

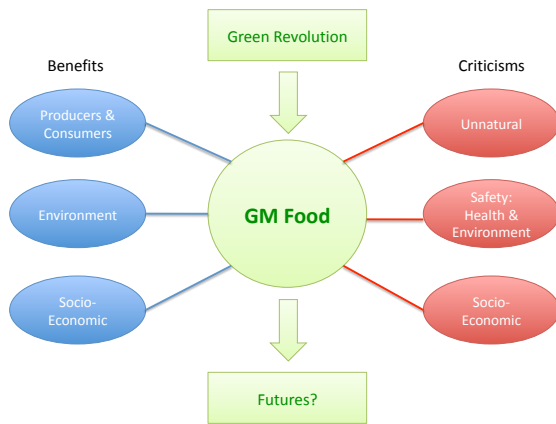
GM Foods

Honor 3215, Fall 2008
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Quick Review

- Green Revolution + rDNA = GM Crops
- Methods & Uses
 - Agrobacteria and Gene gun
 - Ht and Bt, Nutrition, Drugs, Env. Tolerance
- Benefits and Objections

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Unnatural Agriculture?

- General Objection:
 - GM agriculture introduces genetic modifications that are not likely to be found in nature and so either violates divine order or violates natural boundaries (e.g., between species) that we ought not to violate.
 - It further exhibits an unnatural attitude toward nature that commodifies it in ways that are unhealthy for us and the environment.

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Prince Charles (2000)

The idea that there is a sacred trust between mankind and our Creator, under which we accept a duty of stewardship for the earth, has been an important feature of most religious and spiritual thought throughout the ages. Even those whose beliefs have not included the existence of a Creator have, nevertheless, adopted a similar position on moral and ethical grounds. It is only recently that this guiding principle has become smothered by almost impenetrable layers of scientific rationalism. I believe that if we are to achieve genuinely sustainable development, we will first have to rediscover, or reacknowledge, a sense of the sacred in our dealings with the natural world, and with each other. If literally nothing is held sacred anymore – because it is considered synonymous with superstition or in some other way “irrational” – what is there to prevent us treating our entire world as some “great laboratory of life” with potentially disastrous long-term consequences?...(p. 12)

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Prince Charles (2000)

Fundamentally, an understanding of the sacred helps us to acknowledge that there are bounds of balance, order, and harmony in the natural world which set limits to our ambitions, and define the parameters of sustainable development. (see more p. 12)

Above all, we should show greater respect for the genius of nature’s designs, rigorously tested and refined over millions of years. This means being careful to use science to understand how nature works, not to change what nature is, as we do when genetic manipulation seeks to transform a process of biological evolution into something altogether different. The idea that the different parts of the natural world are connected through an intricate system of checks and balances which we disturb at our peril is all too easily dismissed as no longer relevant. (p. 13)

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Prince Charles (2000)

In this technology-driven age, it is all too easy for us to forget that mankind is a part of nature and not apart from it. And that this is why we should seek to work with the grain of nature in everything we do, for the natural world is, as the economist Herman Daly puts it, "the envelope that contains, sustains and provisions the economy, not the other way round." So which argument do you think will win – the living world as one or the world made up of random parts, the product of mere chance, thereby providing the justification for any kind of development? This, to my mind, lies at the heart of what we call sustainable development. We need, therefore, to rediscover a reference for the natural world, irrespective of its usefulness to ourselves... (p. 13)

The idea of taking a precautionary approach, in this and many other potentially damaging situations, receives overwhelming public support, but still faces a degree of official opposition, as if admitting the possibility of doubt was a sign of weakness or even a wish to halt "progress." On the contrary, I believe it to be a sign of strength and of wisdom. It seems that when we do have scientific evidence that we are damaging our environment, we aren't doing enough to put things right, and when we don't have that evidence, we are prone to do nothing at all, regardless of the risks. (p. 12)

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Discuss

- In your own words, what is Prince Charles' argument/point?
- How would you assess this objection to GM Agriculture?
 - e.g., is it persuasive or unpersuasive? Why?

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Response to Unnaturalness?

- What is so unnatural about GM Agriculture?
 - We've been manipulating agriculture for 10,000+ years... GM is just more precise.
 - We have been "commodifying" nature since the beginning, why stop now with GM?
- Besides, the current food demands may not be met using standard/traditional methods; GM agriculture is the only real-world solution to meet global food needs. Why not take advantage of a technology that will feed the hungry and address other food-related issues?

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Safety of GM Crops

- | Human Health | Environment |
|----------------------|-----------------------|
| • Toxins | • Selection Pressures |
| • Allergic reaction | • Gene Flow |
| • Long-term effects? | • Biodiversity |

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Human Health

- **Toxins**
 - Ht and Bt explicitly produce toxins or resistance to toxins that will be consumed by humans. Possibility of exposing humans to greater toxicity than in non-GM crops.
- **Allergic Reactions**
 - Introducing transgenes from organisms that may produce proteins (known and unknown) that humans are allergic to might be a hazardous. E.g., Brazil nut case. But no known reactions to Ht or Bt.
- **Long-Term Effects?**
 - The principle of unintended consequences tells us to be on the look out for unanticipated risks/harms. With GM foods the long-term effects on human health are unknown, but currently no reliable indicators that there has been harm.

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Responses to Health Concerns

- Avoid introducing genes from toxic or allergenic plants
 - a proposal to introduce a gene from Brazil nuts into soybeans was abandoned because of possible allergic reactions.
- Novel allergies or toxins should be tested for or tracked in use.
 - How do we do this?
- Long-term effects are unknown
 - Ambiguous laboratory results (GM pPotatoes and rats, etc.)
 - No known adverse effects since GM Food introduced

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Environment

- **Selection Pressure**
 - Use of Ht and Bt crops exerts profound selection pressures on weeds and insects, perhaps producing “super-weeds” or “super-bugs” that have adapted to Ht and Bt introductions.
- **Gene Flow**
 - Crops may cross with wild plants or other organisms thus introducing the transgene into otherwise natural settings. Possible consequences include “invasive species” effects, increased selection pressures, or environmental degradation.
- **Crop Biodiversity**
 - The success of GM Crops may increase use of these crops thus reducing the biodiversity of crops to “monoculture.” Lower biodiversity risks whole scale collapse of crops if successful disease or pest invades; e.g., Irish potato famine. (Killing non-target species.)

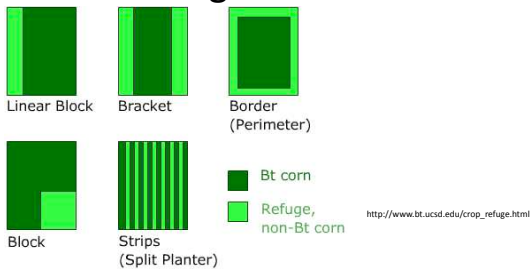
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Responses to Environmental Concerns

- Avoid gene-flow by create sterile plants or remove gene from pollen.
 - Terminator technology?
- Avoid creating resistant bugs/weeds but creating “refuge areas” that reduce selection pressures. (see next slides)
- Even if super-bugs/weeds develop, employ new Ht or Bt transgenics.
- Biodiversity and Non-Target Species
 - Monarch Butterfly...

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Refuge area



In the US, the EPA requires Bt corn farmers implement refuge areas to these guidelines:

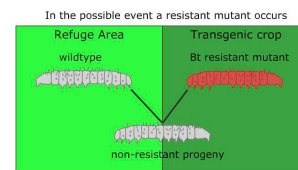
• Growers may plant up to 80% of their corn acres with Bt corn. **At least 20% must be planted with non-Bt corn (refuge area)**

• Refuge area must be within, adjacent to or near the Bt cornfields. It must be placed within 1/2 mile of the Bt field.

http://www.bt.ucsd.edu/crop_refuge.html

Refuge area

The idea behind the refuge area is that any resistant mutants will have to breed with non-resistant mutants from the refuge area. They never mate with other resistant mutants.



Question

Why would a farmer not plant a refuge area?



What should be the general approach to safety issues with GM crops?

- Precautionary Principle
 - Safety first...
- Substantial Equivalence
 - Find out as we go...

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Precautionary Principle

Principle #15 of the 1992 Rio Declaration:

“In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.”

- An ethical and political approach to introducing technology that may have harm that once evident is difficult to remove or reverse. The basic idea: be careful, do no harm, etc.
- Politically intended to counteract policies and regulations that are not precautionary, such as risk-benefit calculations that favor the introduction of new technologies. Thus placing burden of proof on those who wish to introduce the technology, not on the public that might be at risk.
- Worry: Might be too (vague and) restrictive, limiting the development and implementation of valuable technology.

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Substantial Equivalence

“food is considered safe if there is reasonable certainty that no harm will result from its consumption under anticipated conditions. Historically, food prepared and used in traditional way is considered safe on the basis of long-term experience, even though it may naturally contain harmful substances. In principle, food is presumed to be safe unless a significant hazard has been identified.” OECD Report, 1993.

- That is, compare the GM Crop with a relevantly similar crop to indicate what is different in terms of risk; functionally different. If there is no significant difference, they are substantially equivalent. If there is a difference they are not. In the former case, no further risk assessment is needed; in the latter case, further risk assessment/test might be needed.
- Compare risk assessment between toxicological studies with studies of whole foods.
- Worry: Might be too risky, exposing people to undue risk.

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Which Principle?

- Which is the better principle? Why?
- Are these principles significantly different?
- Do they help?

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Risk vs. Benefit

- What are the risks and benefits?
 - Review
- Food and Population
 - It appears GM Crops are more productive, so
 - What are acceptable risks for feeding the world’s population?
- Who benefits? Who is at Risk?
 - Humanitarian efforts need money, but
 - Global Agribusiness consolidates this technology

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Next Time

Socio-Economic Impact and Concerns

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