


History of pesticide use and regulation



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Outline:

- I. History & Definition of pesticides
- II. Pesticide Uses
- III. Pesticide Regulation
- IV. Biotechnology & Pesticides

“Nothing is made in vain, but the fly came near it.”
-Mark Twain

Ancient History of Pesticide Use



“Anting” by birds: use of formic acid secreted by ants as an miticide

Use of smoky fires or application of mud to repel biting insects by prehistoric man

Use of plant roots containing rotenone (Barbazo trees) by indigenous people in South America to capture fish

The Greek poet Homer cited the anti-pest utility of sulfur over 3000 years ago

Romans used salt to destroy the crops of their enemies

The Chinese were using arsenic as an insecticide by AD 900 (a practice that was widespread through most of the 20th Century).

Less Ancient Pesticide History

- 1690: Tobacco extracts were used as a contact insecticide
- 1858: Pyrethrum first used in the U.S.
- 1867: Paris Green employed as an insecticide
- 1939: DDT discovered to be insecticidal in Switzerland
- 1946: Organophosphate insecticides developed by Germans
- 1971: Glyphosate herbicide is introduced
- 1973: Cancellation of virtually all DDT uses in U.S.

What is a pesticide?

EPA definition: A pesticide is any substance or mixture of substances intended for preventing, destroying, repelling or mitigating any pest.

What is a pest?

Depends on your perspective. Essentially pests are organisms that are disadvantageous to mankind, whether it is related to health, economic, aesthetic or other issues.

What are examples of pesticides?

Insecticides	Herbicides	Fungicides
Lampricides	Miticides	Rodenticides
Growth Regulators	Algaecides	Repellents
Microbicides	Molluscicides	Nematicides
Attractants	Disinfectants	Fumigants

Pesticide Incidents & Controversies

1950s-1972: three episodes in Iraq where people consumed wheat seed grain treated with alkylmercury; locals used grain to make homemade bread; official victims = 6530, including 459 deaths.



1960-70s: Use of defoliants (i.e. Agent Orange) during U.S.-Vietnam War; contamination of 2,4,5-T herbicide with 2,3,7,8-TCDD (dioxin)



1960-70s: Link between DDT and other organochlorine insecticides and the thinning of egg-shells in raptors (Bald Eagle & ESA)

July 4, 1985: large outbreak of food-borne illness in Western states (especially CA & OR) linked to unregistered use of aldicarb (carbamate insecticide) on watermelons; over 600 illnesses



February 26, 1989: 60 minutes ran a story on the "risks" posed by Alar, an agent added to apples that allowed longer ripening prior to falling from trees; based on default risk assessment methods, a 50 in 106 was reported; this led to economic hardship for growers and a fair amount of public hysteria.



LBAM aerial spraying for control of moth pest in California; massive public outcry; alleged health complaints; legal maneuvering



Pesticide Use

Pesticides in Forestry

Federal and state forestry agencies use biological & chemical pesticides for:

- control of insect-borne disease
- control of invasive species
- vector/nuisance control



Comprehensive risk assessments focusing on: environmental fate, non-target effects, efficacy & human safety

According to the USFS, the amount of national forests treated with pesticides is 0.1% of total land. What would you want to know about this 0.1%?

Pesticides in Public Health

Several pests (think pestilence) harbor or transmit diseases of public health significance. Most vector control programs focus on mosquito abatement or rodent control.

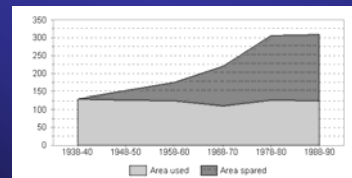


In 1999, NYC experienced an outbreak of encephalitis, carried by mosquitoes, involving 59 cases of neuroinvasive disease. Between 1999-2006, 145 cases have been reported, including 20 deaths. In response, NYC began larval and adult control measures that involved spraying malathion over densely populated neighborhoods, such as Brooklyn.

A conspiracy website asks: "Is New York City truly the beginning of a larger bio-warfare, or population control experiment?" Or, could responsible public health officials want to minimize the incidence of debilitating neurological disease?

Pesticides in Agriculture

Approximately 1/3 of the world's crops are destroyed by pests during growth, harvest & storage. The carrying capacity of a farmer in the U.S. in 1950 was 20 persons/farm worker; increased to 120 persons/farm worker in 2000.



U.S. total crop area spared by application of improved technology on 17 food, feed, and fiber crops in period 1938-40 to 1988-90 (Borlaug and Dowswell 1996).

Pesticides in the Urban Environment



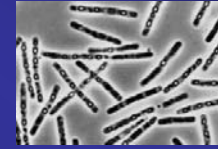
Biopesticides: the future?

Microbial pesticides

- bacteria, fungi, viruses or protozoa

Biochemicals

- natural substances that control pests by non-toxic mechanisms (ex. insect pheromones, IGR)



Plant-incorporated protectants

- primarily transgenic (Bt)
- first used in cotton
- endotoxin that binds to insect receptors in midgut

Regulation of Pesticides □

Historic Regulation of Pesticides

1906: The Federal Food, Drug & Cosmetic Act (a.k.a. the Pure Food Law) required that food shipped in interstate commerce be pure and wholesome.



1910: first federal pesticide regulation - Federal Insecticide Act (designed mainly to protect farmers from fraudulent products)

1947: Congress passed the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) under the authority of the USDA

1958: an amendment to the FFDCFA included the Delaney clause - any chemical found to cause cancer in humans OR animals may not appear in foods consumed by people.

1996: Congress passed the Food Quality Protection Act with mandates for consideration of aggregate risk and protection for vulnerable populations (and exclusion of Delaney clause).

Environmental Protection Agency

In 1970, Congress transferred the administration of FIFRA from the USDA to the newly created EPA. This began a shift in focus from the control of pesticides for reasonably safe use to the reduction of unreasonable risks to man and the environment.



EPA interprets the law through regulations and guidance documents. This includes developing standards for certification by commercial applicators, registration of products, labeling issues, protection of confidential business information and more.

FIFRA basics:

- Use of any pesticide inconsistent with the label is prohibited
- Pesticides will be classified into general or restricted use (RU)
- Anyone applying RU pesticides must be certified by the state
- Manufacturers must be registered and inspected by EPA
- All pesticides must be registered by the EPA and states may register on a limited basis for local needs or emergencies

To register a product, the manufacturer must provide scientific evidence that the product will:

- effectively control the pests on the label
- not result in unreasonable risk to humans, crops, livestock, wildlife and the environment
- not result in illegal residues in food or feed

Toxicity Testing:

The registration of pesticides must undergo a battery of animal and environmental tests. In contrast, the vast majority of chemicals that are manufactured and used in this country have not been tested.



- Acute and 90 day oral, dermal & inhalation tests
- Acute eye irritation and skin sensitization tests
- Reproductive/developmental testing
- Carcinogenicity, gene mutation, chromosomal aberration
- Pharmacokinetics: ADME
- Immunotoxicity and nerve function

Worker Protection & Safety

Occupational exposure to pesticides is coordinated between EPA and OSHA. In 1992, the Worker Protection Standard became a regulation (estimated 3.9 million workers on U.S. farms, ranches, forestry, nurseries, greenhouses, etc).

New pesticide labels specifying restricted entry intervals, notifications when applications are occurring, training requirements for workers and supervisors, and minimum personal protective equipment.



Regulations beyond FIFRA

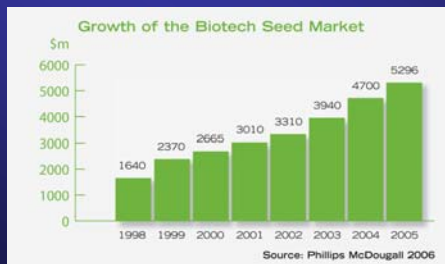
- Clean Air Act
- Clean Water Act
- Coastal Zone Management Act
- CERCLA (Superfund) & Amendments
- Endangered Species Act
- Food, Drug & Cosmetics Act
- Hazardous Materials Transportation Law
- Food Quality Protection Act
- National Standards on Organic Production
- Occupational Safety & Health Act
- Resource Conservation & Recovery Act
- Safe Drinking Water Act
- Toxic Substances Control Act



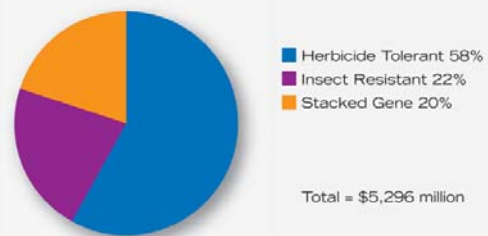
Biotechnology & Pesticides □

Biotechnology & Pesticides

In 1995, EPA registered the first plant pesticide, Monsanto's Bt-cotton containing Bt CryIAc delta-endotoxin; marketed as Bollgard® cotton, it was effective against lepidopteran pests, especially tobacco budworm & bollworms. Since 1995, numerous herbicide-tolerant crops were introduced in the U.S., especially those containing glyphosate (Roundup® Ready)



Biotech Seed Market by Trait



Source: Phillips McDougall 2006

Round-Up Ready® Crops:

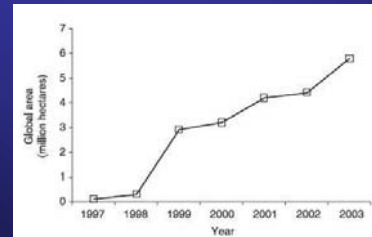
Round-Up® is an highly used herbicide. The a.i., glyphosate, works by inhibiting amino acid synthesis unique to plants.



Engineered plants are designed to tolerate very high amount of glyphosate, while the standard crop (or weed) is not. Spraying can be done from emergence of weeds through flowering.

Stacked Genes

One or more transgenes have been inserted into the same crop for the purpose of multiple characteristics - typically different mode of action to counter resistance or increase efficacy.



Regulating transgenic pesticides:

An-ongoing process! Three federal agencies (USDA, EPA & FDA) coordinate the regulation of transgenic crops & pesticides based on the Office of Science and Technology Policies 1986 FRN. Evaluation of risks posed by biotechnology is based on a case-by-case basis.

Considerable reliance on comparisons between transgenic products & their natural counterparts.

FDA Regulation:

FDA authority is the Federal Food, Drug & Cosmetic Act. FFDCa prohibits the adulteration or misbranding of food. Makes GRAS decisions. Early consultation with FDA is encouraged.

USDA-APHIS Regulation:

Plant Protection and Quarantine section is the chief regulatory entity of APHIS regarding GMOs. APHIS must approve any cross-border release of GMOs. APHIS reviews permits for growing transgenic organisms to test safety and performance.

EPA Regulation:

Under FIFRA, EPA regulates transgenic plants/microorganisms that are engineered to produce pesticides (called Plant Incorporated Protectants). EPA evaluates the environmental risks posed by PIPs, reviews resistance management plants, determines likelihood of an inserted gene to produce a new/unusual toxin, establishes tolerance levels for residues and evaluates mode of action/biochemical makeup of PIP.

Focus Questions:

What are general issues specific to pesticides that differ from other environmental contaminants?

How should GMOs in pesticides or agriculture be assessed? What questions should we be asking?

Is our regulatory infrastructure adequate? Too much? Not enough? What specifically should change?