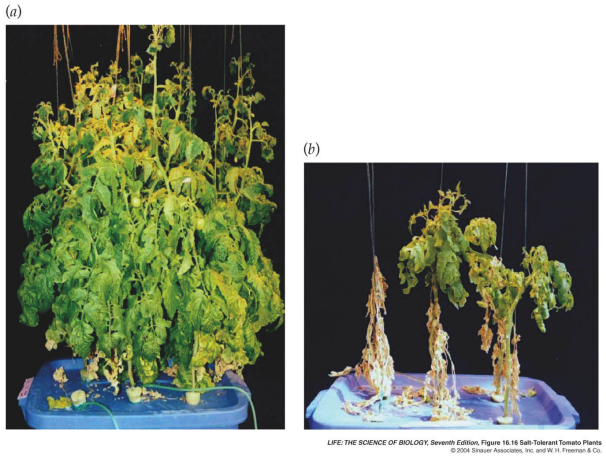
Genetically modified ("GM") crops



Salt-tolerant tomato plants Control tomato plants

Milestones in the history of selective breeding

- As early as 7500 BC: Farmers in China were cultivating rice (either rice or corn was most likely the first domesticated plant)
- 18th century: Early examples of selective breeding in animals, such as sheep
- 1866: Mendel's pea-breeding experiments were published

Milestones in the history of GM crops

- 1950s: Scientists begin using radiation & chemicals to create randomly mutated strains of wheat, rice, peanuts, etc
- 1970s: The 1st GM plant (tobacco) is made at University of Washington
- 1990s: Monsanto started selling Bt-corn, and protests begin (many organized by Mark Lynas)
- 2012: Mark Lynas announces a reversal of his stance on GM crops

Currently available GM foods

- 60% of corn is Bt-corn
- 1/10 of the world's cropland are GM crops
- GM crops mainly go into:
  - animal feed
  - biofuels
  - cooking oils
  - processed foods like cereals & chips
- GM produce currently sold:
  - papaya
  - squash
  - sweet corn

GM crops in developed nations

- 90% of the world's GM crops are grown by the US, Canada, Brazil & Argentina
- 8 EU nations have banned GM crops
- Only 2 GM crops are accepted in the EU:
  - Monsanto maize
  - Amflora potato

GM crops in developing nations

- India and China are the 5th & 6th main producers of GM crops
- Kenya has banned GM crops, amidst widespread malnutrition
- Zambia declined shipments of GM corn, even during a 2002 famine

An example: The GM orange

- What property are they attempting to confer on the orange?
- What else (other than engineering) did they try first?
- From where did they try to get the "new gene"?

Methods of generating pest-resistant plants

- Spray with pesticides
- Search for a naturally immune strain
- Selectively breed to acquire immunity
- Expose seeds to radiation to make immune mutants
- Genetic engineering to insert a new gene

Variables in the methods of creating a GM crop

- Where the new gene comes from
  - Virus
  - Synthetic (from a lab)
  - Animal
  - A different plant ("cisgenic")
- Whether seeds are engineered and whole trees are grown, or new branches are grafted onto adult trees
- How new gene is put in
- Where in the organism's DNA the new gene inserts (randomly, vs targeted)

The approval process for the GM orange

- Trial in locked greenhouse
- 300-tree field trial
- Protein fed to insects/mice
- Pollen fed to insects/mice
- Juice from trees fed to insects/mice
- Three agencies give approval:
  - EPA (safety & efficacy)
  - USDA (will not affect other plants)
  - FDA (compare safety & nutrition to natural oranges)

Benefits of GM crops

Benefits of GM crops:
Increasing the world's food supply

- Resistant to disease
  - Viruses
  - Bacteria
  - Fungus
- Resistant to pests
  - Insects
  - Weeds
- Can grow under more conditions
  - Drought
  - Salty soil
  - Hot/cold temperatures

Benefits of GM crops:
Increasing health & nutrition of food

- Doesn't produce toxins like acrylamide
- Contains nutrients like vitamin A
- (Pest-resistant crops also apply to this list)

Benefits of GM crops:
Increasing appeal of foods to consumers/industry

- Easier to farm or process
  - Flowers earlier in life
  - No pits/stones
- More appealing to consumers
  - Stays fresh
  - Doesn't brown
  - More sugar content

Benefits of GM crops

- Increasing the world's food supply by:
  - Increasing yield
  - Decreasing cost
- Increasing health & nutrition of food
- Increasing appeal of food to consumers & industry
- Reducing use of pesticides
- Allowing for quick adaptation to changing conditions in pests & land
- Conserving soil due to no/low-till farming
- Improving farm work (e.g. higher yields, fewer pesticides)

Concerns about GM crops

Concerns about GM crops
that can be scientifically refuted

Creating unappealing or bizarre hybrid organisms:

- e.g. Fewer than 50% say "no" to: Would a tomato would taste fishy if it were a frost-resistant tomato with a gene from the winter flounder fish?
- Only one gene (of thousands) is inserted

Concerns about GM crops
that can be scientifically refuted

Creating foods that are unsafe:

- WHO, NAS, AAAS, AMA, FDA, European Commission, European Food Safety Authority, British Royal Academy state there are no health risks
- 100s of studies by 100s of independent research groups have shown no effects
- Trillions of GM meals have been eaten over 30 yrs
- GM foods go through multi-step testing and require approval from 3 agencies

What are other concerns about GM crops?

Concerns about GM crops

- Yet unknown risks
- Distrust or dislike of large agricultural companies &/or their patenting of seeds
- Desire to eat natural foods
- Desire to only have natural organisms released into the ecosystem
- Mixing of pollen between GM and non-GM fields
- Unforeseen genetic changes (e.g. due to insertion site of new gene)
- Increased use of herbicides
- Desire to have all GM foods clearly labeled