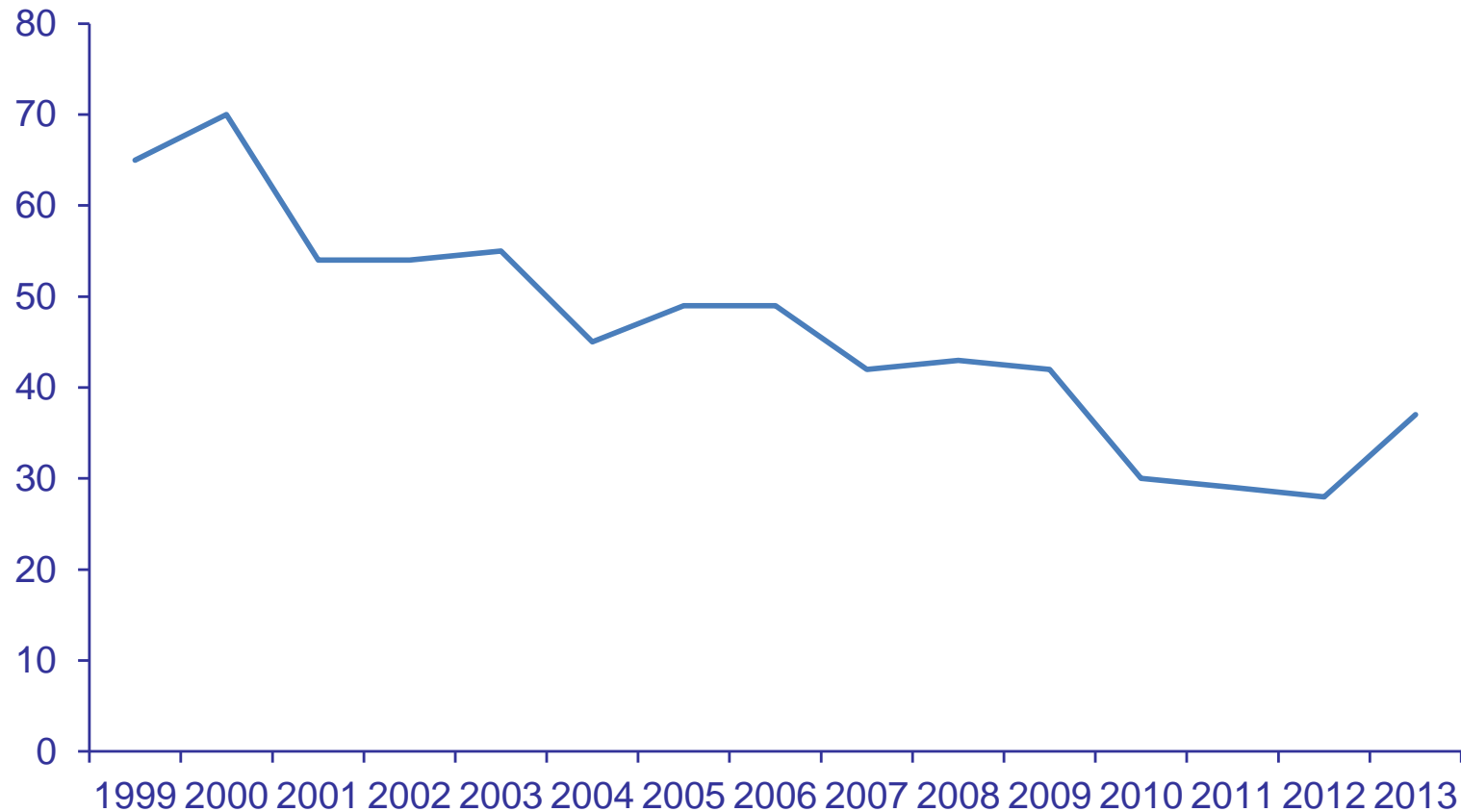


New Active Ingredient Introductions



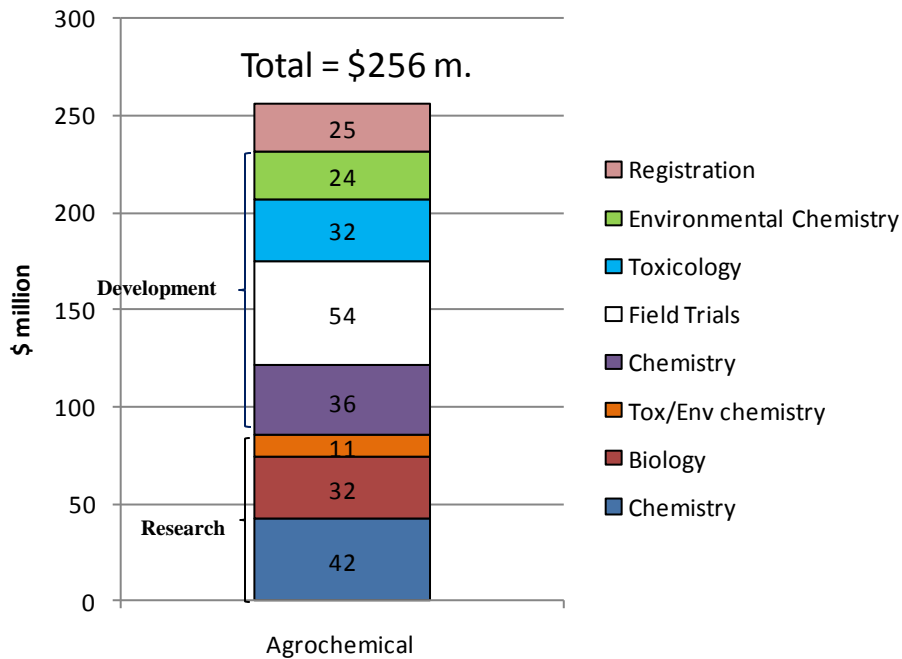
Agrochemical Active Ingredients in Development

a.i.s in development



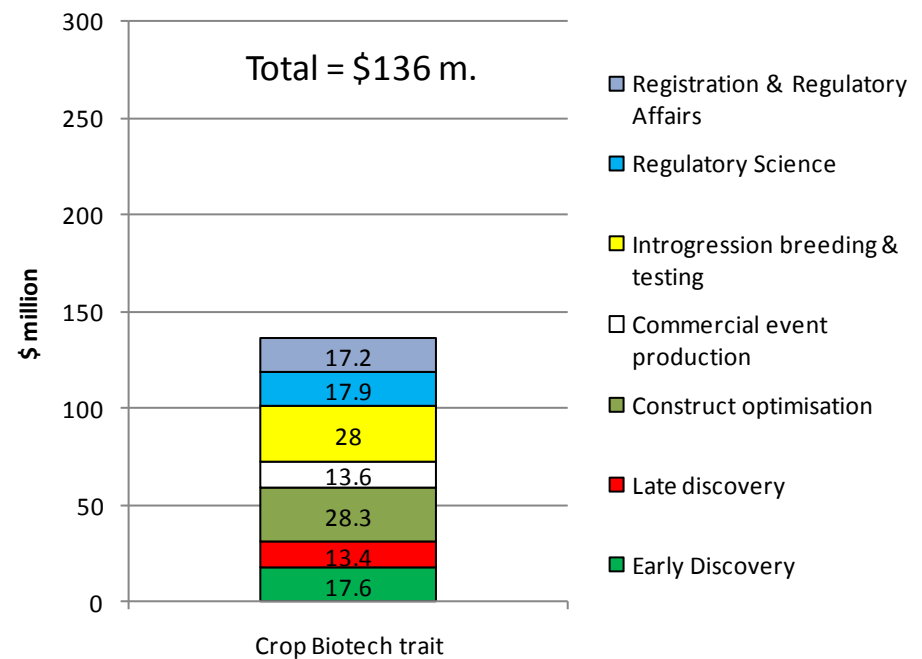
Cost of Bringing a New Product to Market

Agrochemical



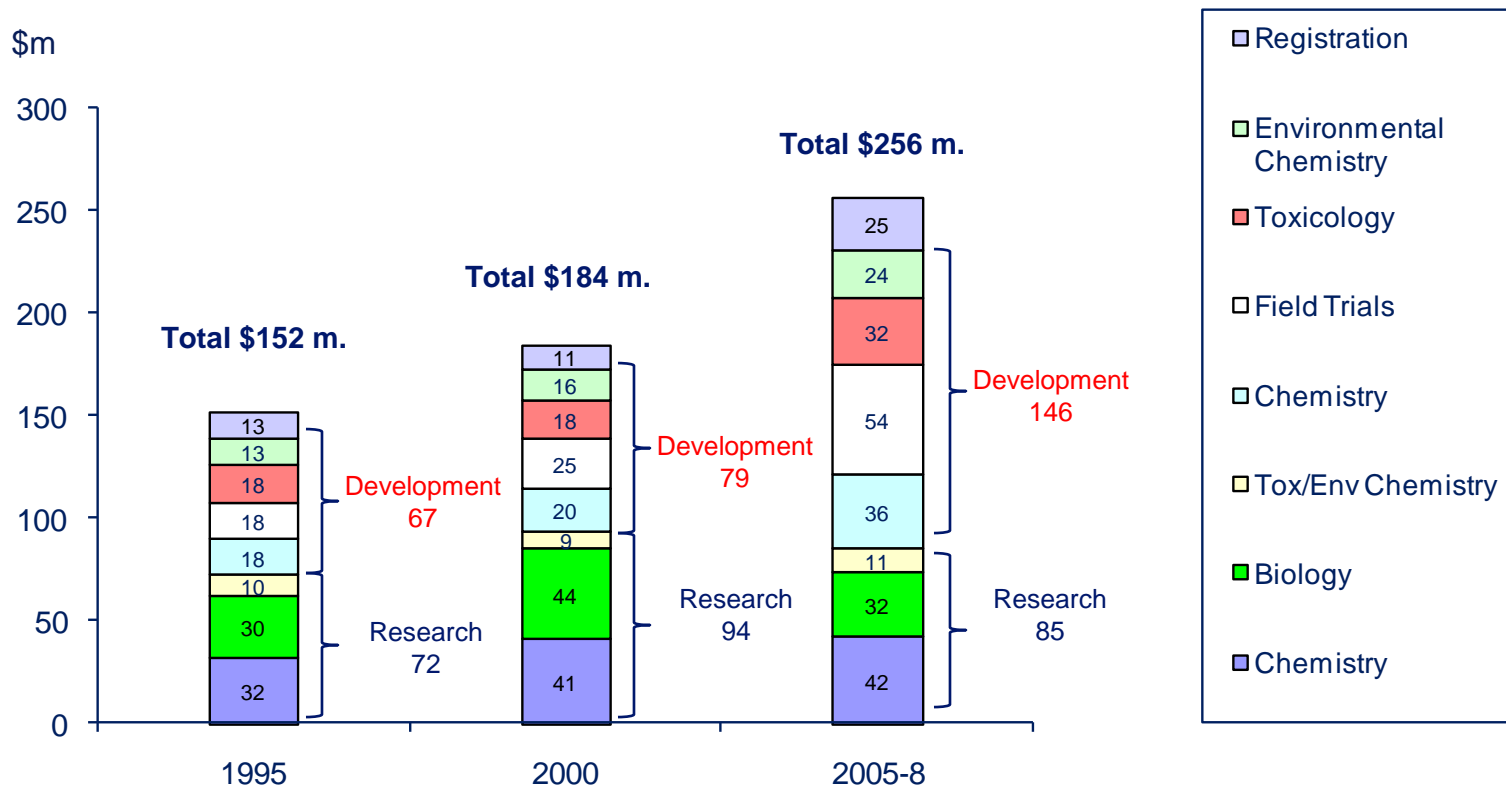
Agrochemical costs based on 2009 Crop Life America/ECPA study

Plant biotechnology trait



Plant biotechnology trait costs based on 2011 Crop Life International study

Cost of Bringing a New Product to Market

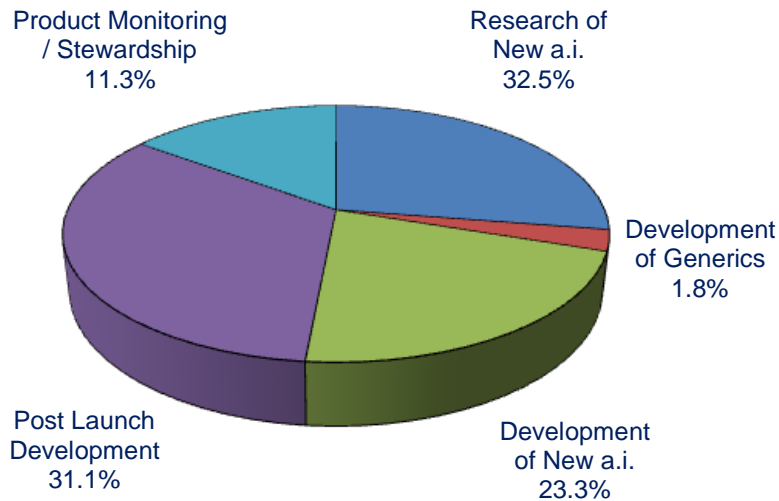


Results of Study undertaken for ECPA and CropLife America

Under 1107/2009, any exposure, regardless of level, is deemed unacceptable when a substance triggers the hazard criteria and the product will not be registered, or it will be refused re-registration.

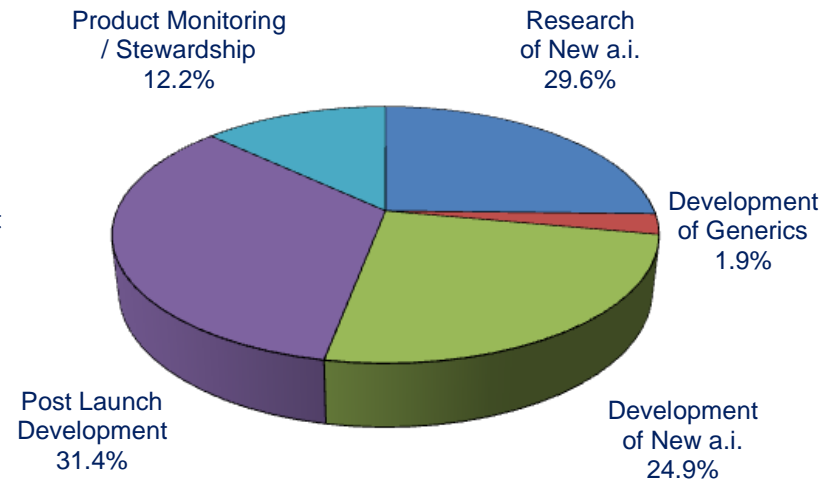
Agrochemical Industry R&D Expenditure by Function (Fourteen Reporting Companies Only)

2007



Total = \$2,328million

2012



Total = \$2,943 million

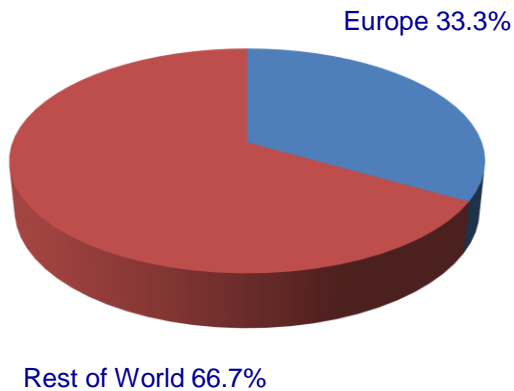
Results of Study undertaken for ECPA and CropLife America

Compound Annual Growth Rate of the European Crop Protection Market (% p.a.) € terms

	2013/2008	2013/2003
EU15	8.5	2.8
New EU12	11.2	6.2
Other	18.1	14.8

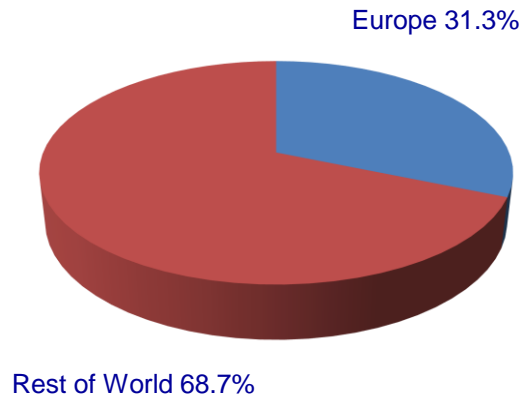
Share of Active Ingredients Introduced or in Development

1980-1989



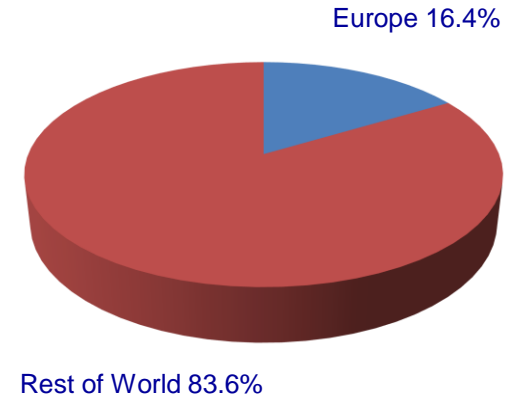
Total = 123 a.i.s

1990-1999



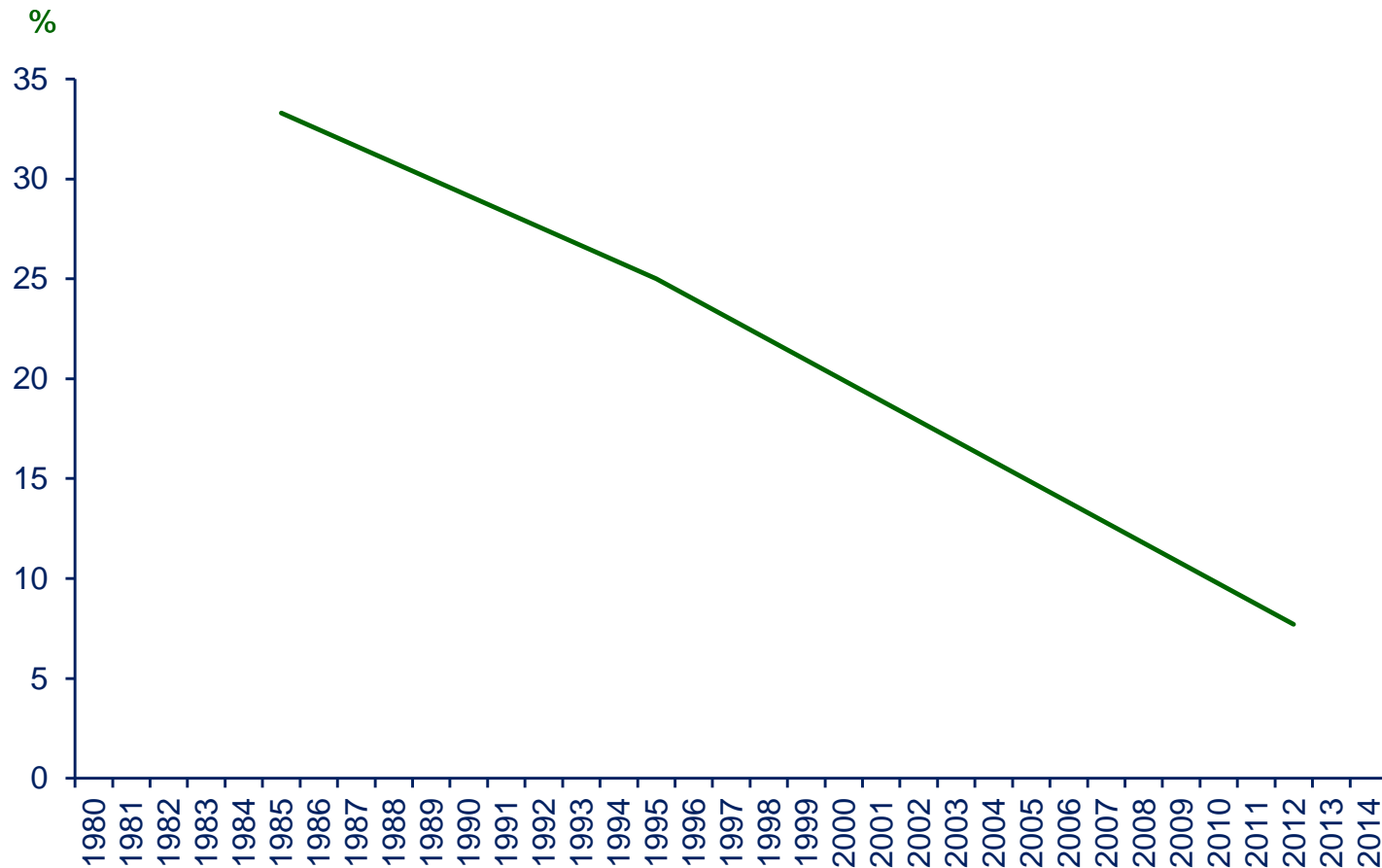
Total = 128 a.i.s

2005-2014



Total = 73 a.i.s

Share of R&D investment due to Agrochemicals for Europe



Current Status of EU Re-registration Procedure

List	No. of Products	Products of Commercial Significance*	Accepted into Annex 1	Re-registration pending / resubmitted	Not accepted / Not Supported
Existing Products					
1	90	90	56	0	34
2	148	114	34	0	80
3	389	262	109	0	153
4	204	12	4	0	8
Biologicals	21	21	15	0	6
Total	831	499	218	0	281
New Active Ingredients			86	49	8
New Biologicals			14	12	1
Total New a.i.s			100	61	9
Total Existing + New a.i.s			318	61	290

* as active ingredients for crop protection

** removed from system for re-submission

Updated December 2013

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Product Introductions and R&D by Crop

Number of new Active Ingredients		Time period				
		1980/1989	1990/1999	2000/2009	2010/13	In R&D
Herbicides	Cereals	15	12	12	0	1
	Soybean	11	10	1	0	1
	Maize	2	10	9	1	2
	Rice	11	19	15	1	7
	F&V	2	1	0	0	0
	Other	10	5	2	2	2
	Total	51	57	39	4	13
Insecticides	F&V	11	16	16	4	8
	Rice	5	2	3	2	1
	Cotton	9	12	3	0	0
	Others	4	7	5	1	6
	Total	29	37	27	7	15
Fungicides	F&V	13	9	17	5	6
	Cereals	14	16	8	6	2
	Rice	9	5	7	1	1
	Others	0	0	0	1	0
	Total	36	30	32	13	9
Others	7	3	5	1	0	
Total	123	127	103	25	37	
Average annual rate of introduction		12.3	12.7	10.3	6.3	7.4

Key Classes in R&D / Early Commercialisation

Herbicides

- Products for the control of glyphosate resistant weeds

Insecticides

- Ryanodine receptor blockers
- Non Neonicotinoid sucking pest control

Fungicides

- Pyrazole carboxamide Succinate dehydrogenase inhibitors
- Low application rate Oomycete disease control

Increasing Focus on Biologicals

- Less Harsh Regulatory Environment
- EU Agrochemical Regulations (1107/2009)
 - 'Comparative assessment and substitution with a safer alternative'
- EU Agricultural Policy
 - Potential push to 'environmental' solutions
- No withdrawal period prior to harvest
- Move to use in combination with existing chemical solutions
- Few Residue issues
- Favoured by food supply companies

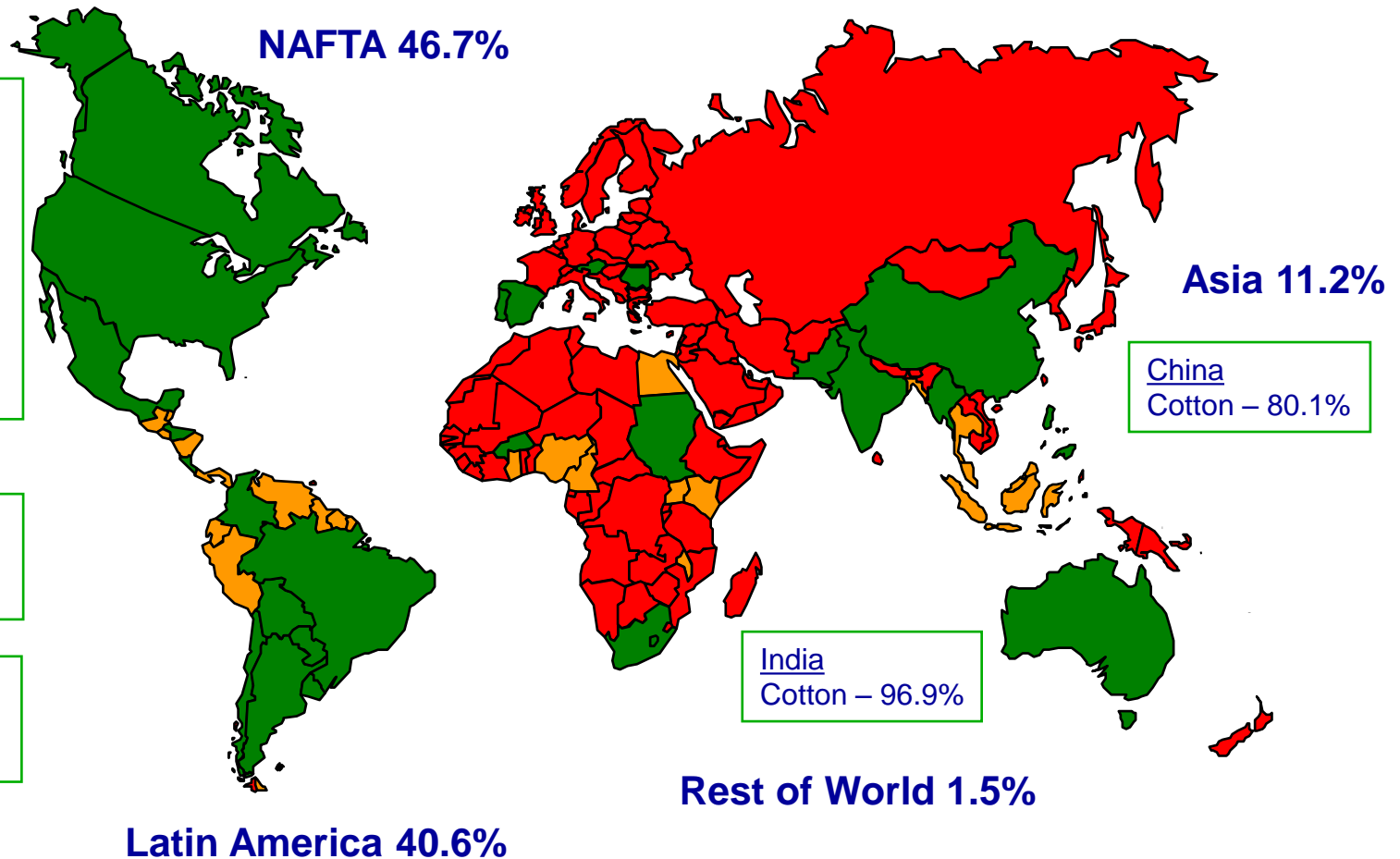
BUT

- Little sign of any significant increase in sales
- Concerns of reproducibility of action in open field situations

Agrochemical Company Activity - Biologicals

Company	Acquisition
BASF	Becker Underwood (2012)
Bayer	AgroGreen (2010), AgraQuest (2012), Prophyta (2012)
Syngenta	Devgen (2012), Pasteuria Bioscience (2012)

Crops Planted with GM Varieties in 2013



Total = 427.0 million acres (+4.8% over 2012)

Key Factors in GM Market

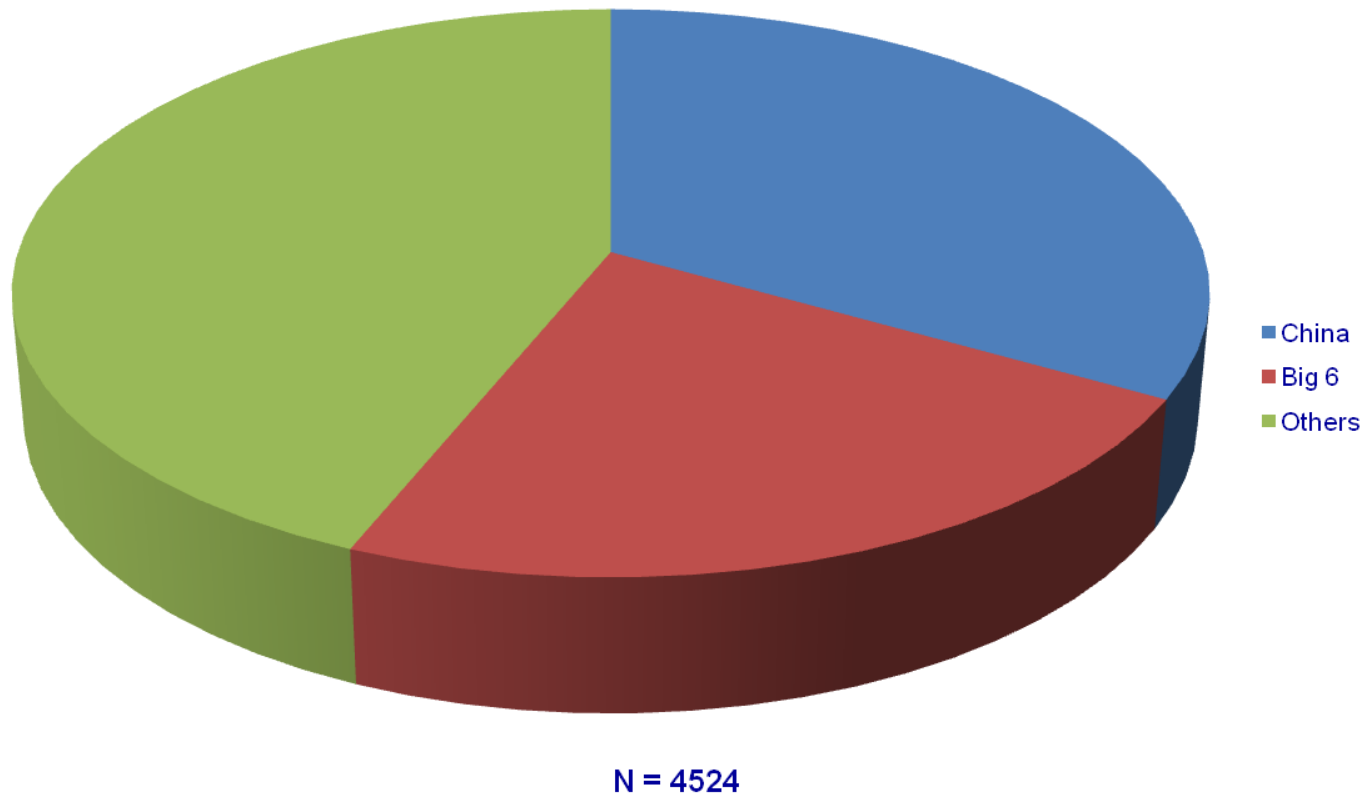
- ❑ **Refuge in the bag and reduced refuge areas**
- ❑ **Input Traits – Maize, Soybean, Cotton, Canola**
 - dicamba / 2,4-D / HPPD
 - Insect resistance traits for soybean
 - VIP traits
- ❑ **Output Traits**
 - Drought / Stress tolerance
- ❑ **Trait Stacking**
 - SmartStax
- ❑ **Market Potential**
 - Value growth through technology introduction in USA
 - Volume growth in Brazil and Asia due to further acceptance

GM Seed Product Introductions

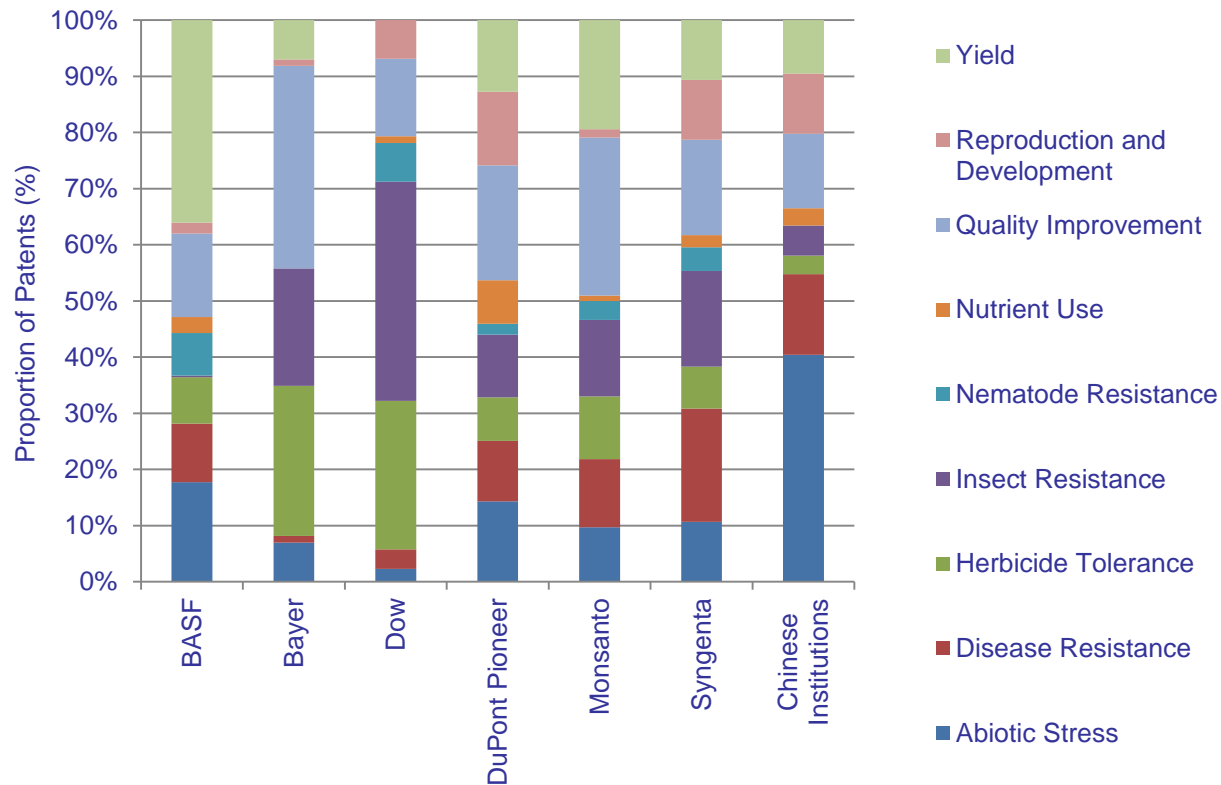
	2010	2011	2012	2013	2014	2015*	Total
Corn	5	6	12	4	6	2	35
Soybean			1	3	1	4	9
Cotton		1		1	2	3	7
Canola				1		2	3
Potato		1					1
Rice						1	1
Total	5	8	13	9	9	12	56

* Scheduled

Total GM Trait Patents for all Crops 2008 - 2013

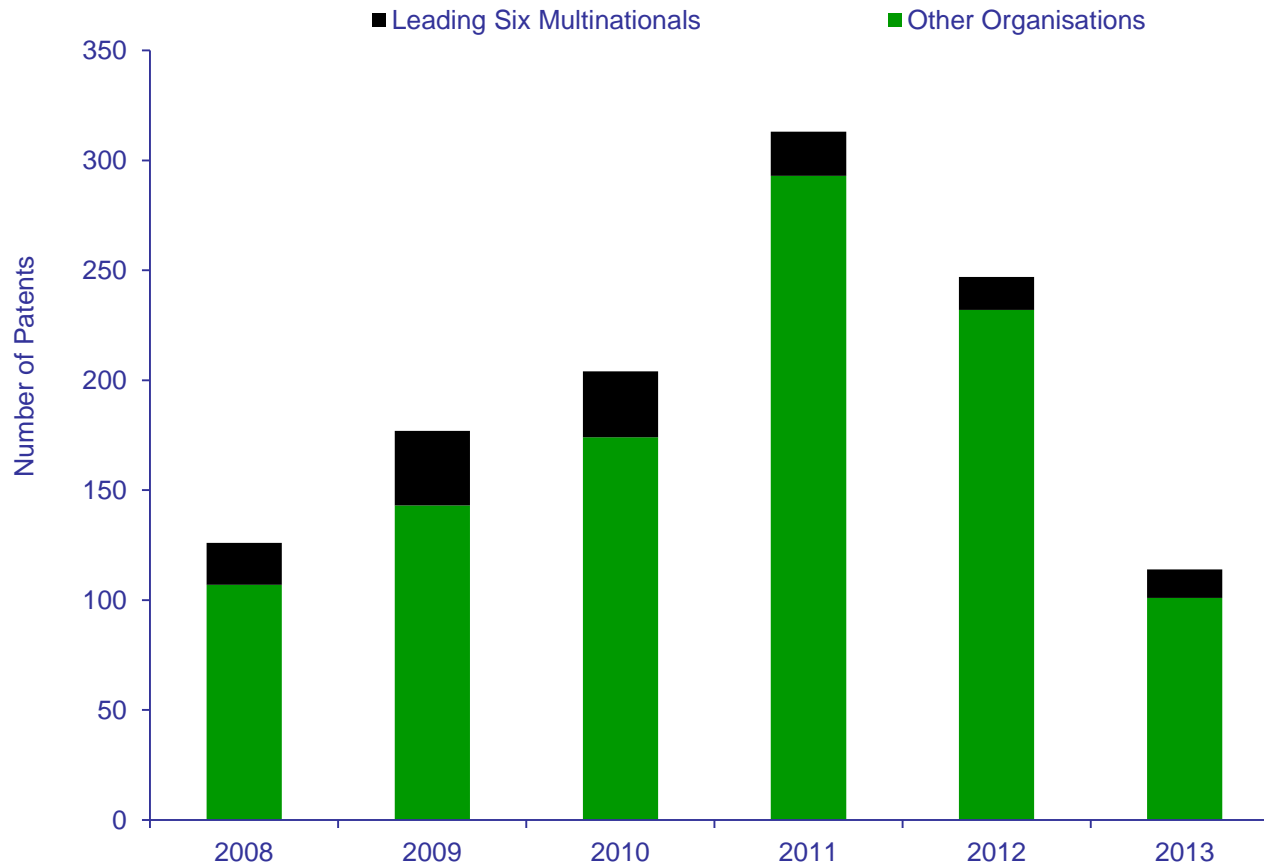


Proportion of Patents¹ Attributed to Different traits for the Big 6 Companies and Chinese Institutions

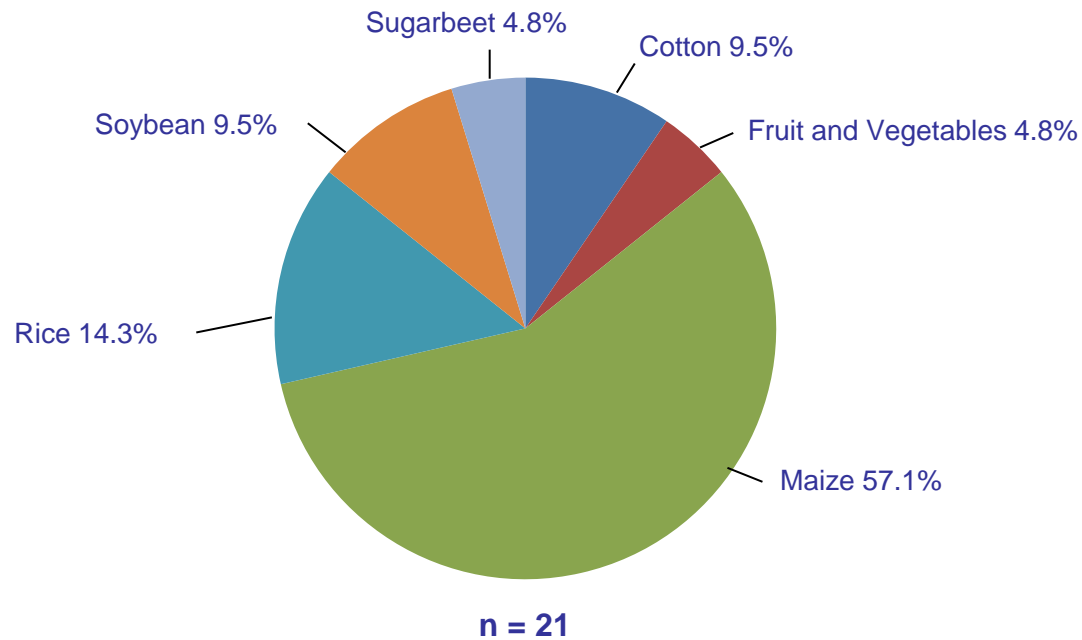


¹Only those patents which were identified as pertaining to modification of plants to produce altered traits were used in the following charts. Duplicates for the same patent filed in different countries were also removed.

Patents for Abiotic Stress 2008-2013

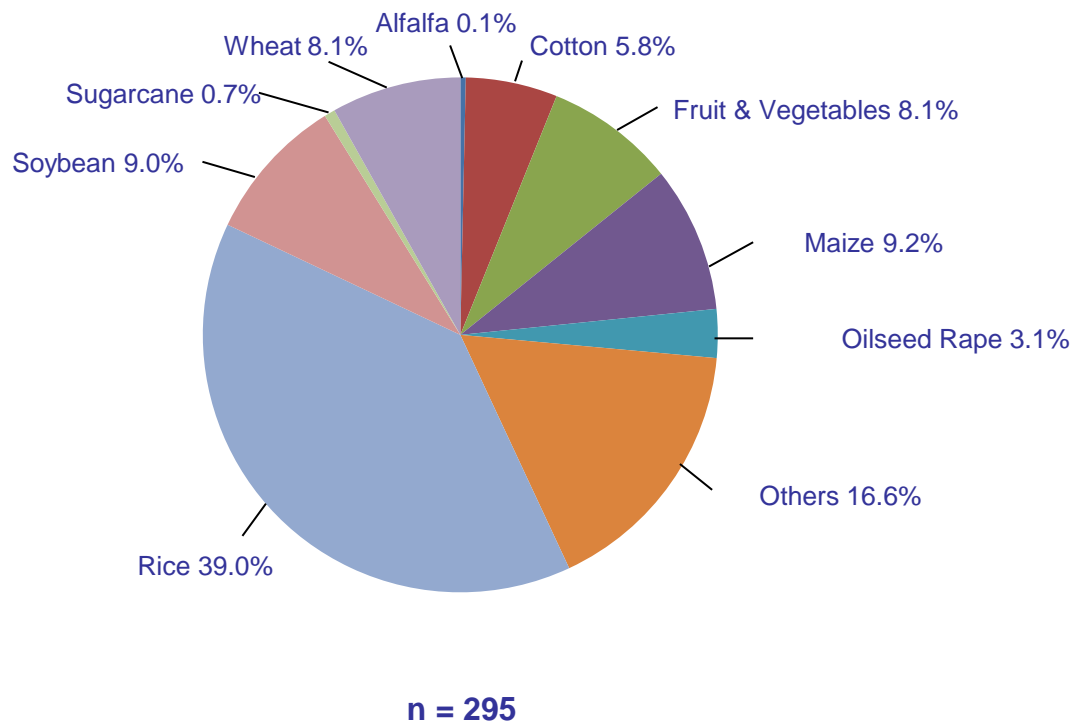


Proportion of Patents Attributed to Abiotic Stress in Different Crops for the Big 6 Companies



Note: Many patents do not relate to one specific crop, and thus are not included in these data.

Proportion of Patents Attributed to Abiotic Stress in Different Crops for Chinese Institutions.

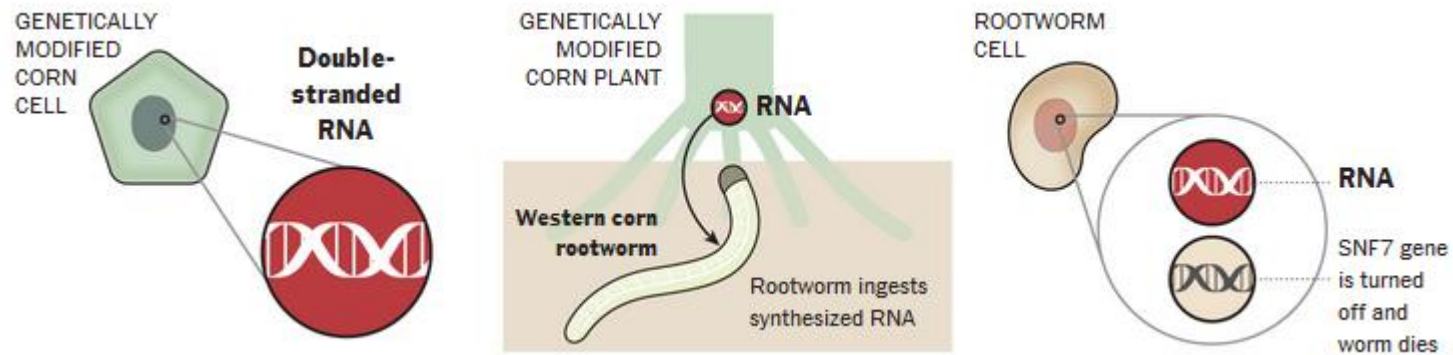


Note: Many patents do not relate to one specific crop, and thus are not included in these data.

RNAi – Gene Silencing

Ribonucleic acid interference (RNAi) is a method of gene silencing in target organisms

RNAi as a method of in-plant insect pest control



The plant is genetically engineered to produce a double stranded RNA molecule that matches the product of a key gene in the target organism.

The target organism ingests some of the GM plant containing the double stranded RNA molecule.

The double stranded RNA molecule inactivates the product of the key gene in the target organism, silencing the gene, resulting in the death of the worm.

Image Source: New York Times

RNAi – Current Seed Products in Development

GM Seed Product Database

Development Results

Next generation SmartStax

Company	Dow
Product Name	Next generation SmartStax
Year of Introduction	
Crop	Maize
Event	MON 89034 x TC1507 x MON 88017 x DAS-59122-7
Gene : Lepidopteran Resistance	Cry1A.105, Cry1F, Cry2Ab2
Gene : Coleopteran Resistance	Cry3Bb1, Cry34Ab1, Cry35AB1, RNAi
Gene : Herbicide Tolerance	CP4 epsps, pat
Gene : Others	
Status	Late Development
Comments	

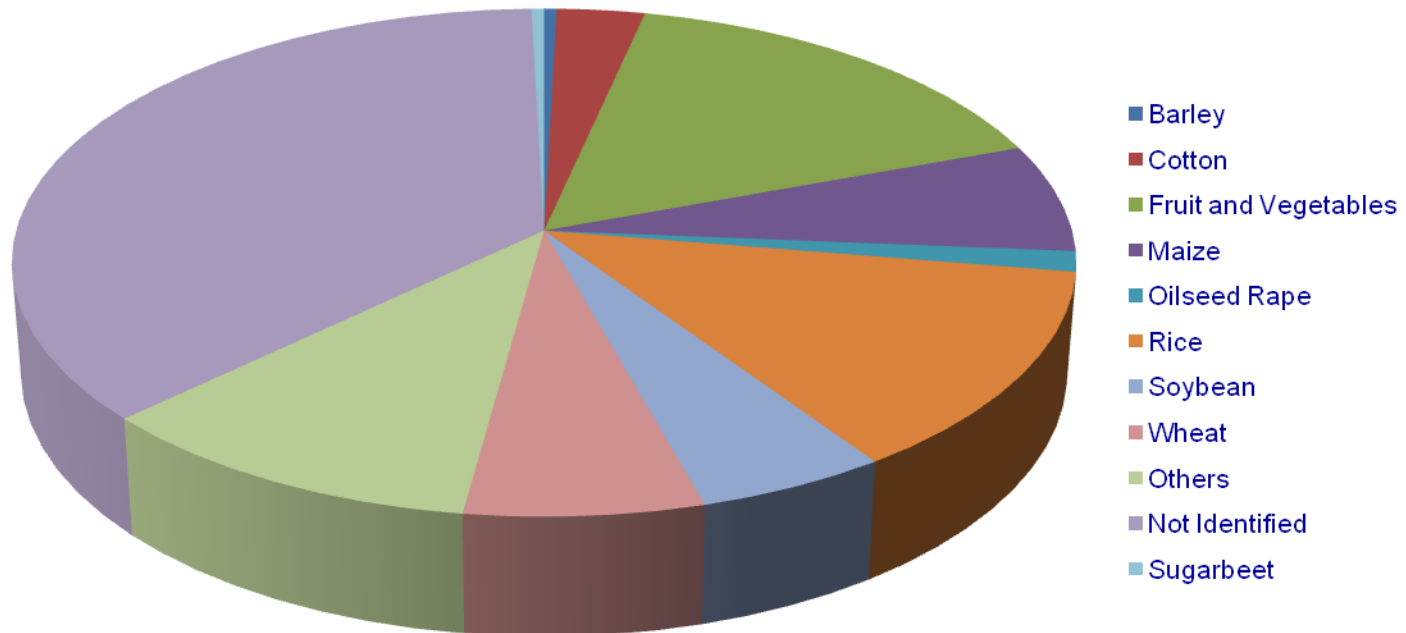
Genuity SmartStax Pro

Company	Monsanto
Product Name	Genuity SmartStax Pro
Year of Introduction	
Crop	Maize
Event	MON 89034 x TC1507 x MON 88017 x DAS-59122-7
Gene : Lepidopteran Resistance	Cry1A.105, Cry1F, Cry2Ab2
Gene : Coleopteran Resistance	Cry3Bb1, Cry34Ab1, Cry35AB1, RNAi
Gene : Herbicide Tolerance	CP4 epsps, pat
Gene : Others	
Status	Late Development
Comments	Formerly CRW III

Genuity CRW IV

Company	Monsanto
Product Name	Genuity CRW IV
Year of Introduction	
Crop	Maize
Event	
Gene : Lepidopteran Resistance	
Gene : Coleopteran Resistance	RNAi
Gene : Herbicide Tolerance	
Gene : Others	
Status	Early Development
Comments	

RNAi – Identified Patents for all Crops 2008 - 2013

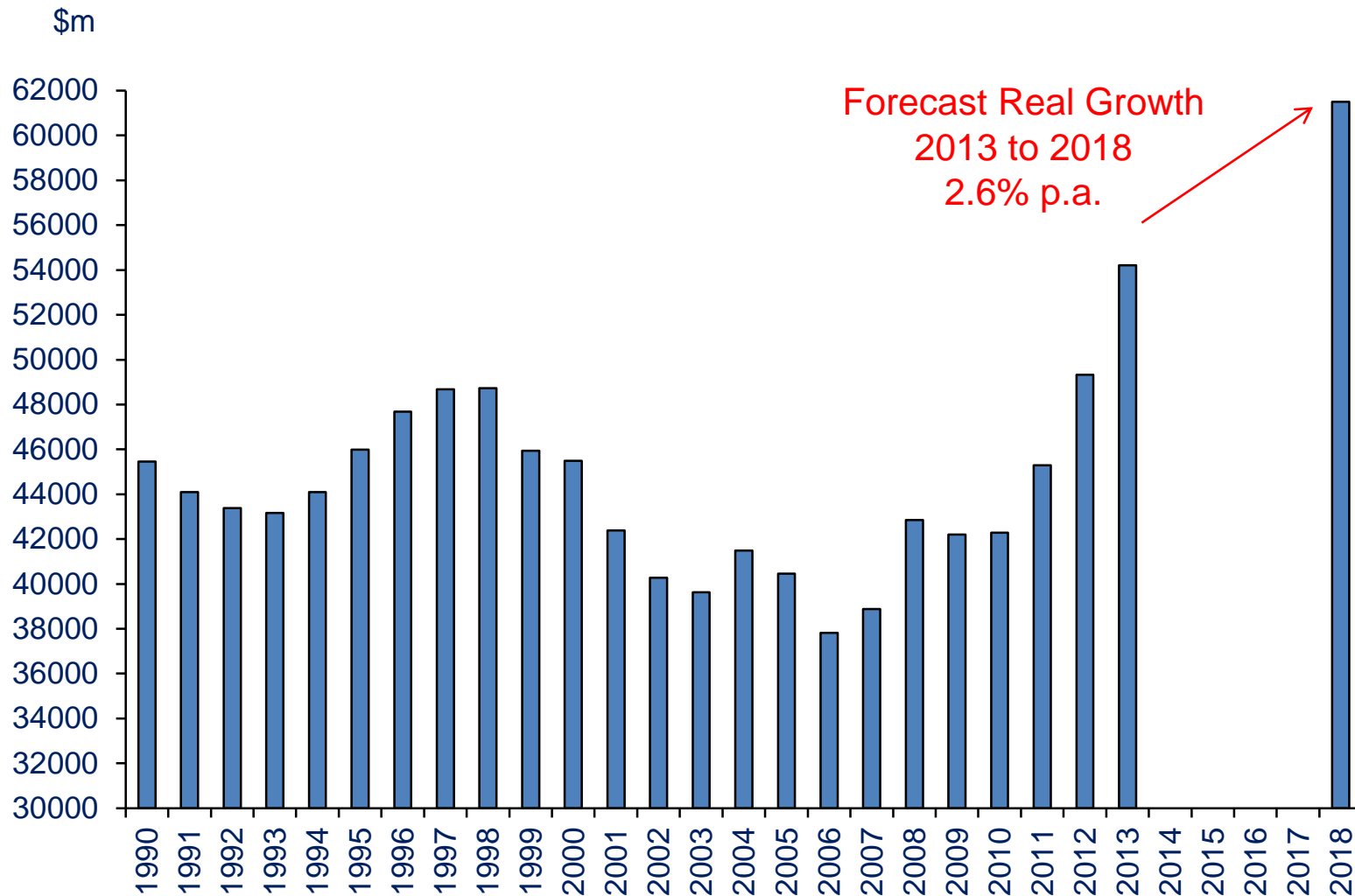


N = 232

Crop Protection R&D, Key Trends

- Fewer Major Companies involved
- High cost limits commercial capabilities of small companies
- Inward licencing/acquisition a growing trend in agrochemicals and seeds/traits
- After a slump, R&D into chemical crop protection products increasing again
- Focus on growing markets and away from crops affected by GM traits
- Growth rate in R&D expenditure now similar between agrochemicals and seed/traits
- Commercial GM trait R&D focussed on high value crops
- Significant number of GM trait patents outside 'big 6' companies
- GM trait R&D shifting from input to output/agronomic traits
- Next technology hurdle/opportunity - RNAi

Crop Protection Market in 2013 Dollar Terms



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Phillips McDougall maintain a wide range of databases covering the crop protection and seed industries, this presentation presents only headline information. Access to these databases can be gained through subscription or consultancy. Our market research databases track product sales from global market totals down to brand level sales by crop and country in both volume, value and area treated terms.

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