Is Transgenic Sugarcane a BMP ?

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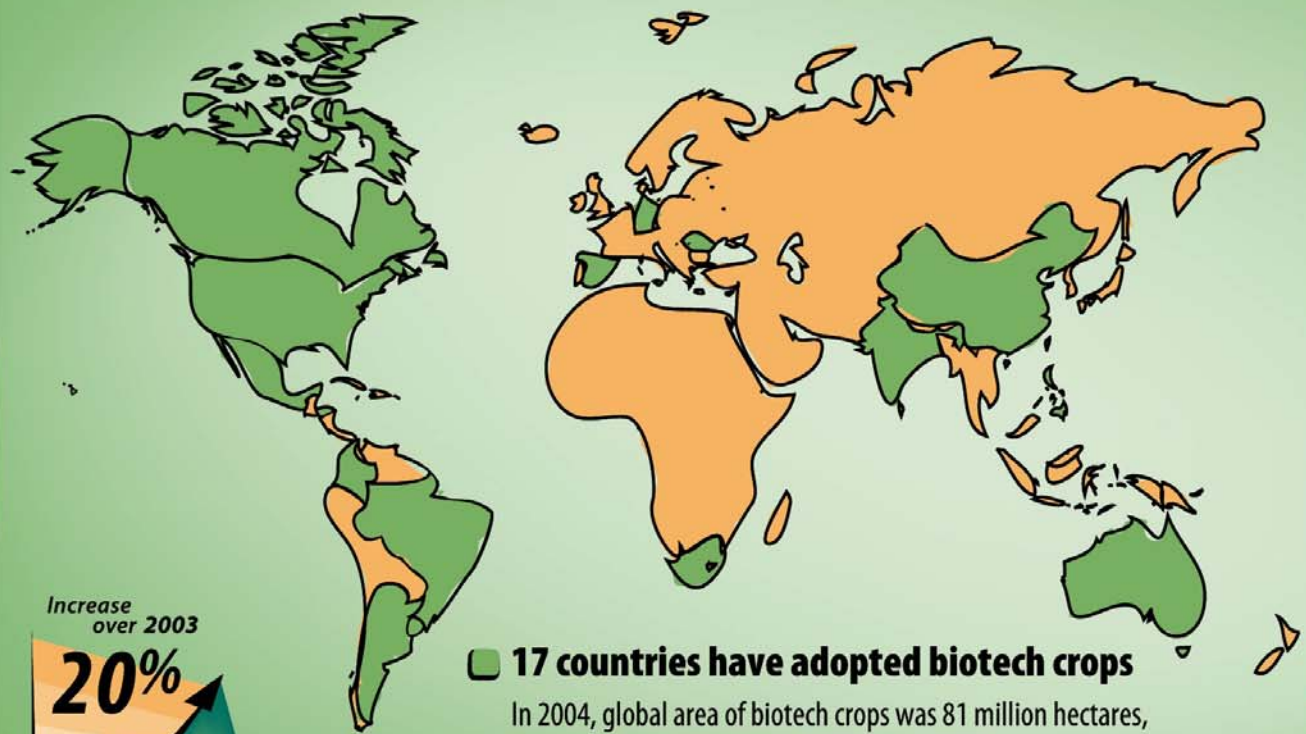
Global Status of Biotech Crops in 2004



Increase over 2003

20%

17 countries have adopted biotech crops

In 2004, global area of biotech crops was 81 million hectares, representing an increase of 20% over 2003, equivalent to 13.3 million hectares.

Source: Clive James, 2004 ISAAA Briefs 32

BIOTECH MEGA-COUNTRIES

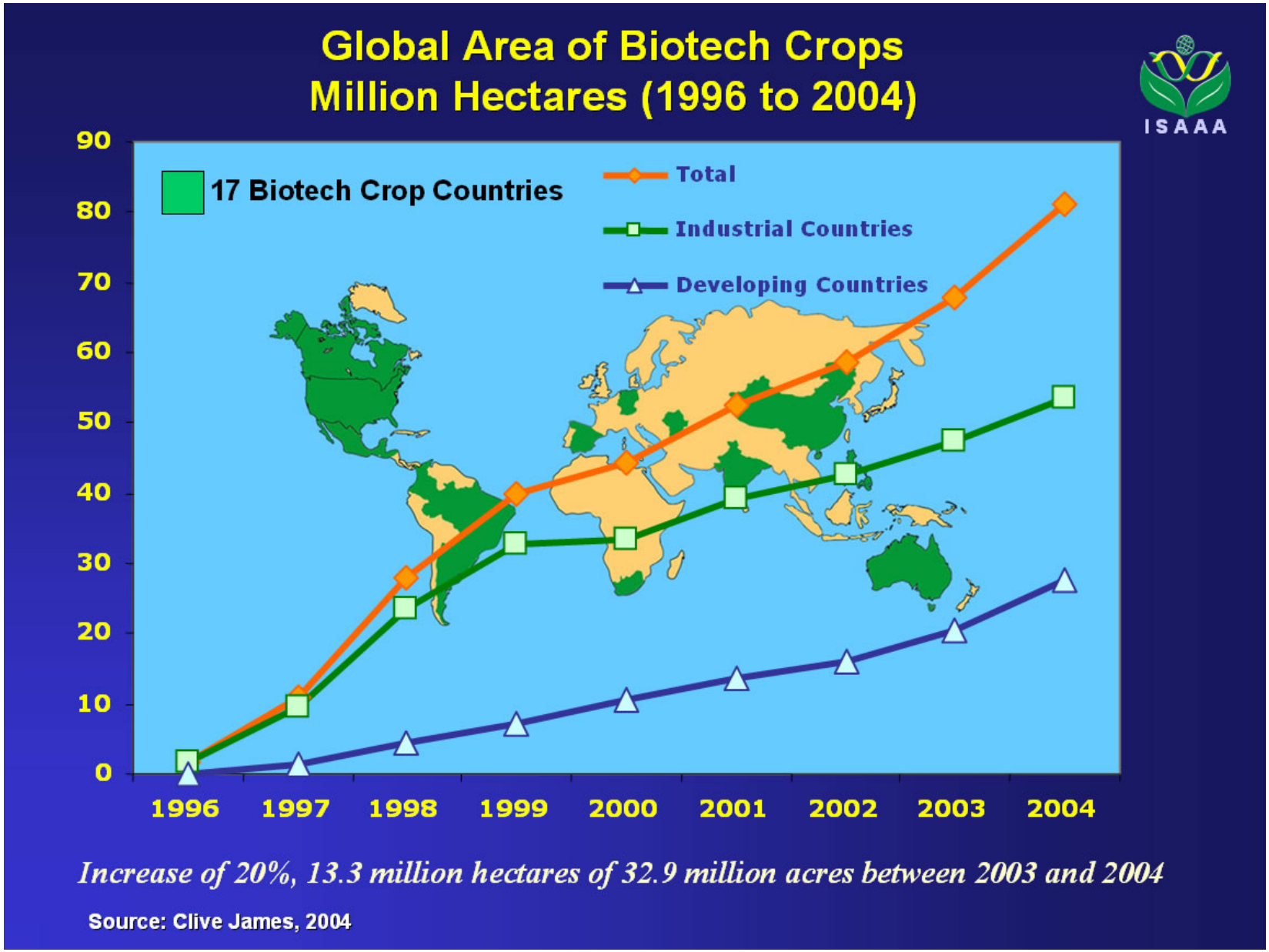
50,000 hectares or more

USA:	47.6 million
Argentina:	16.2 million
Canada:	5.4 million
Brazil:	5.0 million
China:	3.7 million
Paraguay:	1.2 million
India:	0.5 million
South Africa:	0.5 million
Uruguay:	0.3 million
Australia:	0.2 million
Romania:	0.1 million
Mexico:	0.1 million
Spain:	0.1 million
Philippines:	0.1 million

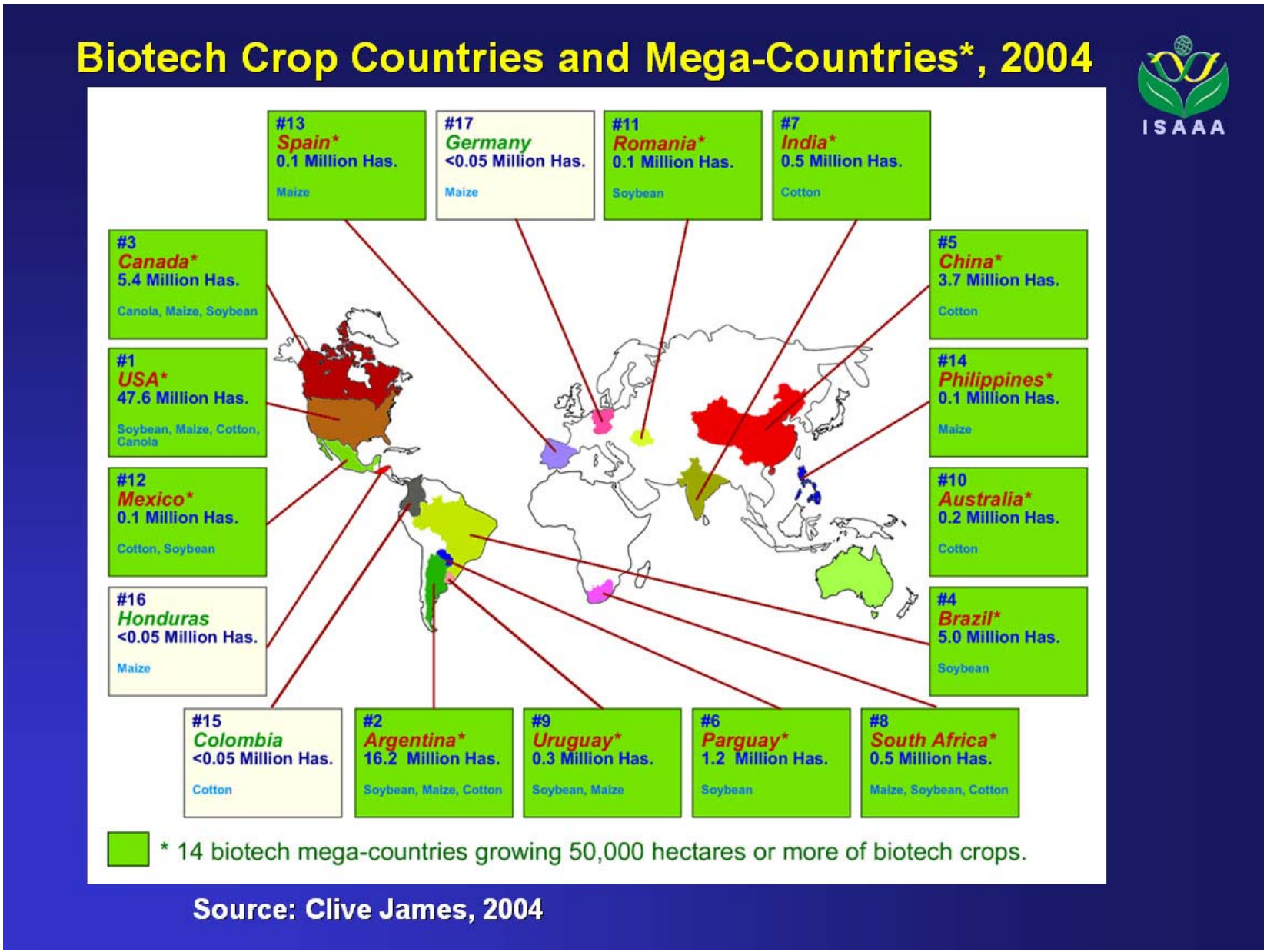
50,000 hectares or less

Colombia Honduras
Germany

Transgênicos no Mundo. Evolução 1996 - 2004



Transgênicos no Mundo



Dominant Biotech Crops , 2004

	Million hectares	% transgenic
Herbicide Tolerant Soybeans	48.4	60
Bt Maize	11,2	14
Bt Cotton	4,5	6
Herbicide Tolerant Maize	4,3	5
Herbicide Tolerant Canola	4,3	5
Bt / Herbicide Tolerant Maize	3,8	4
Bt / Herbicide Tolerant Cotton	3	4
Herbicide Tolerant Cotton	1,5	2
Total	**81**	**100**

International Consortium for Sugarcane Biotechnology

Members:

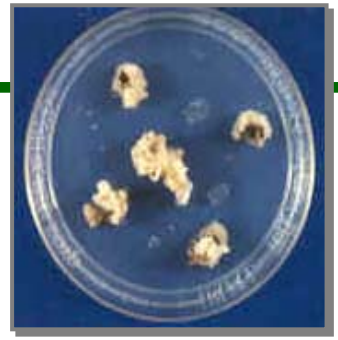
Brazil
Argentina
Australia
Colombia
Ecuador
France/Reunion
Guatemala
India
Mauritius
Phillipines
South Africa
USA
Barbados

Regular meetings to discuss funding of sugarcane biotech research.

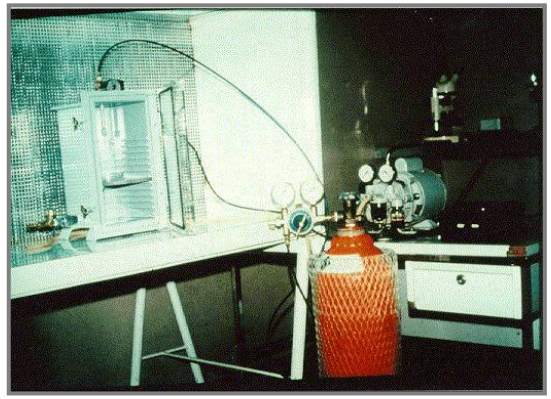
Since 1991, twenty research projects totalling U$ 3,2 million have been funded:

Cornell University, BYU, Texas A&M, Clemson, Univ Georgia, CIRAD (France), Southern Cross Univ. (Australia) are some of the recipients of ICSB funds.

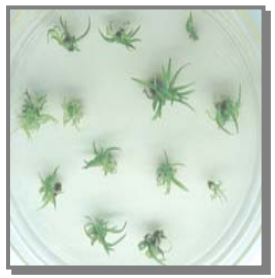
Embriogenic callus



Particle bombardment



Laboratory selection



Transplant and field test

Herbicide tolerant sugarcane Brasil

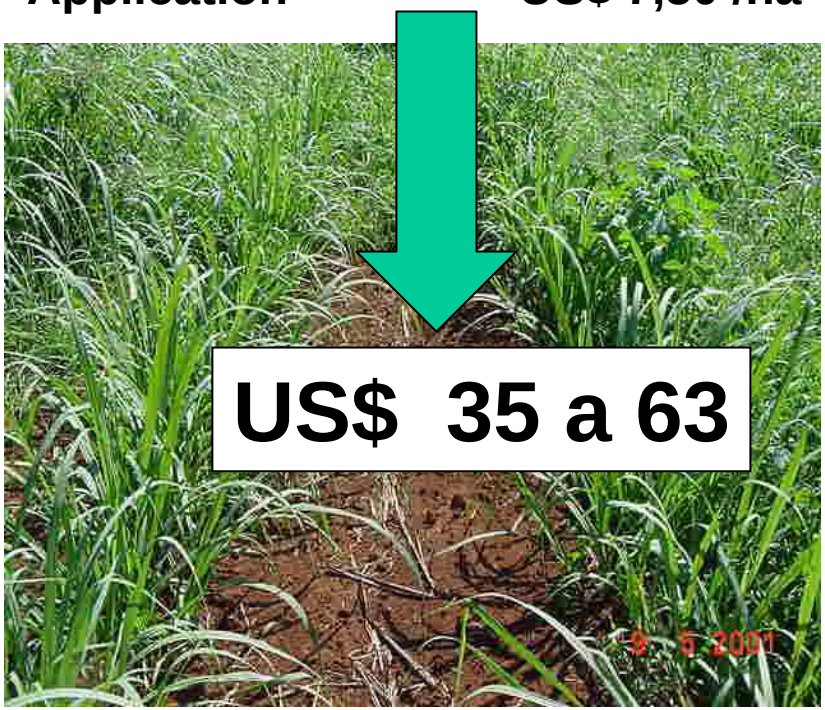
Imazapic = US$ 28,50 /ha

Diuron, Hexazinone = US$ 37,50/ ha

Ametryne + 2,4,D = US$ 27,60/ ha

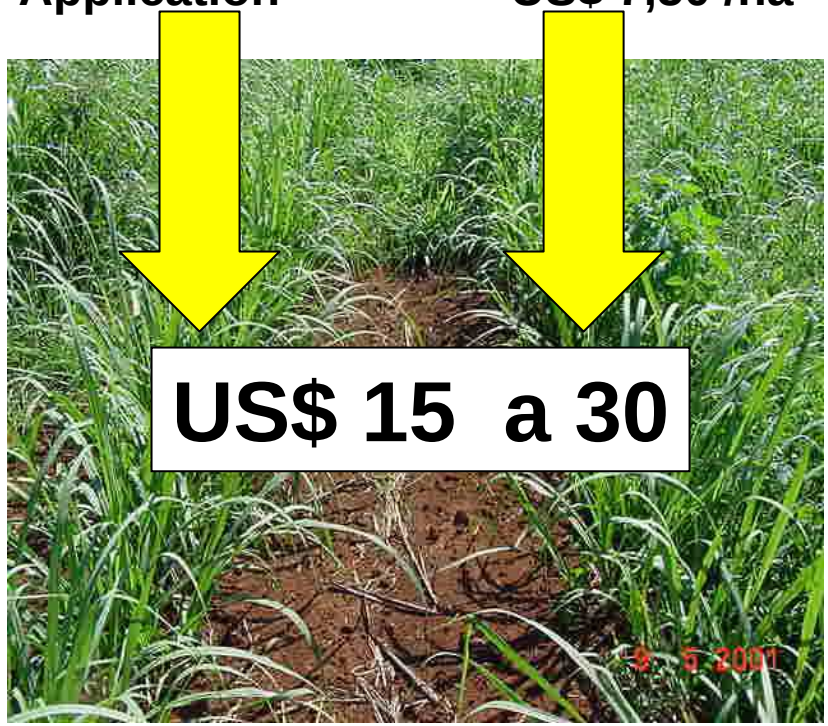
Sulfentrazone = US$ 56,00 /ha

Application = US$ 7,50 /ha



Glyphosate 3l/ ha = US$ 7,50 /ha

Application = US$ 7,50 /ha

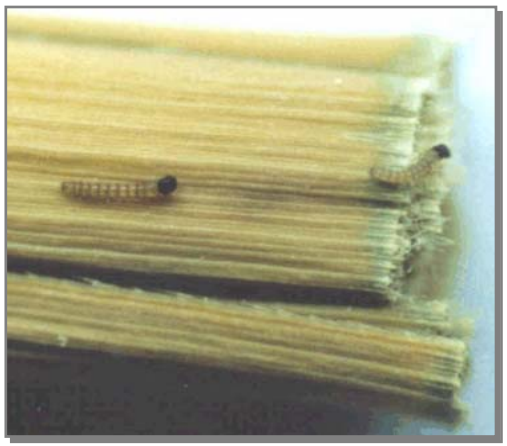


Benefit of herbicide tolerant cane for Louisiana

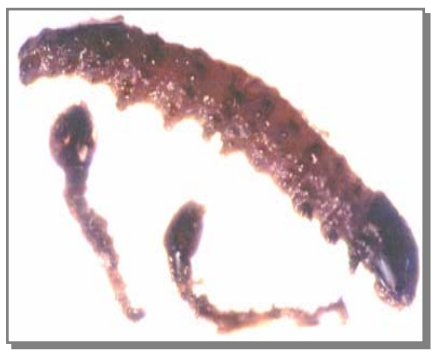
- *Ed Richard USDA/ARS*
  - Louisiana produces 15,000,000 t = US$ 385 M
  - Present herbicide reduce production by 5%
  - Change in production: + 800,000 t = US$ 19,9 M
  - Pesticide use: - 514,000 lbs /yr
  - Production cost : - US$ 10 M/yr

Insect resistance

Genetic transformation for sugarcane borer (Diatreae saccharalis) resistance.



Bioensaio



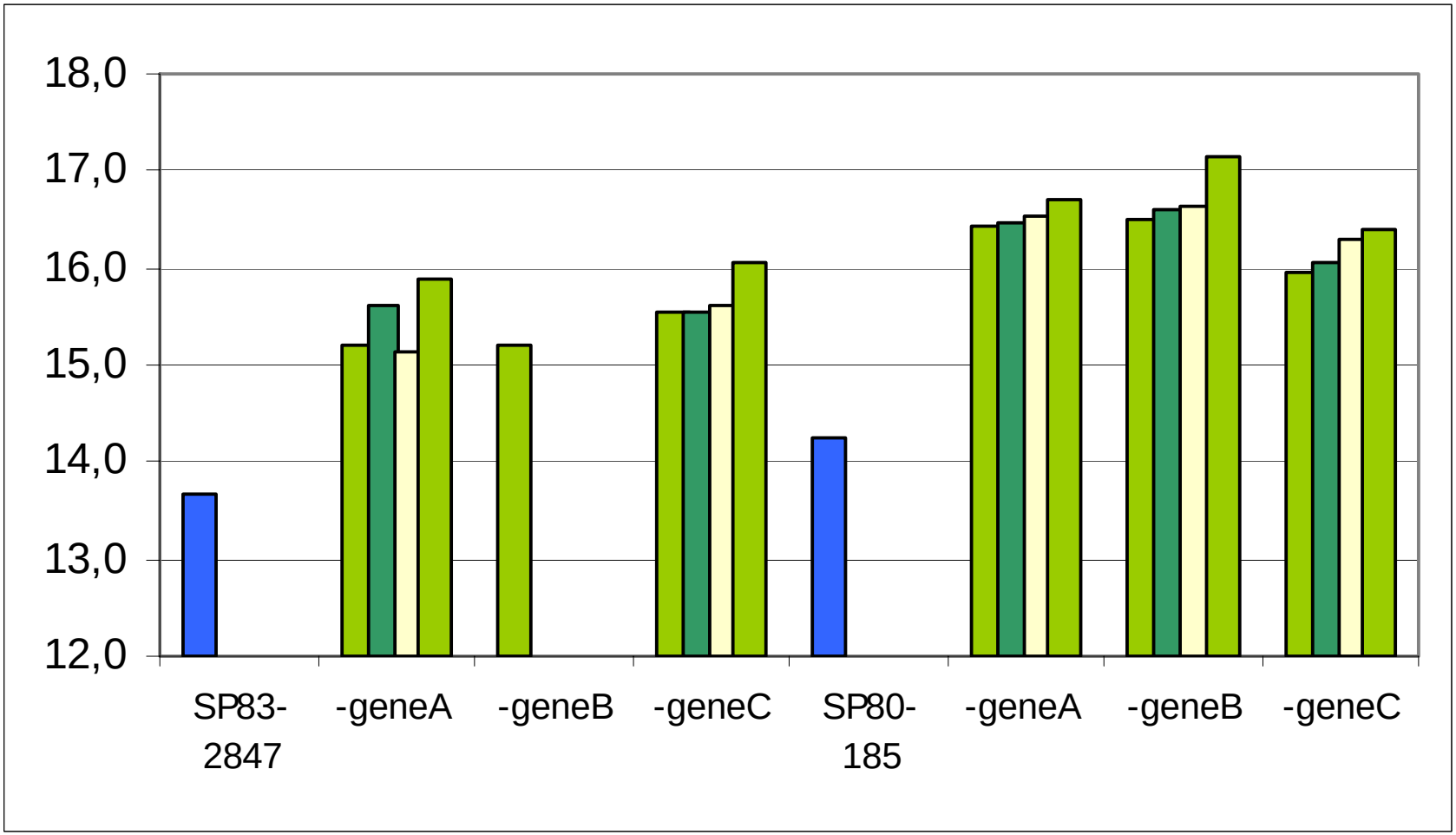
Bioensaio

Field test

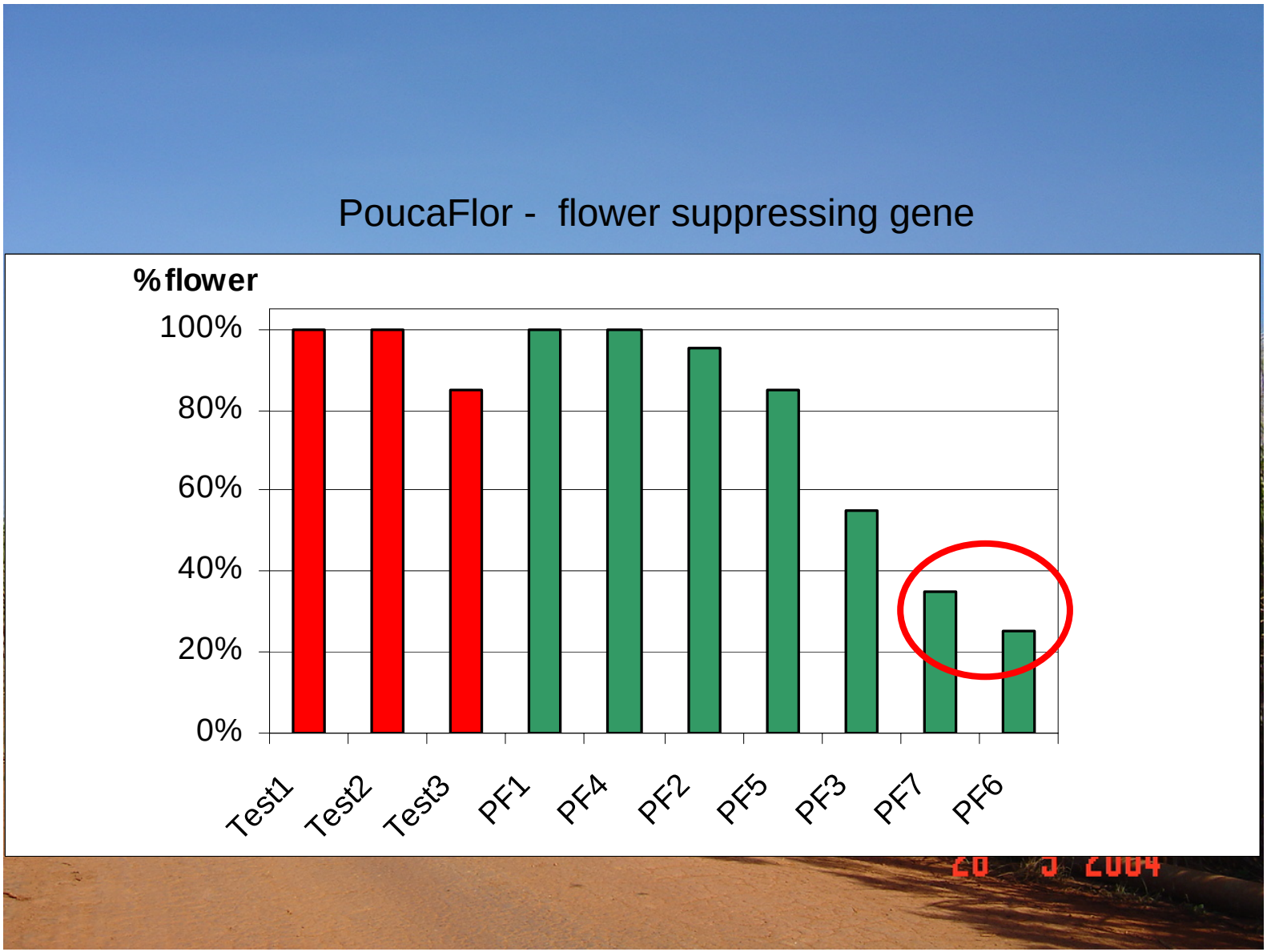
Transgenic ***Control***

Sucrose enhancement

Sucrose content in selected transformed clones in which specific carbohydrate metabolism genes have been silenced.



Flowering in sugarcane



Global Status of Transgenic Sugarcane

- There is no commercially grown transgenic sugarcane.
- Research and development of transgenic sugarcane has been identified in:
  - Australia, Argentina, Brazil, Cuba, Egypt, India, Indonesia, Mauritius, Myanmar, South Africa, USA, Venezuela

Perceived **benefits** by those developing transgenic sugarcane

Transgenic sugarcane will :	
Decrease the cost of producing cane or sugar	1
Permit the production of other products (vaccines, plastics etc)	2
Improve the quality of sugar	3
Reduce the environmental impact of sugarcane production.	3
Expand sugarcane production to new areas	4

Global Status of Transgenic Sugarcane

Barriers perceived by those developing transgenic sugarcane

Barriers to development and deployment of transgenic sugarcane	
Access to genes.	1
Difficulties associated to negotiating rights to use genes from third parties.	2
High cost associated to research in molecular biology and transformation.	3
Regulatory issues.	3
Negative public perception.	3
Market issues (difficulties in commercializing sugar from transgenic crops).	4
Access to adequate transformation technique.	5
Perceived negative environmental impacts of transgenic sugarcane.	6
Access to qualified technical personnel.	7

Risk Assessment for Transgenic Crops

	Assessment Criteria for Environmental Safety
1	Potential of Becoming a Weed of Agriculture or to be Invasive of Natural Habitats.
2	Potential for gene Flow to Wild Relatives Whose Offspring may Become More Weedy of More Invasive.
3	Potential Impact on Non-Target Organisms.
4	Potential Impact on Biodiversity.
5	Potential for the Development of Multiple Herbicide Tolerant Volunteers and Herbicide Tolerant Weeds.
	Assessment Criteria for use as Food or Livestock Feed
1	Nutritional Composition.
2	Anti-Nutritional Factors.

Assessment must be made on a case by case basis, but sugarcane rates well on most of these issues.

Sugar from transgenic crops

Sugarbeet	Country, Approval, Year
T120-7	US, Environmental, 1998 US, Food and/or Feed 1998 Canada, Food, 2000 Canada, Environment, 2001 Canada, Feed, 2001 Japan, Food, 1999 Japan, Feed, 1999
GTSB77	US, Environment, 1998 US, Food and/or Feed 1998 Australia, Food and/or Feed 2002 *
H7-1	US, Food and/or Feed, 2004

As used for human consumption, sugar beet is generally converted directly to refined white sugar (which is composed almost entirely of sucrose) through extensive purification processes. The CP4 EPSPS protein introduced into GTSB77 sugar beet was expressed at low levels in the sugar beet tuber, and was not detectable in refined sugar or molasses derived from sugar beet GTSB77. Consequently, there is no anticipated human exposure to this protein as a result of consumption of refined sugar derived from GTSB77 sugar beet

In Conclusion :

Is the use of transgenic sugarcane a BMP?

Yes, it can be.

Because transgenic sugarcane can increase yields, reduce production costs, improve sugar quality and reduce the environmental impact of sugarcane cultivation.

BUT !!!

Each transgenic event must be analysed separately, because the impact (benefit and risk) of each trait will be different.

Strong and reliable regulatory agencies are needed.

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