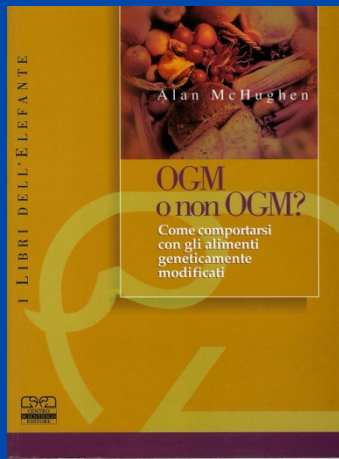
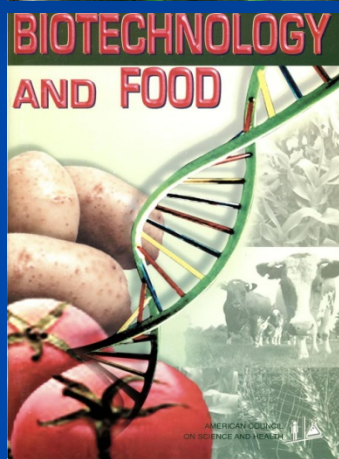




The Potential and Hazards of Genetically Modified Foods



GMOs and Public Policy

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a consumer's
guide to **food**
from green genes
to red herrings

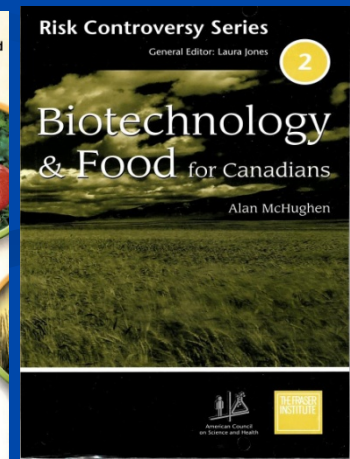
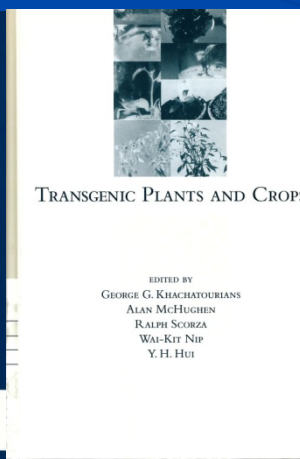
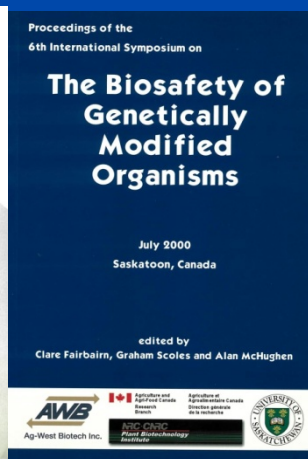
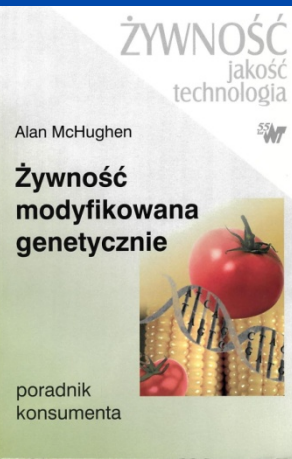


Alan McHughen

Chris A. Wozniak
Alan McHughen Editors

Regulation of
Agricultural
Biotechnology:
The United States
and Canada

Springer



Public Opinion vs. Scientists

	US Adults	AAAS Members	Difference
GMO Food is safe	37%	88%	51
Climate Change	50%	87%	37
Vaccines safety?	68%	86%	18
Population problem?	59%	82%	23

<http://www.pewinternet.org/2015/01/29/public-and-scientists-views-on-science-and-society/>

Most people have romantic notions
of farming and food production



Clicker question

- Farmers in 1900 comprised what % of US labor force?
 - A) $<2\%$
 - B) $2 - 17\%$
 - C) $17 - 37\%$
 - D) $37 - 47\%$

Clicker question

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Modern agriculture is actually...



■ Intense but Sustainable Production Oriented

US Agriculture

- Increased productivity since 1948 = 170%
- 1900 US agriculture workforce = 41%
- 2000 US agriculture workforce = <2%

http://www.ers.usda.gov/media/259572/eib3_1_.pdf

<http://www.ers.usda.gov/data-products/agricultural-productivity-in-the-us.aspx>

Status of GE crops

■ USA

- Corn > 93%
- Cotton > 96%
- Soybean > 94%

■ Argentina: Soybean > 98%

■ Canada: Canola > 97%

■ India: Cotton > 90%

Assurance of Safety

- Scientific studies overwhelmingly show the safety of GM foods and crops
 - Over 1,700 technical, peer reviewed studies in the literature, covering every aspect of GMO safety
 - Nicolia et al., 2013. Crit Rev Biotechnol. 1-12
 - <http://www.biofortified.org/genera/>
- The few studies purporting to show hazard have ALL been rejected on scientific grounds by the scientific and medical community
- **“No adverse health effects attributed to GE have been documented...”** *NAS 2004; AAAS 2014.*

Scientific Consensus on Safety?

■ Generally positive

- * US National Academies
 - * US Institute of Medicine
 - * American Medical Association
 - * British Royal Society
 - * Royal Society of Medicine
 - * EFSA
 - * EU Economic Commission
 - * World Health Organization
 - * AAAS
 - * American Dietetic Association
 - * International Seed Foundation
- Plus > 240 scientific societies

■ Generally negative



Some Popular Misconceptions

- GMOs are untested and unregulated
- GE violates Mother Nature's "species barrier"
- GMOs are all Patented by big companies
- GE foods cause tumors in test animals
- GE crops cause an increase in pesticide use
- Organic farmers may get GE contamination
- rDNA is 'fundamentally different' from traditional crossing, and so they must be more hazardous
- GMO crops and foods are banned in Europe.

Variety release requirements: genetically engineered crops

- USDA (APHIS) - environmental issues
- HHS (FDA)- food and feed safety
- EPA- pesticide usage issues



Comparison of the 1997 documentation required for the approval in Canada of GM-cultured flax (on the left) versus its 'conventional' counterpart (right). Reproduced by courtesy of Professor Alan McHughen.

Special Issue

Biosafety Regulation

Edited by Dr. Vivian Moses
and Dr. C.S. Prakash

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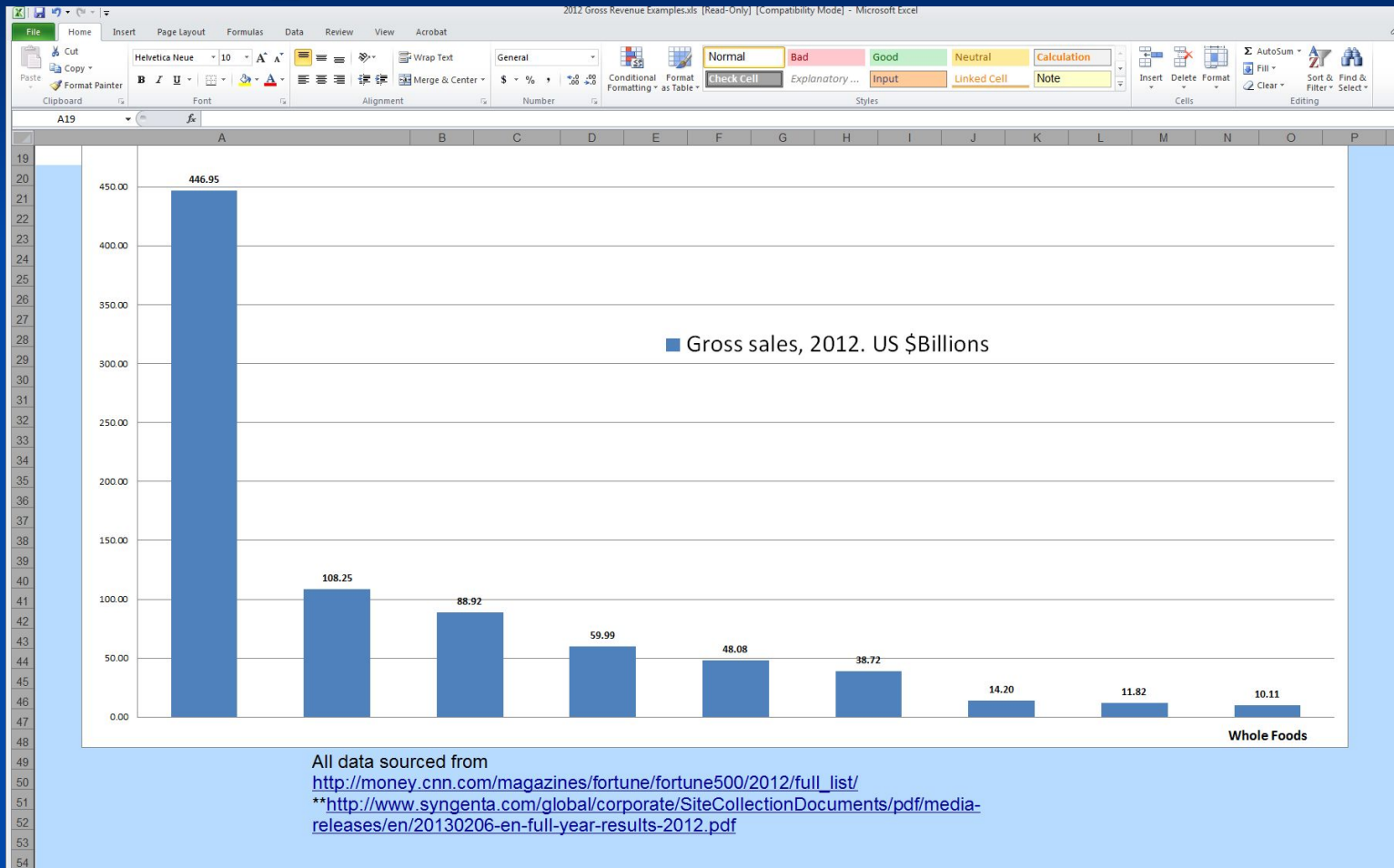
In this issue:

- Introduction by Alan McHughen
- Objectives and barriers to commercializing GM crops under EU regulations, Alan Raybould and Guy M. Poppy
- Gene technology regulation in Australia, David Tribe
- GM food regulation in the UK, Derek Burke
- European attitudes to biotechnology regulation, Mark Cantley
- Regulation of GM crops in Argentina, Moises Burachik
- The costs of compliance with biosafety regulations in developing countries, Jose Falck-Zepeda et al.
- Regulation and litigation in North America, Thomas Redick
- Biosafety regulation and biotech development in Africa, David Wafula et al.
- The emerging international regulatory framework for biotechnology, John Komen

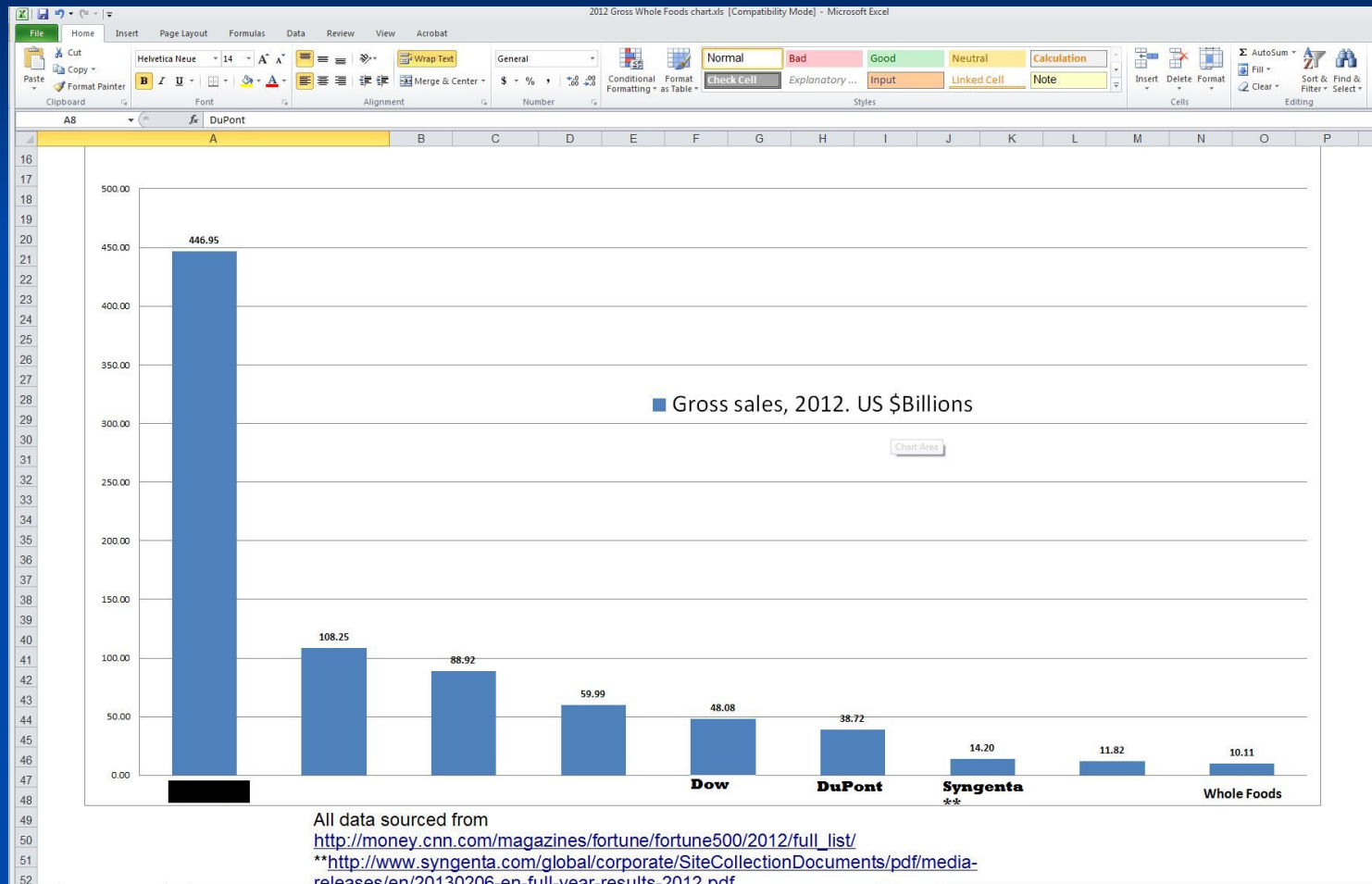
Common Complaint

- “GMOs are designed only to make even more money for Monsanto, already a huge corporation with so much money they can corrupt politicians, academic scientists and even voters. People should support organic farmers and smaller companies like Whole Foods”.

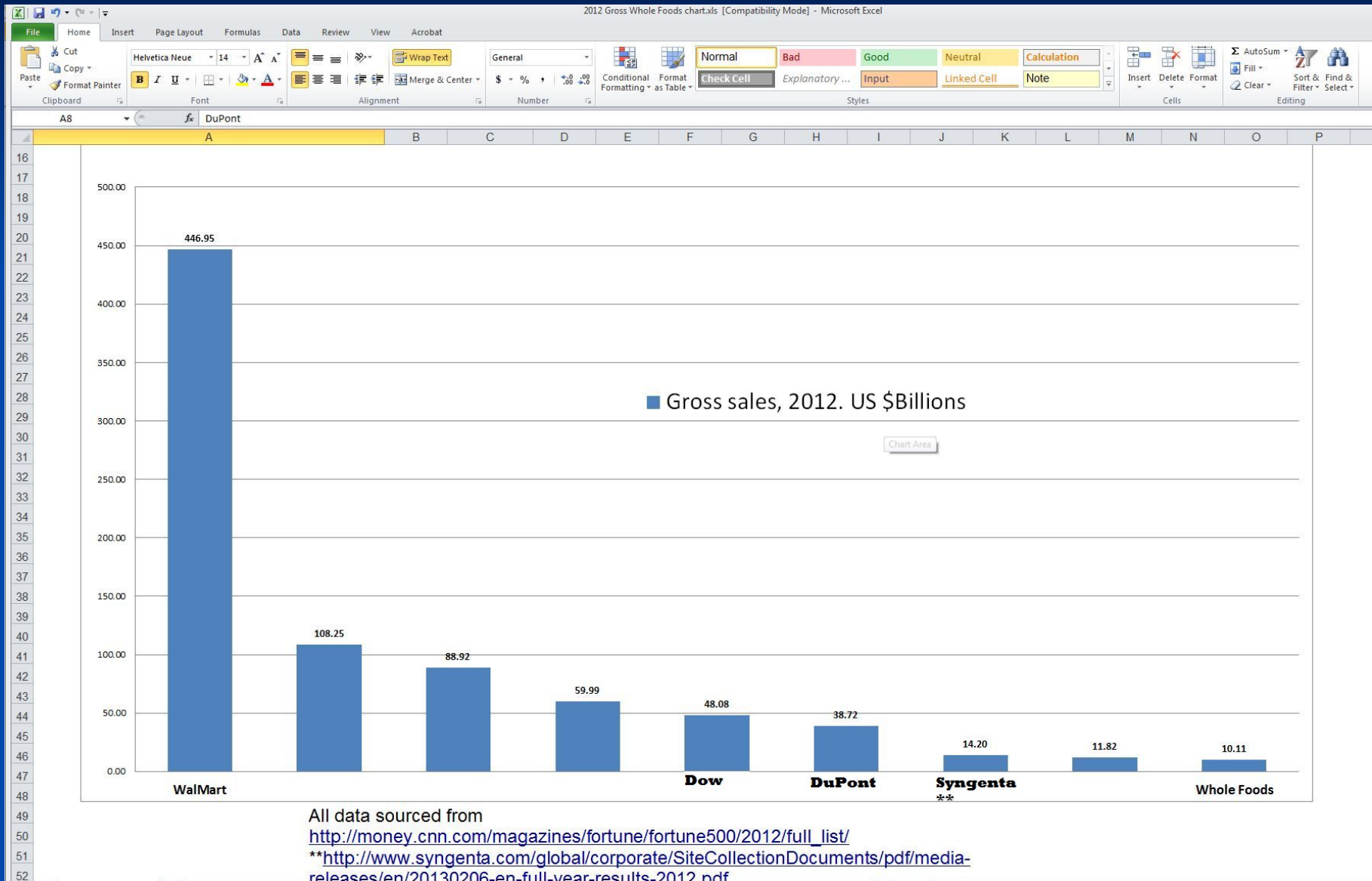
Comparison of some big companies, Gross sales 2012



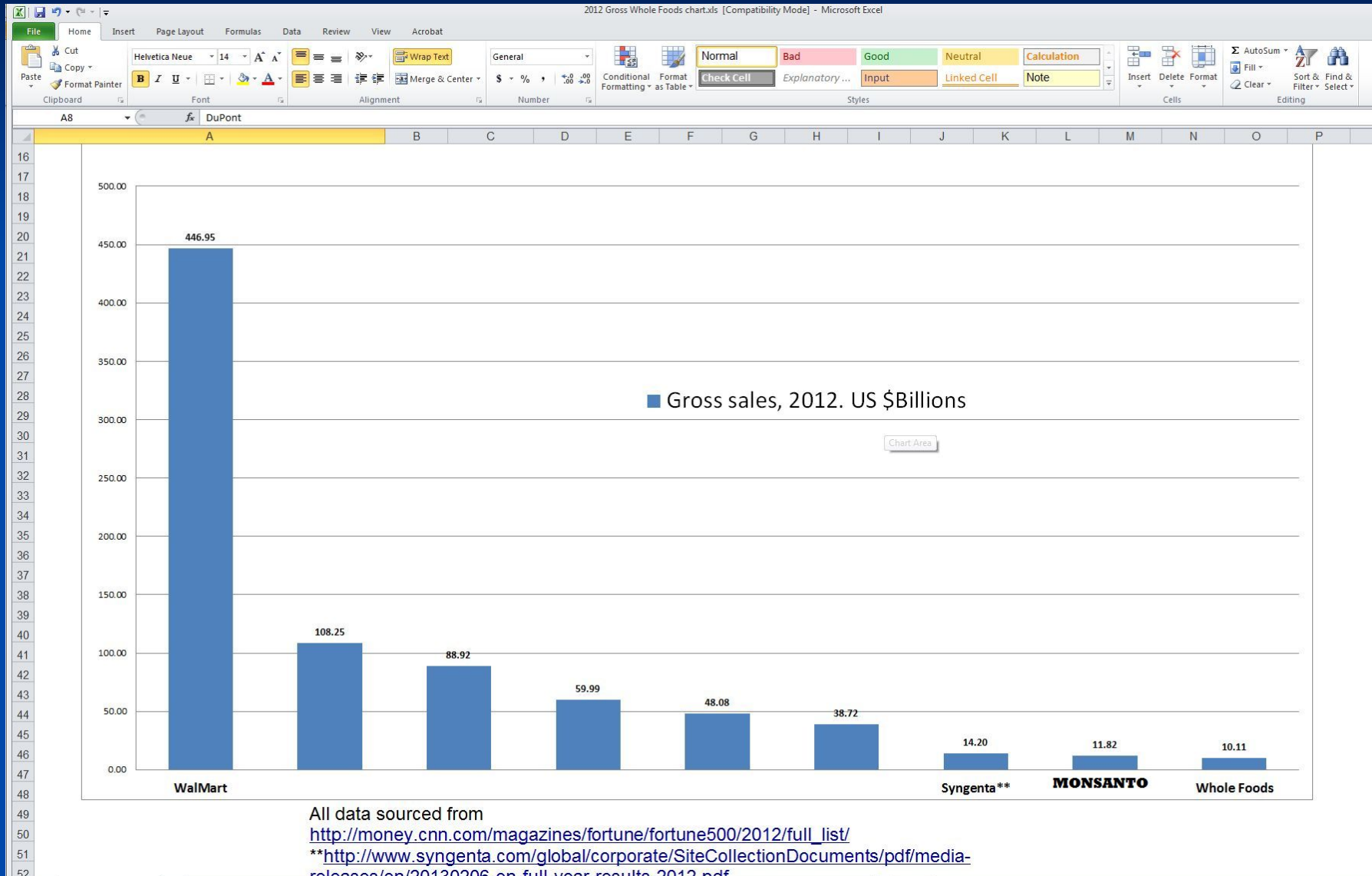
Adding some GMO companies...



And the reveal...



And where's Monsanto?



Organic Misconceptions

- Certified US Organic acreage (2007 figures)
 - 2,285,643ac out of total ac 406,424,909
 - < 1% of US farmland is certified organic
- Certified Organic US Farms (2007)
 - 11,367 farmers out of total 2,200,000
 - <1% of US farmers are certified organic
- Globally, Organic food is ~2% of sales, but costs *ca.* 20-30% more than conventional food
- Organic food serves a specialty niche market.

Organic: Feeding the 1%

- Not safer (*eaten at Chipotle recently?*)
- Not pesticide free (*some organic pesticides highly toxic!*)
- Not better nutrition
- Not better for environment (*esp. tillage*)
- Not as productive per unit area (acre, hectare, etc)
- Can feed only 3-4 Billion humans worldwide
- However, Organic food IS more expensive!

Hunger = Poverty

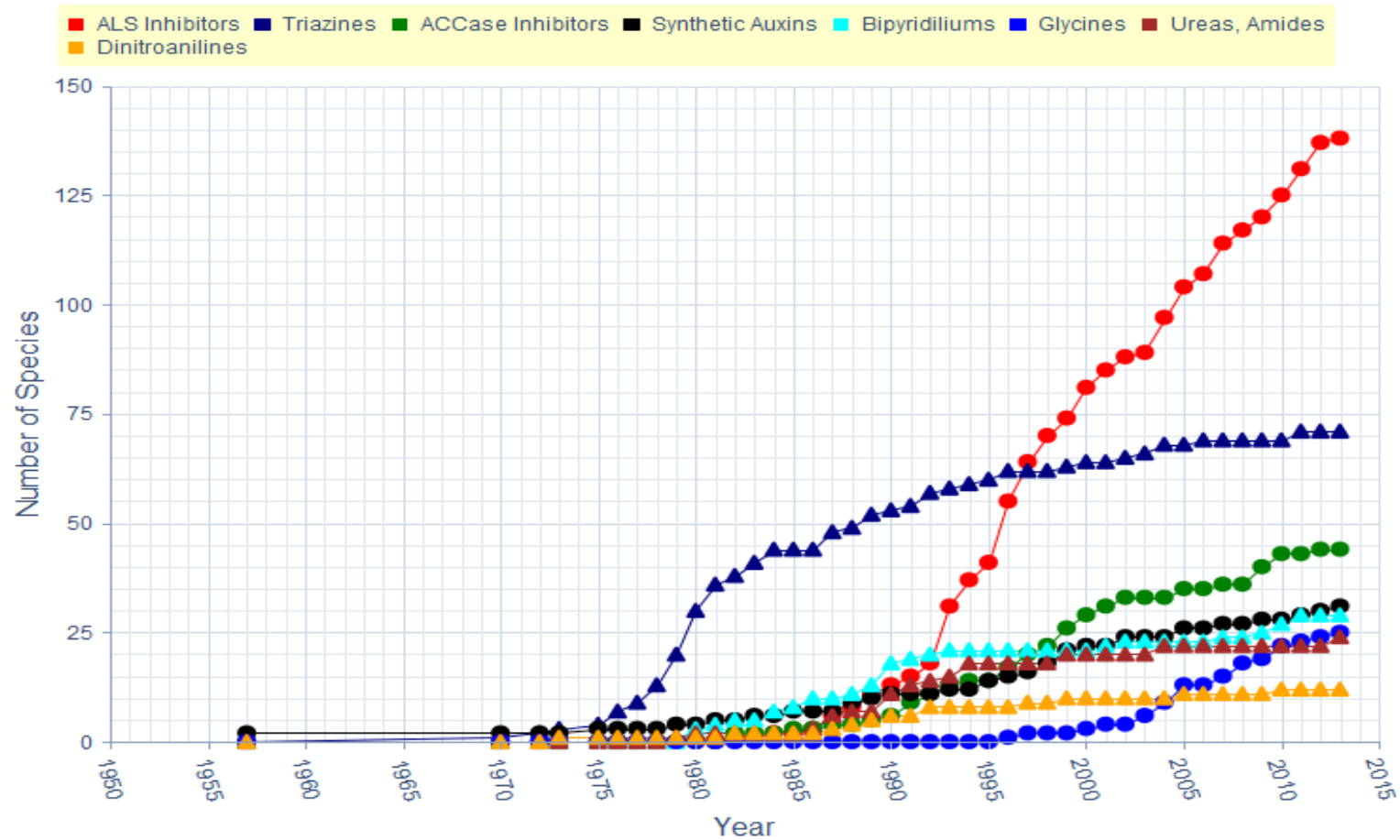
- No rich person goes hungry (involuntarily)
- The ‘redistribution’ myth
 - *“The world has plenty of food, but it’s not distributed evenly”*
 - *“The world has plenty of wealth, but it’s not distributed evenly”*
- The solution is NOT redistribution
- The solution is to increase either wealth or food
 - As supply of food increases, demand/cost goes down
 - As food costs drop, more poor people can eat better
 - Reducing the cost of food increases wealth everywhere.

Another popular misconception

- “GM Crops lead to herbicide resistant Superweeds!”
- “Roundup Ready crops allow the farmers to douse the crops with massive quantities of glyphosate...
- Weeds evolve resistance to the herbicides, forcing the farmer into a vicious cycle of ever-increasing herbicide applications...
- Until the weeds cannot be controlled at all, as has happened in the US with RR pigweed.”

Herbicide resistant weeds

Chronological Increase in Resistant Weeds Globally



Misconceptions lead to policies that are humorous or symbolic

- Mendocino County, California bans GE crops
 - and reclassifies DNA as protein
- GMO foods cause sterility in 350K couples in Serbia (http://english.ruvr.ru/2012_12_27/Are-GMOs-sterilizing-Serbia/)
- Philippine judge rules Bt Corn responsible for marriage breakdown and grants divorce
 - Because the husband walked through a Bt cornfield
 - And turned gay.

Or Tragic

- Zambia 2002 GM food: “poison”
- Terminator gene in Indian Bt Brinjal
- B-Carotene enhanced “Golden” rice

With preventable hunger, malnutrition, and death as a direct consequence.

Do people have a 'Right to Know' what's in their food?

A. Yes

B. No

If YES, what about...

- Recipe for Coca-cola™?
- Ingredients in Kentucky Fried Chicken ?
- Why not mandatory labels on Organic foods?
- Why not pesticides, induced mutagenesis, etc.?
- Why not biological contaminants, like *E. coli* ?
- There is **no** codified “Right to Know”
- Instead, people have a right to safe food and product/compositional/safety info labels
- And the right NOT to buy a given product.

Mandatory Food Labels

- Current US policy
 - Labels must be truthful and not misleading
 - Labels for content, not process
 - Nutritional information, + allergens and toxicants
 - Changes from standard/traditional versions
 - Independently verifiable
- Most 'GE' foods have no detectable DNA
- Those with composition changes must have labels.

Mandatory Process Based Labeling: Economics

- Process based labeling shifts the entire label policy from *Product* to *Process*
- But Process cannot (always) be verified
 - Foods with no physical GM components (oil, sugar)
 - Imported foods cannot be included
- Once one process (GM) is labeled, no basis for denying others (e.g. Organic, Union, Left-handed)
- Cost of process-based labels is substantial
- Who bears the cost?

Refined sugar in the USA

- Cane sugar: ca. 50%
- Sugar beet: ca. 50%
- In both cases, refined sugar is sucrose: $C_{12}H_{22}O_{11}$
- No GE sugar cane on the US market
- 95% sugar beet GE; so almost half sugar eaten is GE
- No current label to specify cane vs beet source
- Cannot verify GE sugar in foods; **Label is useless**
- **Also true for vast majority of 'GE' foods (oil, etc.).**

Biotech beef tomatoes? from Holland?



Sodium free?



Diet Water?

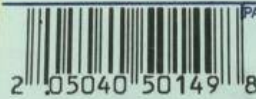


“Truthful and not misleading”?





WATERMELON



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1.00

1.49

08/21

PRICE PER LB.

TOTAL \$ PRICE

COMPARE FOODS
1883 MADISON STREET QNS

GE perspectives

- By 2050, when 9+ Billion people inhabit Earth, we need 70% more food than is produced today.
 - This means using *every* available tool, including GE
- Wherever farmers have been allowed to grow GE crops, they have been successful
- There are NO verified incidents of any harm, to either health or environment, due to GE crops and foods.

The GMO Train...

hop aboard or get run over...?



Clicker question

- Worldwide, how many people died of hunger while I was speaking today?
 - A) ~ 200
 - B) $200 - 700$
 - C) $700 - 1000$
 - D) $> 1,000$

GMOs and Public Policy

- Scientific fact is not subject to democracy or the fleeting whim of popular fashion
- Leadership in a free democracy does NOT mean:
 - Giving people the policies they say they **want**,
 - Or referenda, majority vote, popularity, etc.
- Instead, Leadership means
 - Giving people policies they **need**, based on
 - Critical analysis of valid science and evidence
 - **Especially when the policy is unpopular!**

SCIENCE VS.
EVERYTHING
ELSE

ANSWERS
SIMPLE
BUT WRONG
COMPLEX
BUT RIGHT

POST BY UNIVERSAL UCLICK

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Should people ignorant of issues be allowed to vote?

A. Yes

B. No