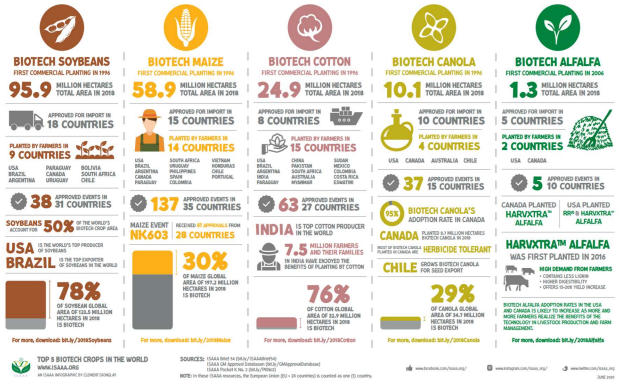
Genetically Modified Soyabeans

A Disaster India Must Avoid

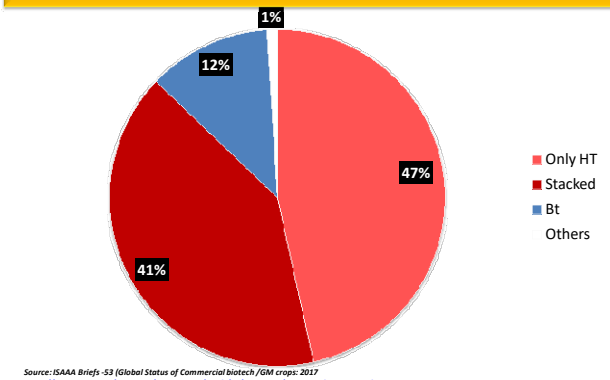
Kapil Shah
Director
JATAN: A Mission for Organic Farming
Vadodara

Presentation made at International Soy Conclave, 9th Oct., 2021, Indore, India

Global Status of GM Crops



Only 2 traits in 99% of GM Crops. Both increase toxins in food.



Source: ISAAA Briefs -53 (Global Status of Commercial biotech /GM crops: 2017
https://www.isaaa.org/resources/publications/briefs/53/download/isaaa-brief-53-2017.pdf

Why Soyabeans are Genetically Modified?

1. To control weeds (Herbicide Tolerance)
2. To control insect pests (Insect Resistance)
3. To improve quality of oil
4. To withstand abiotic stress (Drought Tolerance)
5. To enhance photosynthesis
6. For antibiotic resistance
7. As a visual marker

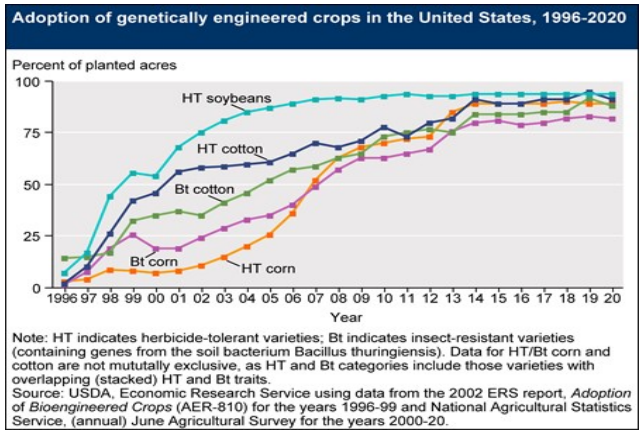
About 78% of Global Soya Production is GM

Global Status
Approvals for Commercial Cultivation of GM Soyabeans

Sr. No.	Country	Year of First Approval	Year of Last Approval	No. of Approved Events for Commercial Cultivation	No. of Events with type of GM Trait												
					Herbicide Tolerance								Lepidopteran insect Resistance	Drought Tolerance	Enhanced Photo synthesis	Modified oil/fatty acid	Antibiotic Resistance	Visual Marker
					Glufosinate	Glyphosate	Mesotrione	Dicamba	Isoxaflutole	Sulfonylurea	2,4-D	Total of HT						
1	USA	1994	2019	25	11	8	1	1	1	3	0	25	3	1	1	4	2	1
2	Japan	2005	2016	23	8	15	1	5	2	4	0	35	0	0	0	8	0	0
3	Canada	1995	2015	21	7	9	1	2	1	4	0	24	3	0	0	6	1	1
4	Brazil	1998	2019	16	6	9	0	3	2	1	1	22	5	2	0	0	0	0
5	Argentina	1996	2018	15	7	6	1	0	2	2	0	18	3	2	0	1	0	0
6	Uruguay	1996	2012	7	2	4	0	1	0	1	0	8	1	0	0	0	0	0
7	Paraguay	2004	2014	3	0	2	0	0	0	1	0	1	1	0	0	0	0	0
8	Costa Rica	2001	2008	2	0	2	0	0	0	0	0	2	0	0	0	0	0	0
9	Bolivia	2005	2005	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0
10	Chile	2007	2007	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0
11	Colombia	2012	2012	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0
12	Mexico	1996	1996	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0
13	South Africa	2001	2001	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0

Global Status
GM Soyabeans: A sinking ship?

- Farmers of **only 9** (out of about 100 countries growing Soyabeans) countries are cultivating GM Soyabeans commercially.
- All approvals do not necessarily translate in to commercial cultivation. e.g. Japan
- HT trait is developed for **7 herbicides**.
- Since 2015, **eight countries** (Uruguay, Paraguay, Costa Rica, Bolivia, Chile, Colombia, Mexico and South Africa, out of those 13, which had approved earlier) **DID NOT approve any new event**.
- **GM soybeans covered 48% of the global biotech crop area.**
- The most adopted biotech crops by the 29 countries were soybeans, maize, cotton, and canola. Soybean was the leading biotech crop with 91.9 million hectares that occupied 48% of the global biotech crop area, **with a 4% reduction from 2018.**
- **Adoption of GM crops declined slightly in 2019 at 190.4 million hectares worldwide.**
- In the 24th year of commercialization of biotech/GM crops in 2019, 29 countries grew 190.4 million hectares of biotech crops – a slight **decline of 1.3 million hectares (3.2 million acres) or 0.7% from 191.7 million hectares in 2018.**
- **12 countries have stopped commercial cultivation of GM crops.**



Source: https://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us/recent-trends-in-ge-adoption/

The Myth of Higher Yields

Evidence of the Magnitude and Consequences of the Roundup Ready Soybean Yield Drag from University-Based Varietal Trials in 1998

By
Dr. Charles Benbrook
Benbrook Consulting Services
Sandpoint, Idaho

The success of RR soybeans is remarkable in light of the magnitude of the so-called Roundup Ready "yield drag." Under most conditions extensive evidence shows that RR soybeans produce lower yields than possible if farmers planted comparable but non-engineered varieties.

This report reviews the results of over 8,200 university-based soybean varietal trials in 1998 and reaches the following conclusions regarding the magnitude of the RR soybean yield drag –

- The yield drag between top RR varieties compared to top conventional varieties averages 4.6 bushels per acre, or 6.7 percent.
- When comparing average yields across the top 5 varieties tested in 8 states, the yield drag averages 4.1 bushels, or 6.1 percent.
- Across all varieties tested, the yield drag averages 3.1 bushels, or 5.3 percent.
- In some areas of the Midwest, the best conventional variety sold by seed companies produces yields on average 10 percent or more higher than comparable Roundup Ready varieties sold by the same seed companies.

It is important to place the RR soybean yield drag in perspective. From 1975 to 1994 soybean yields rose on average about 0.5 bushels per year. In 1999 the RR soybean yield drag could result in perhaps a 2.0 to 2.5 percent reduction in national average soybean yields, compared to what they would likely have been if seed companies had not dramatically shifted breeding priorities to focus on herbicide tolerance. If not reversed by future breeding enhancements, this downward shift in soybean yield potential could emerge as the most significant decline in a major crop ever associated with a single genetic modification.

The "Roundup Ready yield drag" in soy and the generally unimpressive yield performance of GM crops have been well documented.

The Myth of Higher Yields

International Journal of Agricultural Sustainability, 2014
Vol. 12, No. 1, 71–88, http://dx.doi.org/10.1080/14735903.2013.806408

Routledge
Taylor & Francis Group

Sustainability and innovation in staple crop production in the US Midwest

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A **2013** peer-reviewed paper looked at crop production data from the United Nations' Food and Agriculture Organisation (FAO) and found that for staple crops, Western Europe's almost entirely **non-GM agriculture outyielded** North America's GM agriculture, with less pesticide use.

Ref: https://www.gmwatch.org/en/news/latest-news/19591-genetic-engineering-continues-to-fail-to-increase-crop-yields

The Myth of Higher Yields

BUSINESS

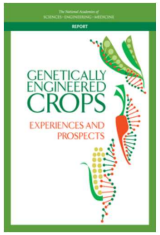
The New York Times

UNCERTAIN HARVEST

Doubts About the Promised Bounty of Genetically Modified Crops

In 2016 the journalist Danny Hakim updated the exercise for the New York Times, looking at more recent FAO data. He found that **"genetic modification in the United States and Canada has not accelerated increases in crop yields or led to an overall reduction in the use of chemical pesticides".**

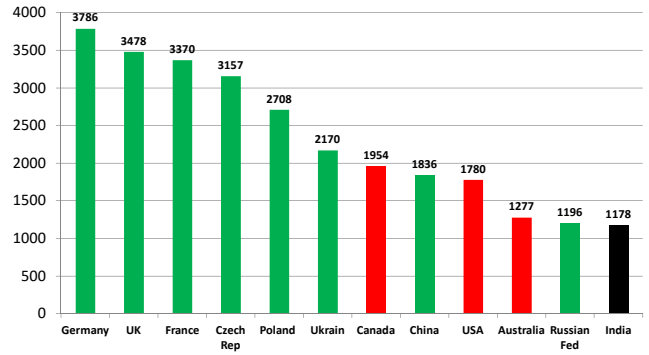
The Myth of Higher Yields



"there was little evidence" that the introduction of GM crops in the United States had led to yield gains beyond those seen in conventional crops.

Ref: https://www.nationalacademies.org/our-work/genetically-engineered-crops-past-experience-and-future-prospects

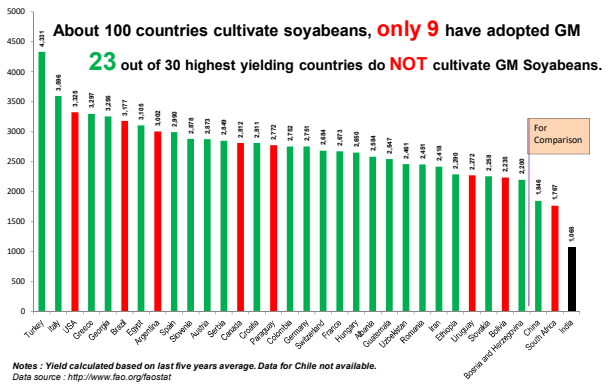
Top Rapeseed Producing Countries
Average Yield per Hectare (2010-14)



RED coloured countries have opted for GM; Top Yielders in Green are non –GM

Source: FAO statistics: http://fenix.fao.org/faostat/beta/en/#data/QC

Comparing Yield of Top 30 Countries having highest productivity of Soyabeans (Kg/ha)



Notes : Yield calculated based on last five years average. Data for Chile not available.
Data source : http://www.fao.org/faostat

Globally GM Not Increased Yields or Food Security

YIELDS: US Dept of Agriculture Report of 2014 states:

"Over the first 15 years of commercial use, GE seeds have not been shown to increase yield potentials of the varieties."

https://www.ers.usda.gov/webdocs/publications/45179/43668_err162.pdf

FOOD INSECURITY: No link with GM. In USA food insecurity has not improved after GM, from 12% in 1995 to 12% in 2018. (US Department of Agriculture)

https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/key-statistics-graphics.aspx
https://www.fns.usda.gov/household-food-security-united-states-1995-summary-report-food-security-measurement-project

GM - Initially rapid growth. Now stagnating/Lowering

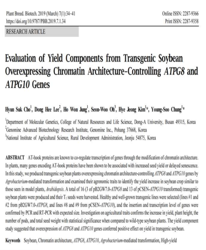
ORGANIC - Is fastest growing technology:

Estimated demand growth is >25% pa

USA organic food growth is >10% pa

SOURCES : ISAAA GLOBAL STATUS REPORTS, IFOAM REPORT and GMO MYTHS AND TRUTHS

Attempts to increasing Yield through GM in Soyabean: Far away from reality, causes another problems


Plant Breed. Biotech. 2019 (March) 7(1):34~41
https://doi.org/10.9787/PBB.2019.7.1.34
Online ISSN: 2287-9366
Print ISSN: 2287-9358
RESEARCH ARTICLE

Evaluation of Yield Components from Transgenic Soybean Overexpressing Chromatin Architecture-Controlling *ATPG8* and *ATPG10* Genes

Hyun Suk Cho[1], Dong Hee Lee[2], Ho Won Jung[1], Seon-Woo Oh[3], Hye Jeong Kim[1]*, Young-Soo Chung[1]*

[1]Department of Molecular Genetics, College of Natural Resources and Life Science, Dong-A University, Busan 49315, Korea
[2]Genomine Advanced Biotechnology Research Institute, Genomine Inc., Pohang 37668, Korea
[3]National Institute of Agricultural Science, Rural Development Administration, Jeonju 54875, Korea

ABSTRACT AT-hook proteins are known to co-regulate transcription of genes through the modification of chromatin architecture. In plants, many genes encoding AT-hook proteins have been shown to be associated with increased seed yield or delayed senescence. In this study, we produced transgenic soybean plants overexpressing chromatin architecture-controlling *ATPG8* and *ATPG10* genes by *Agrobacterium*-mediated transformation and examined their agronomic traits to identify the yield increase in soybean crop similar to those seen in model plants, *Arabidopsis*. A total of 16 (3 of pB2GW7.0-*ATPG8* and 13 of pCSEN-*ATPG10* transformed) transgenic soybean plants were produced and their T_1 seeds were harvested. Healthy and well-grown transgenic lines were selected (lines #1 and #2 from pB2GW7.0-*ATPG8*, and lines #8 and #9 from pCSEN-*ATPG10*), and the insertion and transcription level of genes were confirmed by PCR and RT-PCR with expected size. Investigation on agricultural traits confirms the increase in yield, plant height, the number of pods, and total seed weight with statistical significance when compared to wild-type soybean plants. The yield component study suggested that overexpression of *ATPG8* and *ATPG10* genes conferred positive effect on yield in transgenic soybean.

Keywords Soybean, Chromatin architecture, *ATPG8*, *ATPG10*, *Agrobacterium*-mediated transformation, High-yield

The researchers were trying to increase yield by using GM to force overexpression of the ATPG8 and ATPG10 genes, which produce a certain type of protein (AT-hook proteins) associated with increased seed yield and delayed senescence (ageing).

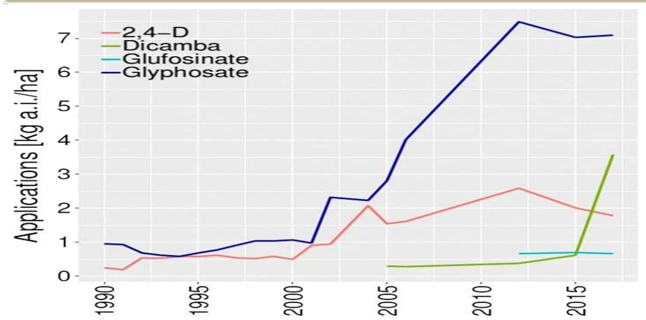
The authors again report increased yield from the GM lines. But their attempts to obtain viable GM lines were fraught with difficulties. Attempts at GM transformation with the ATPG8 gene only succeeded 1% of the time.

Also, they had to add various chemicals to the cultivation medium to prevent browning and cell death in the plant cells "wounded" by the Agrobacterium GM transformation method.

The researchers ran into another problem – obtaining the desired level of expression of the AT-hook protein genes, since too-high **expression** **"causes many troubles such as growth retardation, stay-green phenotype, no bolting, or yield decrease"**. They explain that senescence in plants has dual features: a low level of senescence will delay ageing and extend photosynthesis and cellular activity, increasing growth and/or yield, but a higher level of senescence will only cause abnormal greening in the plant. They conclude, "delicate manipulation of gene expression is needed because of complexity of senescence".

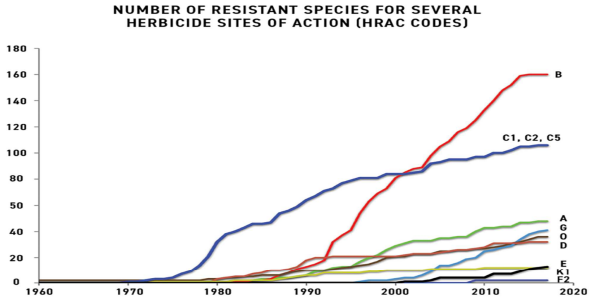
Ref: https://www.gmwatch.org/en/news/latest-news/19591-genetic-engineering-continues-to-fail-to-increase-crop-yields

Herbicide applications (kg (a.i.)/ha) on soybean fields in the USA



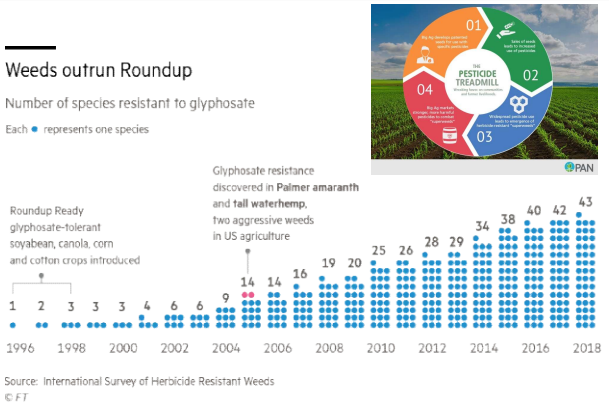
Herbicide applications (kg (a.i.)/ha) on soybean fields in the USA between 1990 and 2017 (pre- and post-emergence). (Source: USDA)

Development of Superweeds in USA

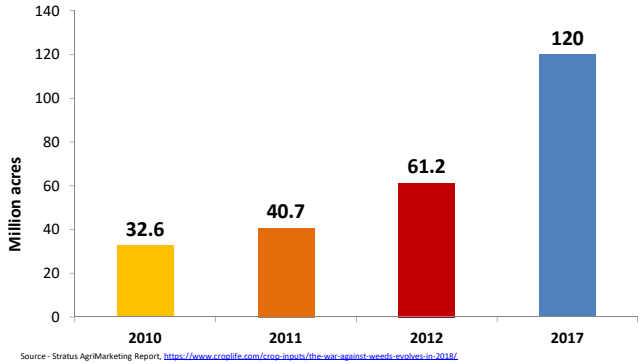


ABOVE: Many weed species have evolved resistance to herbicides in common use. The graph above shows the number of weed species resistant to each herbicide group over time. Adapted from Dr. Ian Heap, Weed Science.org (2018.)

Development of Superweeds



Warnings Denied And Ignored For Years
'Superweeds' on 65% of US Farmland Growing GM crops



Source - Stratus AgriMarketing Report, https://www.croplife.com/crop-inputs/the-war-against-weeds-evolves-in-2018/

Genetically engineered crops, glyphosate and the deterioration of health – Nancy Swanson & Andre Leu

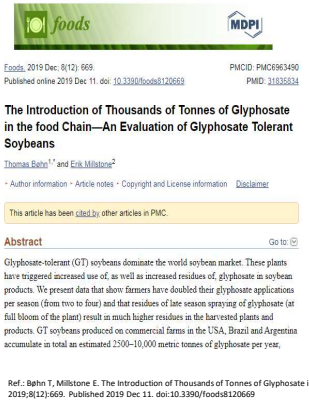
Sr. No	DISEASES	HIGHLY SIGNIFICANT PEARSON CORRELATION COEFFICIENTS Glyphosate ($<10^{-5}$)	Sr. No	DISEASES	HIGHLY SIGNIFICANT PEARSON CORRELATION COEFFICIENTS Glyphosate ($<10^{-5}$)
1.	Senile dementia	R = 0.994	11.	Obesity	R = 0.962
2.	Autism	R = 0.989	12.	Liver	R= 0.960
3.	Cancers of the thyroid	R = 0.988	13.	Inflammatory bowel disease	R = 0.938
4.	Cancers of The Bladder	R = 0.981	14	Diabetes incidence	R = 0.935
5.	Acute kidney failure	R = 0.978	15.	Stroke	R = 0.925
6.	End stage renal disease	R = 0.975	16.	Hypertension	R = 0.923
7.	Intestinal infections	R = 0.974	17.	Pancreas	R = 0.918
8.	Lipoprotein metabolism disorder	R = 0.973	18.	Alzheimer's	R = 0.917
9.	Kidney	R = 0.973	19.	Parkinson's	R= 0.875
10	Diabetes prevalence	R = 0.971			

Birth Defects and Childhood Cancers Increase

In 2015, FESPROSA, Federation of 30,000 Health Professionals of Argentina demanded ban on glyphosate as glyphosate seen to cause birth defects, cancer, organ damage

Govt Report for Chaco Province, Argentina, recorded 4 fold increase in Birth Defects, 3 fold increase in Childrens' Cancers in 10 years, in HT soya/heavy glyphosate use areas.

Accumulation of Toxins in GM Soyabeans



foods

MDPI

Foods. 2019 Dec; 8(12): 669. PMCID: PMC6963490
Published online 2019 Dec 11. doi: 10.3390/foods8120669 PMID: 31835834

The Introduction of Thousands of Tonnes of Glyphosate in the food Chain—An Evaluation of Glyphosate Tolerant Soybeans

Thomas Bøhn[1,*] and Erik Millstone[2]

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This article has been cited by other articles in PMC.

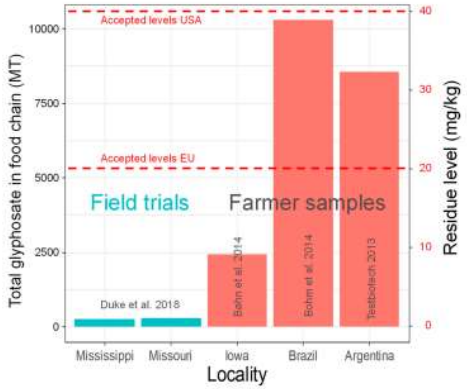
Abstract Go to:

Glyphosate-tolerant (GT) soybeans dominate the world soybean market. These plants have triggered increased use of, as well as increased residues of, glyphosate in soybean products. We present data that show farmers have doubled their glyphosate applications per season (from two to four) and that residues of late season spraying of glyphosate (at full bloom of the plant) result in much higher residues in the harvested plants and products. GT soybeans produced on commercial farms in the USA, Brazil and Argentina accumulate in total an estimated 2500–10,000 metric tonnes of glyphosate per year,

We also review studies that have compared the quality of GT soybeans with conventional and organic soybeans. Feeding studies in *Daphnia magna* have shown dose-related **adverse effects (mortality, reduced fecundity and delayed reproduction) of glyphosate residues in soybeans, even at glyphosate concentrations below allowed residue levels.**

Ref.: Bøhn T, Millstone E. The Introduction of Thousands of Tonnes of Glyphosate in the food Chain-An Evaluation of Glyphosate Tolerant Soybeans. *Foods*. 2019;8(12):669. Published 2019 Dec 11. doi:10.3390/foods8120669

Residues of Glyphosate in Field Conditions



Ref.: Bøhn T, Millstone E. The Introduction of Thousands of Tonnes of Glyphosate in the food Chain-An Evaluation of Glyphosate Tolerant Soybeans. *Foods*. 2019;8(12):669. Published 2019 Dec 11. doi:10.3390/foods8120669

Accumulation of Toxins in GM Soyabeans

ELSEVIER

Food Chemistry
Volume 153, 15 June 2014, Pages 207-215

FOOD CHEMISTRY

Compositional differences in soybeans on the market: Glyphosate accumulates in Roundup Ready GM soybeans

T. Bøhn [a, b], M. Cuhra [a, b], T. Traavik [a, b], M. Sanden [c], J. Fagan [d], R. Primicerio [b]

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https://doi.org/10.1016/j.foodchem.2013.12.054 Get rights and content

Glufosinate Toxicity

Significant body of evidence on Glufosinate and secondary compounds:

- Embryonic Development Effects in mice and pregnant rats
- Glufosinate and its metabolite MMPA 3 are neurotoxins
- Glufosinate (low doses) affects central nervous system development in baby rats
- Teratogenic effects of Glufosinate include growth retardation and deformities of the brain in rats & mice
- Reproductive health adversely impacted
- Glufosinate is persistent and mobile in soils
- Glufosinate is toxic to beneficial soil micro-organisms incl. nitrogen fixing bacteria
- Glufosinate is toxic to some aquatic organisms
- Glufosinate is toxic to some beneficial insects/predators
- Glufosinate is a threat to wild plant communities
- Glufosinate may increase nitrate content in soils and increase risks of nitrate leaching

HAS NOT BEEN ASSESSED FOR CARCINOGENECITY BY IARC.

EU REGULATION RESTRICTS USAGE GIVEN HIGH RISK TO MAMMALS & NON TARGET ARTHROPODS
(Regulation (EC) No 1107/2009 by Nov 13, 2013)

INSUFFICIENT ASSESSMENT IN INDIA!

Health & Environmental Impacts of Glufosinate Ammonium, Friends of the Earth UK, 2001
https://www.foe.co.uk/sites/default/files/downloads/**impacts_glufosinate**_ammon.pdf
Glufosinate Ammonium Monograph, Pesticide Action Network Asia & the Pacific. October 2008
http://www.panap.net/sites/default/files/monograph_glufosinate.pdf

HT Crops: What Executive, Legislative & Judicial Committees Said

Such areas of biotechnological applications which can reduce employment and impinge on the livelihood of rural families should be avoided.

Report of the Task Force on Application of Agricultural Biotechnology, chaired by Dr MS Swaminathan, MoA, GoI 2004

"8.123. Even a miniscule degree of insensitivity on this matter (ethical dimensions of transgenics in the extant socio-cultural milieu in India) can lead to avoidable discontent which apart from causing societal tensions would also have grave socio economic repercussions….

8.125. In case of transgenics in agriculture crops in India, the experience of last decade has conclusively shown that while it has extensively benefitted the industry, as far as the lot of the poor farmers is concerned, even trickle down is not visible. **THE COMMITTEE THEREFORE, UNANIMOUSLY RECOMMEND THAT TILL ALL THE CONCERNS VOICED IN THIS REPORT ARE FULLY ADDRESS AND DECISIVE ACTION IS TAKEN BY THE GOVERNMENT WITH UTMOST PROMPTITUDE, TO PUT IN PLACE ALL REGULATORY, MONITORING, OVERSIGHT, SURVEILLANCE AND OTHER STRUCTURES, FURTHER RESEARCH AND DEVELOPMENT ON TRANSGENICS IN AGRICULTURAL CROPS SHOULD ONLY BE DONE IN STRICT CONTAINMENT AND FIELD TRIALS UNDER ANY GARB SHOULD BE DISCONTINUED FORTHWITH.**

"Cultivation of Genetically Modified Food Crops – Prospects and Effects", 37th Report of (Parl. Standing) Committee on Agriculture, Fifteenth Lok Sabha, August 2012

….Supreme Court's Technical Expert Committee Report

The TEC has examined the issues in relation to HT, particularly with regard to sustainability and the likely socioeconomic impact on major sections of rural society. On both these counts, based on the reasons presented in the section on Herbicide Tolerance, the conclusion of the TEC is that HT crops would most likely exert a highly adverse impact on sustainable agriculture, rural livelihoods, and environment. The TEC finds them completely unsuitable in the Indian context and **RECOMMENDS THAT FIELD TRIALS AND RELEASE OF HT CROPS NOT BE ALLOWED IN INDIA.** (Page 71, Report of the majority 5 Independent Biosafety Experts of TEC, July 2013, along with the Corrigendum)

THIS MATTER IS SUB-JUDICE – BOTH ON BAN ON HT CROPS, AND ALSO ENTIRE RISK ASSESSMENT REGIME DEPLOYED

GM Soya meal import to India

After DGFT nod, India all set to import

12 lakh tonnes of genetically modified deoiled soya cake.

The EPA 1989 Rules for the Manufacture, Use, Import, Export and Storage of Hazardous Micro Organisms / Genetically Engineered Organisms or Cells are clearly applicable to not just Genetically Engineering Organisms or Living Modified Organisms, but also products and substances related to LMOs. The 1989 Rules refer to such products and substances in several clauses like Rule 2(1), 2(2), 3(1)(c), 4(3)(1), 7(1) etc.

Ministry of Environment, Forest and Climate Change has conveyed to the Department of Animal Husbandry and Dairying in the Ministry of Fisheries, Animal Husbandry and Dairying in the Government of India, through its letter dated on 6th August, 2021 that "since soya de-oiled and crushed cake **does not contain any living modified organism**, this Ministry (MoEF & CC) has no objection for import of soya cake or meal from environmental angle".

BUT IT MAY CONTAIN RESIDUES OF HERBIIDES

Such a clearance from MoEFCC is highly objectionable.

What is the role of SOPA in this matter?

Economic Impacts of GM Contamination

Over 400 registered cases, including from field trials.

HUGE LOSSES as Europe, Japan, Korea etc cancel contracts :

- **Rice :** US trial rice - loss of $ 1 billion . Bayer paid $750 mn
- **Wheat :** Millions lost as 'destroyed' GM trial wheat reappeared
- **Maize:** Estimated loss $ 90 million pa to US organic maize.
- **Flax:** Canadian trial flax caused major loss of business.
- **Canola :** 80% of wild canola plants' gene pool contaminated
- **Oilseed Rape:** almost 100% contaminated in Canada
- **Papaya:** 30% fall in Hawaiian production

INDIA :

Priceless germplasm at risk in University based trials. (Dharwad Univ)

Organic cotton exports fell due to GM contamination

HT Litigations

- **2017: HT crops resistant weeds cause millions of $ losses**

Farmers from 10 states suing Monsanto for drift prone dicamba for glyphosate resistant pigweed.

It has damaged 3 million acres of soybeans in 16 states

- **2017 : Consumers sue Monsanto for knowingly causing cancer**

Knew effects of Roundup but covered up with EPA official's help

Number of Litigations now reached to more than 13000

- **2011 Bayer asked to pay 11.8 million** compensatory damages & **$ 125 million punitive damages** to Ricelands foods for unapproved GM rice

- **Litigation by Monsanto against farmers**

144 farmers sued and 700 settled with Monsanto

Non-GM Soyabeans:
Premium Price, A Competitive Advantage

- The global **Non-GMO Soybean market** was valued at US$ 21.3 billion in 2020 and is expected to reach US$ 38.7 billion by the end of 2027, **growing at a CAGR of 8.53%** during 2021-2027.
  (Global Non-GMO Soybean Market Research Report 2021)

- According to BV Mehta, executive director, Solvent Extractors' Association of India (SEA), **Indian soya meal is given priority in the US since it needs non-GM** soybean. *(FE, 09-01-2021)*

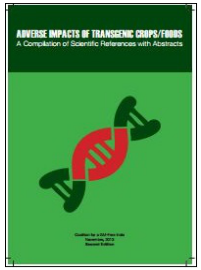
- "Barely 5% of the soya bean crop in the US is non-GM and those who want **non-GM soy products there have to pay a premium. That's the reason way the Indian soya meal is competitive,"** he said. SOPA chairman Davish Jain had earlier stated that US had emerged as the biggest buyer of such specialised soya meal and its demand was growing. *(FE, 09-01-2021)*

Other Concerns

- Limited **seed choices** for farmers
- **Contamination** at various levels: pollen, seeds, grains, meal
- **IPRs and Monopolies eg. Potato farmers sued in Gujarat**
- Impact on **other industry**, eg. Honey Industry
- **Health of animals, especially poultry; evidence exists**
- **Possibilities of residues** in animal products
- Limited choices/ Confusions for end consumers, **labelling?**
- **Poor monitoring and regulation** in India
- **Safer and sustainable ways** to solve the problem are **ignored.**

SCIENTIFIC OPPOSITION TO GM CROPS

4th edition of 'GMO MYTHS AND TRUTHS' can be accessed at :
https://www.amazon.com/GMO-Myths-Truths-Citizens-Genetically/dp/0993436722



Over 400 peer reviewed scientific studies on 'ADVERSE IMPACTS OF TRANSGENIC CROPS/FOODS' can be accessed at :
www.indiagminfo.org/wp-content/uploads/2013/11/Sci-ref-complete-book-2nd-edition.pdf

SOLUTIONS RECOMMENDED IN IAASTD REPORT

"..increasing investments in the agroecological sciences and creating policy and economic incentives for sustainable farming can establish more ecologically resilient systems while maintaining productivity and improving profitability for small-scale farmers."

IAASTD
International Assessment of Agricultural Science and Technology for Development

Organic Yields in Indian Research

ICAR'S All India Network Project on Organic Farming , 2011 found

Soil moisture retention : Higher
Beneficial fauna diversity : Increased 42%
Soil organic carbon increased from 0.23% to 0.31%

YIELDS : 21 out of 28 crops showed yield increase

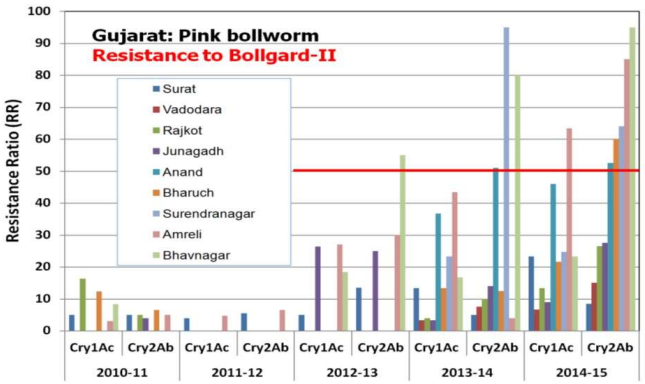
25-30% higher yield : Legumes after 3 years
> 20% increased yield: Okra , turmeric , cotton, carrot, black pepper, and cowpea
10-20% increase in yield : Onion, ginger, dolichos beans
•5 to 10% increase in yield : Greengram, sunflower, and garlic Maize, soyabean, berseem, brinjal, chilli, capcicum, tomato, sorghum and peas

"People are fed
by the food industry,
Which pays no attention to health,
and are treated
by the health industry
which pays no attention to food."

~Wendell Berry

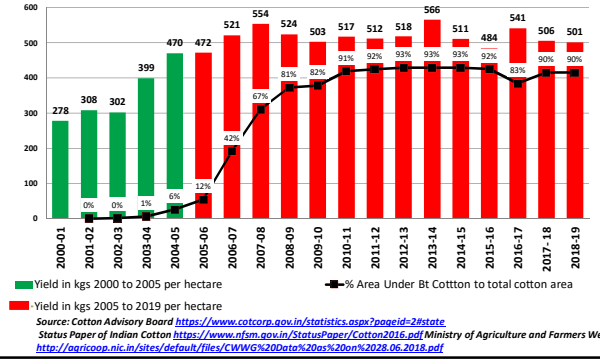
Thanks

Problems: Pink Bollworm Resistance Grows



India's Cotton Yields - Kg/Ha (National data)

2000 to 2004-05 - Yield increased by 69% though Bt was only 6% of total cotton
2005 to 2015 - Yield increased by 7% though Bt grow to 90% of total cotton

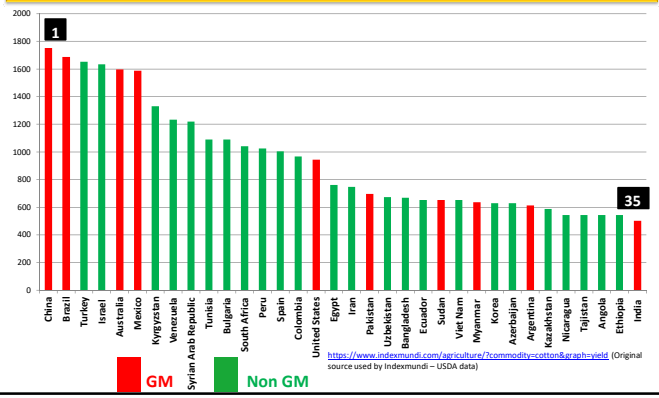


Source: Cotton Advisory Board https://www.cotcorp.gov.in/statistics.aspx?pageid=2#state
Status Paper of Indian Cotton https://www.nfsm.gov.in/StatusPaper/Cotton2016.pdf Ministry of Agriculture and Farmers Welfare
http://agricoop.nic.in/sites/default/files/CWWG%20Data%20as%20on%2028.06.2018.pdf

Global Cotton Yields - in Kg/ha (Index Mundi 2019)

After 17 years OF Bt COTTON, India ranks 35th out of 72

24 countries ahead of India do not grow Bt cotton



https://www.indexmundi.com/agriculture/?commodity=cotton&graph=yield (Original source used by Indexmundi – USDA data)