History of Pesticide Use

Many pests plague humans:
- Rats, mice, cockroaches, termites, beetles, moths/caterpillars, ants, lice, fleas, mosquitoes, spiders, mites, ticks, pigeons, raccoons, coyotes, deer, woodchucks, beavers, nematodes, fungi, weeds etc...
- They compete for our food, eat our clothes, homes, impact our health, transmit disease, disturb our dominance over nature or simply annoy us.

History of Pest Control

Human ancestors had few problems

- Didn’t grow and store food, no permanent homes
- Pest control involved scratching, grooming, swatting and squashing
Relationship with pests changed 10,000 YA
- Advent of agriculture
- Increased human density
- Stocks of domestic animals
- Grain stores
- Clothing fibres

Pests in recorded history
- Locust swarms in Bible
  - Added to list of kosher animals
- Cave paintings in Tassili n’ Ajjer (Algeria) show crop infestations
- Egyptian papyrus documents also

Early Pest Management Practices
- Domain of witch doctors
- Religious ceremonies and superstition
- Limited success
- Greeks assigned Gods to the job
  - Apollo: domain over mice and mildew
  - Hercules: domain over locusts and worms
  - Zeus: “flycatcher”
**Christianity**

- Employed divinity in pest control up until 15th century
- Pests tried in religious court, found guilty, excommunicated and banished

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**Not all “Hoodoo Voodoo”**

- Early non-chemical pest control often based on actual ecological principles
  - E.g. Romans drained swamps, built sewage systems, built baths
  - E.g. Homer (800 BC) recognized usefulness of burning fields to control locusts

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**Geoponika**

- Greek agricultural encyclopedia
- Listed insecticides including:
  - Bay, asafetida, elder, cumin, hellebore, oak, squill, cedar, absinthe, pomegranate etc.
  - Modern chemists have since identified insecticidal chemicals from all of the above
Human Preference for Insecticides as Food

- Question of dosage
- Herbs and spices
- Alcoholic beverages
- History of the world
  - Route to the Orient

Early Chemical Pesticides

- Sumerians: elemental sulfur for insects and mites (2500 BC)
- Romans: added oil and used as insect repellent
- Chinese: arsenic and mercury against body lice
  - Earliest biological control using predatory ants against beetles and caterpillars in citrus orchards

Little progress for ~1700 years

- Ended with fall of Roman Empire (~476AD)
- Dark ages (475-1000AD)
- Middle ages (1000-1700AD), dominated by religion, not much critical thinking
- Resurgence in interest in pest control by 18th century
18th Century

- Agriculture went from subsistence to commercial (revolution)
- Use of manure and other fertilizers
- Expanded acreage
- Row planting
- Facilitated by use of machines

Mid 1800s

- Major pest problems in Europe
  - Potato blight in Ireland, England and Belgium
  - Powdery mildew on grapes
  - Fungus leaf disease on coffee in Ceylon (forced switch to tea crops)
  - French wine industry threatened by grape phylloxera insect
- Infestations caused by
  - 1) Vast area of single food source
  - 2) Imperial colonization and trade spread pests around

Concurrent Medical Discoveries

- Diseases were vectored by pests
  - 1st demonstrated case: Texas Cattle Fever caused by parasite, transmitted by flies
- Later discovered many more:
  - Tse tse flies and African Sleeping Sickness
  - Rat fleas and the plague
  - Mosquitoes and malaria
- This knowledge stimulated push for chemical pest control
Origin of Today's Chemical Pesticides

- Can be traced to accidental observation by French grape farmer
- Sprayed perimeter of vineyard to repel pests (humans)
  - Noticed these plants resisted powdery mildew
- Origin of Bordeaux Mixture (lime and copper sulfate) still widely used fungicide

First Phase of Chemical Pesticides

- French grape farmers started using copper aceto-arsenite against insects
- Led to use of many other inorganic compounds
  - Arsenic, antimony, selenium, sulfur, thallium, zinc, copper
- Full expansion of industry caused by development of spray nozzle and airplane distribution

Phase 2 of Chemical Pesticide Industry

- Chemical warfare
- Chlorine gas (Germany, 1915)
- WWI full expansion of chemical weapons via intense R&D
  - Goal of lowering soldier mortality due to pest vectored disease
  - WWI soldiers plagued by fleas, ticks, bedbugs
  - Another interest was in anti-personnel chemicals
  - Most insecticides neurotoxins and invert/vert nervous systems essentially the same
**World War II**

- Both Axis and Allies developed and tested hundreds of chemicals
- Major breakthrough for USA with discovery of chemical highly toxic at low doses
- Dichloro-diphenyl-trichloroethane (DDT)

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**Post-war period**

- Chemicals abundant and cheap
- Miracle cures to pest infestation
- Second agricultural revolution
- Emphasis switched from pest management to eradication

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**Resistance to Pesticides**

- Overuse of pesticides led to escalation due to resistance
  - 1948: 14 species
  - 1969: 224
  - 1990: >500 insects
- Also: diseases, weeds
Pollution Problems Seen in Wildlife

- Bioaccumulation and Bioamplification caused wildlife declines higher up the food chain
- 1950-1960s

Decline of Top Predators

- Bald Eagle, Peregrine Falcon
- Egg-shell thinning

Reintroduction Programs

- Captive bred and reintroduced to nature
- US and Canadian Wildlife service
- 1970-1990s
- Populations back to normal
Silent Spring: Rachel Carson (1962)

- Awakened world to slow poisoning by misuse of pesticides
- “Everyone should have the right to secure their own home against the intrusion of poisons applied by other persons”

- Linked humans to ecology
- Human body is permeable to toxins
- Died in 1964 but not before environmental movement was triggered
  - DDT banned in N.Am.
  - Earth day
  - Establishment of EPA
  - Post-humous Presidential Medal of Honour (1981)

- Not without opposition from people who hadn’t read it
- Globe-Times Newspaper (Pennsylvania): “No one in either county farm office who was talked to today had read the book, but all disapproved of it heartily”
Silent Spring: Rachel Carson (1962)

- Opposition came for 2 reasons:
  - 1) fear of decreases in profits for chemical industry, negatively affect economy
  - 2) differing views of role of science in society
    - An era of scientific backfiring (nuclear, thalidomide, DDT)
    - Double-edged sword: science can improve life and cause damage

However, the killing goes on...

- Agent Orange [2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T)]
- Used as a defoliant in Vietnam
- Released dioxins (carcinogen)
- Canadian govt secretely tested in Gagetown, NB in 1967
  - Sprayed on Ontario roads in 80s

Environmental Movement

- 1970s: nukes and whales
- 1980s: recycling paper
- 1990s: CFCs and habitat conservation
- 2000s: biodiversity, biotechnology and climate
- Market shift recently towards sustainably produced food products (organic)
  - Stimulated increase in IPM techniques
However, Pesticides Still Widely Used

- Data from USA, 1993
  - 1.1 Billion lbs pesticide used (4 lbs/citizen)
  - 4.5 Billion lbs used worldwide
    - 5.2B in 2008 (40% herbicides)
  - Pest industry worth $8.5 Billion annually
  - 860 active ingredients registered under Federal Pesticide Act
  - 26000 products manufactured by 1200 companies
  - Used on 900 000 farms and 69 Million homes

USE OF PESTICIDES

Global Pesticide Use 2001 (%)

- Herbicide
- Insecticide
- Fungicide
- Other

Next Class

- The cost and economics of pesticides