Genetic Engineering: Failed Promises, Flawed Science

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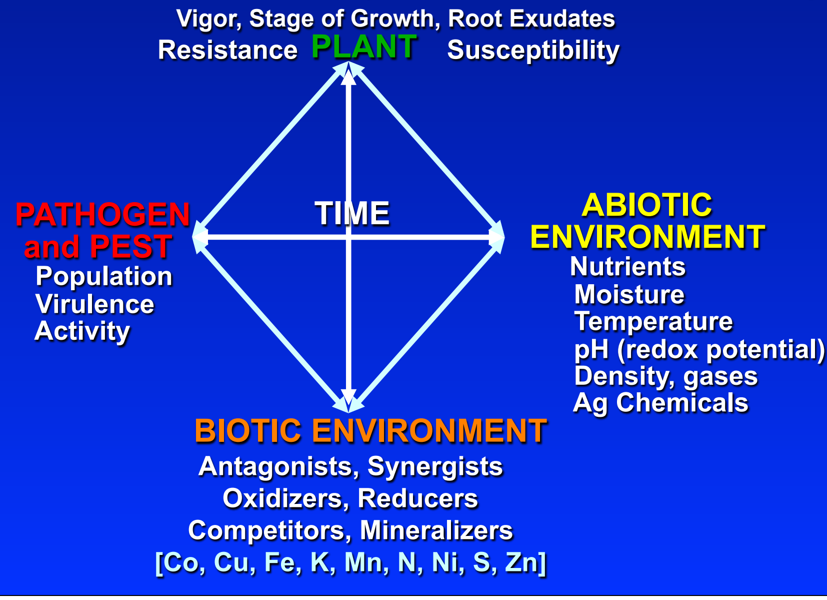
Genetic Engineering is Promoted as the 21st Century Solution to:

- Hunger and Malnutrition
- Climate change
- Economic well being
- Food safety and security
- Toxic chemical usage
- Environmental degradation
- Agricultural sustainability

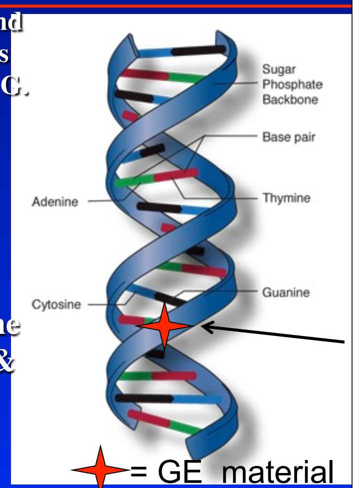
It has failed on all points!

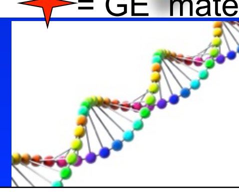
Interacting Factors Determining Yield, Nutrient Availability & Disease Severity



Genetic Engineering's Impact on the Genetic Code

- The bases in DNA are cytosine, guanine, adenine and thymine so the code of DNA is written in C's, G's, T's and A's (codons). A & T are a"base pair"as are C & G.
- The Concept of GE is 'fossil science. GE is like a virus infection; not breeding.
- The code used in GM crops is radically changed from that of the recipient and also the named bacterial sources. GE changes the bases, spatial, amino acid, 'environmental' & internal relationships.
- There is nothing in the GE plant that does anything to the herbicide applied!
- The genetic material is 'promiscuous'.
- Always a yield drag.





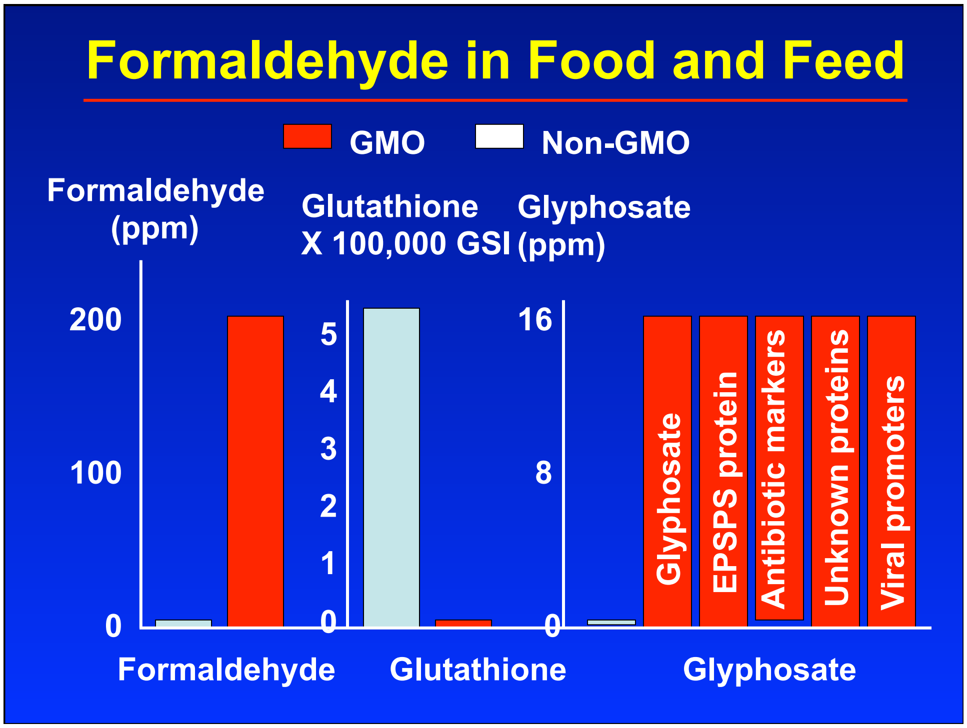
Two Factors to Understand

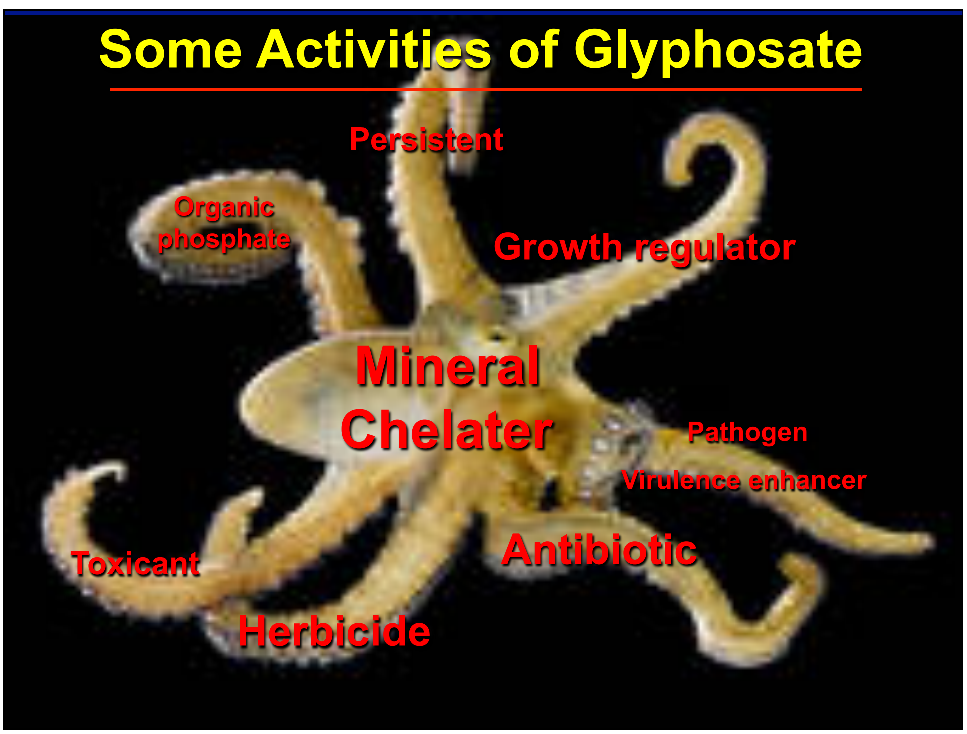
1. Intended and unintended consequences of the genetic changes
   - A. Inserts: traits, promoters, markers
   - B. Other (new) products produced
2. Toxicity of Chemicals in the plant
   - A. Herbicide containing
   - B. Insecticide producing

Nothing in the GE plant affects glyphosate in plant!

New Lethal Products of Genetic Engineering

- Potato (1998) – Arpad Pusztai, Rowat Institute, UK
  1. Within 10 days – lungs, liver, kidneys, intestine
  2. Unknown NEW protein
- GE L-tryptophan – [Japan] - U.S. (1984-1996)
  1. 1989,Thousands in U.S. developed new disease 'EMS' "Eosinophilia Myalgia Syndrome"
  2. 1990, 80 deaths/10,000 disabled by "EMS"
  3. 60 NEW proteins besides L-tryptophan (diLTRY)
  4. 3-phenyl amino diamine (3-PAA)-<0.01% "Killer Contaminant!"
- Flavr-Savr tomato –Stomach lesions, 30% dead @ 2 wks
- Star link corn – U.S. - Highly toxic protein
- GMO Corn, soybean, canola, cotton. alfalfa
  1. Traits, Anti-biotic markers, Viral Promoters
  2. Formaldehyde – highly toxic Class 1 carcinogen!


Formaldehyde in Food and Feed
GMO
Non-GMO
Formaldehyde (ppm)
Glutathione X 100,000 GSI
Glyphosate (ppm)
200
100
0
5
4
3
2
1
0
16
8
0
Glyphosate
EPSPS protein
Antibiotic markers
Unknown proteins
Viral promoters
Formaldehyde
Glutathione
Glyphosate


Some Activities of Glyphosate
Persistent
Organic phosphate
Growth regulator
Mineral Chelater
Pathogen
Virulence enhancer
Toxicant
Antibiotic
Herbicide

Nutrients are:

Components of plant and animal tissues and

Activators,

Inhibitors,

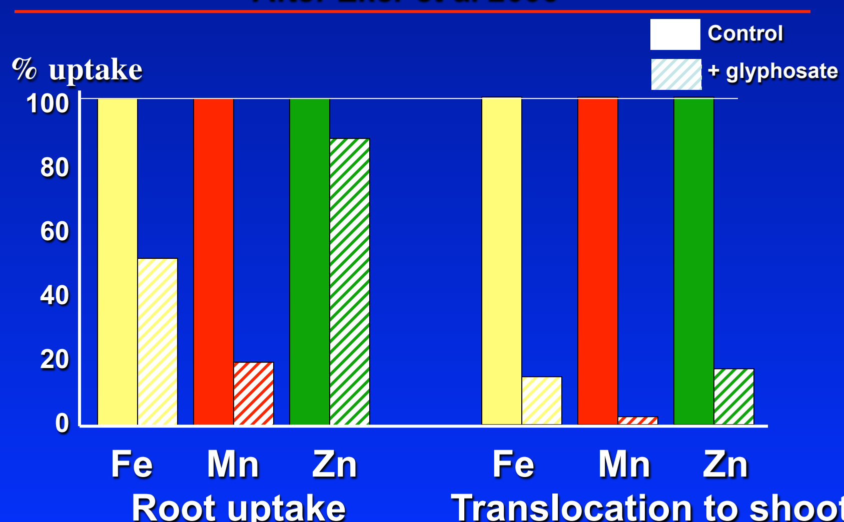
and Regulators

of Physiological Processes

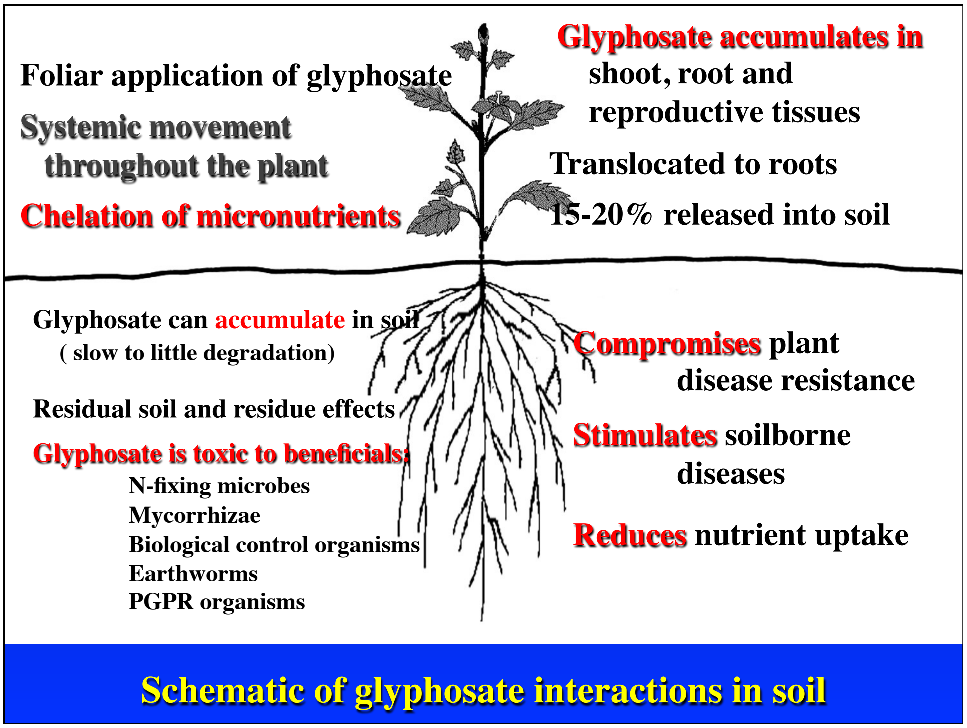
Herbicides and many pesticides are chelators

Effect of Residual or 'drift' Glyphosate on % Nutrient Uptake and Translocation by Plants

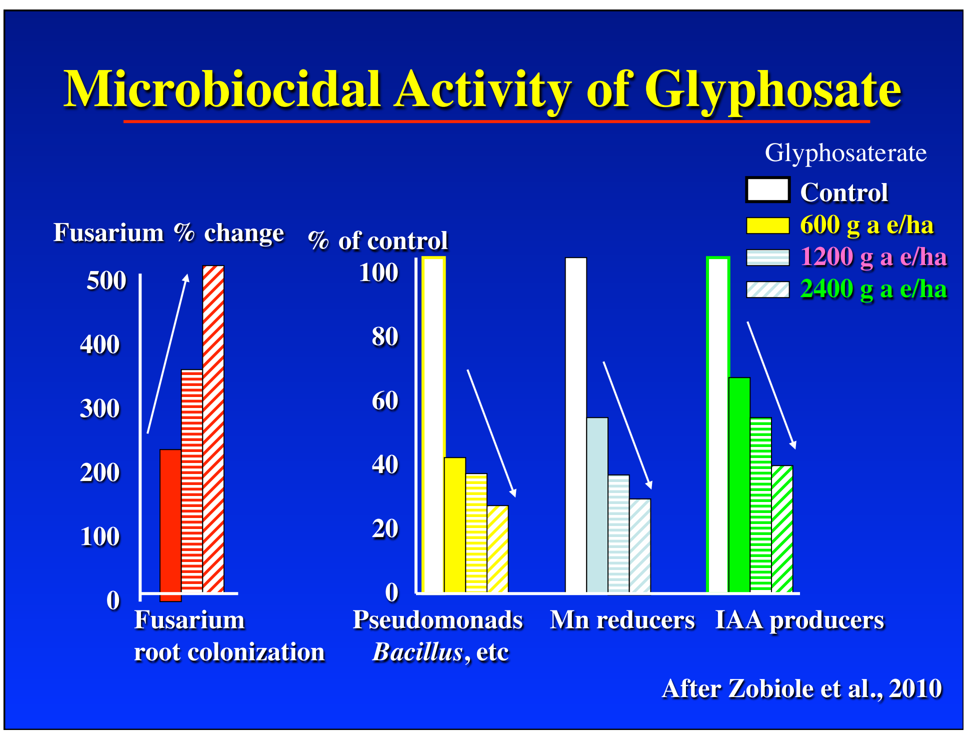
After Eker et al 2006*



* 1/40th of recommended herbicidal rate = 11 g/a = < 1/2 oz/a



Foliar application of glyphosate
Systemic movement throughout the plant
Chelation of micronutrients
Glyphosate accumulates in shoot, root and reproductive tissues
Translocated to roots
15-20% released into soil
Glyphosate can accumulate in soil
(slow to little degradation)
Residual soil and residue effects
Glyphosate is toxic to beneficials:
N-fixing microbes
Mycorrhizae
Biological control organisms
Earthworms
PGPR organisms
Compromises plant disease resistance
Stimulates soilborne diseases
Reduces nutrient uptake
Schematic of glyphosate interactions in soil



Microbiocidal Activity of Glyphosate
Glyphosaterate
Control
600 g a e/ha
1200 g a e/ha
2400 g a e/ha
Fusarium % change
% of control
500
400
300
200
100
0
100
80
60
40
20
0
Fusarium
root colonization
Pseudomonads
Bacillus, etc
Mn reducers
IAA producers
After Zobiole et al., 2010

Reduced Nutrient Efficiency of Isogenic RR Soybeans (After Zobiole, 2008)

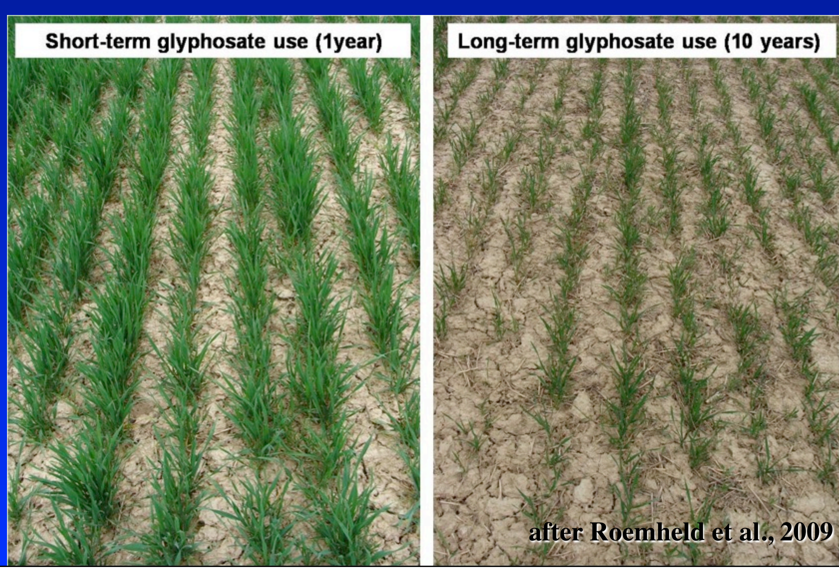
Isoline	Tissue:	Mn %	Zn %
Normal		100	100
Roundup Ready®		83	53
RR + glyphosate		76	45

Copper, iron, and other essential nutrients
Were also lower in the RR isoline and reduced
further by glyphosate!

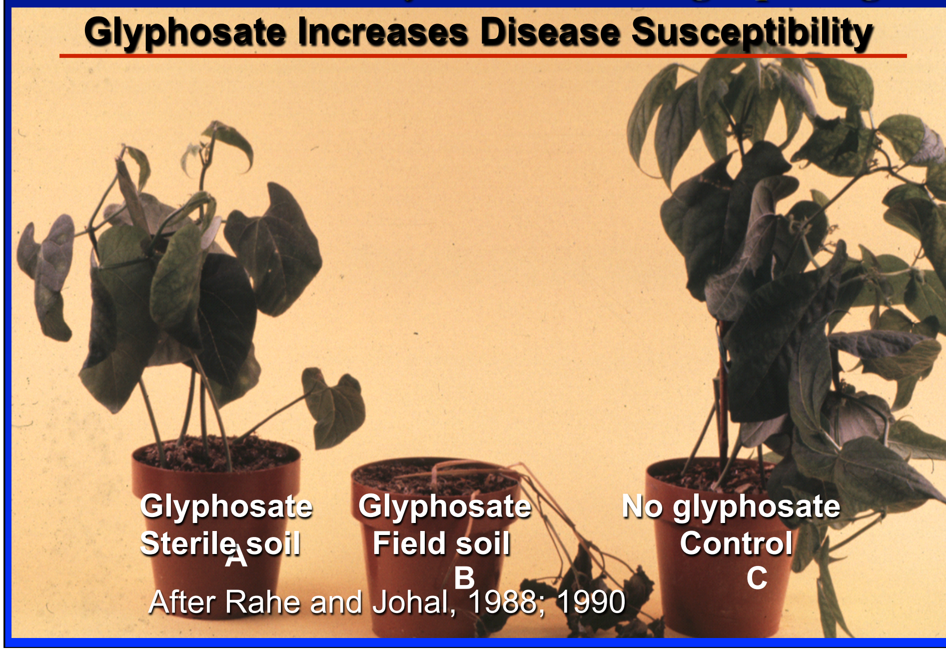
After Zobiole et al., 2009

Long-term Effect of Glyphosate

Negative side-effects of long-term glyphosate use, 2008 & 2009



Herbicide action is by soil-borne fungal pathogens

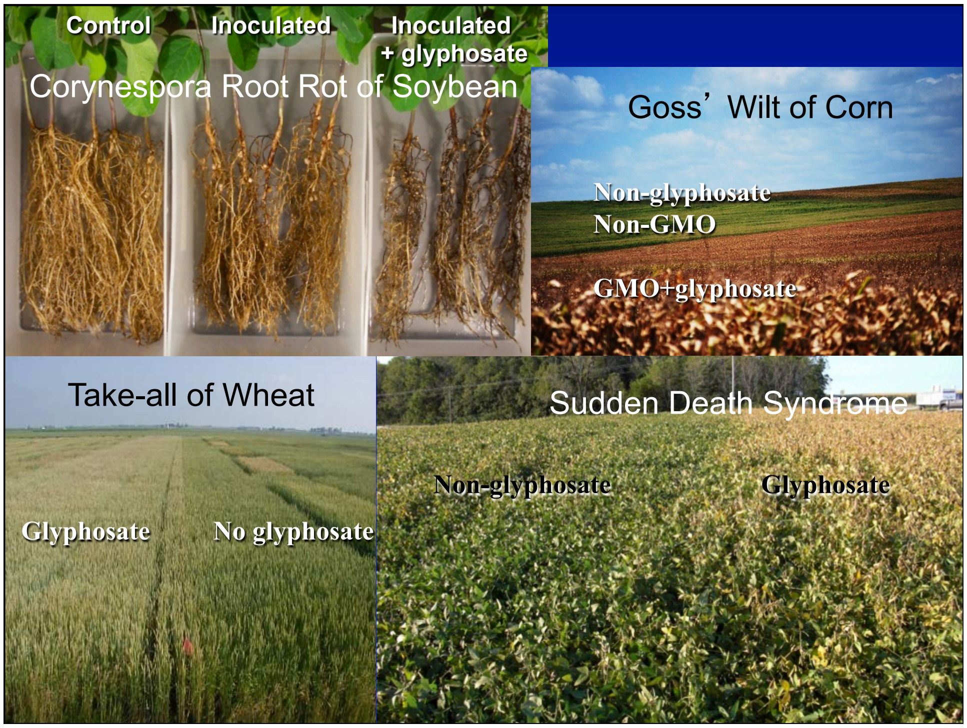


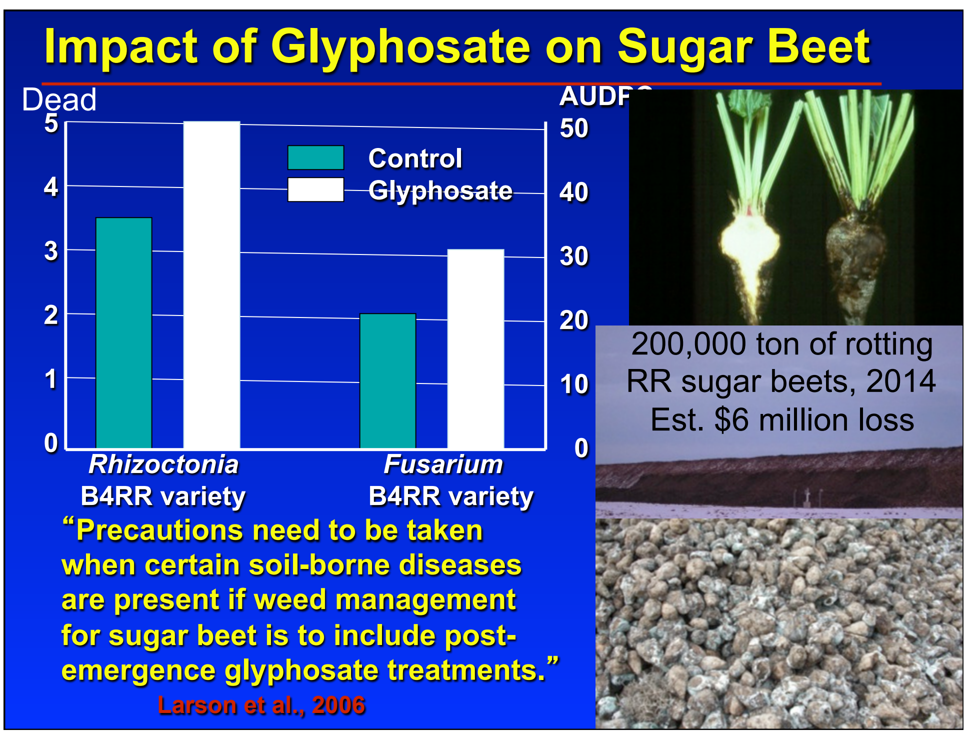
Some Diseases Increased by Glyphosate

Host plant	Disease	Pathogen
Apple	Canker	*Botryosphaeria dothidea*
Banana	Panama	*Fusarium oxysporum* f.sp. *cubense*
Barley	Root rot	*Magnaporthe grisea*
Beans	Root rot	*Fusarium solani* f.sp. *phaseoli*
Bean	Damping off	*Pythium* spp.
Bean	Root rot	*Thielaviopsis bassicola*
Canola	Crown rot	*Fusarium* spp.
Canola	Wilt	*Fusarium oxysporum*
Citrus	CVC	*Xylella fastidiosa*
Corn	Root and Ear rots	*Fusarium* spp.
Cotton	Damping off	*Pythium* spp.
Cotton	Bunchy top	Manganese deficiency
Cotton	Wilt	*F. oxysporum* f.sp. *vasinfectum*
Grape	Black goo	*Phaeomoniella chlamydospora*
Melon	Root rot	*Monosporascus cannonbalus*
Soybeans	Root rot, Target spot	*Corynespora cassicola*
Soybeans	White mold	*Sclerotina sclerotiorium*
Soybeans	SDS	*Fusarium solani* f.sp. *glycines*
Sugar beet	Rots, Damping off	*Rhizoctonia* and *Fusarium*
Sugarcane	Decline	*Marasmius* spp.
Tomato	Wilt (New)	*Fusarium oxysporum* f.sp. *pisi*
Various	Canker	*Phytophthora* spp.
Weeds	Biocontrol	*Myrothecium verucaria*
Wheat	Bare patch	*Rhizoctonia solani*
Wheat	Glume blotch	*Septoria* spp.
Wheat	Root rot	*Fusarium* spp.
Wheat	Head scab	*Fusarium graminearum*
Wheat	Take-all	*Gaeumannomyces graminis*


Fusarium scab


Take-all root rot


Control
Inoculated
Inoculated + glyphosate
Corynespora Root Rot of Soybean
Goss' Wilt of Corn
Non-glyphosate
Non-GMO
GMO+glyphosate
Take-all of Wheat
Glyphosate
No glyphosate
Sudden Death Syndrome
Non-glyphosate
Glyphosate


Impact of Glyphosate on Sugar Beet
Dead
AUDPC
Control
Glyphosate
5
4
3
2
1
0
50
40
30
20
10
0
Rhizoctonia B4RR variety
Fusarium B4RR variety
"Precautions need to be taken when certain soil-borne diseases are present if weed management for sugar beet is to include post-emergence glyphosate treatments."
Larson et al., 2006
200,000 ton of rotting RR sugar beets, 2014
Est. $6 million loss

Factors Predisposing to Fusarium Head Scab

(Fusarium spp.; Gibberella zeae)

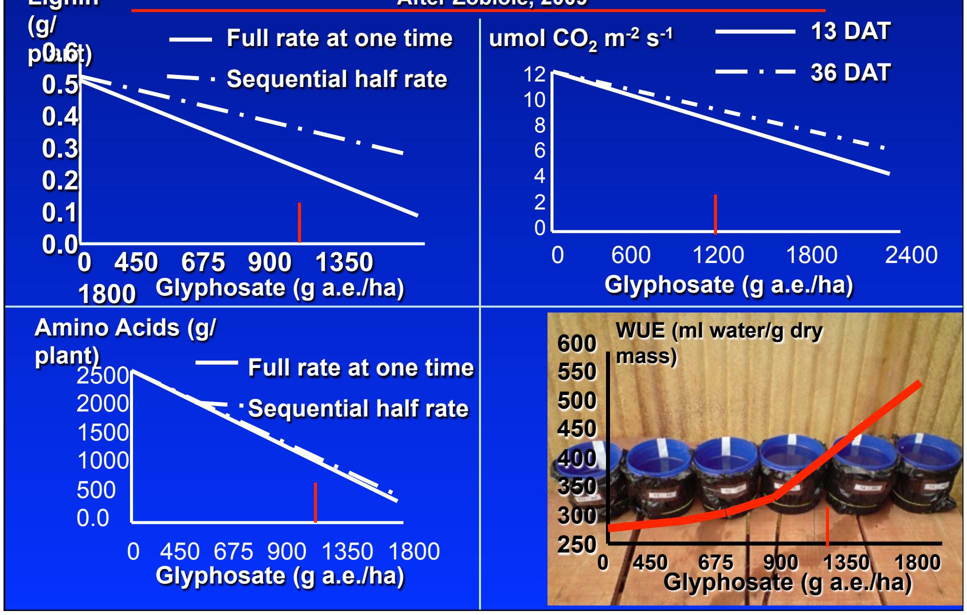
- ✓ *Environment* was the most important factor in FHB development in eastern Saskatchewan, from 1999 to 2002
- ✓ *Application of glyphosate formulations* was **the most important agronomic factor** associated with higher FHB levels in spring wheat
- ✓ Positive association of glyphosate with FHB was *not affected by environmental conditions* as much as that of other agronomic factors…

(Fernandez et al. 2005, *Crop Sci. 45: 1908-1916*)
(Fernandez et al., 2007, Crop Sci. 47:1574-1584)

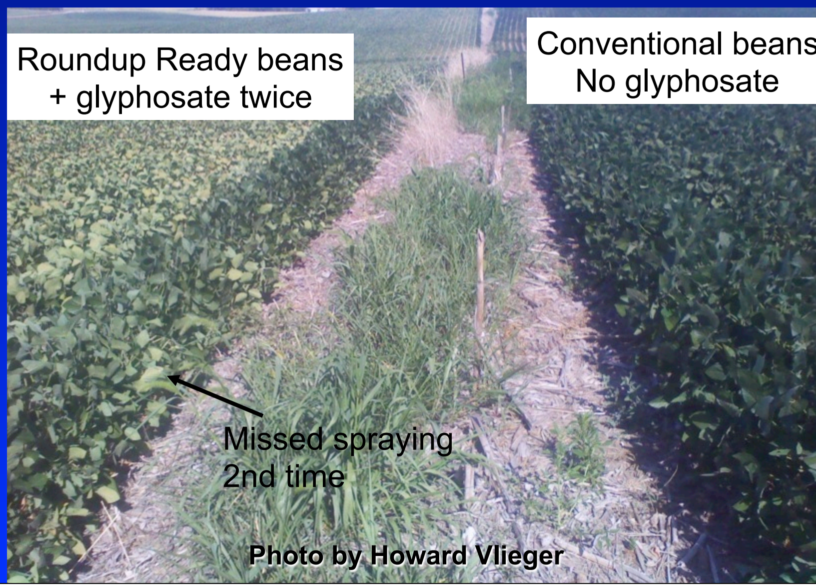
Number of glyphosate applications the previous three years	% Increase in head scab
None	00
1 to 2	152 ***
3 to 6	295 ***

Effect of Glyphosate on Lignin, AA, Water Use Efficiency, and Photosynthesis of Glyphosate-Tolerant Soybeans

After Zobiole, 2009



Does Genetic Engineering Make a Difference?
NE Nebraska, 2012 - Severe Drought



Does Genetic Engineering Make a Difference?
Maurice, Iowa, 2012 - Severe Drought

(these two fields have a gravel road between them)

Triple Stak GMO Corn *+ Glyphosate herbicide*	*Normal, Non-GMO Corn* *No glyphosate herbicide*

% Mineral Reduction in Roundup Ready® Soybeans Treated with Glyphosate

Plant tissue	Ca	Mg	Fe	Mn	Zn	Cu
Young leaves	40	28	7	29	NS	NS
Mature leaves	30	34	18	48	30	27
Mature grain	26	13	49	45		

Reduced:
Yield 26%
Biomass 24%

After Cakmak et al, 2009

Glyphosate Resistant Weeds Also Affect Bee Health & Honey Quality

Food and Feed Safety Concerns

- **Reduced nutrient density**
  - Co, Cu, Fe, Mg, Mn, Zn
- **Increased levels of toxic products**
  - Mycotoxins [Fusarium toxins (DON, NIV, ZEA), aflatoxins]
  - Allergenic proteins and metabolic toxins
- **Premature ageing, reproductive failure**
- **Ecological disruption**
  - bees, amphibians, plant diversity, GI tract, soil, etc.
- **Gene flow** - weeds, soil microbes, intestinal microbes
- **Direct toxicity of glyphosate**
  - Cell death, immune failure, disease resistance
  - Endocrine system, infertility, birth defects, teratogenicity

% Reduced Nutrient Density in RR versus Non-RR*

Nutrient	Alfalfa	Soy Beans**
Nitrogen	13 %	40 %
Phosphorus	15 %	------
Potassium	46 %	16 %
Calcium	17 %	26 %
Magnesium	26 %	30 %
Sulfur	52 %	------
Boron	18 %	------
Copper	20 %	27 %
Iron	49 %	18 %
Manganese	31 %	48 %
Zinc	18 %	30 %

*Third year, alfalfa, second cutting analysis; Glyphosate applied one time in the previous year

**Mature leaf

Erosion of Pig Stomachs, Intestines with GMO Soybean/Corn Feed, Iowa

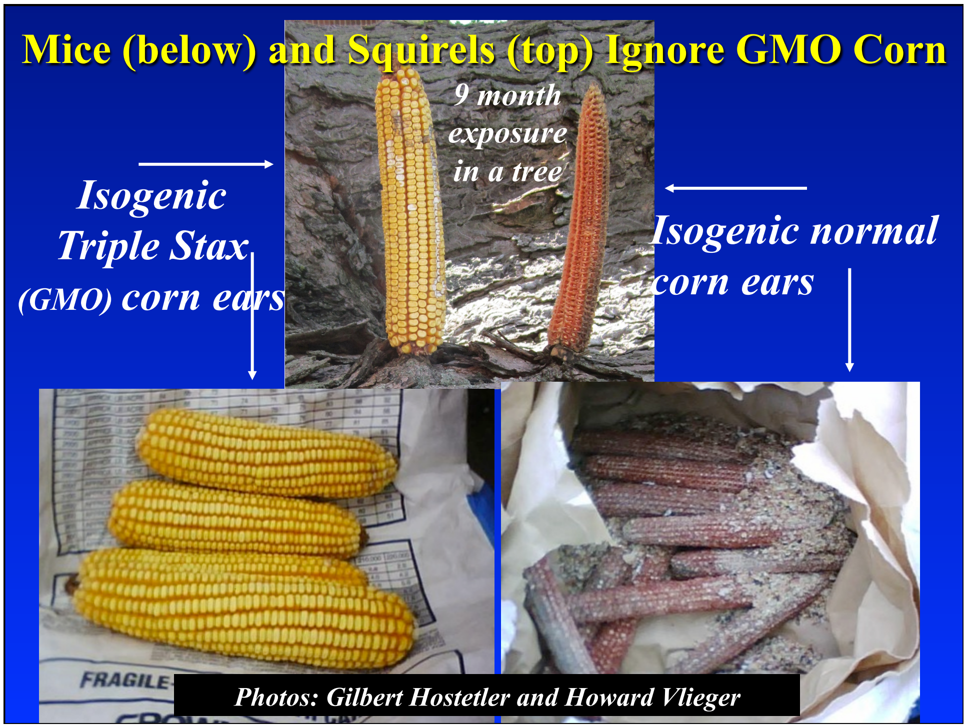
Carman, Vlieger, 2011, 2013

Normal color

Inflamed, irritated

Inflammatory Bowel Disease in Humans

- Inflammatory bowel diseases (IBD)
  - Crohn's disease
  - Ulcerative colitis
  - Leaky gut
  - Celliac disease
  - Glutin intolerance
  - Inflammation in the digestive tract.
  - C.diffficile diarrhea
- Symptoms include:
  Abdominal cramps, Bloody diarrhea, Fever, Gut dysbiosis, Weight loss, Fatigue, Death



U.S. Cattlemen's Association Statement to Congress

"Cattle ranchers are facing some puzzling - and, at times, economically devastating problems with pregnant cows and calves. At some facilities, **high numbers of fetuses are aborting for no apparent reason.** Other farmers successfully raise what look to be normal young cattle, only to learn when the animals are butchered that their **carcasses appear old and, therefore, less valuable."**

"The sporadic problem is so bad both in the United States and abroad that in some herds around **40-50 percent of pregnancies are being lost."**

"Many pesticides and industrial pollutants also possess a hormonal alter ego."

"The viability of this important industry is threatened."

Source: Testimony of the Ranchers-Cattlemen Action Legal Fund, United Stock-growers of America, to the Senate Agriculture Committee July 24, 2002.

Why are so many cows losing pregnancies?

Losing up to 20 percent of pregnancies is not acceptable.

By Jenks Britt, D. V. M. and Fernando Alvarez, M. V. Z.

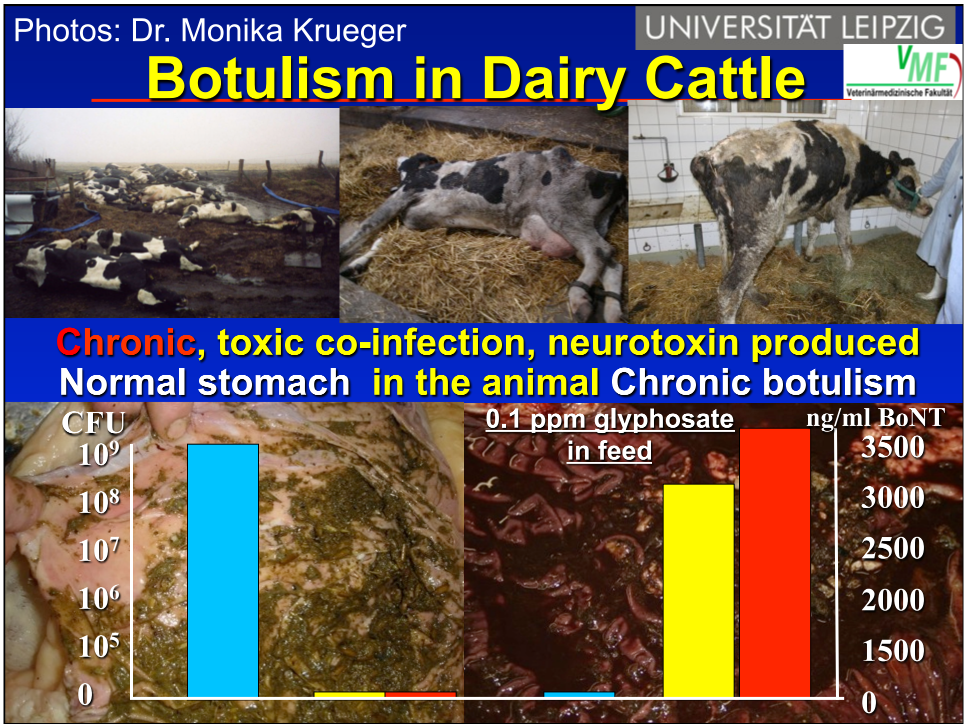
	Herd					
Characteristics	A	B	C	D	E	F
Total cows	1,805	1,211	721	2,007	226	1,083
% herd pregnant	47	49	48	61	47	50
1st service conception	28	27	30	32	41	41
Services for all cows	4.3	4.1	3.6	3.0	2.5	2.4
% pregnant now open	27	25	27	10	6	2

Source: Hoards Dairyman, November 2011, p 751.

Toxicity to and Impact of Glyphosate on Poultry Intestinal Microflora

after Clair et al, 2012;Shehata et al, 2012; Krueger et al, 2012

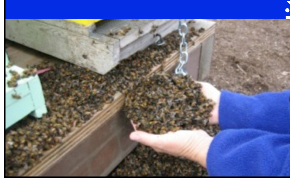
Beneficials (Sensitive)	Pathogens (Resistant)
Enterococcus faecalis	*Salmonella entritidis*
Enterococcus faecium	*Salmonella gallinarum*
Bacillus badius	*Salmonella typhimurium*
Bifidobacterium adolescentis	*Clostridium perfringens*
Lactobacillus spp.	*Clostridium botulinum*
Campylobacter spp.	*Clostridium deficale*
Geotrichum candidum	*Escherichia coli*
Lactococcus lactis subsp. *cremoris*	*Enterobacter cloacae*
Lactobacillus delbrueckii subsp. *bulgaricus*	

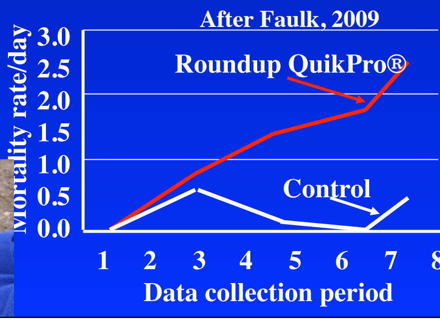


Environmental Impact of Glyphosate

Bee Colony Collapse Disorder

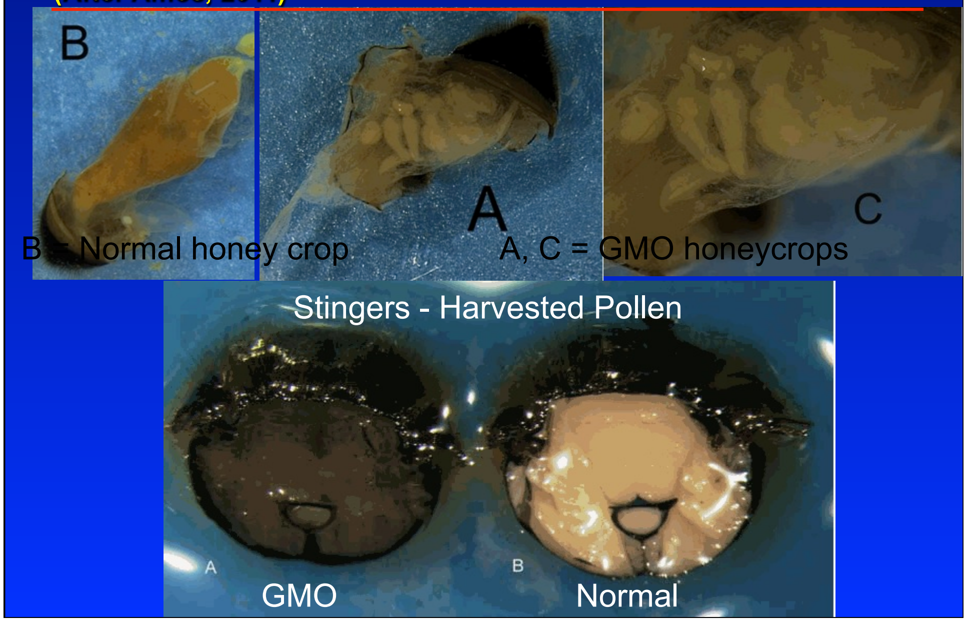
- **Lower mineral availability in plant products**
  - **Malnutrition**
- **Biocidal to *Lactobacillus/Bifidobacterium* in 'stomach'**
  - **Starvation & immunity to mites, viruses, bacteria, stress, etc.**
- **Direct toxicity - endocrine disruption, neurotoxicity**
  - **Reproduction, disorientation**





Effect of Glyphosate on Bee Digestion

(After Amos, 2011)



Direct Toxicity of Glyphosate

Rate (ppm)	System affected	Reference
0.5	Human cell endocrine disruption	Toxicology 262:184-196, 2009
0.5	Anti-androgenic	Gasner et al, 2009
1.0	Disrupts aramatase enzymes	Gasnier et al, 2009
1-10	Inhibits LDH, AST, ALF enzymes	Malatesta et al, 2005
1-10	Damages liver, mitochondria, nuclei	Malatesta et al, 2005
2.0	Anti-Oestrogenic	Gasnier et al, 2009
5.0	DNA damage	Toxicology 262:184-196, 2009
5.0	Human placental, umbilical, embryo	Chem.Res.Toxicol.J. 22:2009
10	Cytotoxic	Toxicology 262:184-196, 2009
10	Multiple cell damage	Seralini et al, 2009
10	Total cell death	Chem.Res.Toxicol.J. 22:2009
All	Systemic throughout body	Andon et al, 2009
1-10	Suppress mitochondrial respiration	Peixoto et al, 2005
	Parkinson's	El Demerdash et al, 2001
POEA, AMPA even more toxic		Seralini et al, 2009

Glyphosate Residues Allowed in:

Food (Crop)	ppm	Livestock Feed	ppm
Beet, sugar, dried pulp	25	Grass, forage,	300
Beet, sugar, roots	10	fodder, hay, group 17	300
Canola, seed, oil	**20**	Grain, cereal,	100
Corn, sweet	**3.5**	forage, fodder, straw	100
Grain, cereals(grp 15)	**30**	Soybean, forage	100
Oil seeds (ex. canola)	**40**	Soybean, hay	200
Pea, dry	**8**	Soybean, hulls	120
Peppermint, tops	**200**	Cattle, meat byproducts	5
Quinoa, grain	5	Hay, alfalfa	400
Shellfish	3		
Soybean seed	**20**		
Spice (group 19B)	**7**		
Sugar, cane	2		
Sugarcane, molasses	30		
Sweet potatoes	3		
Vegetable, legume	**5** (ex. Soybean & dry peas)		

Where is the research and Rationale for such disparity?

Dietary Risk of Pesticides in Food*

(Soybean grain, Serving size = 93 gm = 3.3 oz)

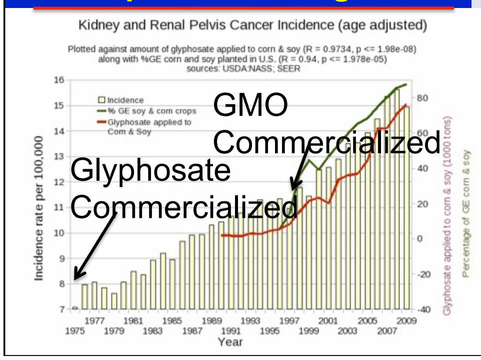
Pesticide	Sample Size	% Positive	Ave (ppm) Residue	Range (ppm)	% DRI**
AMPA	300	95.7	2.28	0.26-18.8	45.9
Glyphosate	300	90.3	1.94	0.26-20.6	36.8
			4.22	**Combined risk:**	**82.7**
Chlorpyrifos	300	2.7	0.005	---	14.9
All Others	300	1.5	0.009	0.001-0.035	0.1

*USDA, NASS, 2011. **Dietary Risk Index, M2M/CSANR/WSU, 2014

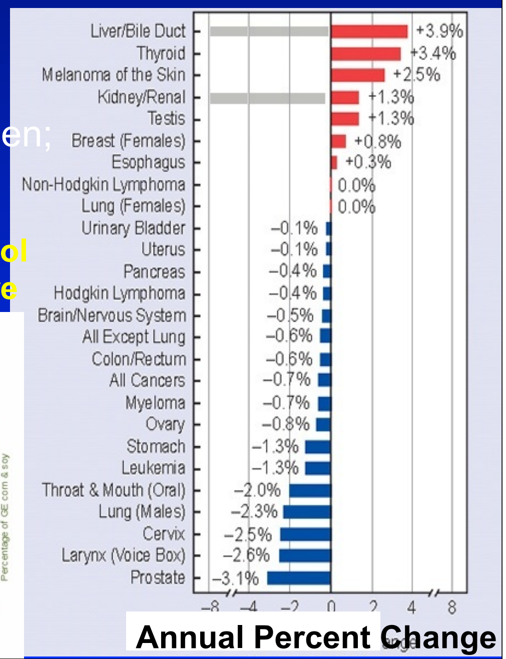
World Health Organization IARC, 2015

Category 2A
Probable Human Carcinogen;
Known Animal Carcinogen

U.S. Center for Disease Control
U.S. Department of Agriculture



U.S. National Cancer Institute

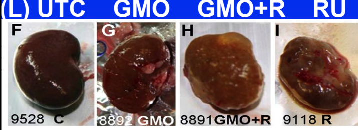


Chronic Toxicity of GMO Crop or Roundup®

GMO and/or Roundup cause adverse health effects
- 50% males & 70 % females died prematurely
- (Tumors developed after 4-7 months vs 23 mo in control)
- Females = 2-3 X mammary tumors & pituitary disorders
- Males = kidney & skin tumors, liver & kidney damage
- All GMO and RU had digestive disorders

Livers (L) UTC; (R) GMO+R

Kidney damage (below)
(L) UTC GMO GMO+R RU



Mammary cancer: GMO, GMO+RU, RU @ (1 ppb)