SEMINAR

Global Status of Commercialized Biotech/GM Crops : 2016

Seoul, S. Korea
June 9, 2017

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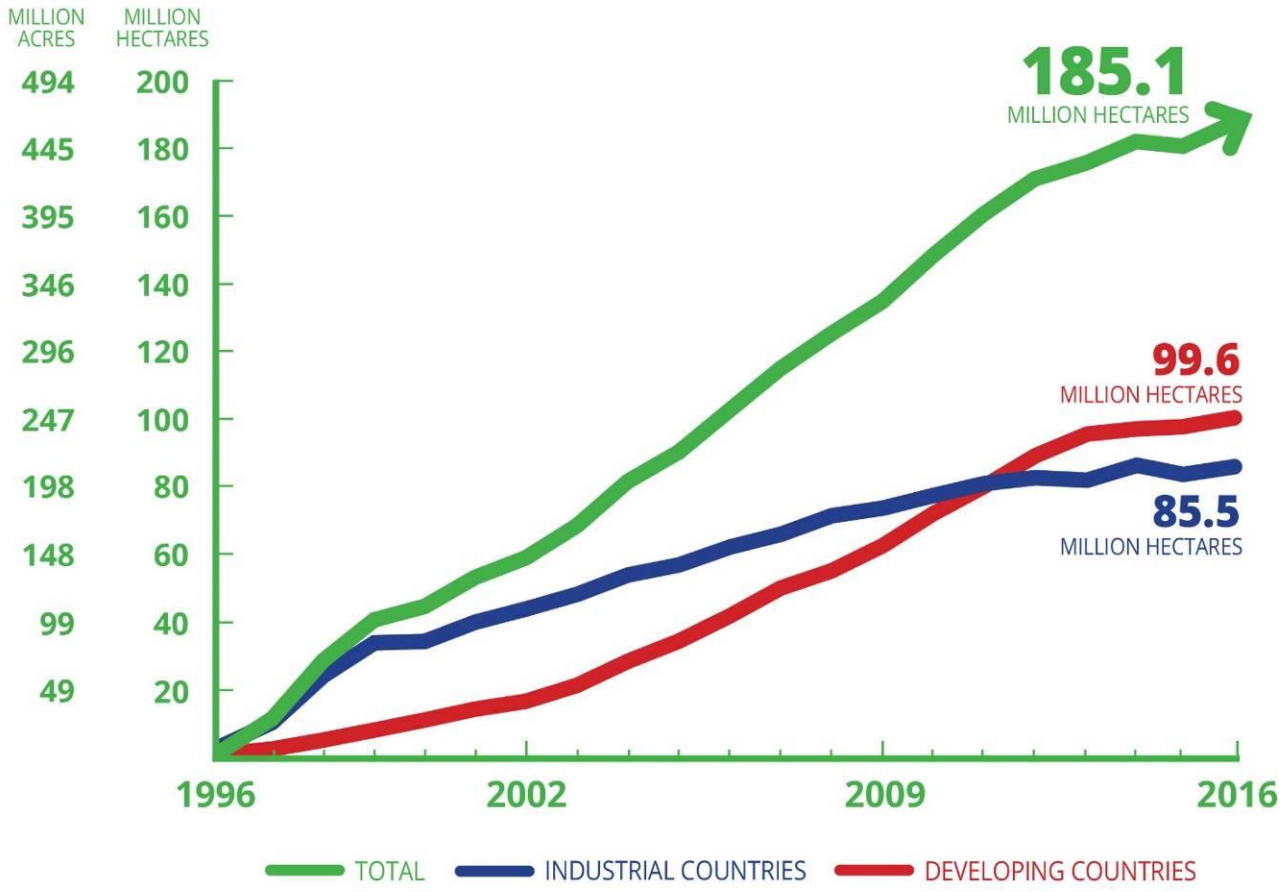
International Service for the Acquisition of Agri-biotech Applications

Overview of Presentation

- Biotech crop adoption in 2016
- Impact (1996-2015)
- Future Prospects (2016 and beyond)

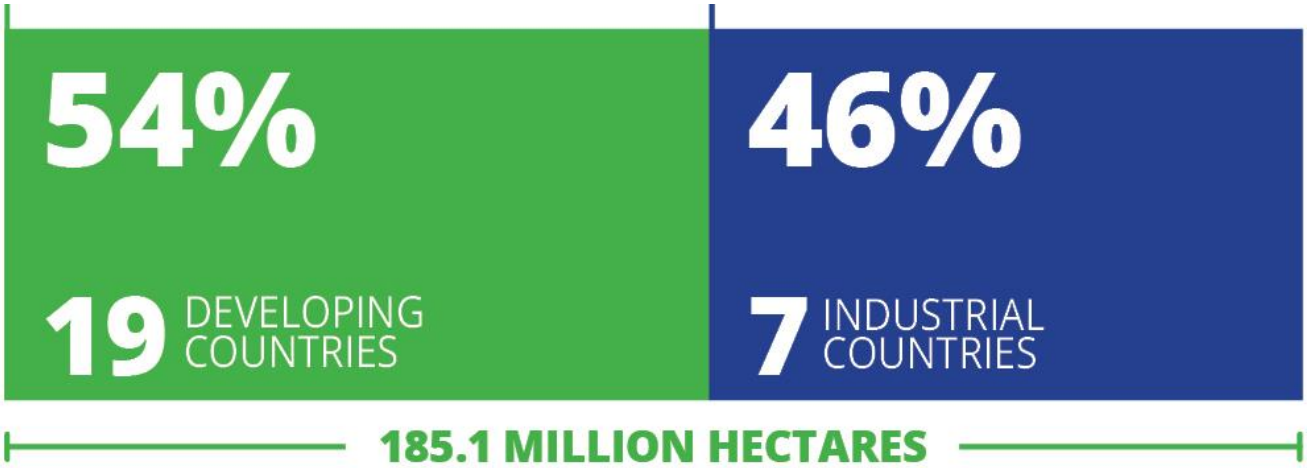
Biotech Crop Adoption in 2016

Global Area of Biotech Crops, 1996 to 2016: Industrial and Developing Countries (Million Hectares, Million Acres)



- Resumes high adoption at 185.1 million hectares
- ~110-fold increase from 1996
- 2.1 billion accumulated hectarage

ISAAA, 2016

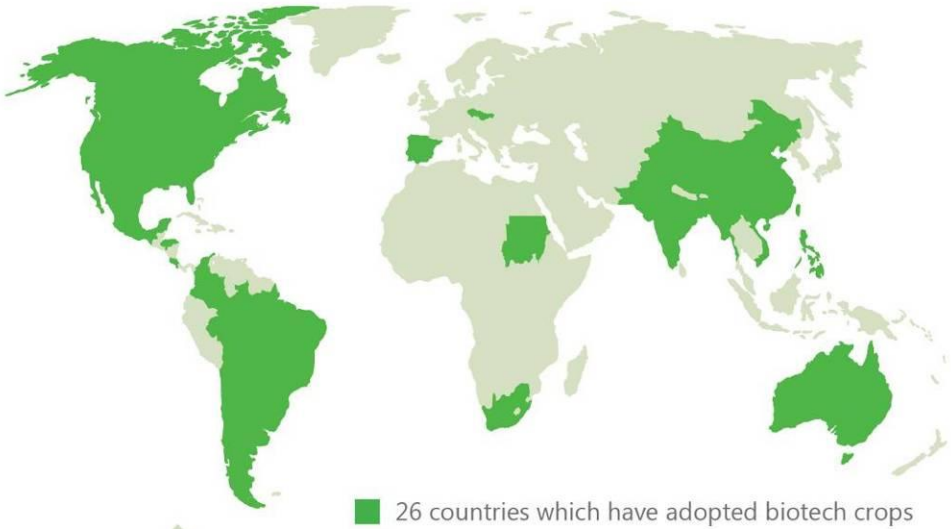


DISTRIBUTION OF BIOTECH CROPS IN DEVELOPING AND INDUSTRIAL COUNTRIES IN 2016

Source: ISAAA, 2016

Developing countries: 99.6 million hectares
Industrial countries: 85.5 million hectares

Global Area of Biotech Crops, 2016: By Country (Million Hectares)



26 countries which have adopted biotech crops

3%
Increase from 2015

In 2016, global area of biotech crops was 185.1 million hectares, representing an increase of 3% from 2015, equivalent to 5.4 million hectares.

Source: ISAAA, 2016.

50,000 hectares, or more

1.	USA	72.9 million
2.	*Brazil**	49.1 million
3.	*Argentina**	23.8 million
4.	Canada	11.6 million
5.	*India**	10.8 million
6.	*Paraguay**	3.6 million
7.	*Pakistan**	2.9 million
8.	*China**	2.8 million
9.	*South Africa**	2.7 million
10.	*Uruguay**	1.3 million
11.	*Bolivia**	1.2 million
12.	Australia	0.9 million
13.	*Philippines**	0.8 million
14.	*Myanmar**	0.3 million
15.	Spain	0.1 million
16.	*Sudan**	0.1 million
17.	*Mexico**	0.1 million
18.	*Colombia**	0.1 million

Less than 50,000 hectares

*Vietnam**	*Bangladesh**
*Honduras**	*Costa Rica**
*Chile**	Slovakia
Portugal	Czech Republic

** Developing countries*

- Top five countries: 3 Dev countries (Brazil, Argentina, and India) and 2 Industrial countries (USA and Canada) grew 91% of biotech crops

Some countries had double digit percent area increases in GM/biotech crops planting

Australia	29%	90% increase in GM Cotton to reach 98% adoption
S. Africa	17%	22 % increase in GM corn to reach 90% adoption
Brazil	11%	16% increase in GM corn to reach 88% adoption
Philippines	16%	16% increase in GM corn to reach 65% adoption

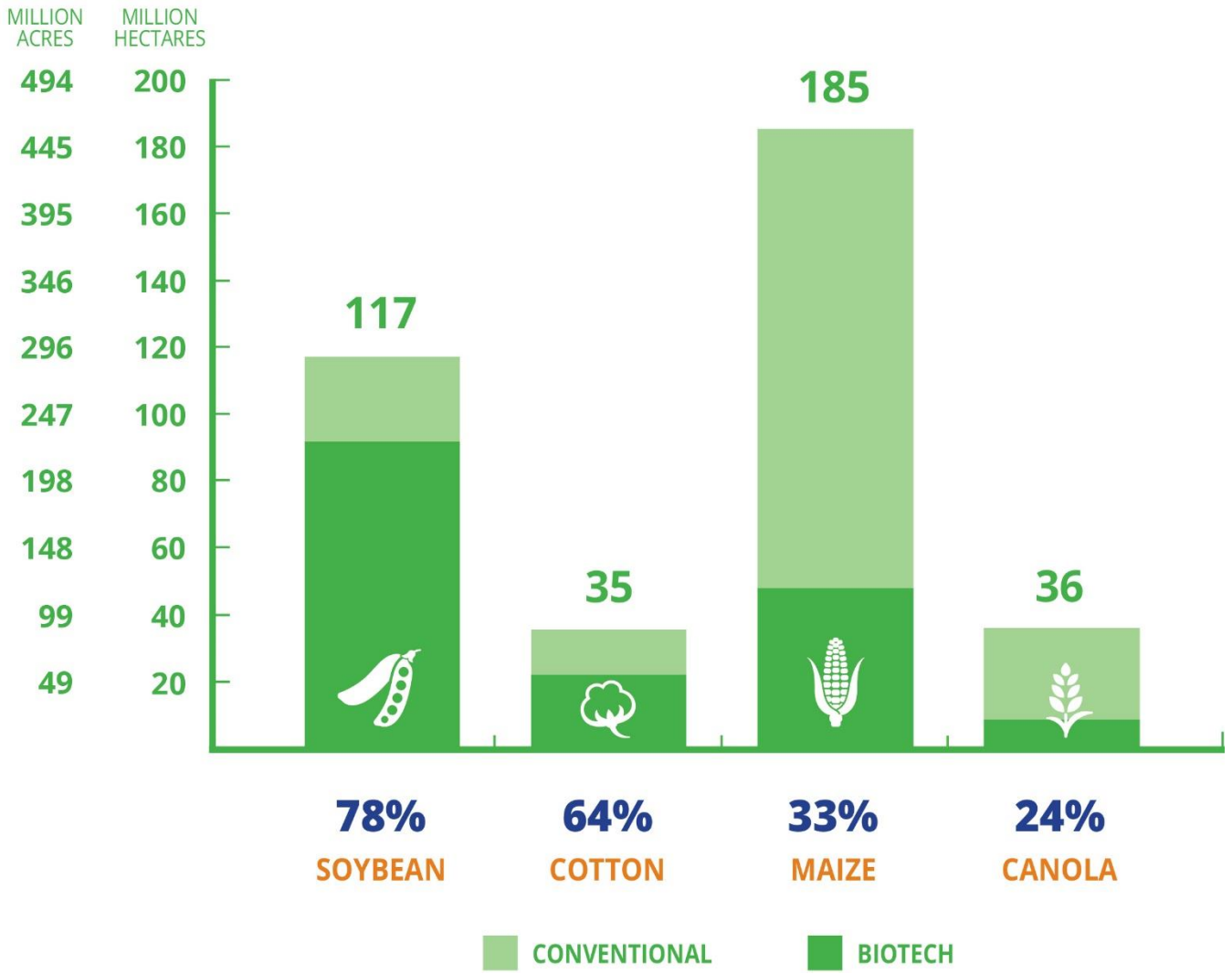
Biotech Crops and Area Grown in the Region

Region	Countries	Biotech Area	Crops Planted
North America	USA and Canada	84.5 M Ha	Maize, soybean, cotton, canola, sugar beet, alfalfa, ppaya, squash, potato
Latin America	Brazil, Argentina, Paraguay, Uruguay, Bolivia, Mexico, Colombia, Honduras, Chile, Costa Rica	~ 80 M Ha	Soybean, maize, cotton, pineapple
Asia and the Pacific	India, Pakistan, China, Australia, Philippines, Myanmar, Vietnam, Bangladesh	~ 18.6 M Ha	Cotton, maize, canola, eggplant
European Union	Spain, Portugal, Slovakia, Czech Republic	>136,000 Ha	Maize
African continent	South Africa and Sudan	~ 2.8 M Ha	Maize, soybean, cotton

Countries with Close to or Over 90% Major Biotech Crop Adoption

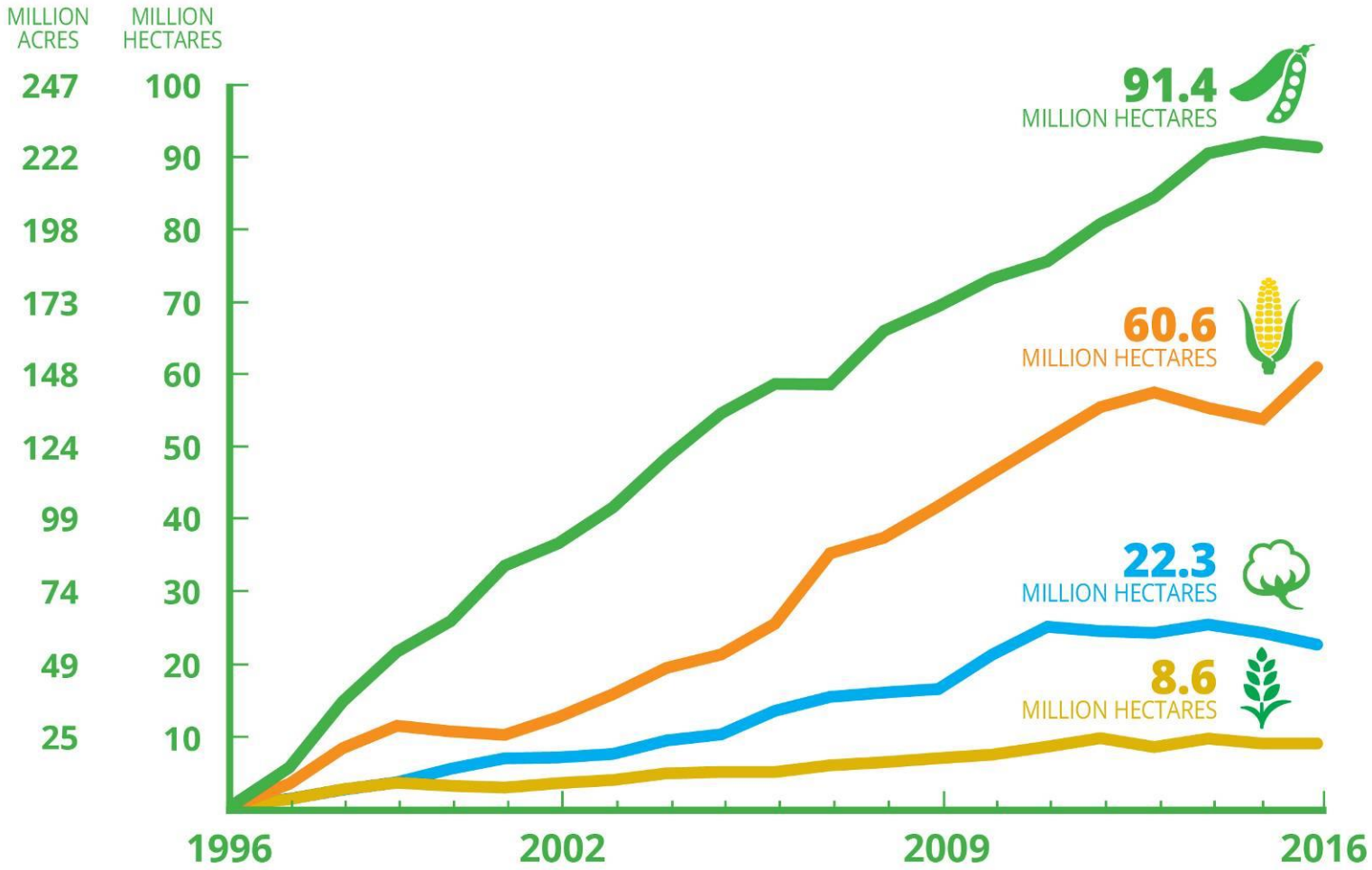
- **Biotech soybean** - USA, Brazil, Argentina, Canada, South Africa, and Uruguay
- **Biotech maize** – USA, Brazil, Argentina, Canada, South Africa and Uruguay
- **Biotech cotton** – USA, Argentina, India, China, Pakistan, South Africa, Mexico, Australia, and Myanmar
- **Biotech canola** – USA and Canada

Global Adoption Rates (%) for Principal Biotech Crops (Million Hectares, Million Acres), 2016



ISAAA, 2016

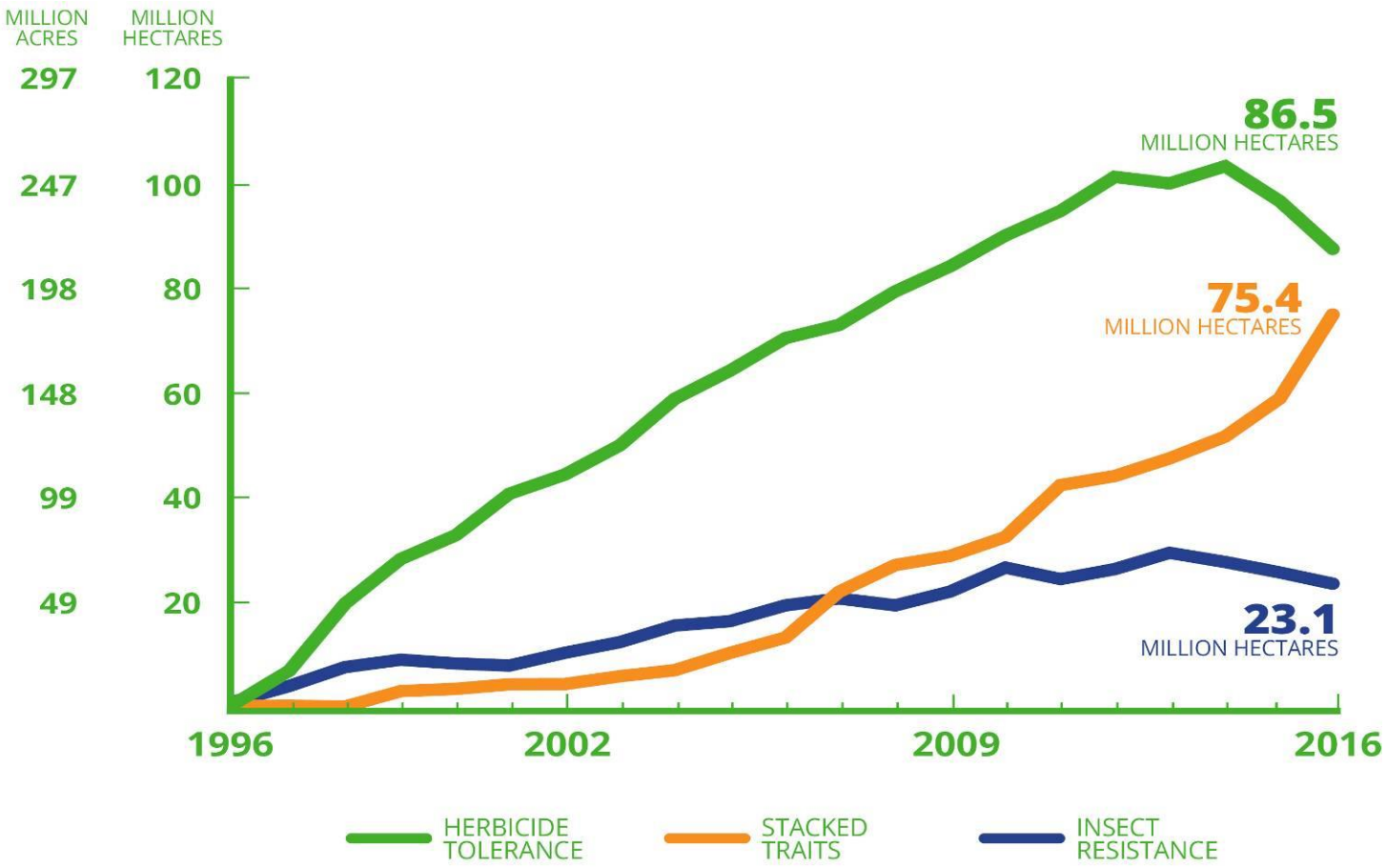
Global Area of Biotech Crops, 1996 to 2016: By Crop (Million Hectares, Million Acres)



- Biotech soybean reached 50% of global biotech crop hectarage

ISAAA, 2016

Global Area of Biotech Crops, 1996 to 2016: By Trait (Million Hectares, Million Acres)



- Herbicide tolerance at 47% and
- Stacked traits occupied 41% of the global hectarage

ISAAA, 2016

Impact (1996-2015)

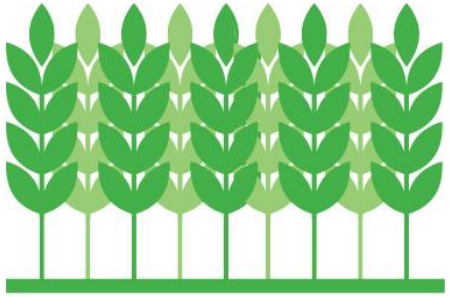
Contribution of Biotech Crops to Food Security, Sustainability and Climate Change

INCREASING CROP PRODUCTIVITY

US$167.8 BILLION

FARM INCOME GAINS IN 1996-2015 GENERATED GLOBALLY BY

BIOTECH CROPS



CONSERVING BIODIVERSITY

IN 1996-2015, PRODUCTIVITY GAINED THROUGH BIOTECHNOLOGY SAVED

174 MILLION HECTARES

OF LAND FROM PLOUGHING & CULTIVATION

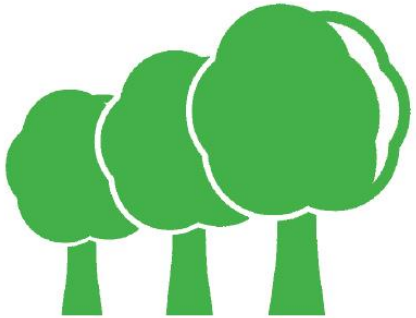
Source: Brookes and Barfoot, 2017 Forthcoming

Contribution of Biotech Crops to Food Security, Sustainability and Climate Change

PROVIDING A BETTER ENVIRONMENT

REDUCED PESTICIDE SPRAYING

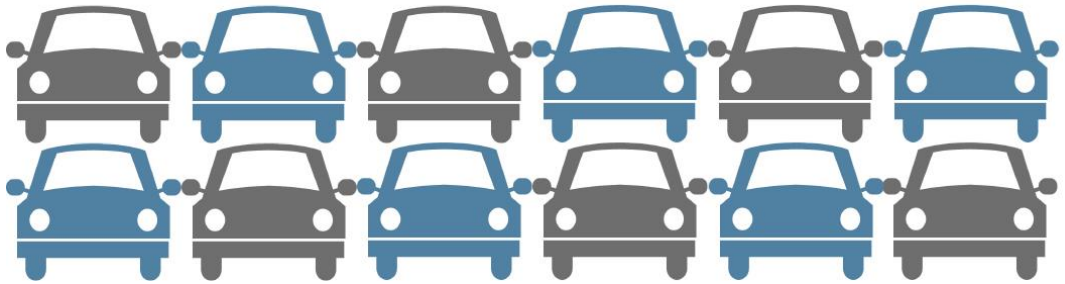
DECREASED ENVIRONMENTAL IMPACT FROM HERBICIDE & INSECTICIDE USE BY **19%** IN 1996 - 2015



REDUCING CO2 EMISSIONS

IN 2015, 26.7 BILLION KGS CO2 SAVED EQUIVALENT TO REMOVING

~12 MILLION CARS OFF THE ROAD FOR 1 YEAR

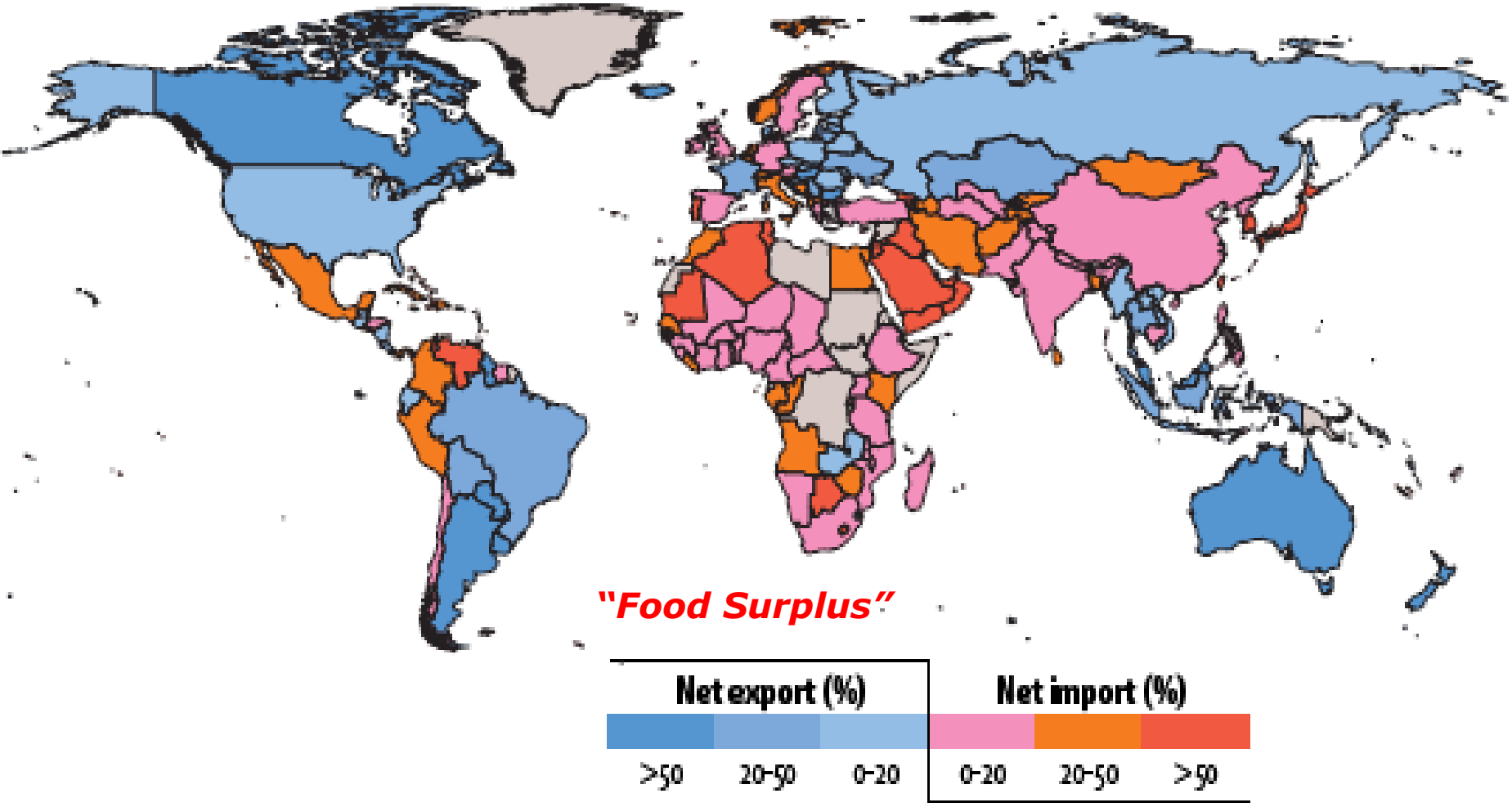


Source: Brookes and Barfoot, 2017 Forthcoming

Contribution of Biotech Crops to Food Security, Sustainability and Climate Change

Source: ISAAA, 2016

Longer term implications for global food security: Percent of net food imports over domestic supply



Source: FAO Global Perspectives Studies, using 2011 food balance sheets from FAO, 2016a.

Source: The Future of Food and Agriculture. FAO, UN. February 2017

Longer term implications for global food security: CROP "YIELD GAPS"

Average crop yields 2013, t/ha

Biotechnology crop varieties

Country	Food status	Maize	Soybeans
U.S.A.	Exporter	9.97	2.9
Canada	Exporter	8.9	2.9
Argentina	Exporter	6.6	2.5
China	Importer	6.1	1.9

Sources: FAO Statistics; USDA FAS

Farmers' Record Yields

Corn	22.3 t/ha (Rainfed)	Chile
	26.8 t/ha (Irrigated)	Chile
Soybean	10.8 t/ha	MO, US
Wheat	15.5 t/ha	NZ
Rice	18.0 t/ha	China

From: Fisher, Edmeades & Byerlee, 2013

Biotech crops provide more diverse offerings to consumers in 2016

New Biotech Crops and Traits Commercialized in 2016 and Pending in 2017

	Crop	Trait	Country	Hectares
1	Alfalfa	HarvXtra™ low lignin	USA Canada	20,000 800
2	Apples	Golden Delicious and Granny Smith Arctic® Apples, Non-browning	USA	~ 81
3	Pineapple	High Anthocyanin	Costa Rica	~15
4	Soybean	Herbicide tolerant	Brazil*	2017
5	Bean	Virus resistant	Brazil*	2017

***Approved in 2015, estimated planting in 2017**

"New" Biotech Crop Approvals in 2016

	Crop	Trait	Country
1	Potato	Innate™ Gen 2 = Non-bruising, less browning, less acrylamide, lowered reducing sugars, plus late blight resistance	USA
2	Potato	Innate™ Gen 1 = Non-bruising, less browning, less acrylamide, reduced levels of reducing sugar	Canada
3	Apples	Arctic® Fuji, Non-browning	USA

News Flash! 15 May 2017

Biotech regulatory committee approves commercial release of GM Mustard

The GM Mustard seeds will be released for sowing after the environment ministry approves it…….Hindustan Times. Updated: May 11, 2017 20:02 IST

Developed by Delhi University's Centre for Genetic Manipulation of Crop Plants (CGMCP)

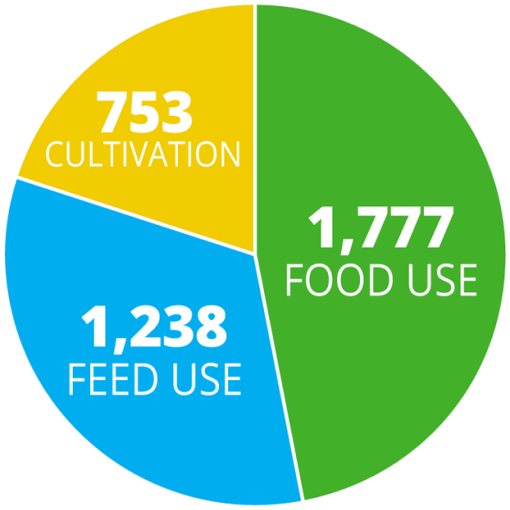
Status of Approved Events for Biotech Crops Used in Food, Feed, and Processing

40 COUNTRIES HAVE ISSUED

3,768 REGULATORY APPROVALS

FOR **26** GM CROPS

392 EVENTS SINCE 1994



MAIZE

HAS LARGEST NUMBER OF APPROVED EVENTS

218 IN **29** COUNTRIES

HERBICIDE TOLERANT MAIZE EVENT

NK603

HAS MOST APPROVALS

54 IN **26** COUNTRIES

ISAAA, 2016

Statement of Support

- 123 Nobel Laureates supported biotechnology and condemned critics
- International bodies: UN FAO, IFPRI, G20 to eradicate hunger and malnutrition in 16 years or less through modern tools of plant breeding
- US National Academies of Sciences, Engineering and Medicine reported that GM crops are as safe or safer than conventional crops

Future Prospects

- Expansion of global GM crop area
- New biotech crops and traits in the pipeline
- The potential of Plant Breeding Innovations/ New Breeding Techniques such as genome editing CRISPR technology in variety development
- Application of science-based and efficient GM crop regulation

Expansion of GM Crop Area

Substantial potential for selected products remain

- At least an additional 100 million hectares for **biotech maize**: 60 million Ha in Asia, with 35 M Ha in China alone, and up to 35 M Ha, in smaller parcels in Africa.

- **Bt cotton** potential in up to 10 African countries each growing 100,000 hectares or more

- Potential **biotech potato** area of 5.6 to 7 million hectares in 2020 in China

New biotech crops and traits in the pipeline

Potential of New Breeding Technologies

CRISPR, TALENs, Zinc Finger Nucleases

- **Capability – Ability to edit native crop genes** coding for important traits and generating **non-transgenic plants**
- **<u>Four Comparative Advantages over Conventional/GM</u>**

  1. Precision – more precise, similar to natural mutations, no new material inserted in the genome

  2. Regulation – science-based, fit-for-purpose, proportionate and non-onerous regulation – several countries have classified genome-edited as non-GM

  3. Speed – substantially faster

  4. Cost – faster-speed and less onerous regulation translates to significant cost savings
- **Genome-edited crops** being improved include, soybean, maize, wheat, rice, potato, tomato, and peanuts

Enabling country and global regulations are essential

- Technology in conjunction with conducive policies can double food production
- Regulation should be science/evidence based, fit for purpose, and harmonized globally

Biotechnology continues to be important to meet the 50% increase in food demand by 2050!

Biotech crops can help address the following challenges named by F.A.O., U.N.:

- Population growth, urbanization and ageing
- Climate change
- Agricultural productivity and innovation
- Transboundary pests and diseases
- Nutrition and health
- Food losses and waste

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EXECUTIVE SUMMARY

Global Status of Commercialized Biotech/GM Crops: 2016

Thank you