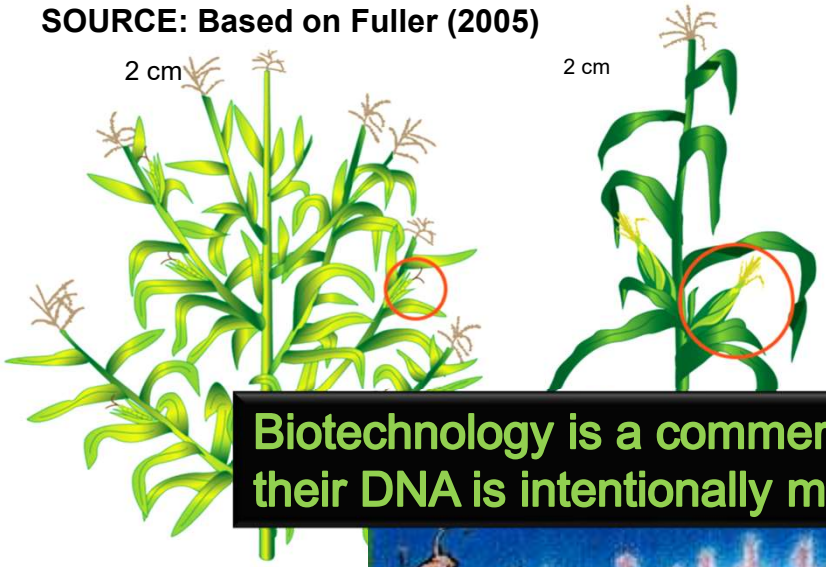
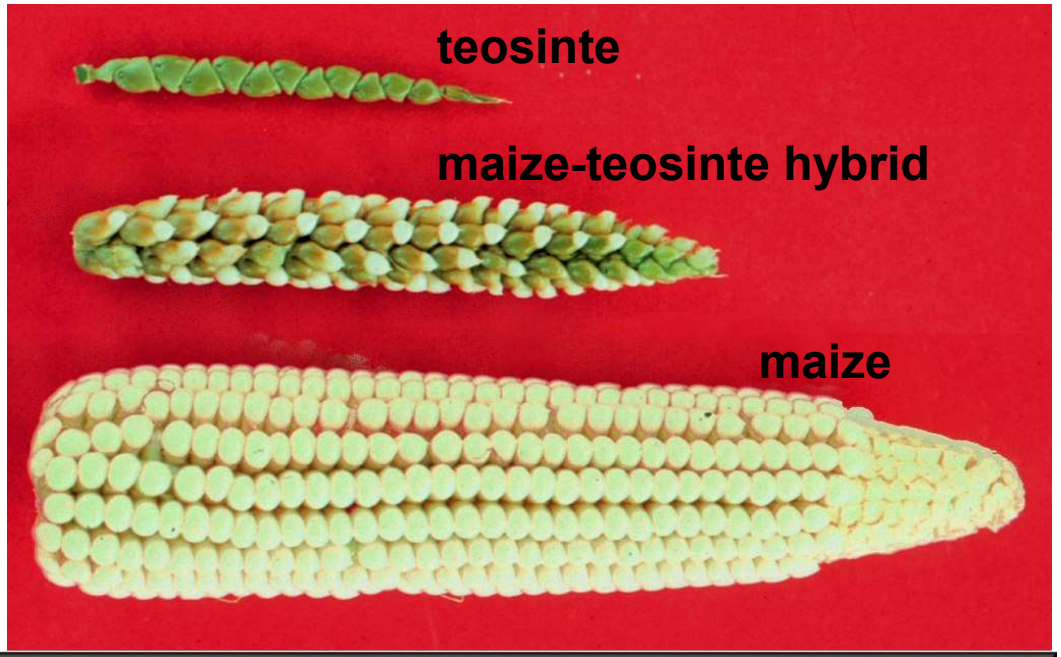
Genetically modified crops - current state, issues and perspectives

Fidanka Trajkova, Liljana Koleva Gudeva

SOURCE: Based on Fuller (2005)





Biotechnology is a commercial usage of organisms and their products where their DNA is intentionally manipulated.

S. Kamle, S. Ali / Gene 522 (2013) 123–132

Why we need transgene crops?

- Growing human population and loss of farmable land
- High costs of plant protection programmes
- Novel possibilities for pharmaceutical industry
- Crop cultivation resistant to viruses and drought, herbicide tolerance, increased nutritional value, improved fruit quality, altered ripening…….

Why we fear from transgene crops?

Genetic pollution and lost of biodiversity

- Gene transfer with pollen, insects, wind from transgene to conventional plants

Health concerns - new toxins and allergens

Unpredictable – long term harmful effect which is unpredictable at the beginning

Undesirable – creation of plants tolerant to herbicides

Uncontrolled –transfer of new gene and creation of “super weeds” and “super insects”

Irrevocable – transgene organism can be reverted to the original form

?Conspiracy? - biotechnology companies control agriculture

The very beginnings of genetic transformations

Plant Physiology
AMERICAN SOCIETY OF PLANT BIOLOGISTS

Plant Physiol. 1978 Dec; 62(6): 780–786. PMCID: PMC541824

Cell-free Synthesis of the Major Storage Protein of the Bean, *Phaseolus vulgaris* L. [1]

Sai-Ming M. Sun, Barry U. Buchbinder, and Timothy C. Hall

Author information ▸ Copyright and License information ▸

This article has been cited by other articles in PMC.

Abstract

As seeds of the French bean (*Phaseolus vulgaris*, L. cv. Tendergreen) mature, a single protein, G1 globulin (analogous to legumin), represents the majority of protein synthesized. Washed polysomes extracted from develo[illegible] cotyledons had little [illegible]logenous activity in amino acid [illegible]ncorporation, but on addition of cell-free ex[illegible] [illegible]m, a [illegible] incorporation [illegible]ed, [illegible] to th[illegible] RNA [illegible] Mg^{2+} [illegible] protein [illegible] the [illegible] of [illegible]

How far we have reached since 1983?

Plant Physiology

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Research Article | Articles

Storage Protein Synthesis in Maize

Isolation of Zein-synthesizing Polyribosomes

Brian A. Larkins, Charles E. Bracker, C. Y. Tsai

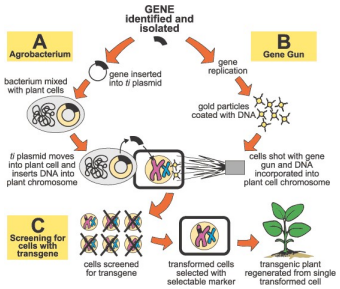
Published May 1976. DOI: https://doi.org/10.1104/pp.57.5.740

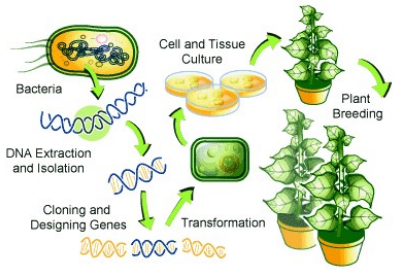
Article | Info & Metrics | PDF

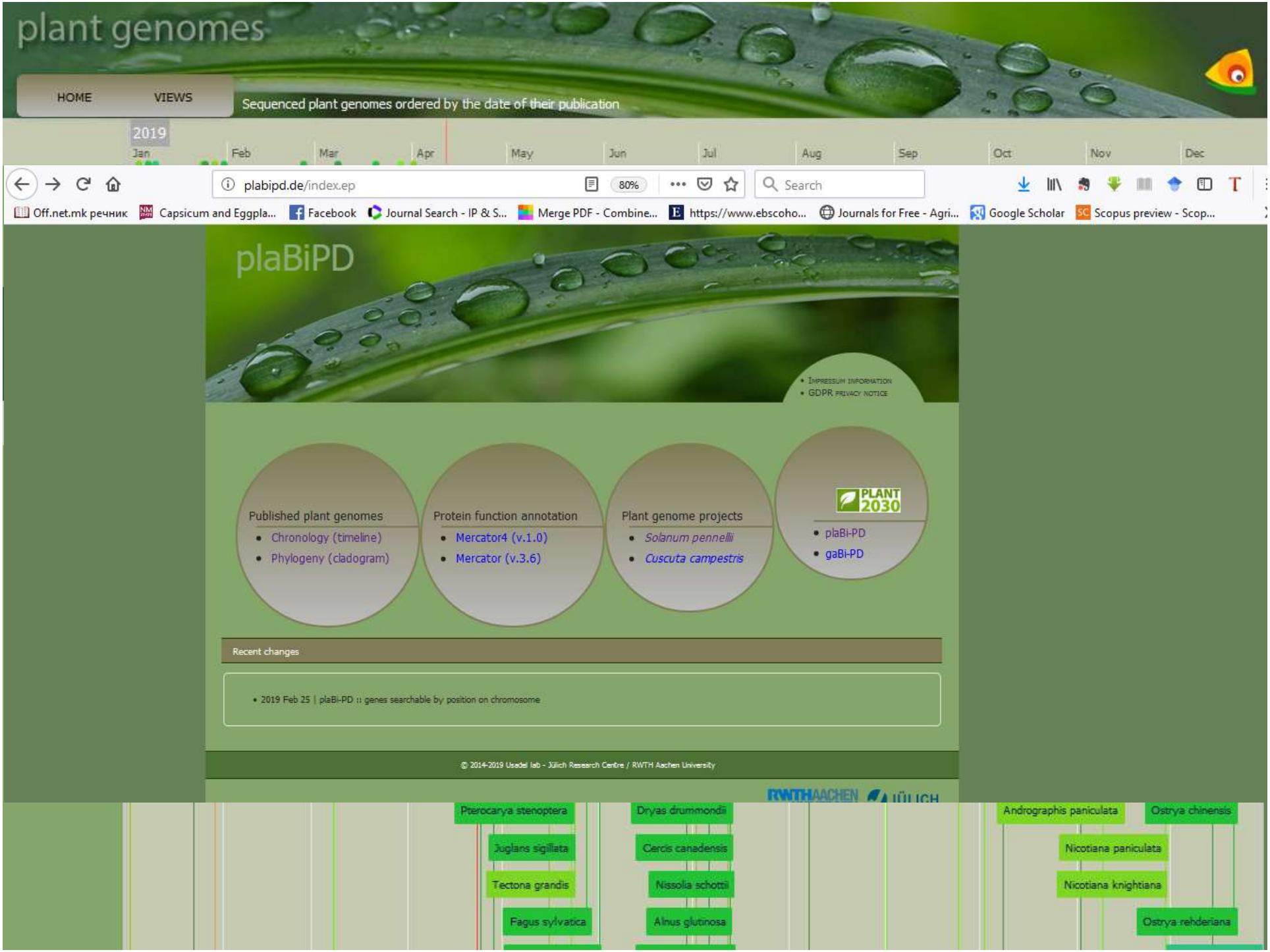
Science. 1983 Nov 4;222(4623):476-82.

Phaseolin gene from bean is expressed after transfer to sunflower via tumor-inducing plasmid vectors.

Murai N, Kemp JD, Sutton DW, Murray MG, Slightom JL, Merlo DJ, Reichert NA, Sengupta-Gopalan C, Stock CA, Barker RF, Hall TC.






plant genomes
HOME
VIEWS
Sequenced plant genomes ordered by the date of their publication
2019
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Oct
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Dec
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Off.net.mk речник
Capsicum and Eggpla...
Facebook
Journal Search - IP & S...
Merge PDF - Combine...
https://www.ebscoho...
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Scopus preview - Scop...
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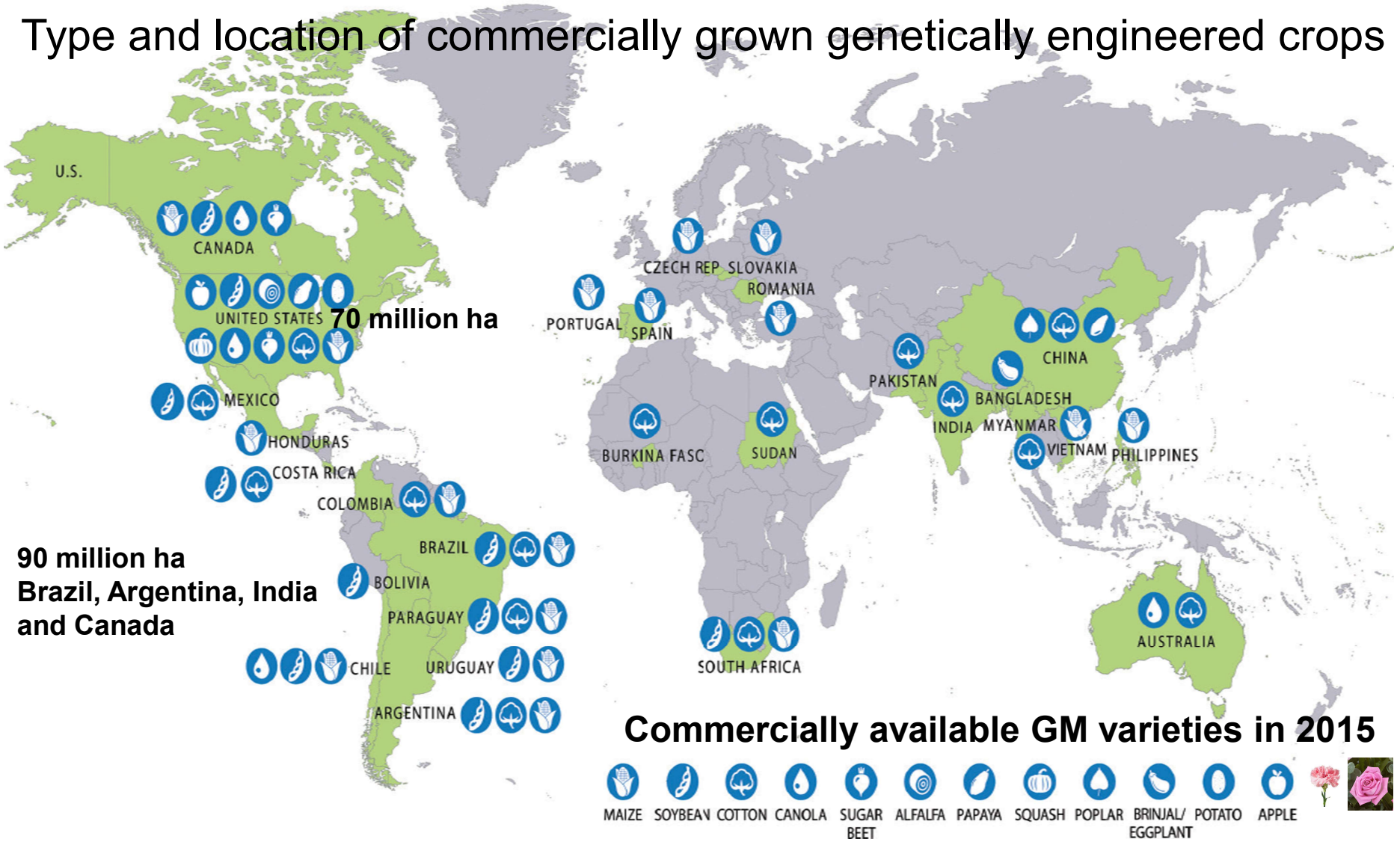
Protein function annotation
Mercator4 (v.1.0)
Mercator (v.3.6)
Plant genome projects
Solanum pennellii
Cuscuta campestris
PLANT 2030
plaBi-PD
gaBi-PD
Recent changes
2019 Feb 25 | plaBi-PD :: genes searchable by position on chromosome
© 2014-2019 Usadel lab - Jülich Research Centre / RWTH Aachen University
RWTH AACHEN
JÜLICH
Pterocarya stenoptera
Dryas drummondii
Andrographis paniculata
Ostrya chinensis
Juglans sigillata
Cercis canadensis
Nicotiana paniculata
Tectona grandis
Nissolia schottii
Nicotiana knightiana
Fagus sylvatica
Alnus glutinosa
Ostrya rehderiana

Type and location of commercially grown genetically engineered crops



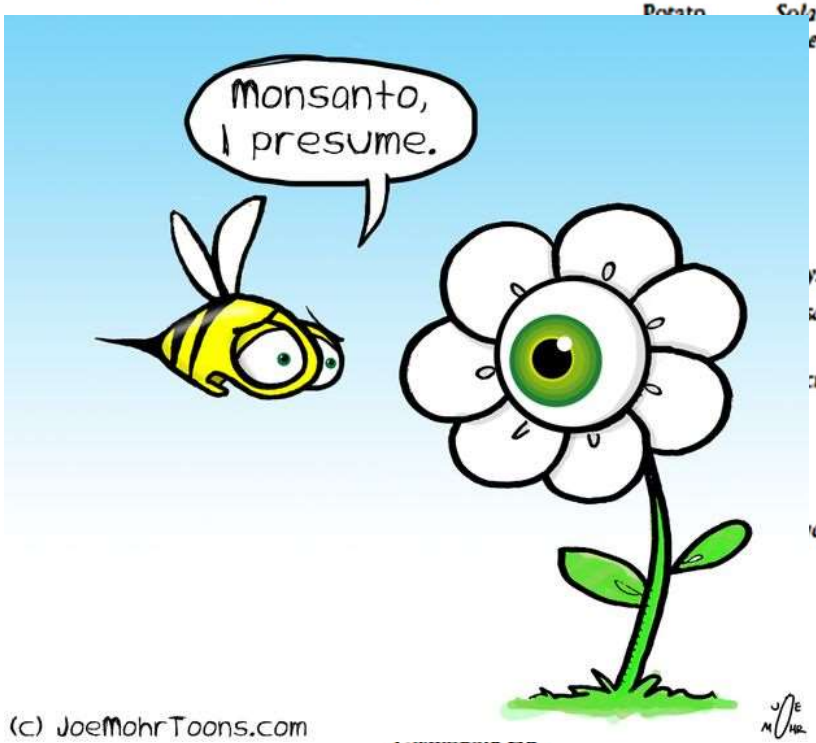
In 2015, 180 million hectares of GE crops planted globally

TABLE 3-1 Genetically Engineered Traits D
Field Release in the United States as of 2015

Crop	Crop Scientific Name	Trait
Alfalfa	*Medicago sativa*	Glyphosate HR[a,b]

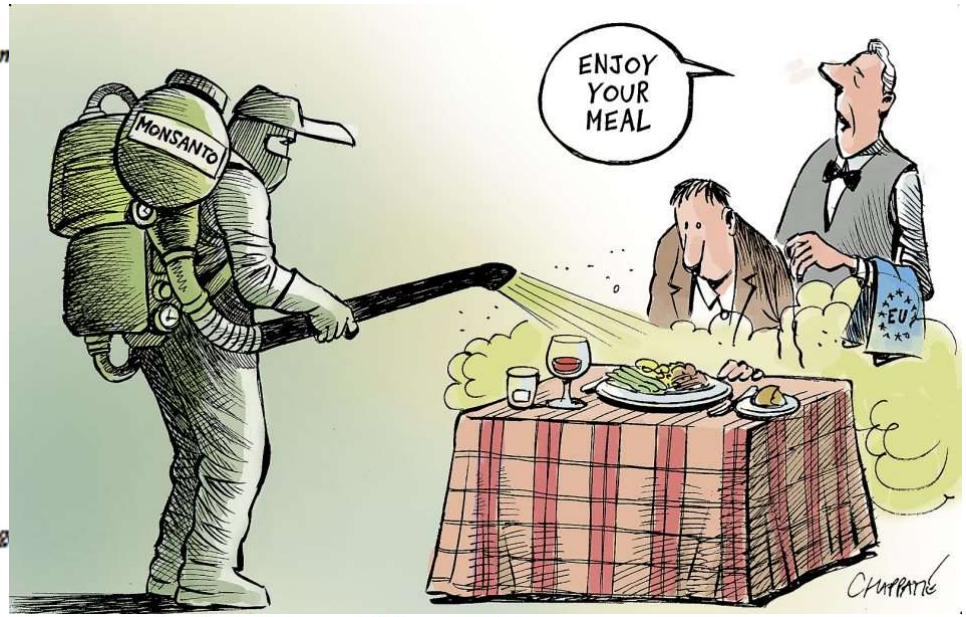
TABLE 3-1 Cont

Crop	Crop Sc Name
Plum	*Prunus*
Potato	*Solanun*



(c) JoeMohrToons.com

ber 20, 2015.



		Glyphosate HR		
		Increased Lysine[c]		
		Imidazolinone HR[c]		
		Alpha-Amylase		
		Drought Tolerance		
		ACCase[c] HR		
		2,4-D HR		
		Increased Ear Biomass		
Papaya	*Carica papaya*	Ring Spot Virus VR		
Sugar beet	*Beta vulg*			
Tobacco	*Nicotiana tabacum*	Reduced nicotine[c]	2002	Vector


GE feed is safe for animals.
RoundUp is biodegradable.
GMOs are safe.
GMOs will produce higher crop yield.
GMOs will decrease herbicide use.
We are helping bees.
RoundUp is as safe as table salt.
RoundUp is practically nontoxic.
RoundUp Resistant superweeds are highly unlikely.
Bovine Growth Hormone is safe.
GM wheat WILL NOT contaminate non-GM wheat fields
Why do I get the feeling it's just another lie?
Ahem. Genetically Modified Truth.
MONSANTO
(c) JoeMohrtoons.com
Some of the 60+ million acres of RoundUp resistant superweeds

GENETIC ENGINEERING - FOOD SAFETY AND ENVIROMENTAL ISSUES

UDC: 633.11:575.2(4)

Стручен труд
Professional paper

АНАЛИЗА НА ЕКОЛОШКИОТ РИЗИК ОД ГЕНЕТСКИ МОДИФИЦИРАНА ПЧЕНИЦА (*Triticum*) ВО ЕВРОПА

Трајкова Фиданка*

Краток извадок

Можните влијанија од хибридизацијата и интрогресијата помеѓу културите и дивите растенија засега се нејасни, бидејќи е тешко да се предвиди како генетски манипулираните гени ќе бидат изразени во соодветните диви видови. Пченицата е типично самоопрашувачки род (преку антери во рамките на секое соцветие) и секое вкрстување кое се случува е поддржано од расејувањето на полен со ветер. Доказите укажуваат дека пченицата има ограничен потенцијал за вкрстување со диви сродници во Европа. Дивите сродници со кои е познато дека пченицата се вкрстува се потврдени за меѓите на полињата или нарушените места и најверојатно никогаш не формираат одржливи популации или не стануваат инвазивни за другите станишта.

Клучни зборови: *Triticum, тек на гени, диви сродници, хибриди, еколошка анализа*

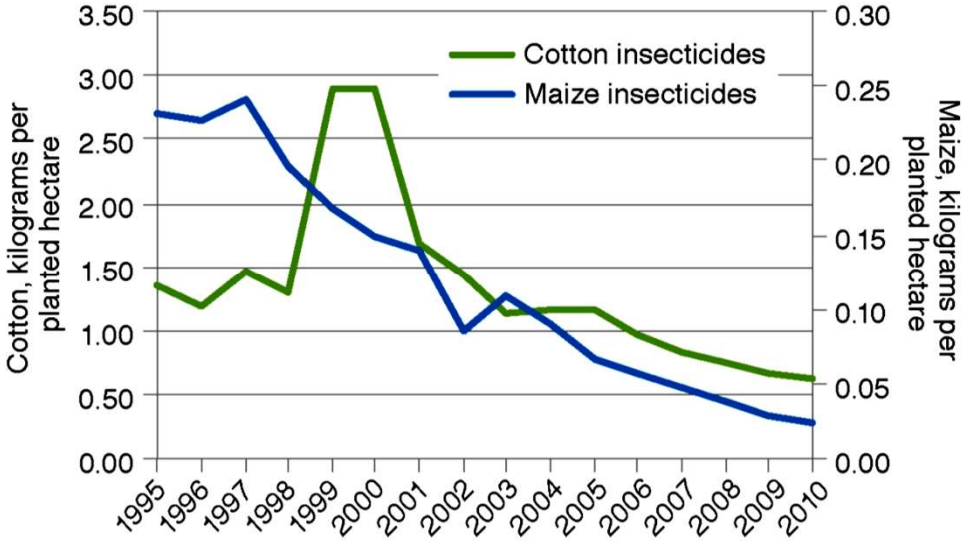
ECOLOGICAL RISK ASSESSMENT OF GENETICALLY MODIFIED WHEAT (*Triticum*) IN EUROPE

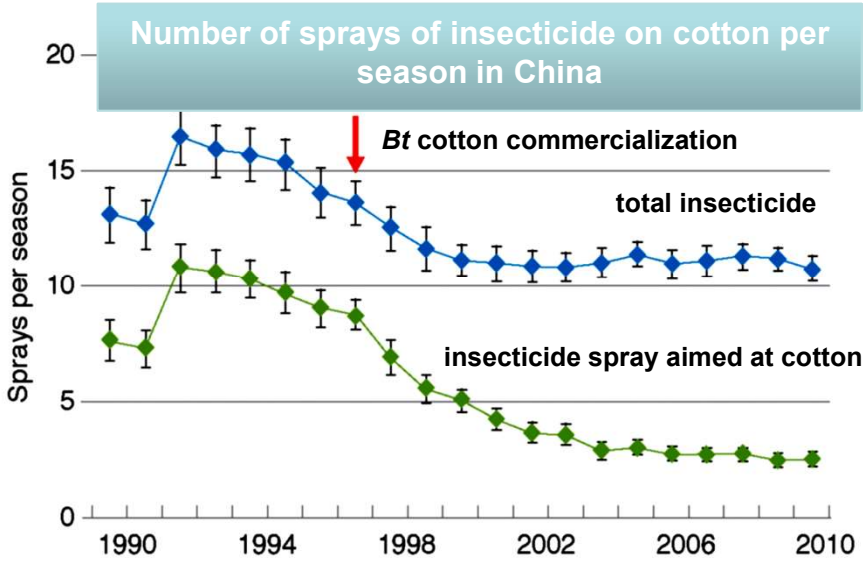
Trajkova Fidanka*

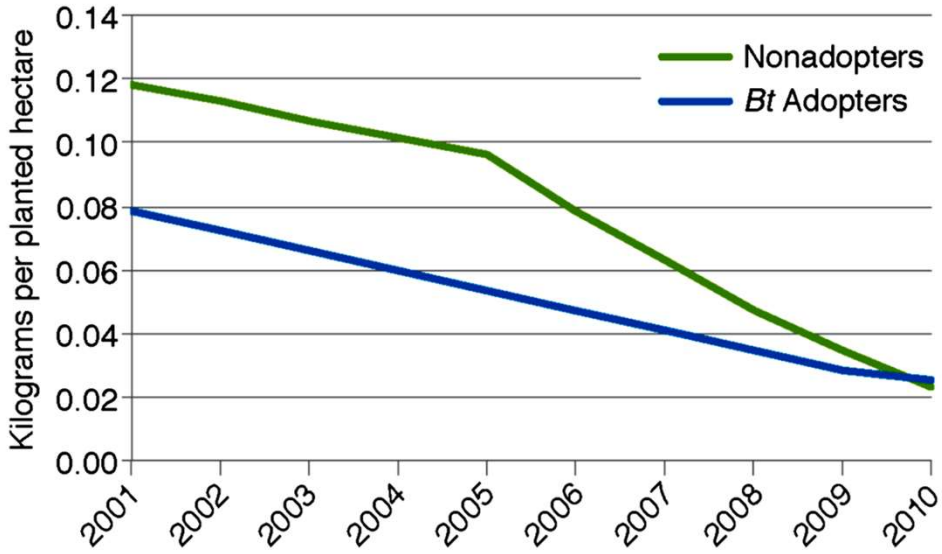
Abstract

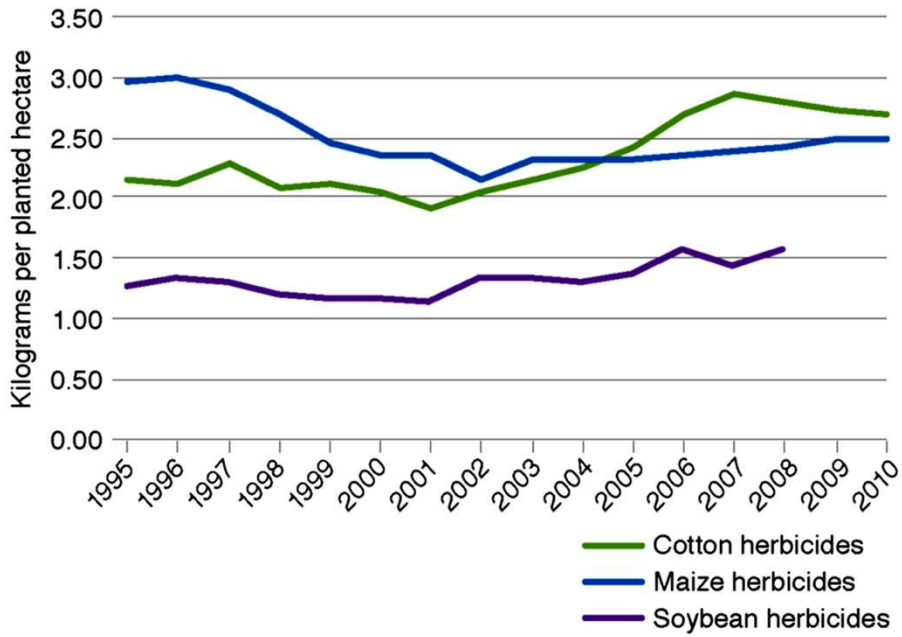
The possible implications of hybridisation and introgression between crops and wild plant species are so far unclear because it is difficult to predict how the genetically engineered genes will be expressed in a related wild species. Wheat is typically self-pollinated (via anthers within each enclosed

Report Title	Publication Year	Sponsor	Task
Safety of Genetically Engineered Foods: Approaches to Assessing Unintended Health Effects	2004	USDA, U.S. Food and Drug Administration (FDA), and U.S. Environmental Protection Agency (EPA)	Outline science-based approaches for assessing or predicting the unintended health effects of GE foods and compare the potential for unintended effects with those of foods derived from other conventional genetic modification methods
Biological Confinement of Genetically Engineered Organisms	2004	USDA	Evaluate three general strategies for those GE organisms that require biological confinement: reducing the spread or persistence of GE organisms, reducing unintended gene flow from GE organisms to other organisms, and limiting expression of transgenes
The Impact of Genetically Engineered Crops on Farm Sustainability in the United States	2010	National Academies	Review and analyze published literature on impact of GE crops on the productivity and economics of farms in the United States; examine evidence for changes in agronomic practices and inputs; evaluate producer decision-making with regard to the adoption of GE crops


Cotton insecticides
Maize insecticides
Cotton, kilograms per planted hectare
Maize, kilograms per planted hectare
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010


Number of sprays of insecticide on cotton per season in China
Bt cotton commercialization
total insecticide
insecticide spray aimed at cotton
Sprays per season
20
15
10
5
0
1990 1994 1998 2002 2006 2010


Nonadopters
Bt Adopters
Kilograms per planted hectare
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
2001 2002 2003 2004 2005 2006 2007 2008 2009 2010


Kilograms per planted hectare
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010
Cotton herbicides
Maize herbicides
Soybean herbicides

wning
Apple

Bt Maiz
to European Corn Borer

esistant
Papaya

Low on genetically modified organisms in Republic of North Macedonia

1/29/2015 Law

ЗАКОН ЗА ГЕНЕТСКИ МОДИФИЦИРАНИ ОРГАНИЗМИ

КОНСОЛИДИРАН ТЕКСТ [1]

I. ОПШТИ ОДРЕДБИ

Член 1

Предмет на уредување

(1) Со овој закон се уредува управувањето со генетски модифицираните организми и комбинација од генетски модифицирани организми и производите коишто содржат генетски модифицирани организми и/или се состојат или потекнуваат од комбинација на генетски модифицирани организми вклучувајќи и генетски модифицирани организми како производ, мерките за спречување и намалување на можните негативни влијанија врз здравјето на луѓето и животната средина, како последица при ограниченото користење на генетски модифицирани организми, намерното ослободување на генетски модифицирани организми во животната средина или пуштањето на пазар на производи коишто содржат генетски модифицирани организми и/или се состојат или потекнуваат од

Англиски текст

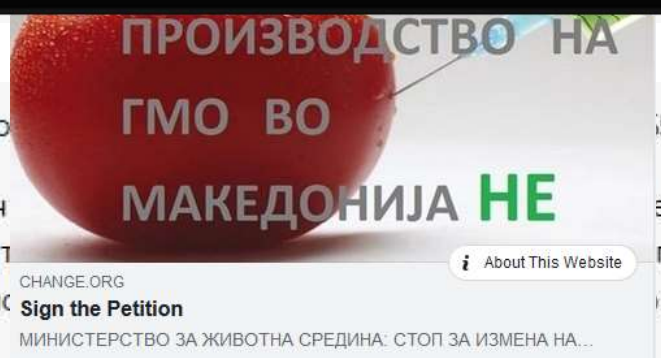
Law on Genetically Modified Organisms

Поврзани прописи

148/2009
163/2009
8/2011
22/2012
150/2012
18/2013
23/2014
23/2014
29/2014
67/2014
135/2014
175/2014
190/2014

WHO CONTROLS THE PRESENCE OF GM CROPS/PRODUCTS IN THE COUNTRY?

HOW AND WHERE THE CONTROL IS DONE?



Во врска со оризот, дир 50 килограми.

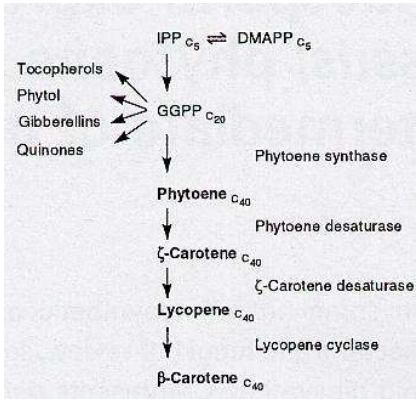
– Оризот е произведен ераторот. Ставен е под официјален надзор и ќе биде уништ парична казна, 5.000 евра во денарска противвредно лице, вели Атанасов.

Македонија се уште не дозволува увоз на храна со ГМО или генетски модифицирани производи.

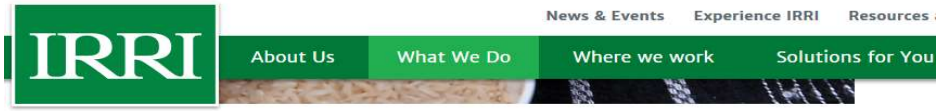
Free access for those who need it

Patents are tools to protect commercial interests and investments, but as the Golden Rice example shows, they are not an impediment to the use and dissemination of a technology. Apart from being national in scope and limited in time, their owners can decide to whom to license and under what conditions. Notwithstanding the fact that a number of patented technologies were involved in the production of *Golden Rice* (Kryder et al. 2000), Syngenta Seeds AG was able to negotiate access to all pieces of the puzzle actively necessary for the intended humanitarian purposes, providing the *Golden Rice* Humanitarian Board with the right to sublicense breeding institutions in developing countries free of charge.

The patented key technology for *Golden Rice* production, invented by Prof emeritus Ingo Potrykus, of ETH-Zurich and Prof Peter Beyer, of the Univ of Freiburg, provided access to a package of ancillary technologies required to engineer the trait into rice. A license to those technologies was obtained from Syngenta. The package contained proprietary technologies belonging not only to Syngenta but also to Bayer AG, Monsanto Co, Orynova BV, and Zeneca Mogen BV. These companies provided access to the required technologies free of charge, for humanitarian purposes.



Yu *et al.*,
Science 287, 303-5, 2000



IRRI's work with Golden Rice

IRRI is working with partners to develop Golden Rice as a potential new food-based approach to improve vitamin A status. Our work will:

Develop varieties suitable for Asian farmers

Breeders at the Philippine Department of Agriculture - Philippine Rice Research Institute (DA-PhilRice), the Bangladesh Rice Research Institute (BRRI), and the Indonesian Center for Rice Research (ICRR) are developing Golden Rice versions of existing rice varieties that are popular with their local farmers, retaining the same yield, pest resistance, and grain qualities. Golden Rice seeds are expected to cost farmers the same as other rice varieties. Once PhilRice, BRRI, and ICRR are able to secure an approval from their respective regulatory agencies, cooking and taste tests will be done to make sure that Golden Rice meets consumers' needs.

The Chinese government does not issue commercial usage licenses for genetically modified rice. All GM rice is approved for research only. Pu, et al., stated that rice engineered to produce human blood protein (HSA) requires a lot of modified rice to be grown. This raised environmental safety concerns about gene flow. They argued that this would not be a problem because rice is a self-pollinating crop, and their test showed less than 1% of the modified gene transferred in pollination.[22] Another study suggested that insect-mediated gene flow may be higher than previously assumed.[27]

The case of LibertyLink variery 601 rice

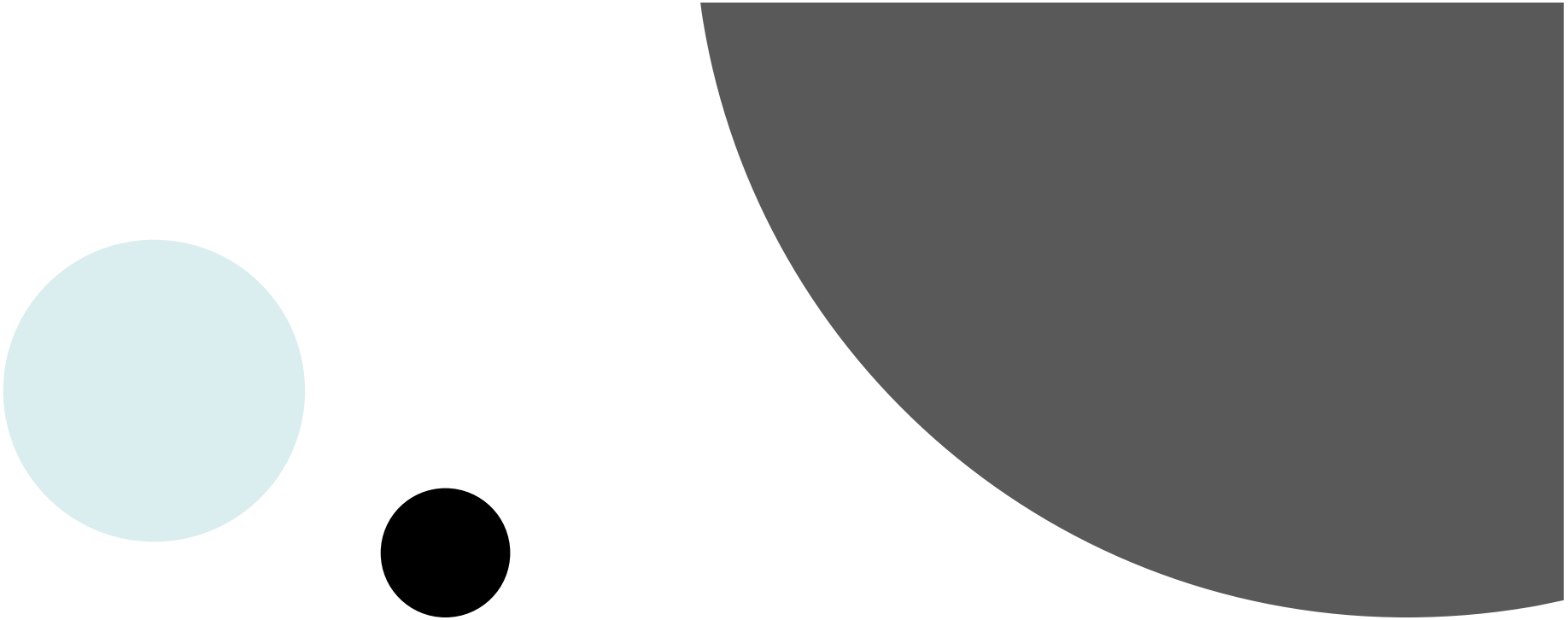
In the summer of 2006, the USDA detected trace amounts of LibertyLink variety 601 in rice shipments ready for export. LL601 was not approved for food purposes.[24] Bayer applied for deregulation of LL601 in late July and the USDA granted deregulation status in November 2006.[25] The contamination led to a dramatic dip in rice futures markets with losses to farmers who grew rice for export.[24] Approximately 30 percent of rice production and 11,000 farmers in Arkansas, Louisiana, Mississippi, Missouri and Texas were affected.[24] In June 2011 Bayer agreed to pay 750 million dollars in damages and lost harvests.[24] Japan and Russia suspended rice imports from the U.S., while Mexico and the European Union imposed strict testing. The contamination occurred between 1998 and 2001.[26] The exact cause of the contamination was not discovered.

ONE OF THE BIGGEST CONCERNS

- Half of the farmers in the world are poor and they can not pay for seeds each season.
- Those farmers grow 15-20% of the world food and directly feed at least 1.4 billion people.

CAN WE DRAW OUT CONCLUSIONS?

- On a global scale, the debate is conducted in 3 categories:
  - Science vs. Religion
  - Culture vs. Big business
  - NGO / Governmental politics vs. Moral dilemmas



THANK YOU!