

Genetically Engineered Food: The Science Behind the Controversy

Toby Bradshaw

Washington Research Foundation
Professor of Basic Biological Science

Department of Biology
University of Washington



KCPQ 13 News



KIRO 7 News



Prof. Kern Ewing (Center for Urban Horticulture, UW)



An hour from now, I hope that you:

- Know more, and perhaps worry *less*, about the genetic engineering (GE) of food plants
- Know more, and perhaps worry *more*, about “traditional” food plants produced by “conventional” breeding

Genetically engineered (GE) or genetically modified (GM)?

- ***Genetic engineering*** -- Intentional transfer of genes (DNA) from one organism to another by an asexual process called *transformation* or *transgenesis*

Genetically engineered (GE) or genetically modified (GM)?

- ***Genetic modification*** -- Change in genes or genomes by any means, including mutation, chromosome doubling, selection, or hybridization (cross-pollination)

- Why is plant genetic engineering so controversial?
- Why genetically engineer plants?
- How is plant genetic engineering done?
- How was plant breeding done before genetic engineering?
- Does genetic engineering pose unique, unfamiliar risks?

Why is plant genetic engineering so controversial?

- It is an unnatural breaching of the species barrier
- Potential risks to human health
- Potential risks to the environment
- Increased corporate control of food

A polarizing debate

“I happen to believe that this kind of genetic modification takes mankind into realms that belong to God and to God alone.” -- Charles, Prince of Wales

A polarizing debate

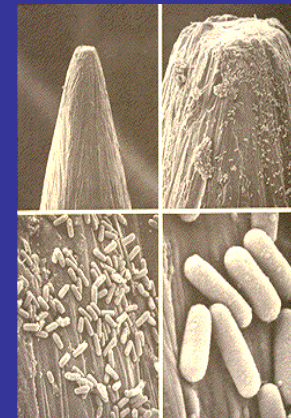
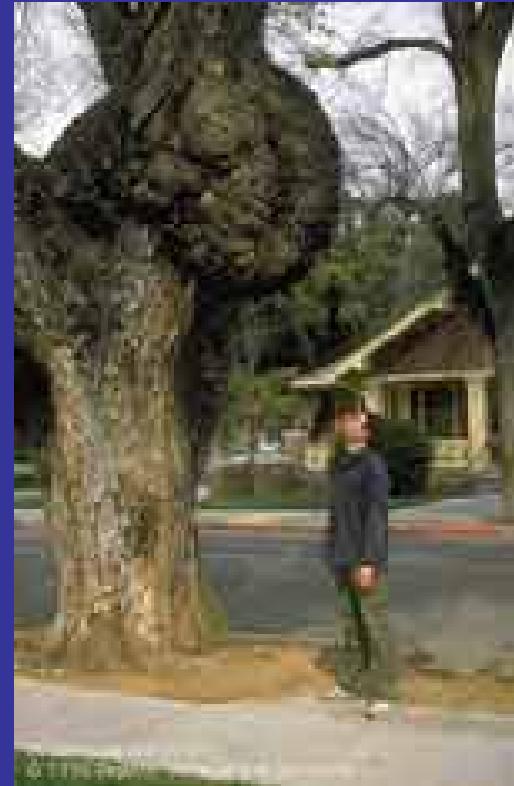
“In all honesty, if scientists don’t play
God, who will?” -- James Watson

Why genetically engineer plants?
For exactly the same reasons that we have genetically modified them by “conventional” methods for centuries

- Increased yield
- Improved quality and variety
- Profit
- Basic research on plant form, function, and evolution

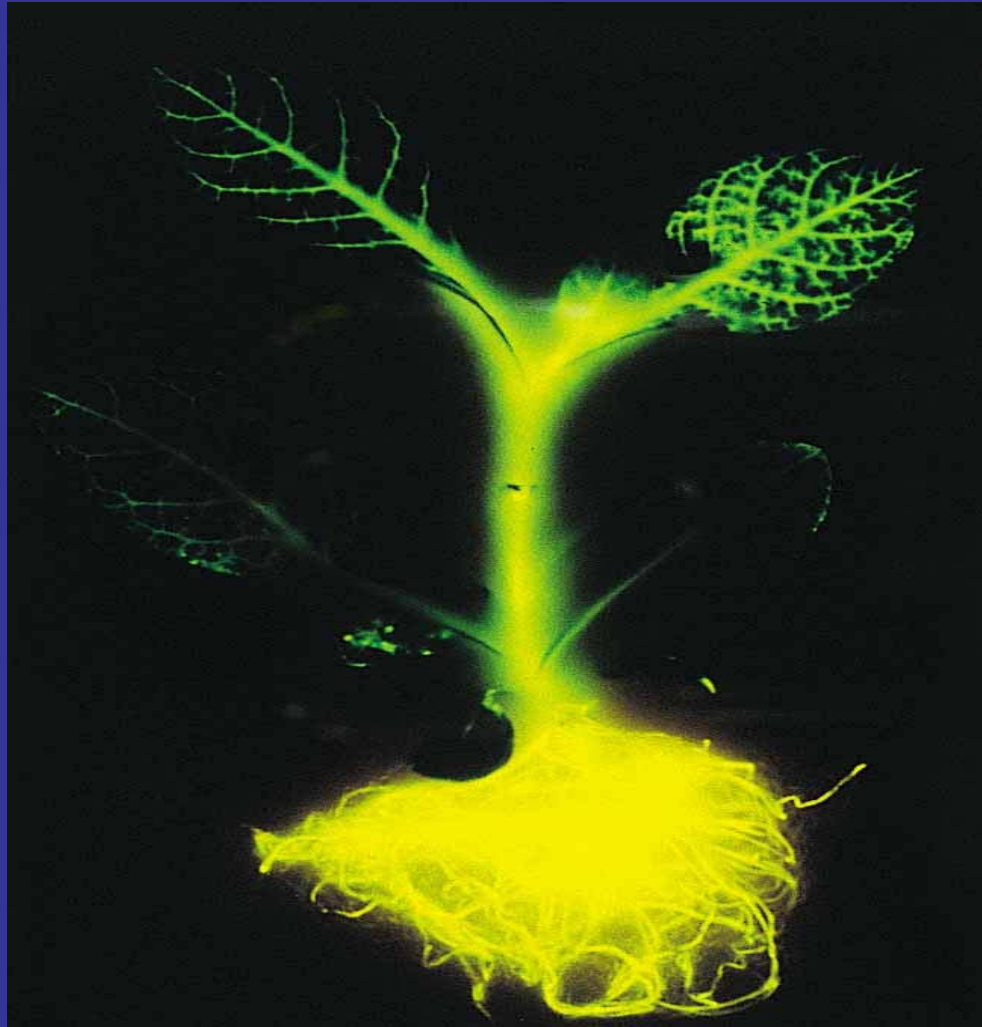
How is genetic engineering
done?

“Genetic engineering enables scientists to create plants, animals and micro-organisms by manipulating genes in a way that does not occur naturally.” -- Greenpeace





<http://www.nikkei-bookdirect.com/science/beyond-discovery/transgenics/closeup04d.html>



http://www.mun.ca/biology/scarr/Fig15_transgenic_tobacco.gif

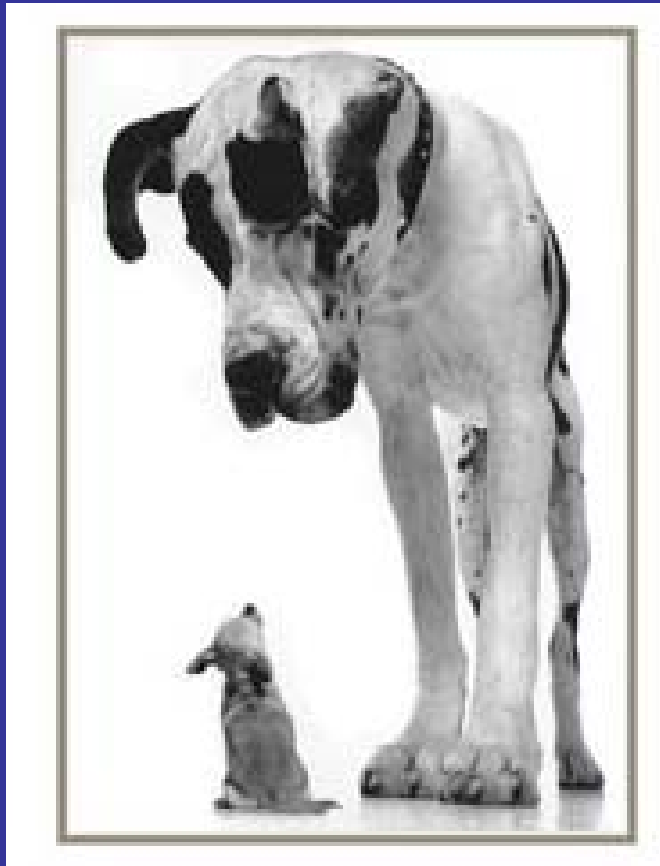
Griffiths et al. 1996

How was genetic modification done in the 10,000 years before genetic engineering?

- Artificial selection of spontaneous mutations and spontaneous hybrids
- Artificial hybridization, including “unnatural” wide crosses between species and genera
- Mutations induced by radiation or DNA-damaging chemicals

The power of “unnatural” selection

<http://www.wsdot.wa.gov/environment/biology/usfw-list/images/wolf.jpg>



http://imagecache2.allposters.com/images/pf/PHD0308_f.jpg

Here is the wolf. What is the chihuahua?



What is the chihuahua?

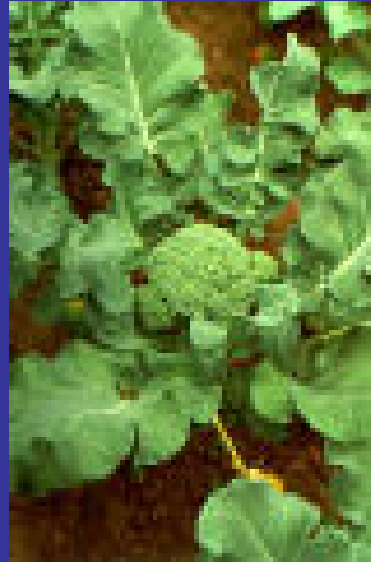


Here is the wolf. What is the chihuahua?



http://www.first-nature.com/flowers/images/brassica_oleracea1.jpg

What is the chihuahua?



Here is the wolf. What is the chihuahua?



<http://www.primitiveways.com/Images2/teosinte.jpg>

What is the chihuahua?



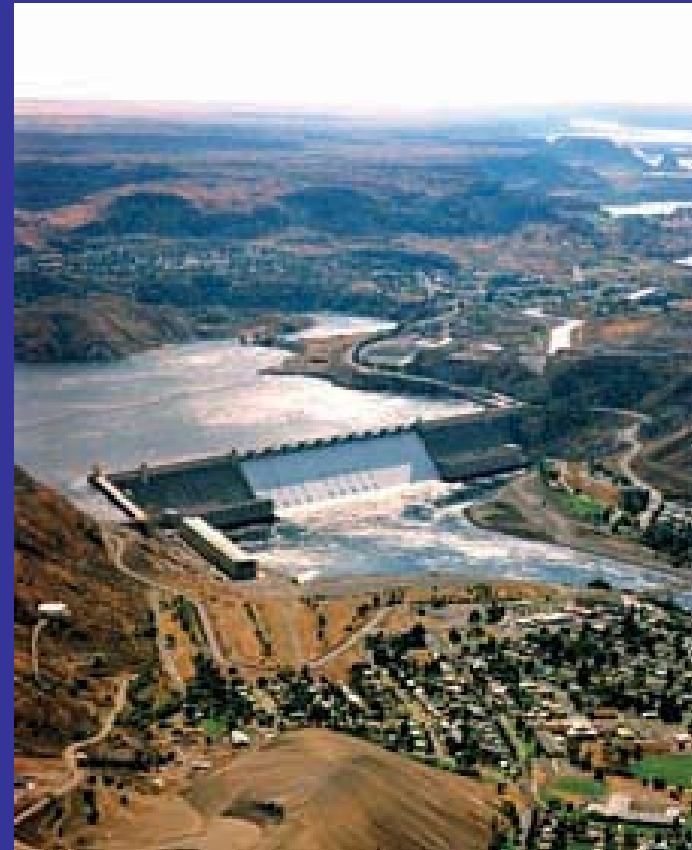
Here is the wolf. What is the chihuahua?



What is the chihuahua?



Crops are as out of place on a natural landscape as the Grand Coulee Dam or a nuclear power plant.



- Humans have harnessed (critics might say “subverted”) natural processes (hydrological cycle, gravity, nuclear fission, mutation, hybridization, genetic engineering) to concentrate energy and food production.
- Concentrated production of energy and food make modern civilization possible, but has health and environmental risks.

The question is not whether plant genetic engineering has risks – as with *all* technologies, it does.

The question we should be asking is:

DOES PLANT GENETIC
ENGINEERING POSE ANY *UNIQUE*
RISKS – RISKS WITH WHICH WE
ARE NOT ALREADY FAMILIAR
AFTER 10,000 YEARS OF
GENETICALLY MODIFYING
PLANTS THROUGH
“CONVENTIONAL” BREEDING?

Is genetic engineering unique in breaching the species barrier?

- Rutabaga
- Canola (oilseed rape)
- Triticale (*Triticum x Secale*)
- Strawberry
- Wheat, potato, tomato, tobacco, cotton ...

Is genetic engineering unique in potentially introducing toxins?



<http://www.rogerlovejoy.co.uk/elf/invasive/gt-hogweed/images/blister.jpg>

Plant chemical warfare

- Chili pepper
- Potato
- Oilseed rape
- Cassava
- Castor bean

Plant carcinogens

- Coffee contains >1000 chemical compounds. Of 28 tested, 19 cause cancer in rats and mice.
- Plants produce “natural” pesticides. Of 71 tested, 37 cause cancer in rats and mice. One of these is pyrethrum, perhaps the most widely used insecticide in organic farming.

Is genetic engineering unique in potentially introducing allergens?

Genetic engineering

- Brazil nut protein gene → soybean

“Traditional” agriculture

- Peanuts
- Wheat gluten

Does genetic engineering pose unique environmental risks?

- Herbicide resistant crops have been produced by genetic engineering (e.g., “Roundup Ready”) and by traditional breeding. They have the same:
 - benefits (no-till weed control)
 - risks (evolution of resistant weeds, dependence on chemical weeding)

Does genetic engineering pose unique environmental risks?

- Insect resistant crops have been produced by genetic engineering (e.g., “NewLeaf” potato) and traditional breeding. They have the same:
- benefits (plant protection, reduced reliance on sprayed insecticides)
- risks (evolution of resistant insects)

- Not everything that is natural is good for you.
- Not everything that is good for you is natural.
- We have 10,000 years of experience with many of the risks posed by genetic engineering.
- In plant breeding, it is the properties of the **PRODUCT** that determine benefits and risks, *not the process* by which it was made.

Are there products of plant genetic engineering that may be of unique concern?

- Transgenes encoding common allergens from nuts, wheat, crustaceans, mollusks, or eggs if introduced into staple food crops
- Pharmaceutical proteins or other drugs in food crops

Are there products of plant genetic engineering that may increase public acceptance?

- Improved nutrient content and flavor
- Edible vaccines
- Non-food plants engineered for production of industrial raw materials
- Crops engineered for low-input, sustainable agriculture

GE in perspective

- In the U.S., we have cut down, burned, and plowed 300 million acres of native ecosystems to grow just four crops – corn, soybeans, wheat, and cotton – none of which is native to the U.S.

GE in perspective

- Introduction of these four non-native crops brought *ca.* 200,000 “new” and untested genes into the U.S.
- Genetic engineering has added about a dozen “new” genes, all of which have been tested extensively.

But isn't there something creepy about putting flounder genes into a tomato?

Flounder	PRGLKMSSTFIGNSTAIQELFKRMSEQFTAMFRRKAFLHWYTGEGMDEMEFTEAESNMND
Human	PRGLKMSATFIGNSTAIQELFKRISEQFTAMFRRKAFLHWYTGEGMDEMEFTEAESNMND
Potato	PTGLKMASTFVGNSTSIQEMFRRVSEQFTAMFRRKAFLHWYTGEGMDEMEFTEAESNMND
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“Ignorance more frequently begets confidence than does knowledge: it is those who know little, and not those who know much, who so positively assert that this or that problem will never be solved by science.” -- Charles Darwin

You are not what you eat.

**YOU ARE WHAT YOU
KNOW!**



8.30.03