



# **Cultivating GMO Crops:** Destination Unknown

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**One Health One Planet Symposium**

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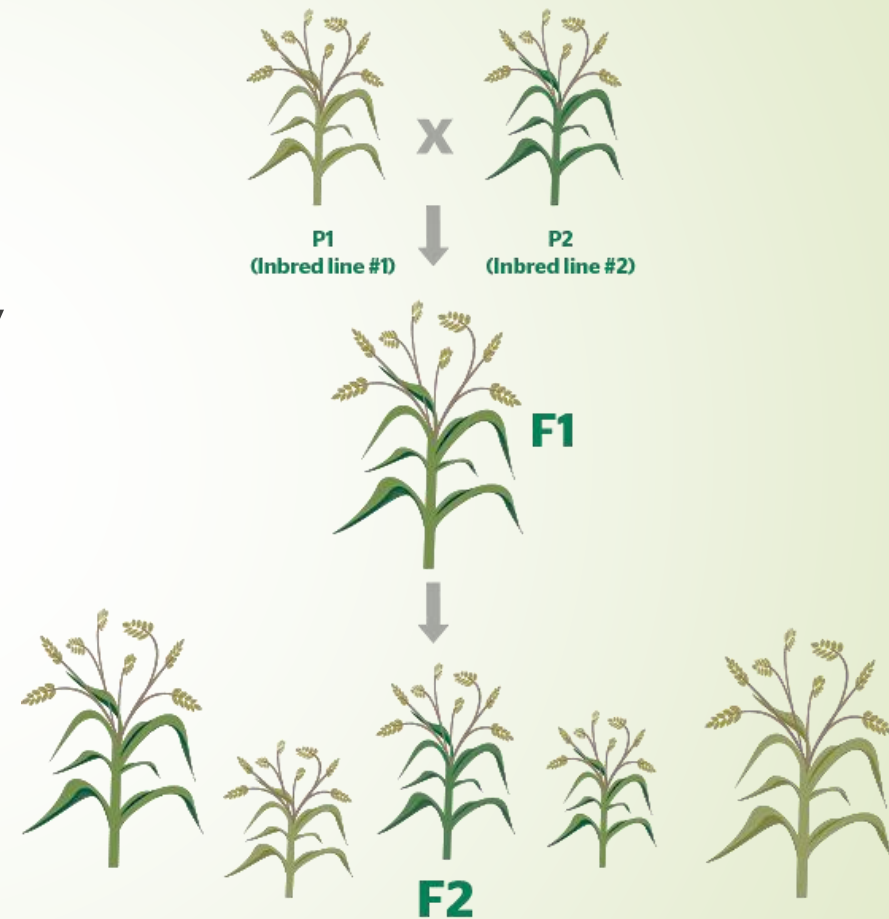
# From Gatherers to Farmers

- Selective breeding
- Gregor Mendel's principles of inheritance
- Choose traits desired and cross pollinate



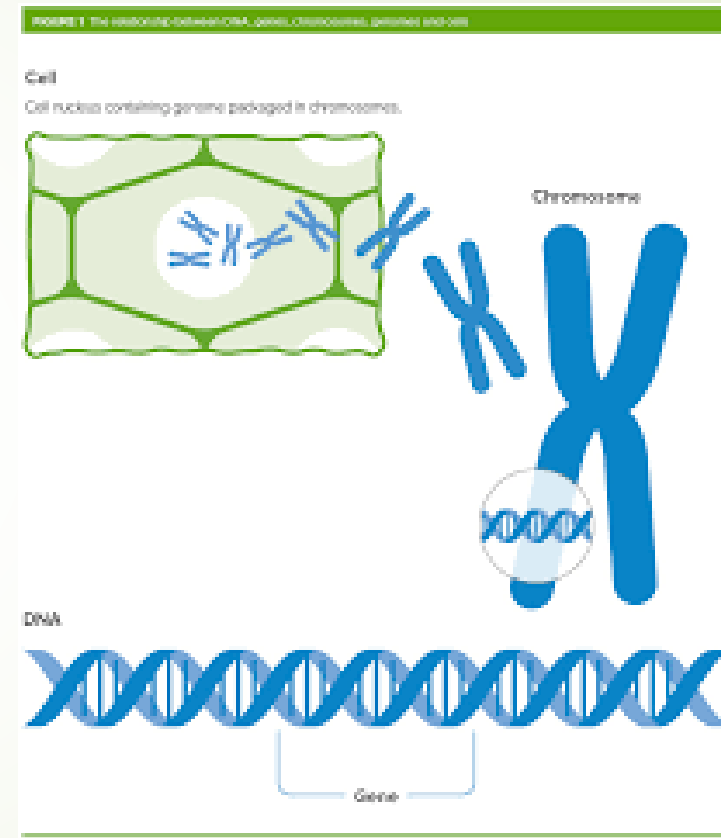
# Hybridization

- Cultivate varieties with different traits by sequential selecting and breeding
- Cross fertilization between representatives of **same species**



# Genetically Modified Organisms

- Combining traits across species- even across phyla
- Insert a strand of DNA with the desired trait (from a bacterium or virus vector)
- Into the genome of the target plant
- Grow in tissue culture to produce new plants whose seeds carry the new trait



# Applications of GMO

- **Medical and pharmaceutical**
  - Animal models of human genetic diseases like hemophilia
  - Creating “edible vaccines” for diseases like Hepatitis, HIV and malaria
  - Biosynthesis of pharmaceuticals such as human insulin



**1978**

Genentech produced the world's first genetically engineered human insulin. They engineered bacteria that produced human insulin whereas previous methods for obtaining insulin involved taking it from animals.

# Applications of GMO

## ➤ Bioremediation-

Creating genetically modified bacteria to:

- Clean up pollution such as mercury
- Remediate Persistent Organic Pollutants (PCB, PAH, pesticides)
- Clean up oil spills



*Alabaster Corporation  
Bio-remediation of oil spill*

# Applications of GMO

- **Agricultural Uses**
  - Pest management
  - Nutritional enhancement



M.Buiatti, P.Christou, G.Pastore. "The Application of GMO in Agriculture and Food Production for Better Nutrition- Two Different Scientific Points of View"  
Genes Nutr. May 2013. **8(3)**:255-270  
[http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3639326/#\\_\\_ffn\\_sectitle](http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3639326/#__ffn_sectitle)

# US leading user of GMO in crops



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



# Roundup Ready!



# Arguments For Agricultural GMO

- Enhance food quality
- Enhance agricultural productivity (yields)
- Enhance nutrition
- Create “drug factories” for producing edible vaccines and pharmaceuticals



“Golden Rice” enhanced with vitamins

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4346933/>

10/01/18

# Arguments For Agricultural GMO

- Reduce environmental footprint of agriculture
  - Reduce fossil fuel use for tilling and harvesting
  - Conserve water
  - Use “less” pesticides



*Glyphosate sprayed just before harvest for crop drying*

<https://www.ag.ndsu.edu/cpr/plant-science/glyphosate-as-a-pre-harvest-aid-in-small-grains-07-17-14>

# Arguments Against GMO



GMO Monoculture crops



Organic farming

- Effects untested, unknown will take decades to manifest
- GMO escape and transfer to wild populations
- Loss of biodiversity and habitat destruction

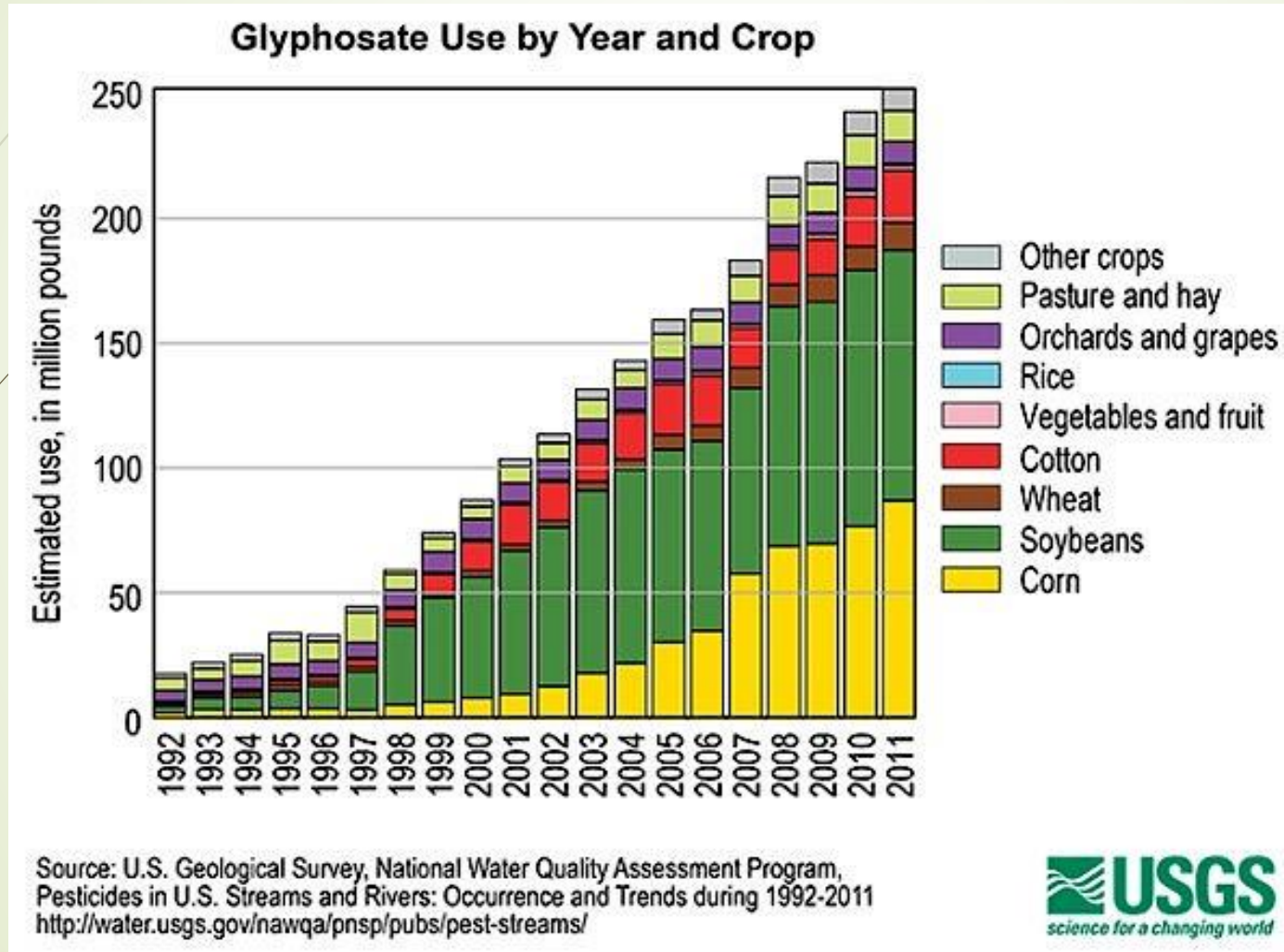
# Arguments Against GMO



*Palmer amaranth is one of the most prolific glyphosate resistant weeds in the US, producing up to a million seeds per plant. (Superior Ag Resources photo/Tom Sinnot)*

- Increased use of chemicals in agriculture & persistence in harvested foods
- Unintended transfer to other organisms (for example *E.coli* in your intestines)
- "Super Weeds"

# GMO crops increase pesticide use



- Monsanto introduced GMO Roundup Ready crops in 1995

# Ecological Effects

- **Essential Pollinators:** Nearly 90 per cent of all wild flowering plants and **75 % of food crops** depend on animal pollination
- **Biodiversity reduction:** Herbicide spraying destroys non-crop plants reducing habitat
- **Pollinator toxicity:** – Neonicotinoids, sub-lethal and indirect effects of GM crops on pollinators are poorly understood and not usually accounted for in risk assessments.

<http://www.fao.org/news/story/en/item/384726/icode/>



# Economic Impact of losing Pollinators



Insect pollinators  
contribute \$29  
billion to U.S. farm  
income





# Glyphosate residues in finished foods

- FDA has expanded testing for residues of herbicides: **glyphosate**, **2,4-D** and **dicamba** because of projected *increased use* of these weed killers on new genetically engineered crops
- FDA chemist, N. Chamkasem, found “over-the-tolerance” levels of glyphosate at 6.5 parts per million in corn. The legal limit is 5.0 parts per million.



EWG tested granola, oatmeal and cereals - 45 of 47 samples found Glyphosphate at higher levels than safe

<https://www.ewg.org/childrenshealth/glyphosateincereal/#.W7JPRy-ZOL>

<https://usrtk.org/pesticides/fda-foia-documents-regarding-glyphosate-residue-testing/>

# EPA finds no harm to humans- rescinds restrictions in 2017

- The EPA's assessment found "no meaningful risks to human health when the product is used according to the pesticide label."
- "There is potential for effects on birds, mammals, and terrestrial and aquatic plants."



<https://www.epa.gov/pesticides/epa-releases-draft-risk-assessments-glyphosate>

# Effects on Health and Worker Safety

- numerous negative health effects have been associated with chemical pesticides
- dermatological, gastrointestinal, neurological, carcinogenic, respiratory, reproductive, and endocrine effects
- Exposure through ingestion, inhalation, contact
- Bio-accumulation in fat tissue

Alewu B, Nosiri C. Pesticides and human health. In: Stoytcheva M, editor. Pesticides in the Modern World – Effects of Pesticides Exposure. InTech; (2011). p. 231–50.

[www.patriciademarco.com](http://www.patriciademarco.com)



# The Ethical Dilemma

**Who has the right to decide for the countless legions of people who were not consulted?**

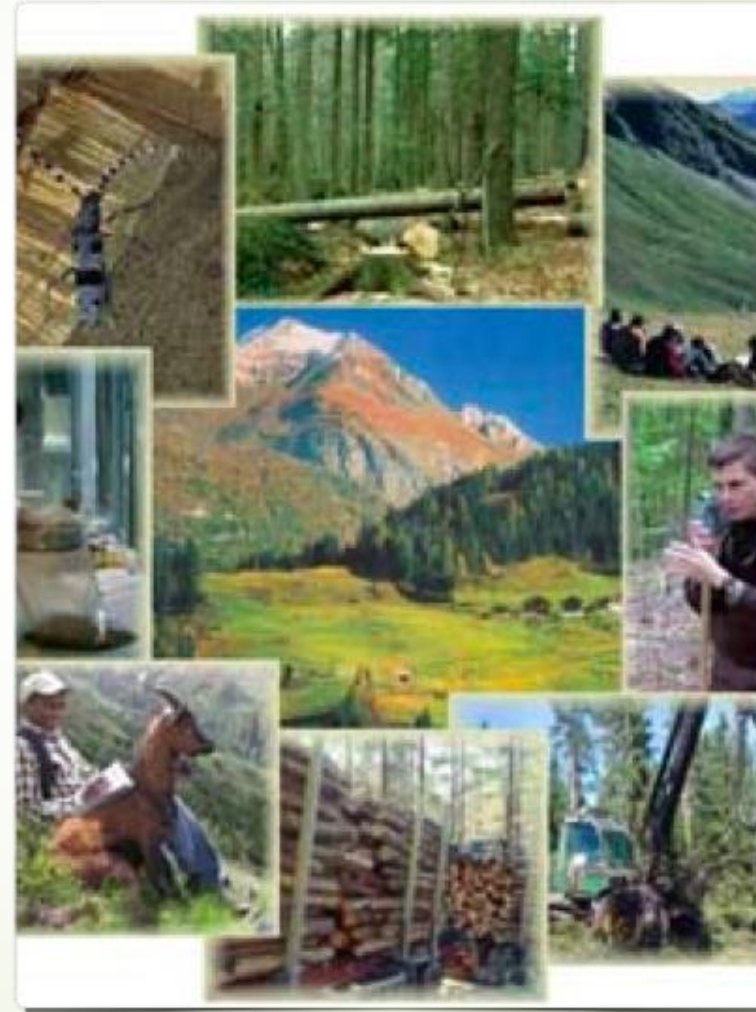
- Preserving the Ecosystem Services of the Earth
- Precaution Principle
- Intergenerational Equity



# Interconnected Web of life

“...man does not live apart from the world; he lives in the midst of a complex, dynamic interplay of physical, chemical, and biological forces, and between him and this environment are continuing, never ending interactions.”

*Rachel Carson*



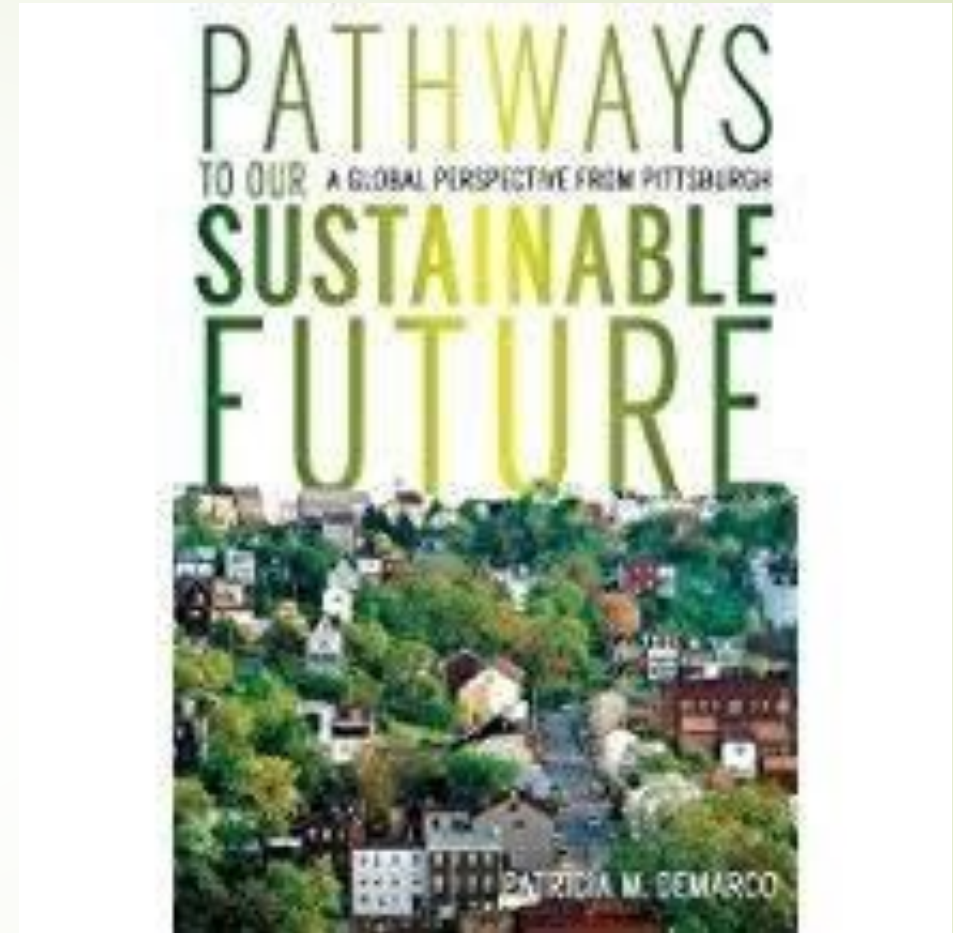


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## Resources for further study:

Batista, Rita, and Maria M. Oliveira. "Facts and Fiction of Genetically Engineered Food. Trends in Biotechnology 27.5 (2009): 277-86. Web. 18 Nov. 2013.

Maghari, Behrokh M. "Genetically Modified Foods and Social Concerns." Avicenna Journal of Medical Biotechnology 3.3 (2011): 109-17. Web. 18 Nov. 2013.

Singh, Om V., Shivani Ghai, Debarati Paul, and Rakesh K. Jain. "Genetically Modified Crops: Success, Safety Assessment and Public Concern." Appl Microbiol Biotechnol 71 (2006): 598-607. Web. 18 Nov. 2013.

# Further resources

- ▶ <https://www.baumhedlundlaw.com/toxic-tort-law/monsanto-roundup-lawsuit/roundup-cancer-study/>
- ▶ <https://www.activistpost.com/2018/08/monsanto-taken-to-the-cleaners-in-jury-verdict-dwayne-johnson-v-monsanto.html>
- ▶ <https://www.wakingtimes.com/2018/08/10/monsanto-was-just-fined-289-million-by-san-francisco-jury-for-failing-to-warn-of-known-cancer-risk/>
- ▶ <https://www.nytimes.com/2018/04/23/well/eat/are-gmo-foods-safe.html>
- ▶ <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3558185/>
- ▶ <https://www.ers.usda.gov/data-products/adoption-of-genetically-engineered-crops-in-the-us/recent-trends-in-ge-adoption.aspx>
- ▶ <https://usrtk.org/pesticides/fda-foia-documents-regarding-glyphosate-residue-testing/>