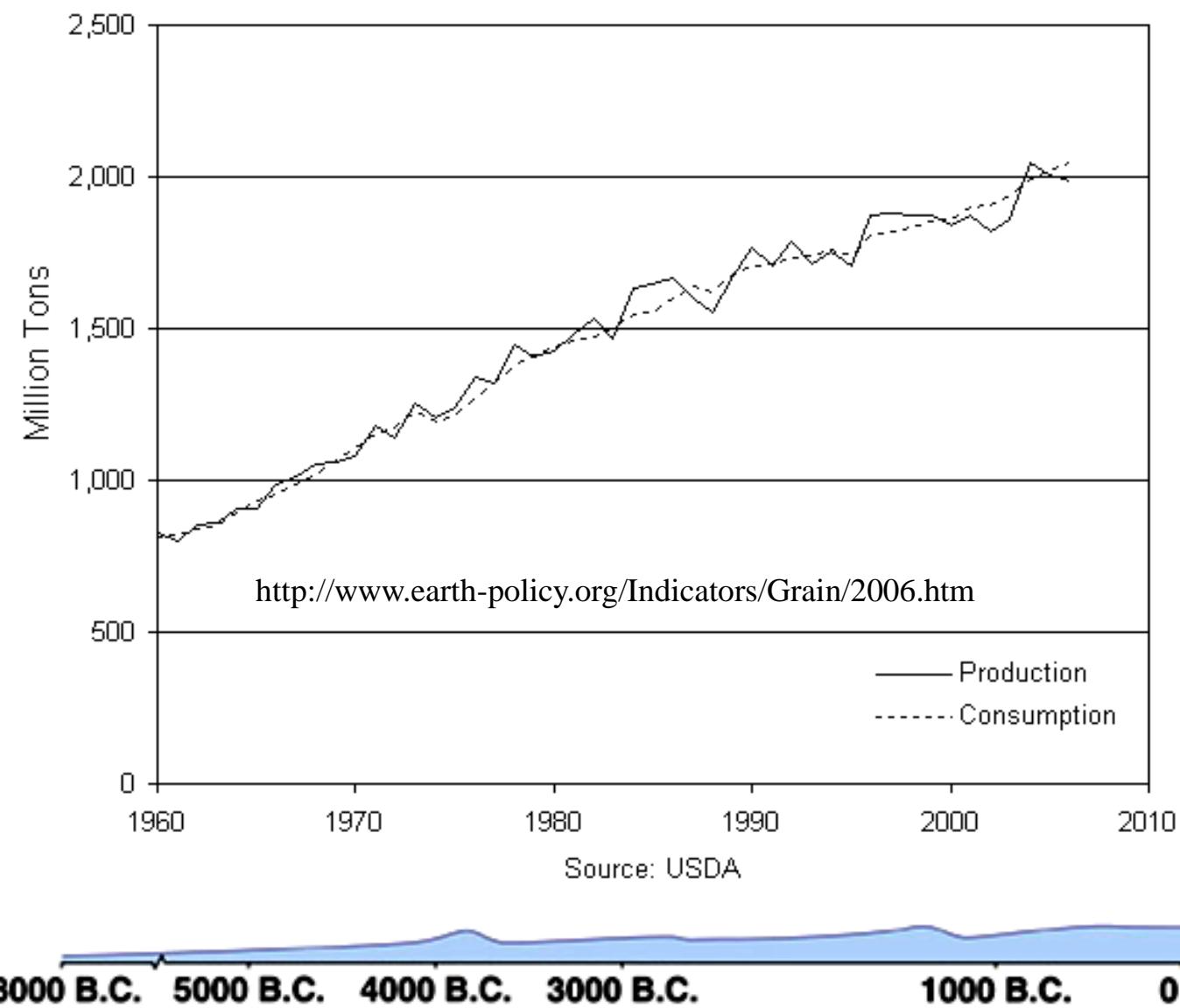


Today: Genetically Modified Plants (see textbook section 38.3)



Human resource production and use

World Grain Production and Consumption, 1960-2006



World pop.=
6,914,330,387
as of 10:45pm
on 4/24/11

<http://www.census.gov/main/www/popclock.html>

Plague

Population (billions)

1

2

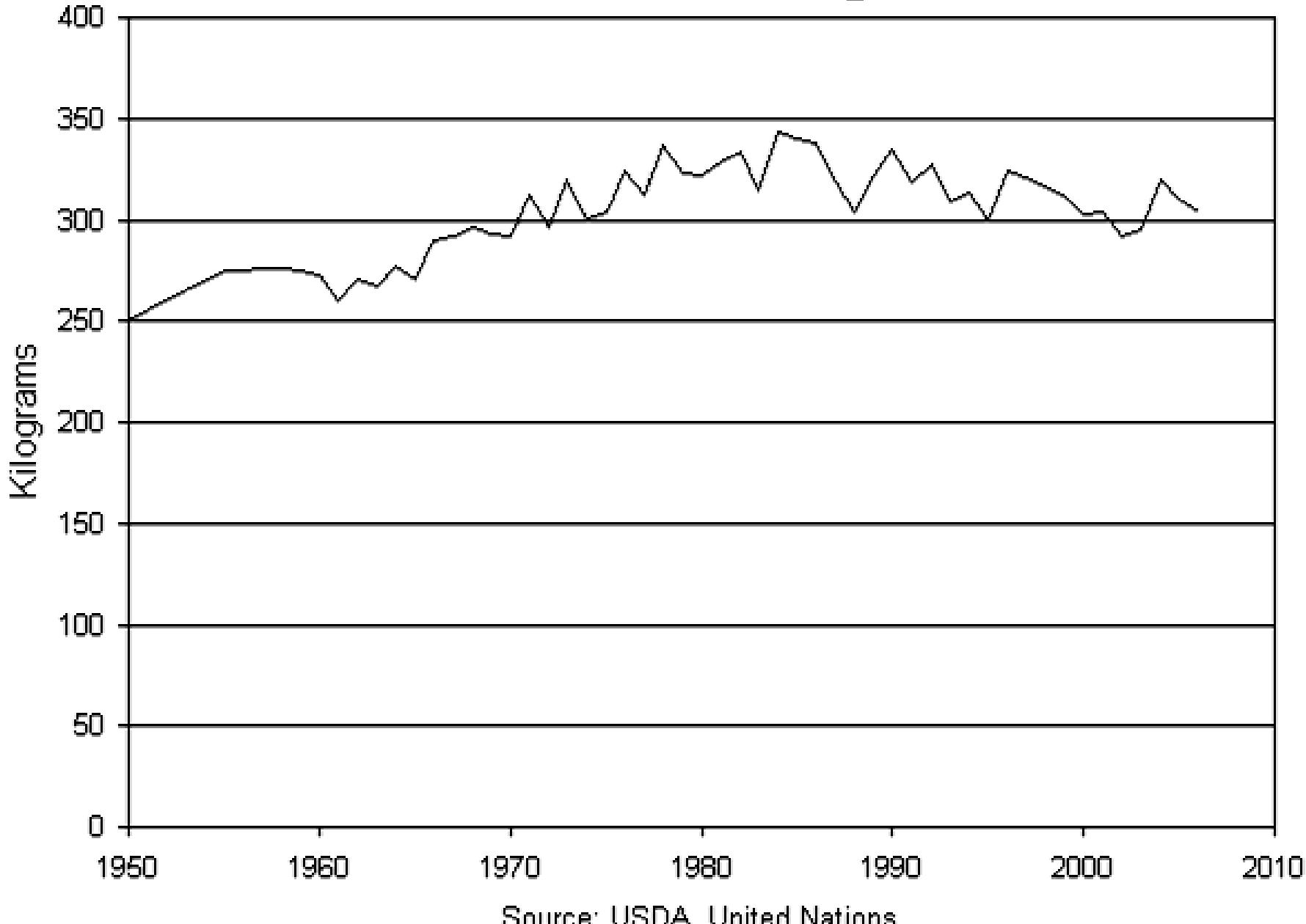
3

4

5

6

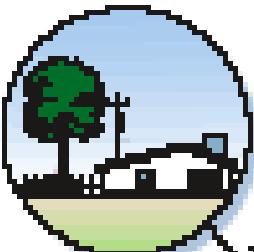
Worldwide Grain Production per Person



Source: USDA, United Nations

<http://www.earth-policy.org/Indicators/Grain/2006.htm>

Land use in USA, 1997



Urban, semi-natural
and other
26%



Forest-use
land
28%



Cropland
20%

Grassland,
pasture and range
26%

Artificial Selection



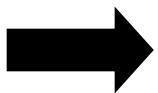
Benjamin Cummings

from Teosinte → Maize

By artificial selection that began ~10,000 years ago.



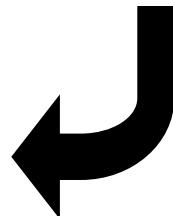
Hunter-
Gatherer



Agricultural



Industrial



8000 B.C. 5000 B.C. 4000 B.C. 3000 B.C.

1000 B.C. 0 A.D. 1000 A.D. 2000

The Plague

6
5
4
3
2
1
Population (billions)

Genetic Engineering: Direct manipulation of DNA

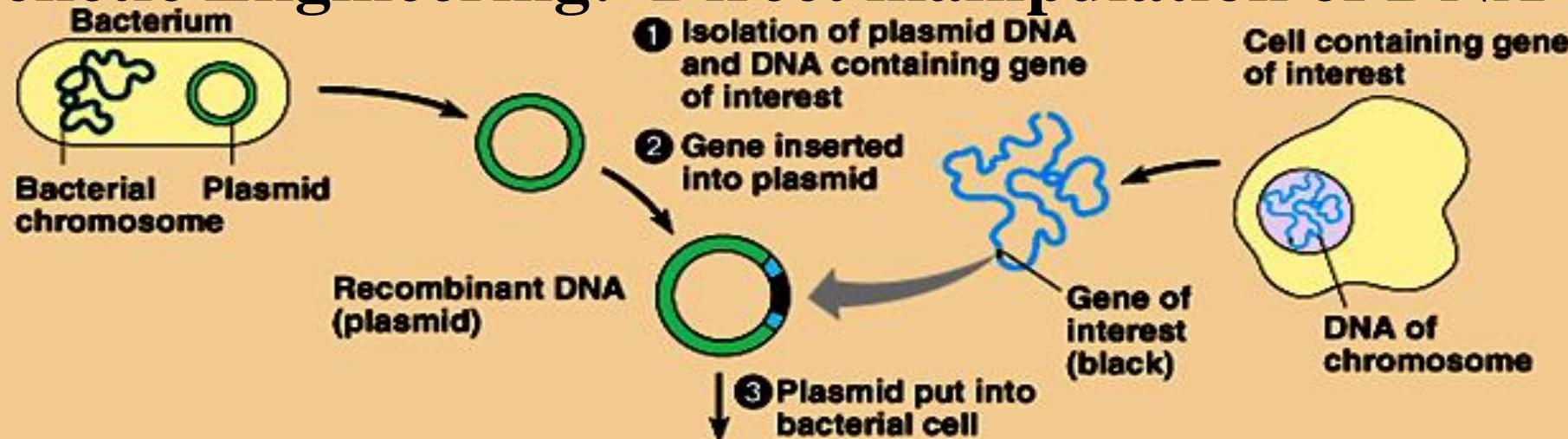
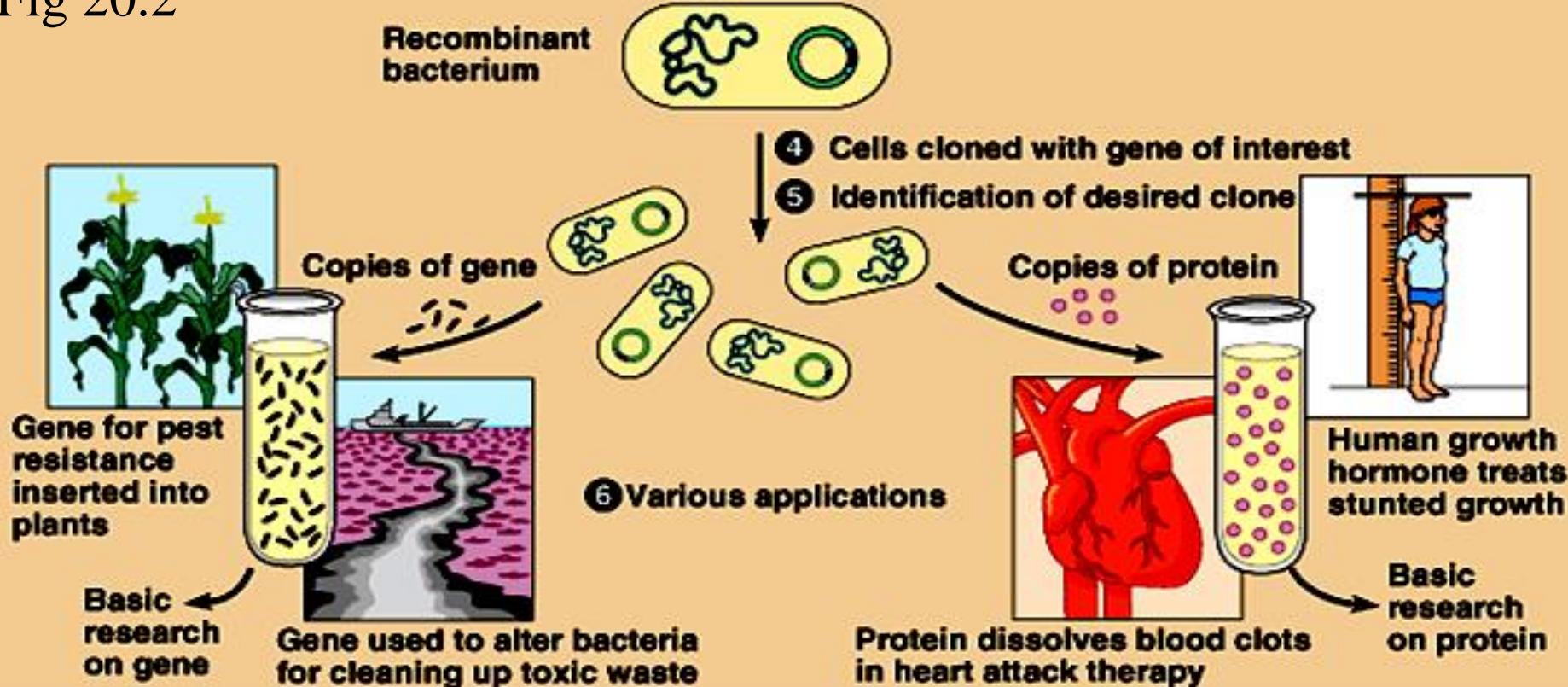
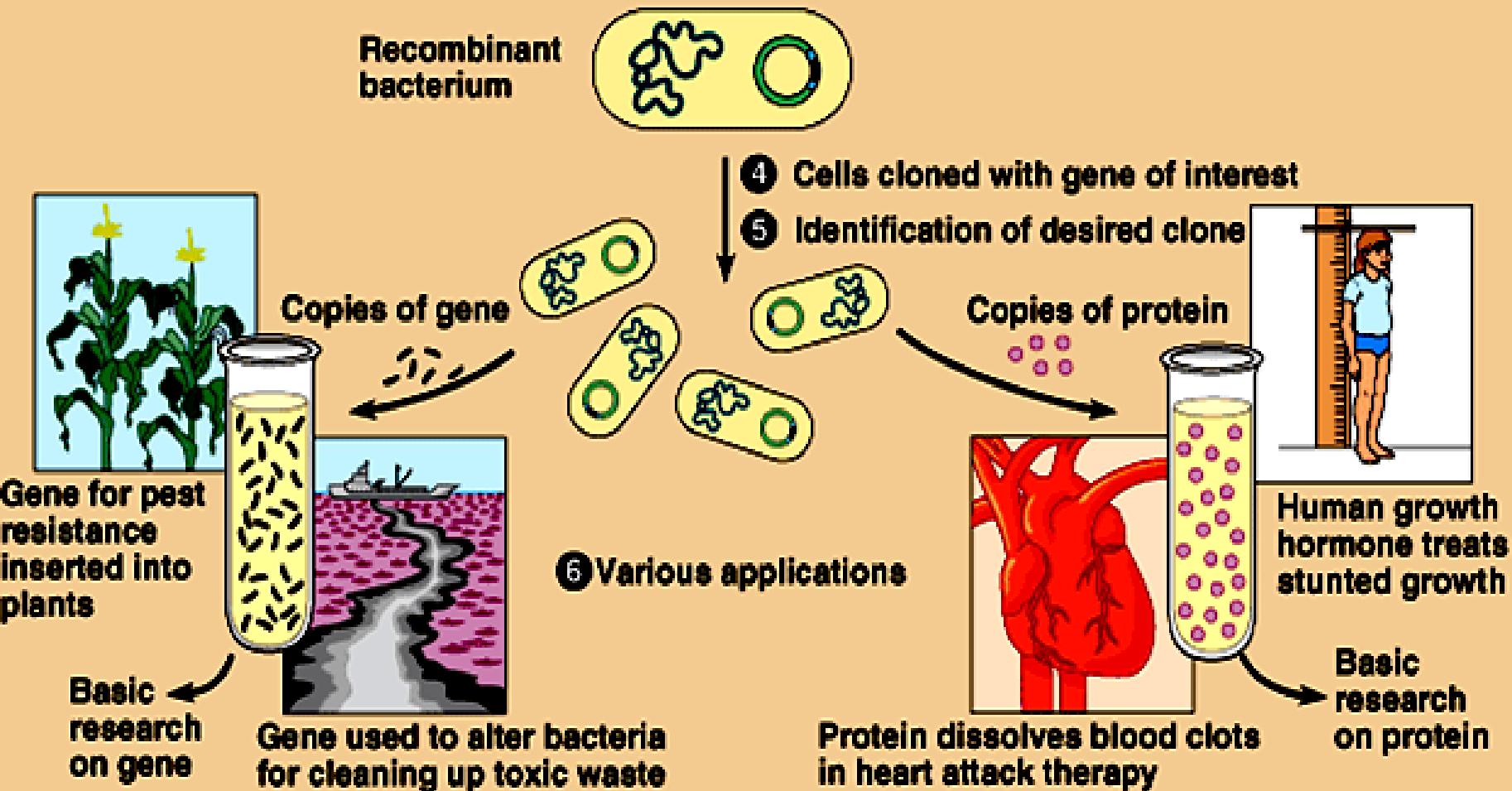


Fig 20.2



We can now insert new genes or modify existing genes of organisms



Genetically modified plants



Agrobacterium infect plants, inserting some of their DNA into the plants genome and forming a gall.



Agrobacterium infect plants, inserting some of their DNA into the plants genome.

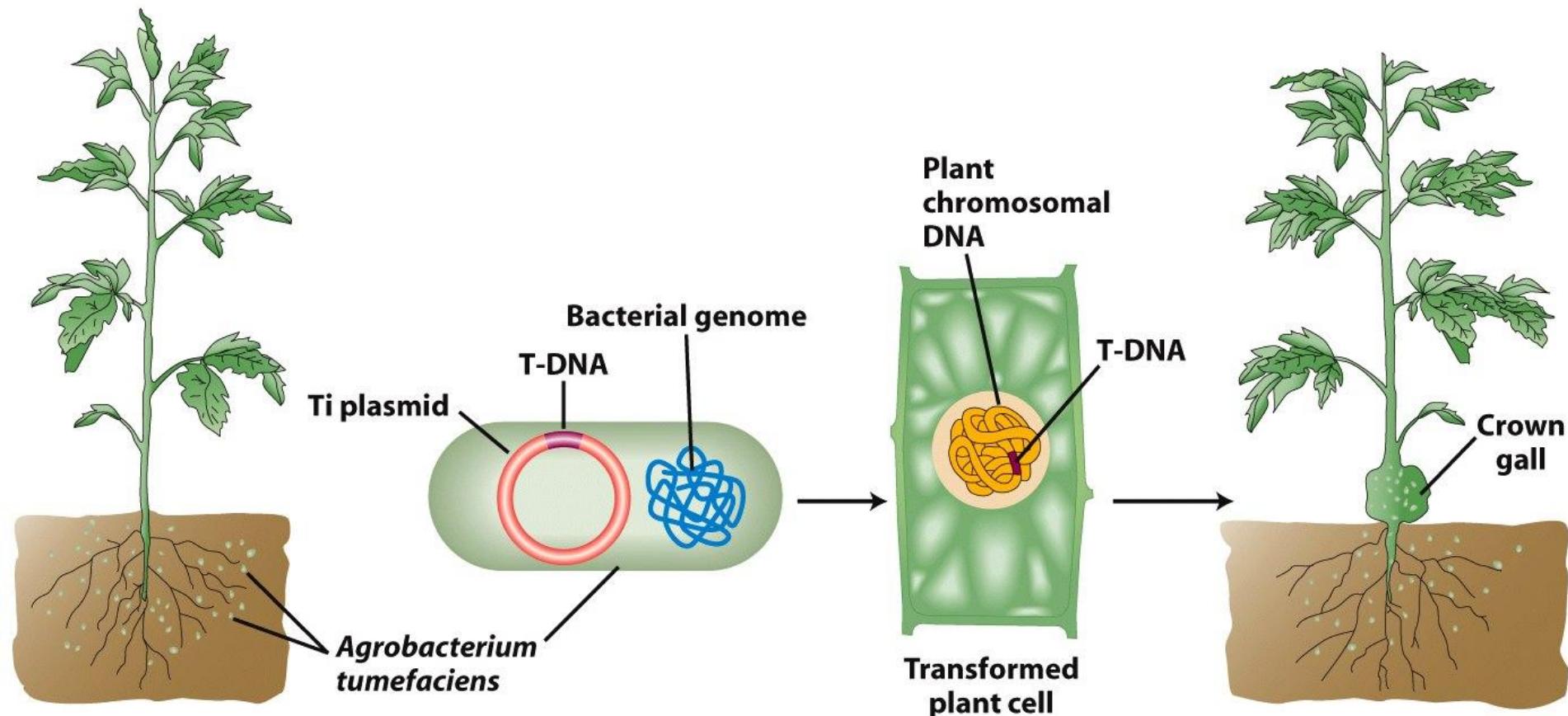


Fig 20.25

After inserting a gene into the *Agrobacterium*, they will insert that gene into the plant's DNA.

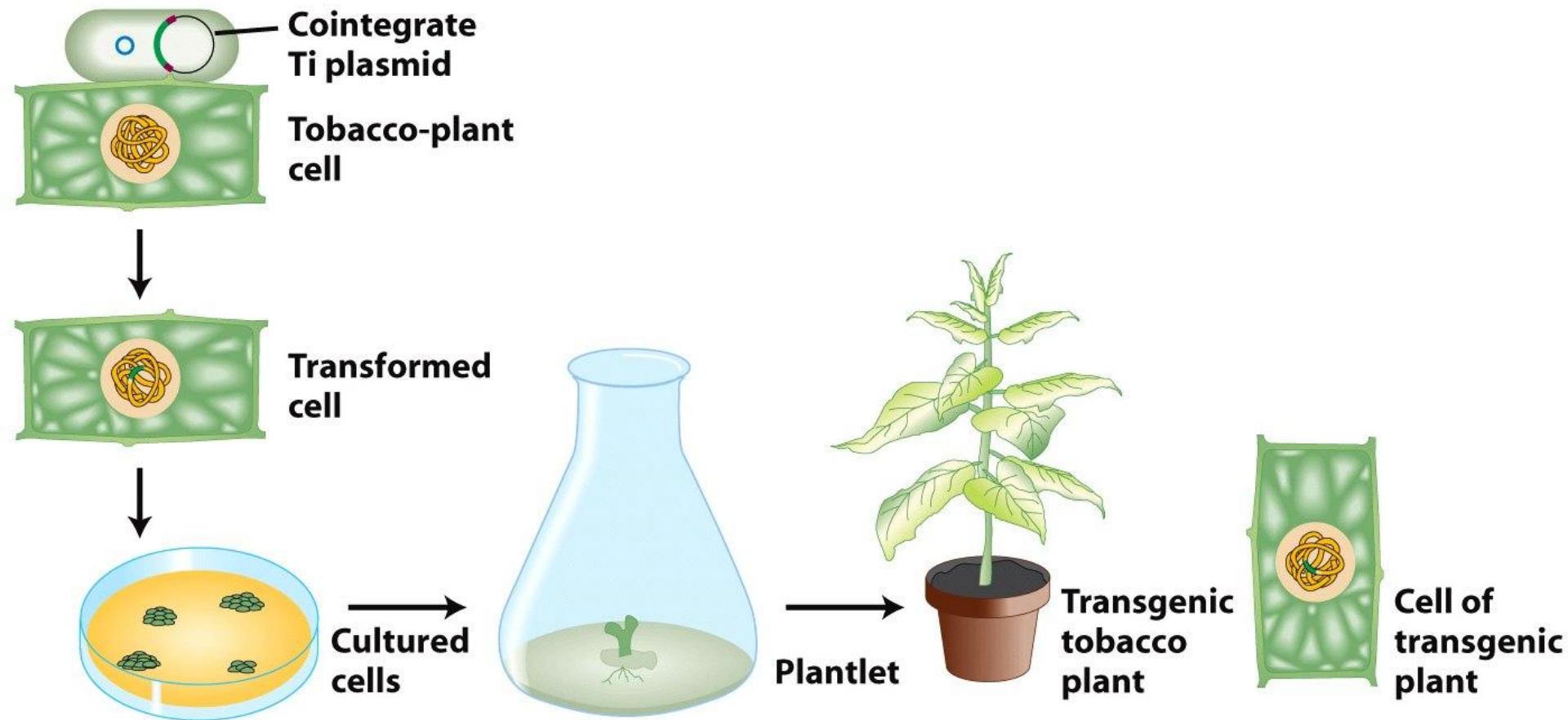
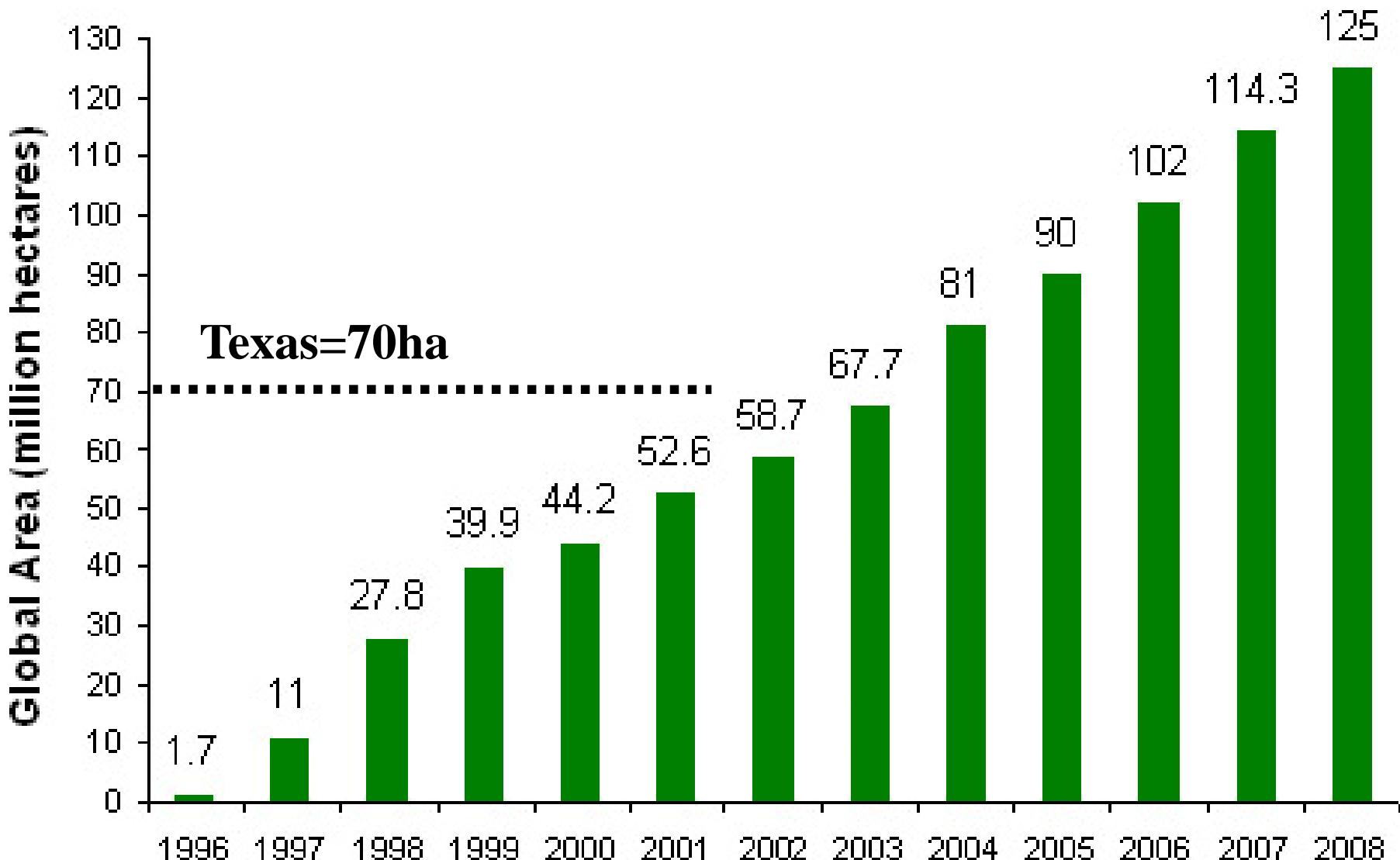


Fig 20.25

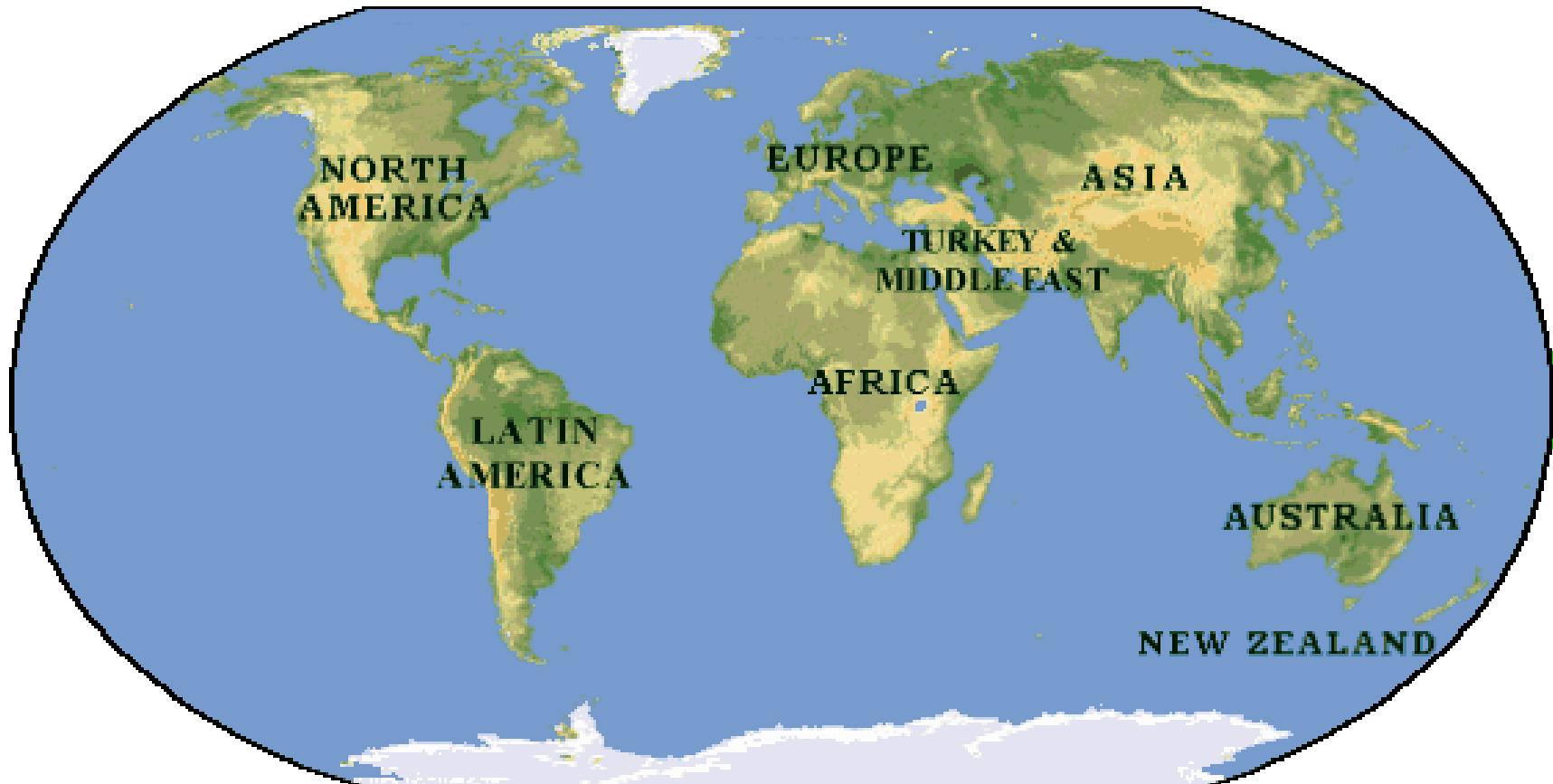
Global area planted with GM crops



http://www.gmo-compass.org/eng/agri_biotechnology/gmo_planting/257.global_gm_planting_2006.html

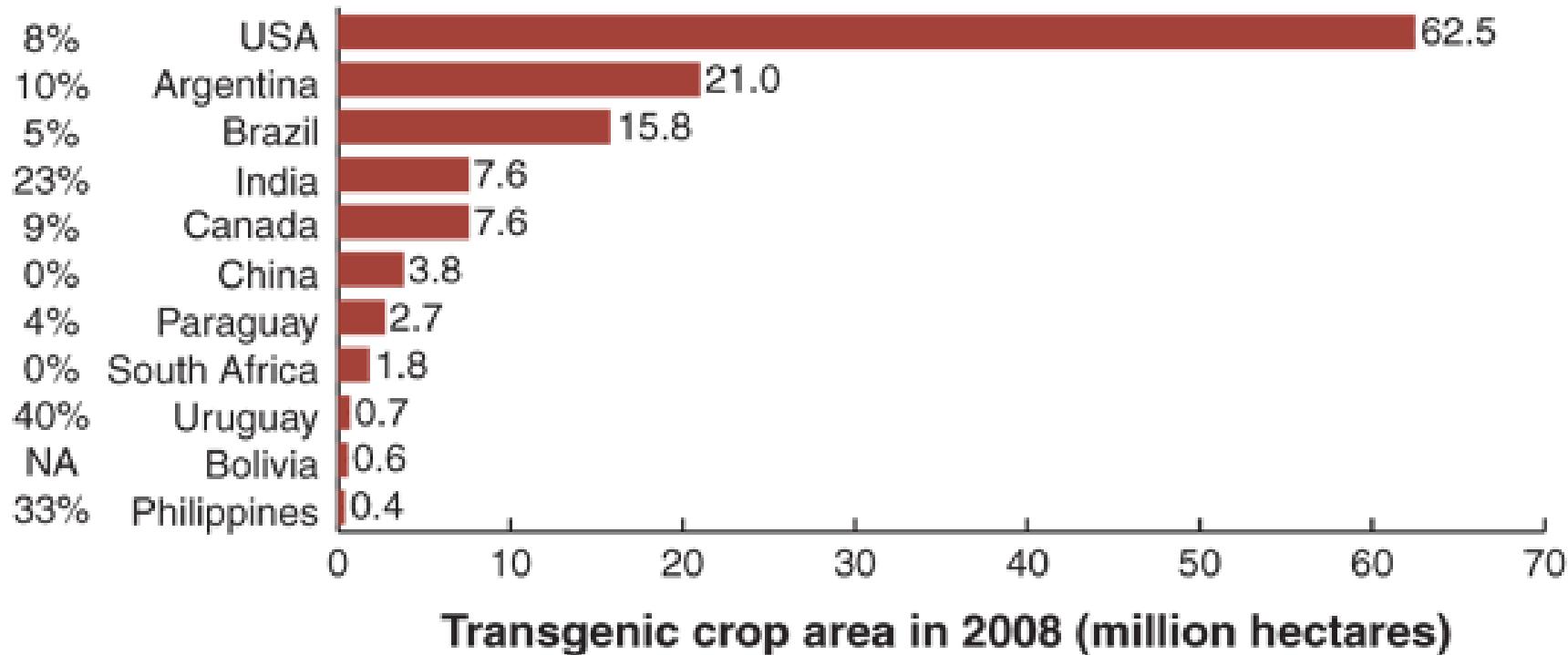
And http://www.monsanto.com.au/_images/global_area_chart.gif

The agricultural release of genetically modified plants is the largest scale experiment that has ever been performed.



GM crops by country...

Percentage change
since 2007

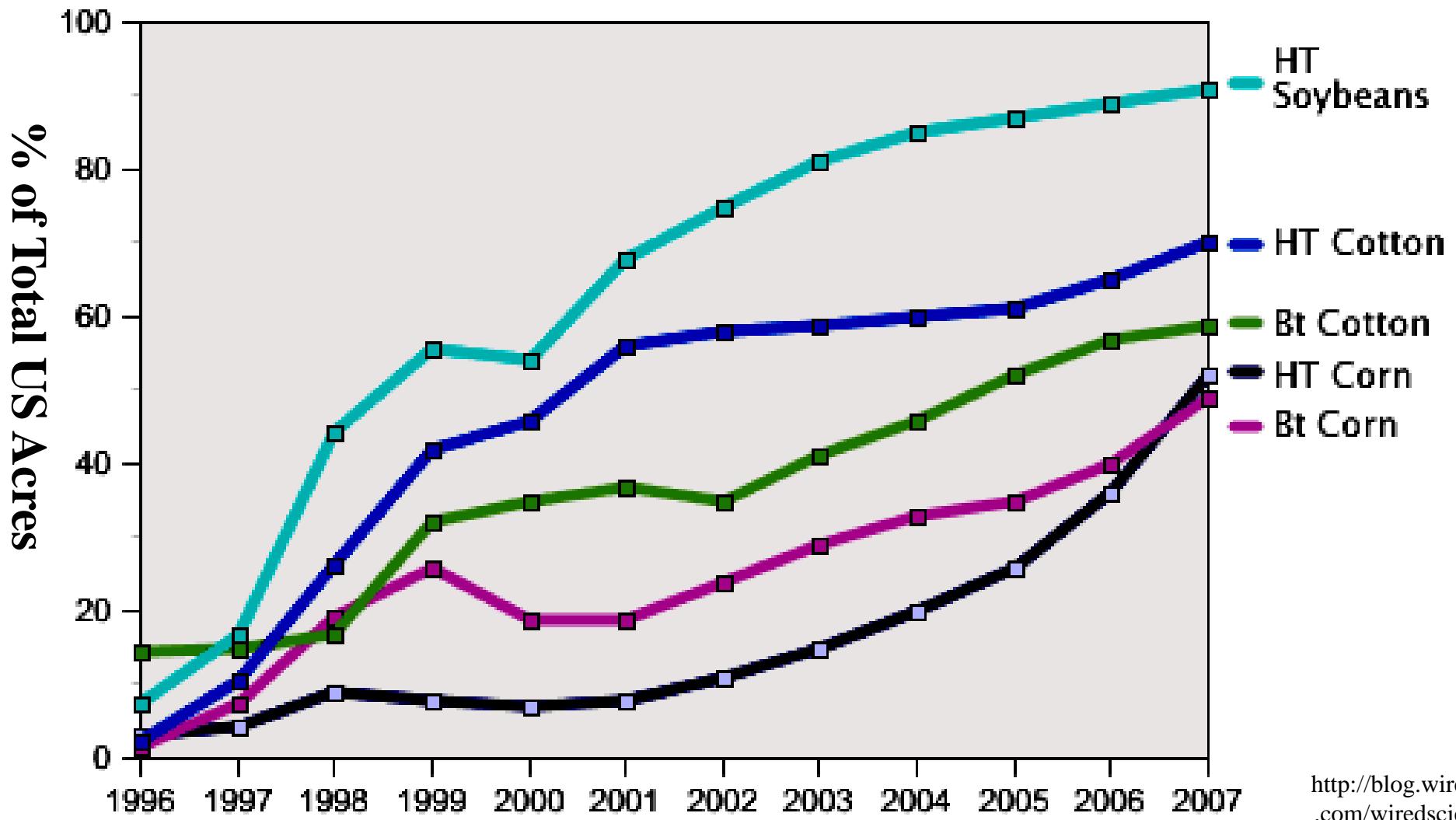


Source: International Service for the Acquisition of Agri-Biotech Applications

Why Change a Plant's DNA?

- Can change plant so that it has new or different characteristics
- Stress resistance (cold, drought, disease...)
- Insect resistance (Bt toxin)
- Herbicide resistance (Round-up)

Common GM Crops in the U.S.



Note: Data for each crop category include varieties with both HT and Bt (stacked) traits.

Source: 1996-1999 data are from Fernandez-Comejo and McBride (2002). Data for 2000-07 are available in the ERS data product, Adoption of Genetically Engineered Crops in the U.S., tables 1-3.

<http://blog.wired.com/wiredscience/2007/09/mon-santo-is-hap.html>

Why Change a Plant's DNA?

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Have GMO's been
beneficial, and what
are the risks?

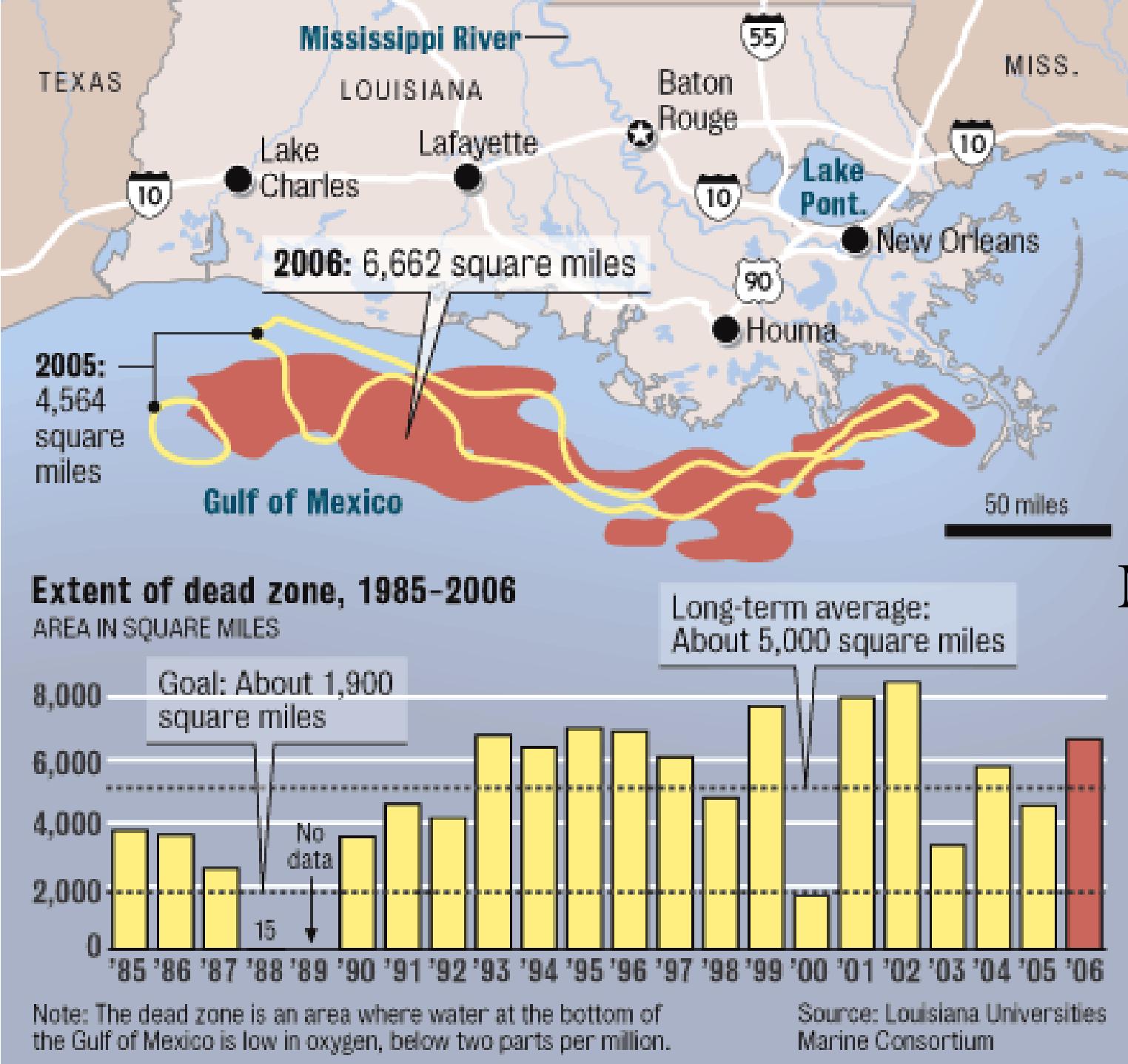
... It's complicated.



more precise application vs unintended release



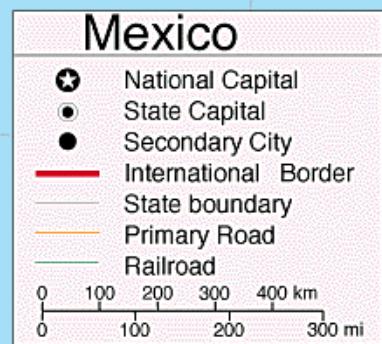
Human impacts: Dead zone in Gulf of Mexico from Mississippi River



Genetic information moves,
and is self-replicating.

GM crops found in Oaxaca and other MX states

GM crops illegal



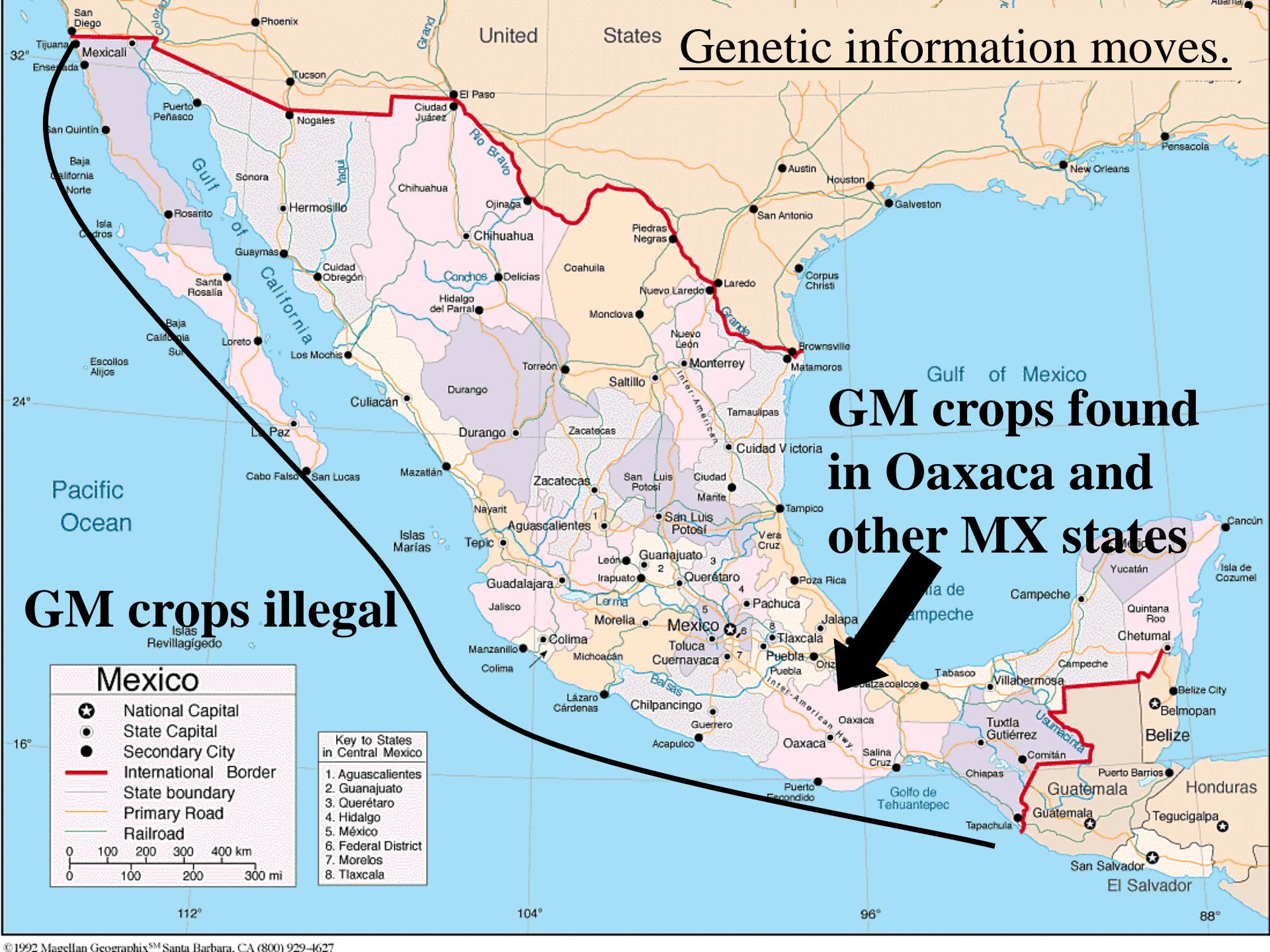
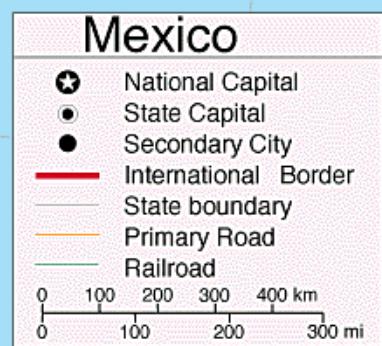
Pollen is easily transferred from plant to plant, and to related species.



Genetic information moves.

**GM crops found
in Oaxaca and
other MX states**

GM crops illegal

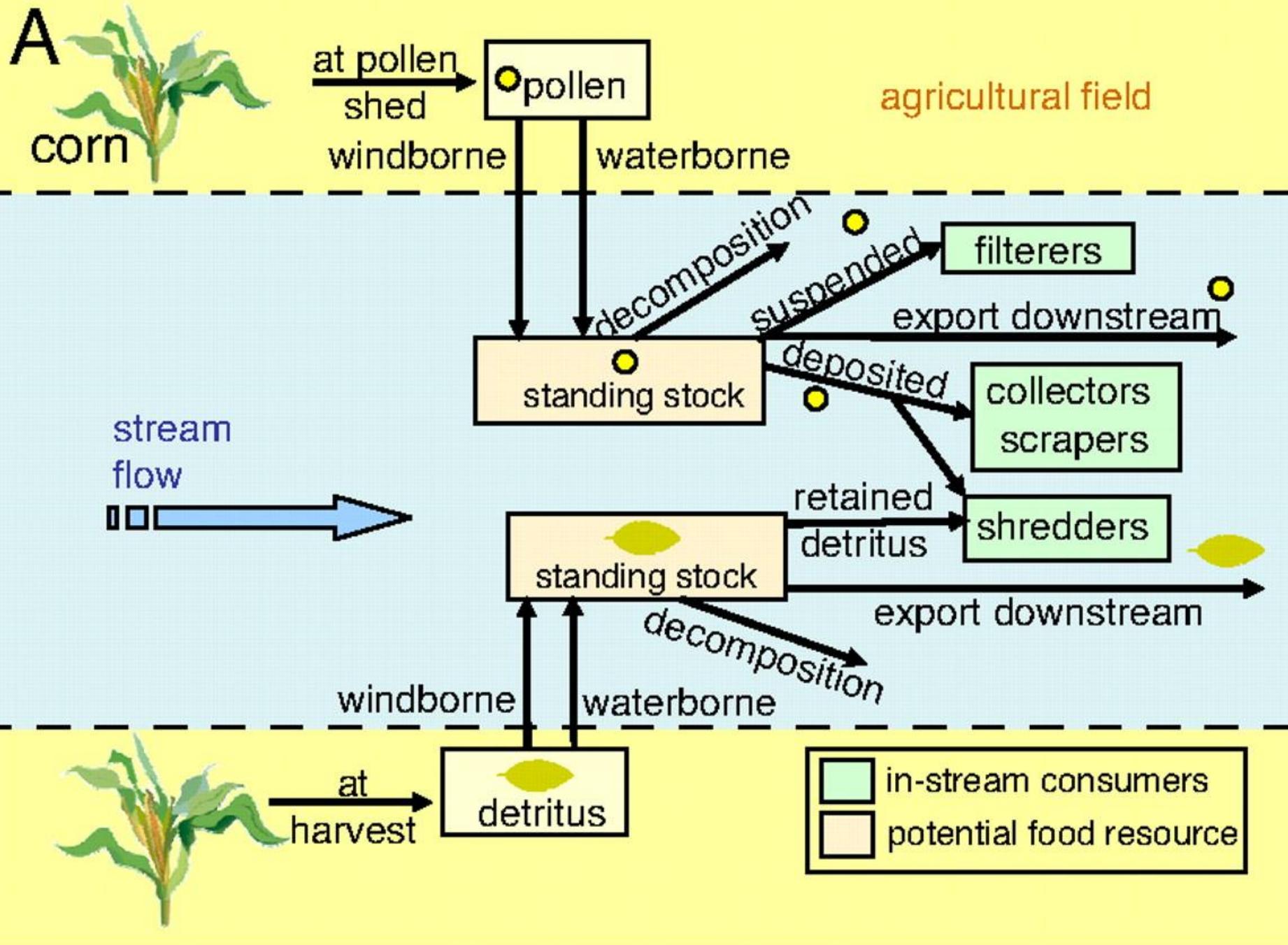


Toxins in transgenic crop byproducts may affect headwater stream ecosystems (2007)
E. J. Rosi-Marshall, J. L. Tank, T. V. Royer, M. R. Whiles, M. Evans-White, C. Chambers, N. A. Griffiths, J. Pokelsek, M. L. Stephen PNAS 104:16204-16208



Jennifer Tank (left) and Emma Rosi-Marshall study human-dominated ecosystems





B. corn growing near a stream and C. corn detritus in/near a stream



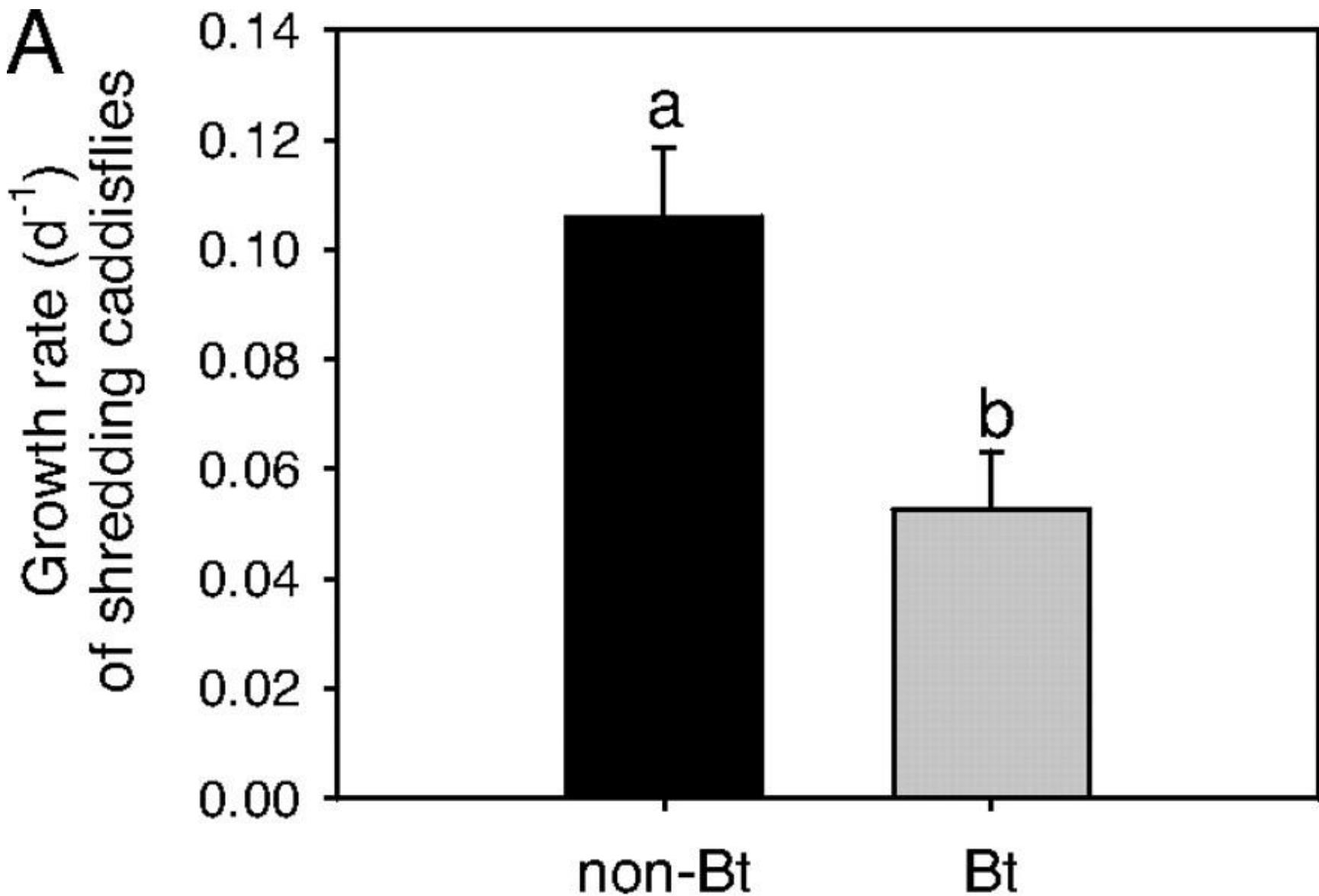


Fig. 3. Growth rates of the shredding caddisfly *L. liba* fed non-Bt and Bt corn leaves ($P = 0.008$, Student's t test)

Can you own an idea?



- Can you own an idea?
- Would you share your idea if others will profit from it?

- Can you own an idea?
- Would you share your idea if others will profit from it?
- Would you accept someone else taking credit for your idea(s)?

Patents give 20 year monopoly for inventor



Patentable inventions must be:

- Useful
- New or Novel
 - Non-obvious

The patent application must include sufficient information for someone “practiced in the art” to apply the patent.



Protection of intellectual property was guaranteed in the U.S. Constitution (1787).

The 1980 U.S. Supreme Court ruling (*Diamond v. Chakrabarty*) allowed patents for nonhuman life forms if there was human intervention in their creation.

Examples of current patents:

- Atryn- antithrombin produced in transgenic goats (in milk) has anti-clotting properties



Examples of current patents:

- Atryn- antithrombin produced in transgenic goats (in milk) has anti-clotting properties
- Evolutec has patents on proteins in tick saliva for use as anti-inflammatory



Examples of current patents:

- Atryn- antithrombin produced in transgenic goats (in milk) has anti-clotting properties
- Evolutec has patents on proteins in tick saliva for use as anti-inflammatory
- GTG in Australia has patents on non-coding human DNA for detecting risk of various diseases

Neem, say the women, helps babies sleep, keeps flies away, is a cosmetic, a disinfectant and a pesticide. Its leaves make good cattle fodder, its twigs are good for teeth and gums. It is used, they say, for snake bites, malaria, hysteria, high blood pressure, pain relief, skin diseases and a host of other ailments.

Over 70 U.S. patents for use
of Indian neem tree



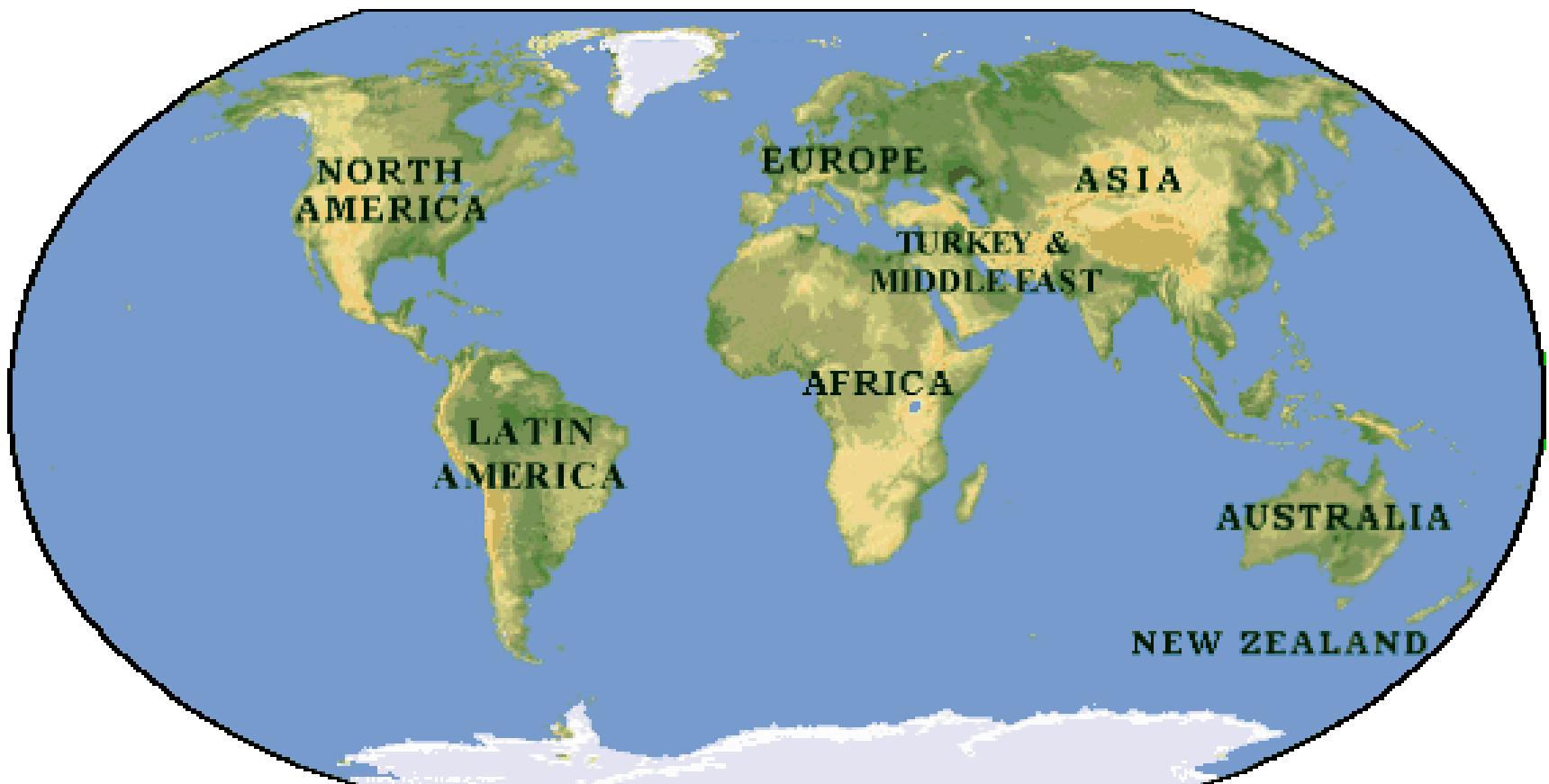
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Over 70 U.S. patents for use of Indian neem tree

One was rejected due to previous use in indigenous Indian culture



Concerns of developing nations vs. industrialized countries



Bioprospecting



Next... For Sale: smart, obedient, happy, tall,
healthy, studious, helpful, and quiet children
Act now and receive a glow in the dark plant

