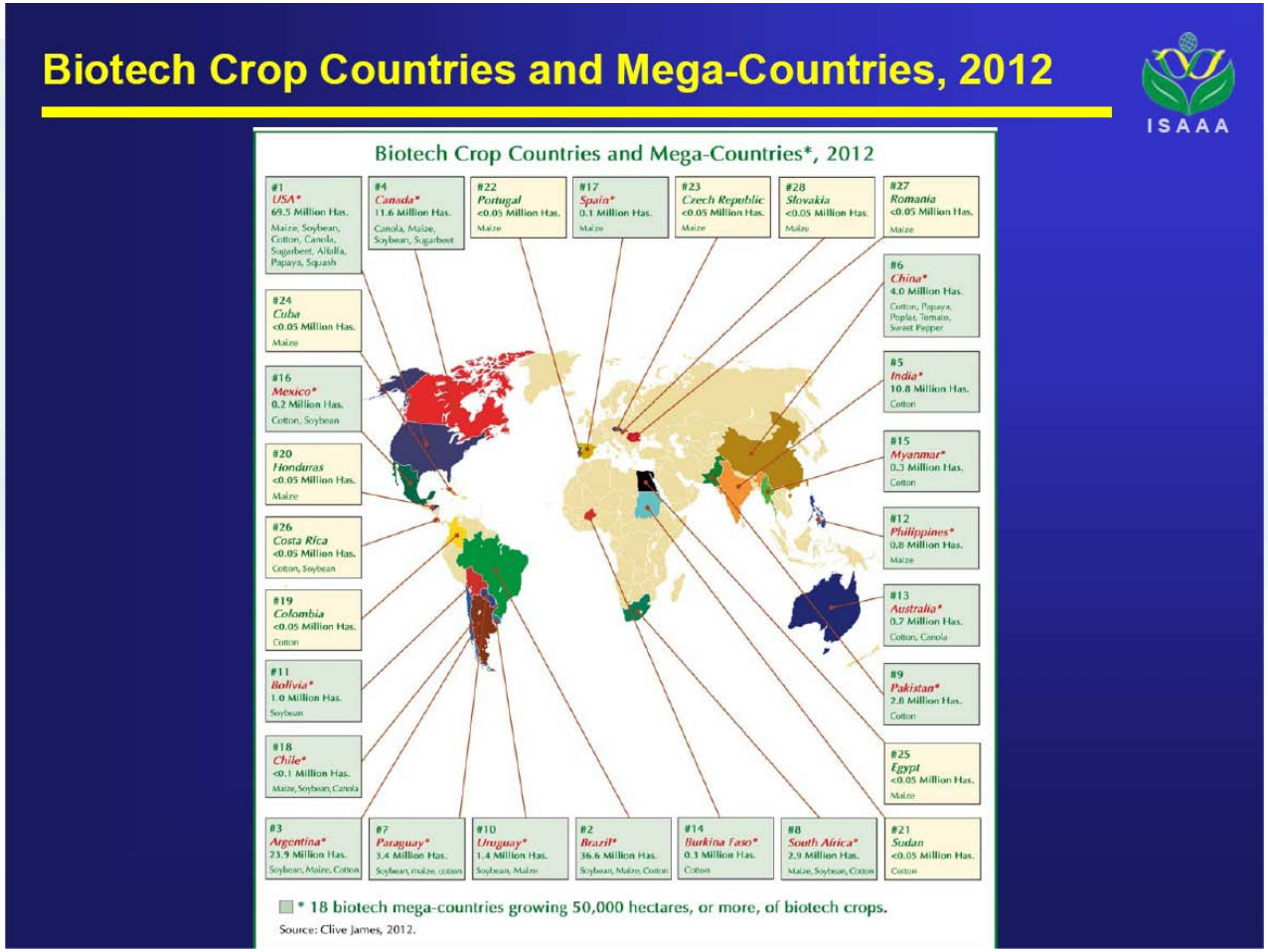
NATIONAL INSTITUTE OF BIOLOGY

Overview of current GMO situation

Dr. Jana Žel

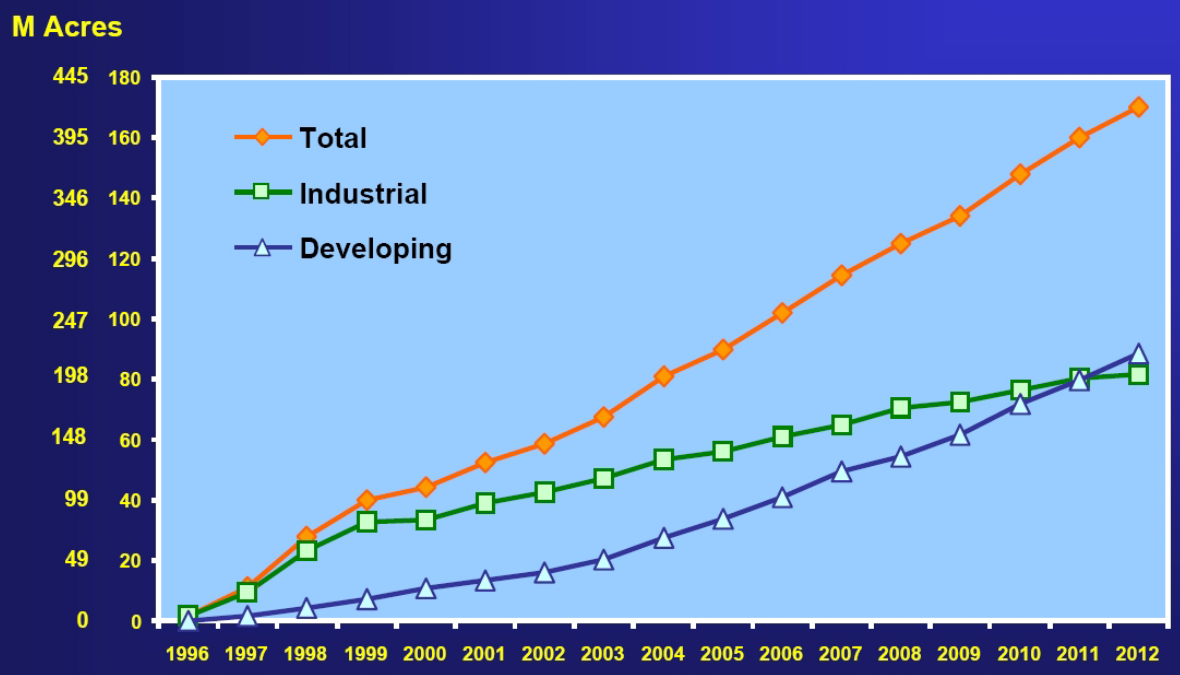
WORLD


Biotech Crop Countries and Mega-Countries, 2012
ISAAA
Biotech Crop Countries and Mega-Countries*, 2012
#1 USA* 69.5 Million Has. Maize, Soybean, Cotton, Canola, Sugarbeet, Alfalfa, Papaya, Squash
#4 Canada* 11.6 Million Has. Canola, Maize, Soybean, Sugarbeet
#22 Portugal <0.05 Million Has. Maize
#17 Spain* 0.1 Million Has. Maize
#23 Czech Republic <0.05 Million Has. Maize
#28 Slovakia <0.05 Million Has. Maize
#27 Romania <0.05 Million Has. Maize
#6 China* 4.0 Million Has. Cotton, Papaya, Poplar, Tomato, Sweet Pepper
#24 Cuba <0.05 Million Has. Maize
#5 India* 10.8 Million Has. Cotton
#16 Mexico* 0.2 Million Has. Cotton, Soybean
#15 Myanmar* 0.3 Million Has. Cotton
#20 Honduras <0.05 Million Has. Maize
#12 Philippines* 0.8 Million Has. Maize
#26 Costa Rica <0.05 Million Has. Cotton, Soybean
#13 Australia* 0.7 Million Has. Cotton, Canola
#19 Colombia <0.05 Million Has. Cotton
#9 Pakistan* 2.8 Million Has. Cotton
#11 Bolivia* 1.0 Million Has. Soybean
#25 Egypt <0.05 Million Has. Maize
#18 Chile* <0.1 Million Has. Maize, Soybean, Canola
#3 Argentina* 23.9 Million Has. Soybean, Maize, Cotton
#7 Paraguay* 3.4 Million Has. Soybean, maize, cotton
#10 Uruguay* 1.4 Million Has. Soybean, Maize
#2 Brazil* 36.6 Million Has. Soybean, Maize, Cotton
#14 Burkina Faso* 0.3 Million Has. Cotton
#8 South Africa* 2.9 Million Has. Maize, Soybean, Cotton
#21 Sudan <0.05 Million Has. Cotton
* 18 biotech mega-countries growing 50,000 hectares, or more, of biotech crops.
Source: Clive James, 2012.

WORLD

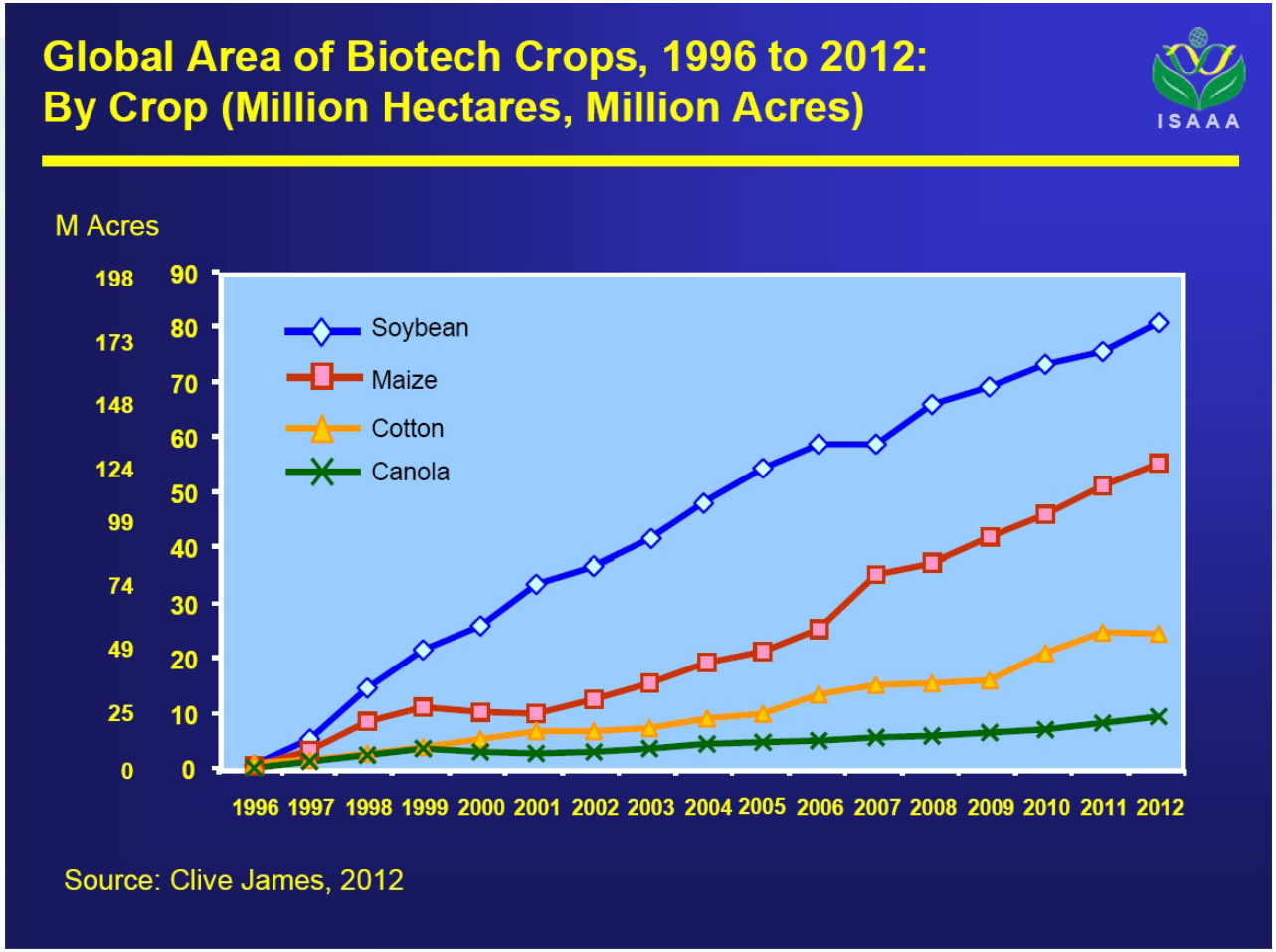
Global Area of Biotech Crops, 1996 to 2012: Industrial and Developing Countries (M Has, M Acres)

ISAAA

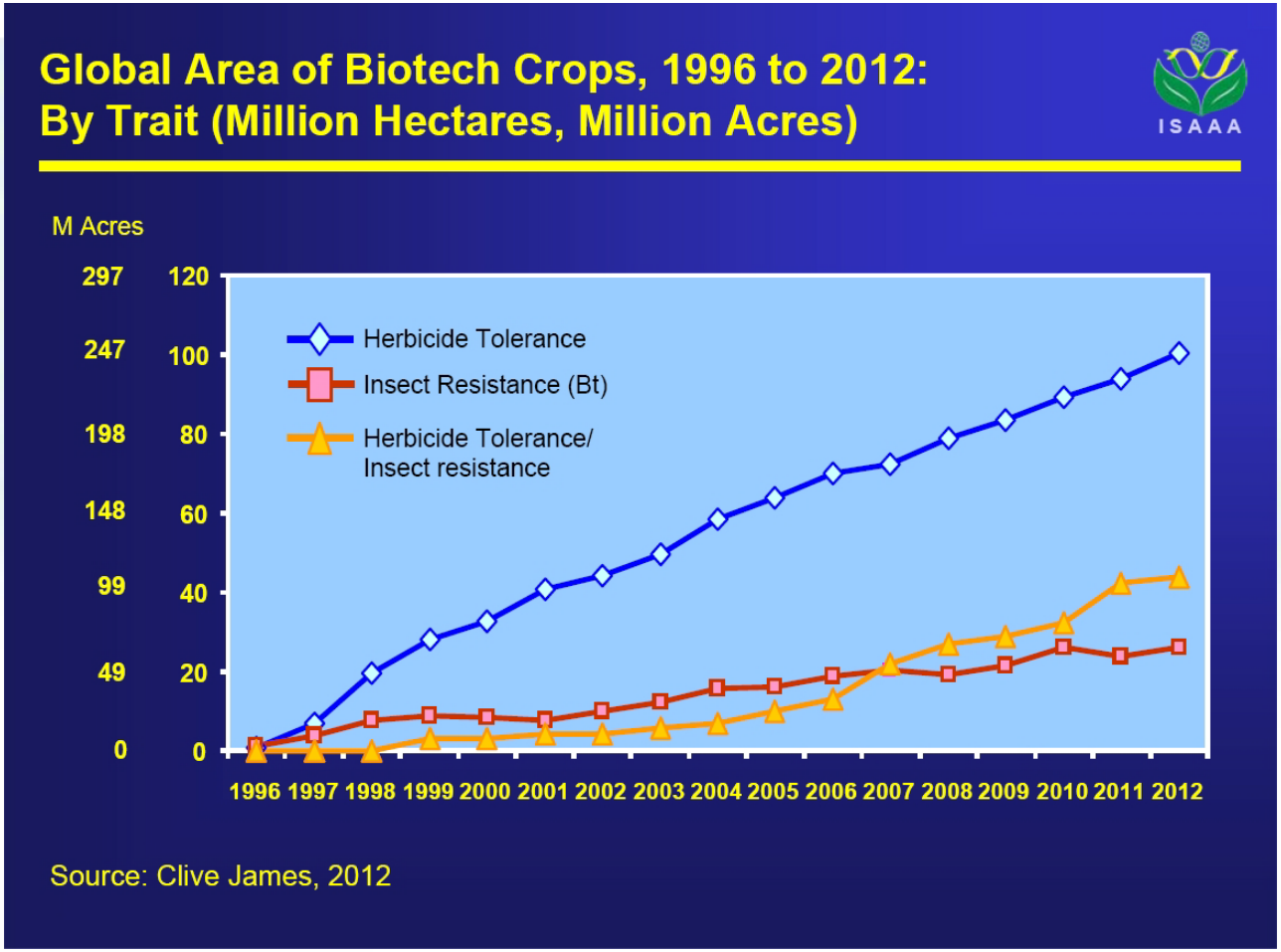


Source: Clive James, 2012

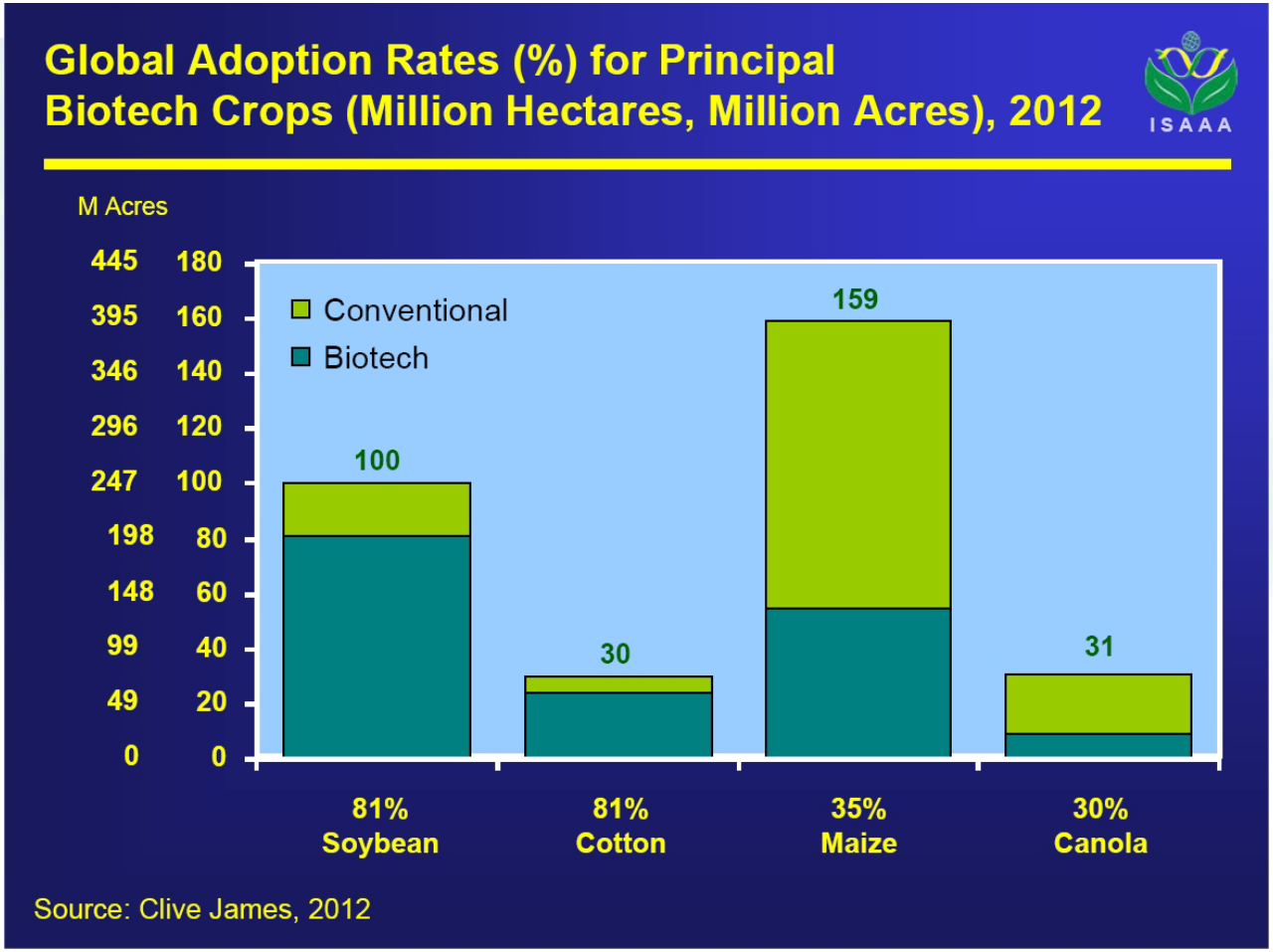
WORLD


Global Area of Biotech Crops, 1996 to 2012:
By Crop (Million Hectares, Million Acres)
ISAAA
M Acres
198
173
148
124
99
74
49
25
0
90
80
70
60
50
40
30
20
10
0
Soybean
Maize
Cotton
Canola
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Source: Clive James, 2012

WORLD


Global Area of Biotech Crops, 1996 to 2012:
By Trait (Million Hectares, Million Acres)
ISAAA
M Acres
297
247
198
148
99
49
0
120
100
80
60
40
20
0
Herbicide Tolerance
Insect Resistance (Bt)
Herbicide Tolerance/
Insect resistance
1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Source: Clive James, 2012

WORLD


Global Adoption Rates (%) for Principal Biotech Crops (Million Hectares, Million Acres), 2012
ISAAA
M Acres
445
395
346
296
247
198
148
99
49
0
180
160
140
120
100
80
60
40
20
0
Conventional
Biotech
100
30
159
31
81% Soybean
81% Cotton
35% Maize
30% Canola
Source: Clive James, 2012

WORLD

- 170 milion ha of GMOs
- 28 countries
- 20 development coutries
- 8 industrialized
- 17,3 milion farmers
- Especialy farmers in China and India – additionaly GM cotton
- In 2012 6% more then in 2011
- First time planting in: Sudan (Bt cotton) and Cuba(Bt maize).

Ref: James, Clive. 2012. ISAAA Brief No. 44.

WORLD

- In Brazil each year more area on GMOs
- Public institution Brazilian Agricultural Research Corporation (EMBRAPA) – in 2012 get permition to commertialize virus resistant bean, developed by their own knowledge and finances.

Ref: James, Clive. 2012. ISAAA Brief No. 44.

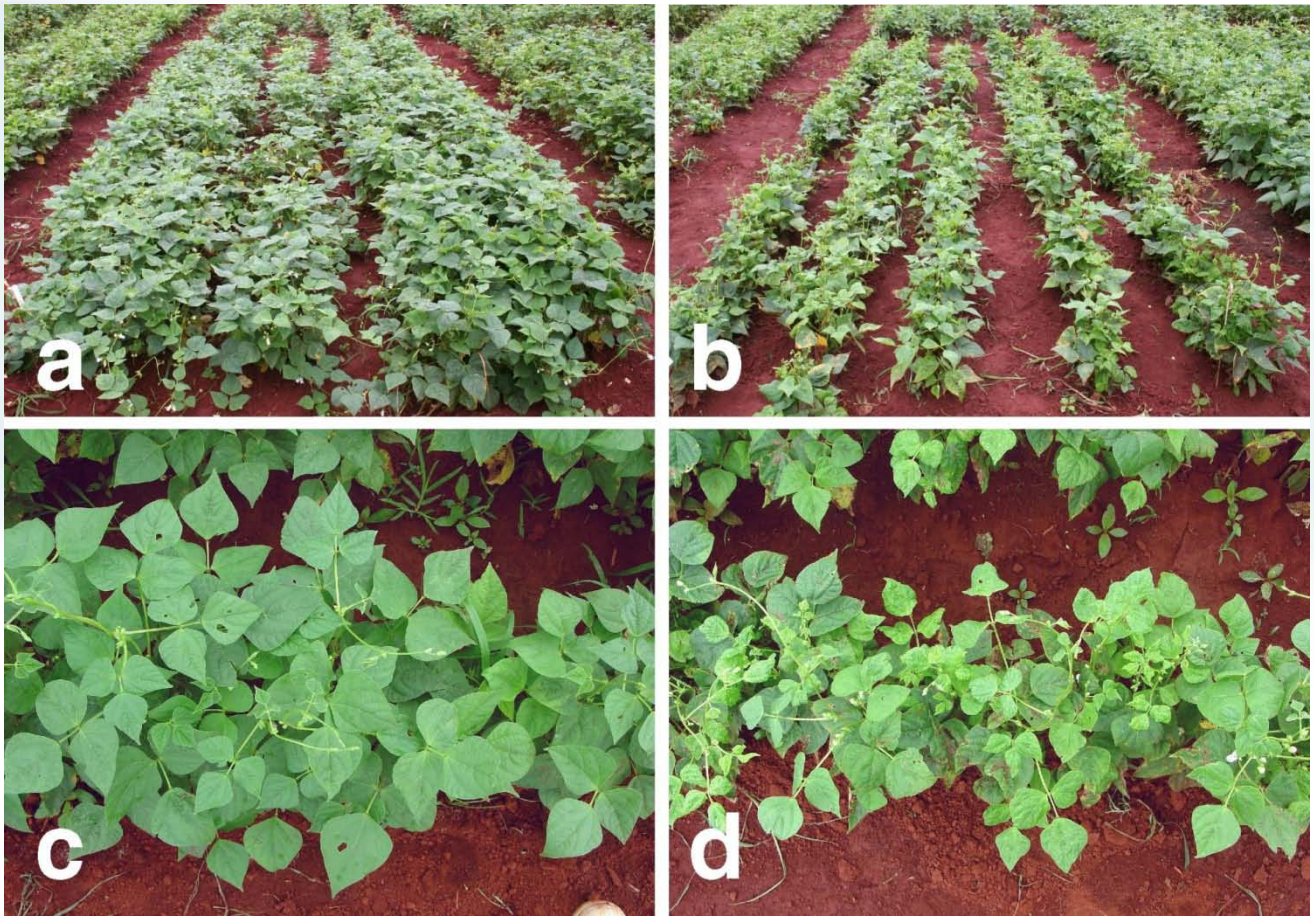
WORLD

- It is resistant to golden mosaic virus, the worst enemy of this crop in Brazil and in South America.
- They genetically modified the plant so that it could produce small fragments of RNA, responsible for the activation of its defense mechanism against the golden mosaic virus.
- Technology is that there is no production of new protein in the plants, and consequently, simplifies toxicity and allergenicity studies
- The RNA fragments can cause resistance to several variations of the same virus.

- Registration of varieties needed, launch of new cultivars to farmers expected for the use during the “dry” season of 2015

http://www.cenargen.embrapa.br/_comunicacao/2011/cenargenda/cenargenda62_en_2011.html
http://www.europabio.org/sites/default/files/position/capalbo_-_gmos_in_brasil_-_the_virus_resistant_bean_as_a_fact.pdf

WORLD



GM **Non-GM**

http://www.europabio.org/sites/default/files/position/capalbo_-_gmos_in_brasil_-_the_virus_resistant_bean_as_a_fact.pdf

Table 1. Global Area of Biotech Crops in 2012: by Country (Million Hectares)**

Rank	Country	Area (million hectares)	Biotech Crops
1	USA*	69.5	Maize, soybean, cotton, canola, sugarbeet, alfalfa, papaya, squash
2	Brazil*	36.6	Soybean, maize, cotton
3	Argentina*	23.9	Soybean, maize, cotton
4	Canada*	11.6	Canola, maize, soybean, sugarbeet
5	India*	10.8	Cotton
6	China*	4.0	Cotton, papaya, poplar, tomato, sweet pepper
7	Paraguay*	3.4	Soybean, maize, cotton
8	South Africa*	2.9	Maize, soybean, cotton
9	Pakistan*	2.8	Cotton
10	Uruguay*	1.4	Soybean, maize
11	Bolivia*	1.0	Soybean
12	Philippines*	0.8	Maize
13	Australia*	0.7	Cotton, canola
14	Burkina Faso*	0.3	Cotton
15	Myanmar*	0.3	Cotton
16	Mexico*	0.2	Cotton, soybean
17	Spain*	0.1	Maize
18	Chile*	<0.1	Maize, soybean, canola
19	Colombia	<0.1	Cotton
20	Honduras	<0.1	Maize
21	Sudan	<0.1	Cotton
22	Portugal	<0.1	Maize
23	Czech Republic	<0.1	Maize
24	Cuba	<0.1	Maize
25	Egypt	<0.1	Maize
26	Costa Rica	<0.1	Cotton, soybean
27	Romania	<0.1	Maize
28	Slovakia	<0.1	Maize
	Total	**170.3**	

* 18 biotech mega-countries growing 50,000 hectares, or more, of biotech crops
** Rounded off to the nearest hundred thousand

Source: Clive James, 2012.

WORLD

- Biotech crops are important but are not a panacea," he added. "Adherence to good farming practices, such as rotations and resistance management, are a must for biotech crops as they are for conventional crops."
- Future with more modest annual gains predicted because of the already high rate of adoption in all the principal crops in mature markets in both developing and industrial countries.

Ref: James, Clive. 2012. ISAAA Brief No. 44.

EU - APPROVED

- 8 cottons
- 27 maize
- 3 rapeseed
- 7 soybean
- 1 sugar beat
- 1 potato

EU - APPROVED

- Planting – only 2 maize (MON810 being planted) and potato for industrial production (not planted).
- Among approved ones also many stack GMOs.
- A lot of applications (also some withdrawals).

UNAPPROVED GMOs

- Not approved in EU, approved somewhere else
- Exeptions “Low level presence” (EU) No 619/2011 (0,1%)
- Approved nowhere
- Unknown

UNAPPROVED GMOs

Rapid alert 2013

- Mostly rice from China
- Papaya from Thailand
- Rarely maize

FUTURE - WORLD

DROUGHT TOLERANT MAIZE

- The first and most advanced drought tolerant biotech/transgenic maize, will be launched commercially by Monsanto in the USA in 2013 (?). Notably, the same technology, has been donated by the technology developers, Monsanto and BASF, to a Private/Public sector partnership Water Efficient Maize for Africa (WEMA) which hopes to release the first biotech drought tolerant maize as early as 2017 in sub-Saharan Africa where the need for drought tolerance is greatest.
- Gene: cold shock protein B (CspB) gene to improve drought-tolerance in maize. The gene was initially identified in bacteria under cold stress. The gene is from a common soil miroorganism Bacillus subtilis.
- Ref: James, Clive. 2012. ISAAA Brief No. 44.
- http://allafrica.com/stories/201309240936.html?page=2
- WEMA is a sub-regional, public-private partnership project between the Nairobi-based African Agricultural Technology Foundation (AATF) and national agro-research systems of five sub-Saharan African countries — Uganda, Kenya, Tanzania, Mozambique and South Africa

VITAMIN A ENHANCED GOLDEN RICE

- Subject to regulatory approval, Vitamin A enhanced Golden rice could be released in the Philippines in 2013/2014
- An experimental plot of golden rice being grown in the Philippines was uprooted during direct action on August 8, 2013

Photo courtesy of Sikwal-GMO/ Bulatlat.com
http://bulatlat.com/main/2013/08/09/farmers-in-bicol-uproot-golden-rice/

Ref: James, Clive. 2012. ISAAA Brief No. 44.

DROUGHT TOLERANT SUGARCANE

- Drought tolerant sugarcane approval in Indonesia – expected next year to be planted.
- RmbetA gene was derived from Rhizobium meliloti for the event NXI-4T and NXI-6T.
- Developed by state plantation firm PT Perkebunan Nusantara, the Indonesian Sugarcane Plantation Research Center (P3GI) and experts from the State University of Jember in East Java.

Ref: James, Clive. 2012. ISAAA Brief No. 44.
http://www.thejakartapost.com/news/2013/05/20/development-underway-first-transgenic-sugarcane-plantation.html
http://www.isaaa.org/kc/cropbiotechupdate/article/default.asp?ID=9793

INSECTS

- Fly that decimates olive trees could soon be released in Spain in an attempt to control the pests?
- In Brazil, GM mosquitoes are already at large as part of the biggest project yet involving engineered insects. The aim is to stamp out their natural counterparts, which carry dengue fever.
- http://www.oxitec.com/oxitec-features-in-the-new-scientist-magazine/

FISH

- AquaBounty is developing advanced-hybrid salmon, trout, and tilapia designed to grow faster than their conventional siblings. AquAdvantage® Salmon (AAS) include a gene from the Chinook salmon, which provides the fish with the potential to grow to market size in half the time of conventional salmon.
- Glowing fish - the fluorescent color in GloFish is produced by a fluorescent protein gene, derived from naturally occurring genes found in marine organisms.

http://www.aquabounty.com/products/aquadvantage-295.aspx
http://www.glofish.com/about/faq/

OTHER

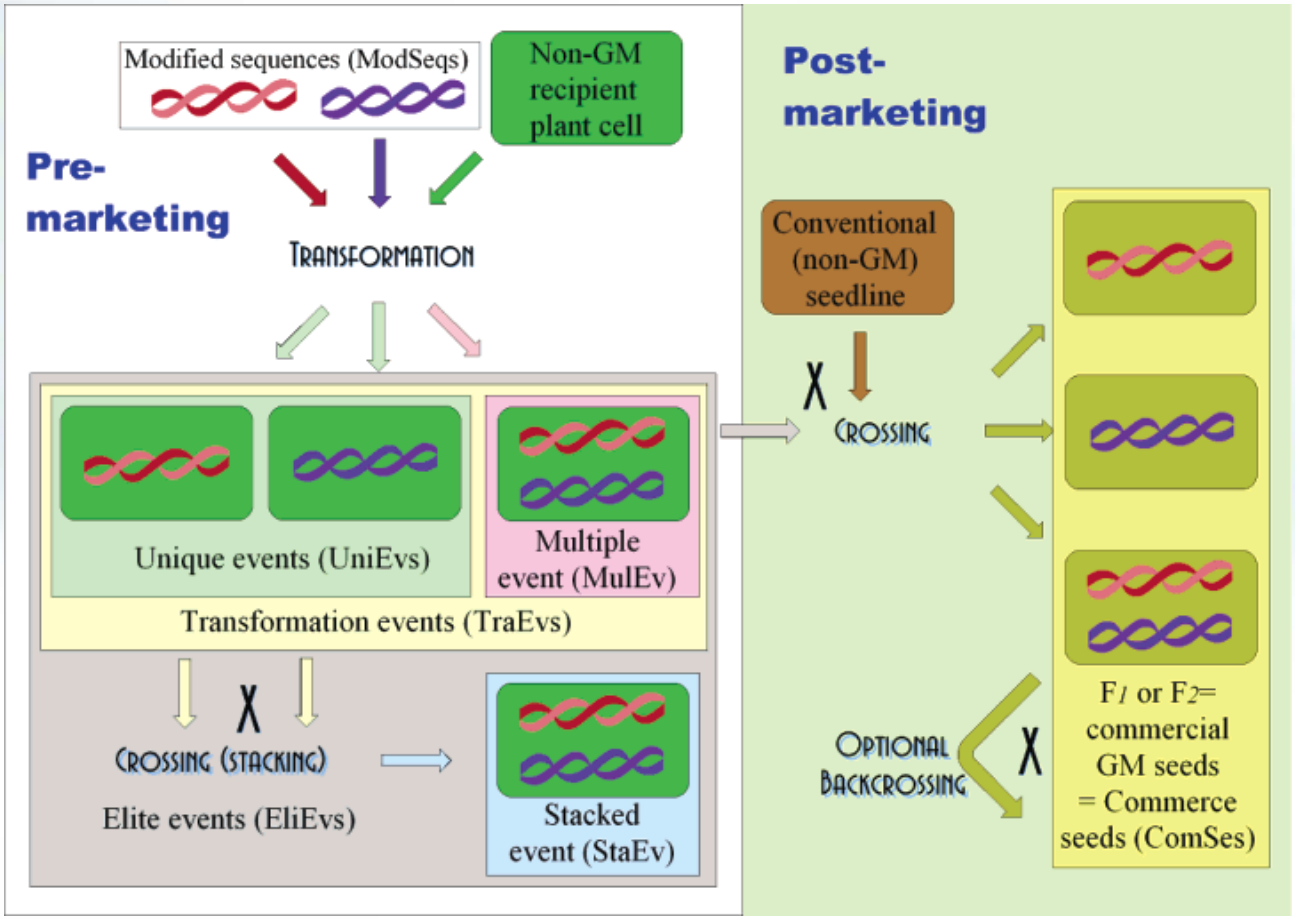
- PIGS
- ANIMALS producing proteins in the milk
- ....

FUTURE - EU

- SmartStax – classican breeding of GMOs - is a brand of genetically modified seed made through a collaboration between Monsanto Company and Dow Chemical Company
  - Yieldgard VT Triple (Monsanto),
  - Herculex Xtra (Dow),
  - RoundUp Ready 2 (Monsanto),
  - Liberty Link (Dow).
- Protect against -multiple modes of insect protection and herbicide tolerance:
  - above-ground insects,
  - Below-Ground insects,
  - broad herbicide tolerance.
- Eight genes.
- Acceleron Seed Treatment System which protects against insects at the earliest stages of development. It requires only 5% refuge acres (before 20%).

http://mycogen.com/Grain_Corn/Information/SitePages/SmartStax.aspx

STACK GMOs (nalaganje genov)



Holst-Jensen A. J. Agric. Food Chem. 2006, 54, 2799-2809

STACK GMOs (nalaganje genov)

- More and more stack GMOs on the market.
- Stack GMO- when on one GMO at least two genetic constructs are present and they are integrated in different parts of genome.
- Detection of stacks is as for individual GMOs, since till now it was not possible to distinguish between stack and individual GMOs. Therefore with quantification of individual GMOs in sample we overestimate in comparison with refrence material with one insert.
- Because of SmartStack application in EU discussions on diferentiation between stacks and individual GMOs started again.
- ENGL-WG for identification of stacked GM events – regarding new technologies as digital PCR, New generation sequencing etc. The WG will evaluate the possibility to distinguish between stacks and individual GMOs in the sample. NIB also member of WG.

NEW TECHNIQUES

- E.g. Cisgenics
- Zink-finger technology
- Etc..