

APES Ch. 16 Notes: Pests and Pest Control

16.1 Notes

I. The Need for Pest Control

A. Defining **pest**

- 1) various definitions
 - a) an organism that is *noxious, destructive, or tiresome*
 - b) an annoying thing; a nuisance
 - c) a pestilence
 - d) any organism detrimental to humans
 - e) an *injurious plant or animal*, especially one harmful to humans
- 2) categories
 - a) **agricultural pests** (*plant pests*)—*organisms which feed on crops or ornamental plants*
 - *vertebrate pests* such as **scale insects** which extract plant liquids
 - *weed pests*: annual grasses, perennial grasses, annual broadleaf, perennial broadleaf (**weeds** compete with other plants for resources)
 - *invertebrate or insect/arthropod pests*: aphid, beetle, weevil, wireworm, cutworm, armyworm, moth, caterpillar, white fly, mealy bug, whitehopper, grasshopper, cricket, mite, maggot, thrip
 - *microbial pests or pathogens*: nematode, fungi, viruses
 - b) *arachnids*: spiders, ticks, flour/grain/cheese mites
 - c) *crustaceans*: woodlice / pill bugs, flour / grain / cheese mites
 - d) *pathogens*: bacteria, viruses, fungi
 - e) *rodents*: house mouse, common rat, black rat
 - f) insect pest examples

Hide Beetle
Cluster Fly
American Cockroach
Angoumois Grain Moth
Black Ant
Australian Cockroach
Australian Spider Beetle
Biscuit / Drugstore Beetle
Bluebottle
Booklouse
Brown House Moth
Brown Tail Moth
Bed Bug
Carpenter Ant
Tropical Warehouse Moth
Common Clothes Moth
Common Cricket
Dermestid Beetle
Earwig

Warehouse / Cocoa /
Tobacco Moth Filter Fly
Human Flea
Cat Flea
Dog Flea
Tropical Rat Flea
Bird Flea
Flour Beetle
Fruit Fly
German Cockroach
Horse Fly
Common House Fly
Lesser House Fly
Indian Meal Moth
Mill Moth
Mosquito
Oriental Cockroach
Pharaoh Ant
Sawtooth Grain Beetle
Silverfish

Small Ermine Moth
Brown Banded Cockroach
Mealworm Beetle
Termite
Tobacco / Cigarette Beetle
Wasp
White Shouldered House
Moth Woodworm /
Furniture Beetle Smoky
Brown Cockroach
Carpet Beetle
Grain Weevil
Rice Weevil
Rust Red Grain Beetle
Khapra Beetle
Dried Bean Beetle
Lesser Grain Borer
Larger Grain Borer

B. Importance of pest control

- 1) general types
 - a) **herbicide**—chemical that kills *weeds*
 - b) **insecticide**—chemical that kills *insect pests*

- c) **pesticide**—chemical that kills *pests in general (insects/animals)*
 - d) **fungicide**—chemical that kills *pathogens*
 - e) **rodenticide**—chemical that kills *rodents*
 - 2) two parts to these chemicals
 - a) *active ingredients*—chemicals that kill the targeted pests
 - b) *formulants*—chemicals acting as emulsifiers, dilutants, or solvents (sometimes more dangerous than the active ingredients)
 - 3) other characteristics
 - a) **broad spectrum**—effective against a *wide variety* of pests
 - b) **persistence**—the ability of a chemical to last; to not break down
- C. Different philosophies of pest control
- 1) **chemical treatment**—*use of various chemicals to eliminate or reduce pest presence and effects*
 - a) short-term
 - b) risk of environmental damage
 - c) risk of damage to beneficial organisms
 - 2) **ecological control**—*protection from damage, not pest elimination*
 - 3) **IPM—Integrated Pest Management** (see 16.4 notes)
 - a) *combination of chemical and ecological approaches*
 - b) uses sustainable methods
 - c) long-term solutions
 - d) minimal environmental impact

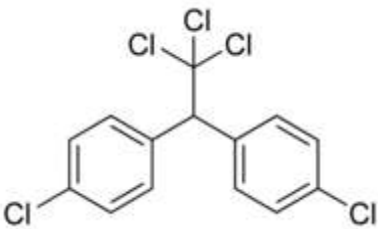
"A weed is a plant whose virtues have not yet been discovered." - Ralph Waldo Emerson

16.2 Notes

II. Promises and Problems of the Chemical Approach

A. development of chemical pesticides and their successes

- 1) **first-generation pesticides**
 - a) (1400s +) *chemical*: contained *Hg, As, Pb*
 - b) (1800s +) *botanical*: contained *natural plant extracts* such as nicotine (from tobacco leaves), pyrethrum (from chrysanthemum flowers) and rotenone (from the root of the derris plant)
 - c) pests built up *resistance*
- 2) **second-generation pesticides**
 - a) over 1600 different chemicals
 - b) famous example: *DDT*
 - $C_{14}H_9Cl_5$
 - dichloro-diphenyl trichloroethane [1,1,1-trichloro-2,2-bis-(p-chlorophenyl) ethane]
 - first prepared in 1873; rediscovered in 1938 by Paul Muller (he subsequently awarded the Nobel Prize for it in 1948!)
 - *water insoluble, lipid soluble (can't wash it away), so it stays in the environment and in organisms*
 - it is a **broad spectrum** and **persistent PCB**
 - *accumulation*—the buildup of DDT in the body; continues until saturation is reached



from <http://www.chem.ox.ac.uk>

“The use of DDT increased enormously on a worldwide basis after World War II, primarily because of its effectiveness against the mosquito that spreads malaria and lice that carry typhus. The World Health Organization estimates that during the period of its use approximately 25 million lives were saved. DDT seemed to be the ideal insecticide—it is cheap and of relatively low toxicity to mammals... However, *problems related to extensive use of DDT began to appear in the late 1940s*. Many species of insects developed resistance to DDT, and DDT was also discovered to have a high toxicity toward fish.

The chemical stability of DDT and its fat solubility compounded the problem. DDT is not metabolized very rapidly by animals; instead, it is deposited and stored in the fatty tissues. *The biological half-life of DDT is about eight years; that is, it takes about eight years for an animal to metabolize half of the amount it assimilates. If ingestion continues at a steady rate, DDT builds up within the animal over time...*

The use of DDT was banned in the United States in 1973, although it is still in use in some other parts of the world. The buildup of DDT in natural waters is a reversible process: the EPA reported a 90% reduction of DDT in Lake Michigan fish by 1978 as a result of the ban.”

additional info from <http://www.usda.gov>

- 3) focusing on crops
 - a) *field crops*: corn, cotton, soybeans, wheat, potatoes, sorghum, peanuts, rice
 - b) other crops: fruit, non-potato vegetables
 - c) categories of **herbicides** (with examples) *widely used for corn, soybeans, and other crops*
from http://www.alanwood.net/pesticides/summ_herbicides.html

amide antibiotic aromatic acid arsenical benzothiazole benzoylcyclohexanedione benzofuranyl alkylsulfonate carbamate carbanilate cyclohexene oxime cyclopropylisoxazole dicarboximide dinitroaniline
--

dinitrophenol diphenyl ether dithiocarbamate halogenated aliphatic imidazolinone inorganic nitrile organophosphorus oxadiazolone phenoxy phenylenediamine pyrazole pyridazine pyridazinone pyridine
--

pyrimidinediamine quaternary ammonium thiocarbamate thiocarbonate thiourea triazine triazinone triazole triazolone triazolopyrimidine uracil urea unclassified
--

- d) categories of **insecticides** *widely used for cotton and other crops*
from http://www.alanwood.net/pesticides/summ_insecticides.html

antibiotic arsenical botanical carbamate desiccant diamide
--

dinitrophenol fluorine formamidine fumigant inorganic insect growth regulators

neristoxin analogue nicotinoid organochlorine (“chlorinated hydrocarbons”) organophosphorus
--

(including
organophosphates)
 phthalimide
 pyrazole
pyrethroid

pyrimidinamine
 pyrrole
 tetramic acid
 tetrionic acid

thiazole
 thiazolidine
 thiourea
 urea
 unclassified

e) categories of **fungicides** widely used for potatoes and other crops
 from http://www.alanwood.net/pesticides/summ_fungicides.html

aliphatic nitrogen
 amide
 antibiotic
 aromatic
 aryl phenyl ketone
 benzimidazole
 benzimidazole
 precursor
 benzothiazole
 bridged diphenyl
 carbamate
 conazole
 copper
 dicarboximide

dinitrophenol
 dithiocarbamate
 imidazole
 inorganic
 mercury
 morpholine
 organophosphorus
 organotin
 oxathiin
 oxazole polysulfide
 pyrazole
 pyridine
 pyrimidine
 pyrrole

quinoline
 quinone
 quinoxaline
 thiazole
 thiazolidine
 thiocarbamate
 thiophene
 triazine
 triazole
 triazolopyrimidine
 urea
 unclassified

B. problems from chemical pesticide use

- 1) development of *pest resistance*
 - a) pesticides are made more potent
 - b) *the most resilient individuals survive and reproduce*
 - c) the pest population becomes more resistant
 - d) *individuals may develop resistance to related chemicals even if they are not directly exposed to them*
 - e) pesticides are made more potent again—the cycle continues...
- 2) resurgences and secondary pest outbreaks: the “**pesticide treadmill**”
 - a) **resurgence**—*a population exploding after being nearly wiped out*
 - b) **secondary pest outbreak**—*small populations of other organisms explode as well, creating new threats*
- 3) examples of *human health effects* of pesticide external exposure or ingestion

lymphoma, breast cancer
 dermatitis
 neurological disorders
 birth defects
 male sterility (banned)
 possible estrogen-like effects
 headaches
 dizziness
 nausea

vomiting
 mild irritations of skin
 /nose
 loss of appetite
 respiratory inflammations
 organ dysfunction
 diarrhea
 swelling
 nervousness
 hallucinations
 convulsions

blue or yellow skin color
 tremors
 shock
 sweating
 excessive thirst
 skin rashes
 lack of coordination
 excessive salivation
 eye irritant

4) *SUMMARY OF DISADVANTAGES OF PESTICIDE USE*
from <http://www.greenventure.ca/>

- “threatens human health through direct exposure, and exposure to pesticide residues in food and water
- creates insects and weeds that are genetically resistant to pesticides, leading to more spraying and more toxic formulations (pesticide treadmill)
- destroys beneficial organisms, such as earthworms and bees
- harms wildlife, producing hormonal and genetic defects
- contaminates groundwater, including drinking wells, streams and lakes
- some pesticides accumulate and become amplified in the food chain (POPs :persistent organic pollutants)
- economic costs: homeowners spend an average of \$300 per year on pesticide products or services

5) examples of *environmental effects of pesticides*
additional info from <http://extoxnet.orst.edu/tibs/ecologic.htm>

- “decline of forests, due to air pollution and acid deposition
- loss of fish production in a stream, due to death of invertebrates from copper pollution
- loss of timber growth, due to nutrient losses caused by mercury poisoning of microbes and soil insects
- decline and shift in age of eagle and hawk (and other top predator) populations, due to the effects of DDT in their food supply on egg survival
- losses of numbers of species (diversity)
- loss of commercially valuable salmon & endangered species from forest applications of DDT”
- water contamination
- cancer in animals
- death of pollinating insects and other beneficial insects
- thinning of egg shells, decreasing healthy hatching rate (DDE, a product of the partial breakdown of DDT, causes this)
- **bioaccumulation**—increase in concentration of a pollutant from the environment to the first organism in a food chain
- **biomagnification**—increase in concentration from one link in a food chain to another pollutant must be long-lived, mobile, soluble in fats, and biologically active

C. *Silent Spring* by Rachel Carson (1907-1964)
from <http://www.nrdc.org/health/pesticides/hcarson.asp> by Rachel Carson 1962

“*Silent Spring*... meticulously described how DDT entered the food chain and accumulated in the fatty tissues of animals, including human beings, and caused cancer and genetic damage. A single application on a crop, [Carson] wrote, killed insects for weeks and months, and not only the targeted insects but countless more, and remained toxic in the environment even after it was diluted by rainwater. Carson concluded that DDT and other pesticides had irrevocably harmed birds and animals and had contaminated the entire world food supply.”

- D. *nonpersistent pesticides*
- 1) they break down into nontoxic components
 - 2) pesticide impact is a function of persistence, toxicity, dosage, and application location
 - 3) all insects can be affected, beneficial as well as pests

- 4) **resurgence** and **secondary pest outbreaks** are still possible

A SUMMARY OF PEST CONTROL METHODS:
<ul style="list-style-type: none">• Chemical control: mortality (<i>toxicants</i>), disrupt developmental processes (<i>growth regulators</i>), prevent reproduction (sterilants), or modify insect behavior (<i>semiochemicals</i>)• Cultural (ecological) control – non-chemical control• Natural / Biological control – use of living pest controls• <i>Legal control</i> – legislation, border quarantines, licensing or certification programs• <i>Physical / Mechanical control</i>• Genetic (such as Eugenic) control• IPM – Integrated Pest Management

16.3 Notes

III. Alternative Pest Control Methods

A. background info: **natural control / biological control**

- *the use of living organisms (parasites, predators, and pathogens) as pest control agents*
- *considers the relationship of the pest to other organisms and to the ecosystem*
 - 1) *importation*, such as obtaining pests' exotic natural enemies
 - 2) *conservation*, such as decreasing use of pesticides which kill pests' natural enemies
 - 3) *augmentation*, such as raising and periodically releasing natural enemies which don't do well in that environment on their own
 - 4) **IPM** substances used (from <http://edis.ifas.ufl.edu/IN197>)
 - a) *botanical insecticides*
 - limonene and linalool (from citrus extracts)
 - neem (from the Indian neem tree)
 - nicotine (from tobacco)
 - pyrethrum / pyrethrins (from African daisies)
 - rotenone (from tropical legumes)
 - ryania (from a specific South American plant)
 - sabadilla (from ripe tropical lilly seeds)
 - b) *soaps and oils*
 - horticultural oils (examples: vegetable)
 - insecticidal soap (from plant oils or animal fat)
 - c) *mineral insecticides*
 - diatomaceous earth (fossilized diatom shells; a desiccant)
 - sulfur
 - d) *water spray* (to drown aphids, mites, and some caterpillars)

B. **cultural control** (also called *ecological control*)—*non-chemical ways of rendering the environment undesirable or inaccessible to pests* (purposeful manipulation of the pest's environment)

- 1) affecting humans
 - a) *proper disposal of sewage wastes*
 - b) *avoid contaminated drinking water*
 - c) *sanitation*
 - *personal hygiene* keeping the body and living space clean

- sanitation of *food preparation and handling* facilities

2) affecting lawns, gardens, and crops

CROPS...

a) *crop rotation*

- increases the diversity of the environment
- creates discontinuity in pests' food supply
- avoids monoculture

b) *intercropping (mixed cropping)*

- lowers the overall attractiveness of the environment to pests
- concentrates the pest in a smaller, more manageable area

c) *phenological asynchrony*—altering time of year for planting / harvesting

- creates discontinuity in the pest's food supply

d) *managed application of water or fertilizer*

- irrigation

e) *sanitation of planting area*

- removal of debris such as fallen fruit or branches
- pruning

f) *plowing and/or burning of plant residue* to kill spores

g) actions of the U.S. Customs Bureau and State Depts. of Agriculture

LAWNS...

h) letting *grass* grow to at least *3-inch height*

i) *increase diversity of wildflowers*

j) elimination of pest host organisms

k) elimination of plants that attract pests

l) *encourage pest predators* by giving them refuge such as shelterbelts and hedges

m) *use plants acting as natural insect repellents* www.ci.carlsbad.ca.us

<u>Pest</u>	<u>Plant Repellent</u>
Ants	Mint, Tansy, Pennyroyal
Aphids	Mint, Garlic, Chive, Coriander, Anise
Bean Leaf Beetle	Potato, Onion, Turnip
Codling Moth	Common Oleander
Colorado Potato Beetle	Green Bean, Coriander, Nasturtium
Cowpea Curculio	Garlic, Clove, Radish
Cucumber Beetle	Radish, Tansy
Flea Beetle	Garlic, Onion, Mint
Harlequin Bug	Radish, Turnip, Onion
Imported Cabbage Worm	Mint, Sage, Rosemary, Hyssop
Japanese Beetle	Garlic, Larkspur, Tansy, Rue, Geranium
Leaf Hopper	Geranium, Petunia
Mexican Bean Beetle	Potato, Onion, Garlic, Radish, Petunia, Marigold
Mice	Onion
Root Knot Nematodes	French Marigold
Slugs	Prostrate Rosemary, Wormwood
Spider Mites	Onion, Garlic, Clove, Chive
Squash Bug	Radish, Marigold, Tansy, Nasturtium
Squash Vine Borer	Clove, Onion, Garlic
Stink Bug	Radish
Tarnished Plant Bug	Garlic, Pepper

Thrips (thunderflies, thunderbugs, storm flies, corn lice) Tomato Heartworm	Marigold Marigold, Sage, Borage
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C. control by natural enemies

from <http://www.anbp.org/beneficialinsectprofiles.htm>

1) general examples

ladybug (ladybird beetle)
scale insects
parasitic wasps
some caterpillars, mealybugs
“Bt” *Bacillus thuringiensis*
Japanese beetle

viral agents
rabbit population in Australia
Brazilian weevil
water hyacinth
“Green Muscle” (fungal spores in oil)
desert locust

2) more examples of *predators of pests*

<u>Predator</u>	<u>Pest</u>
green lacewing	small insects and mites; aphids
<i>Orius</i> - minute priate bug	mites and small insects
<i>Geocorus</i> – bigeyed bug	insects and mites
<i>Persimilis</i> – predatory mite	spidermites (esp. in strawberry fields and greenhouses; warm humid conditions)
<i>Neoseiulus californicus</i> – predatory mite	mites (tolerates hot and dry conditions)
<i>Helveolus</i> – predatory mite	Persea mite
<i>Amblyseius occidentalis</i> – predatory mite	various (on strawberry and mint plants)
<i>Mesoseiulus longipes</i> – predatory mite	various (warm and dry environments)
<i>Amblyseius cucumeris</i>	thrips (greenhouses)
<i>Hypoaspis</i> – soil mite	fungus gnats (greenhouses)

3) more examples of *parasites of pests*

<u>Parasite</u>	<u>Pest</u>
<i>Aphioletes</i>	some aphids
<i>Goniozous</i>	pink bollworm
<i>Mucidifurax</i>	some flies
<i>Aphytis</i>	California Red Scale
<i>Tricogramma</i>	many types of moth eggs
<i>Encarsia</i>	immature whitefly

4) challenges

- a) pests’ natural enemies could attack unrelated desirable species
- b) pests’ natural enemies could attack related but unthreatening species
- c) natural enemies are not always available (some are accidentally imported)
- d) conservation of natural enemies

D. genetic control

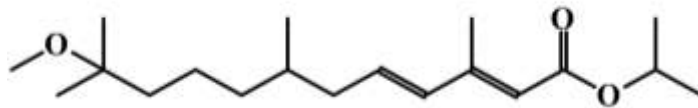
1) control with *chemical barriers*

- a) *plants produce the toxins themselves*
- b) the pests many become more resistant over time, but there is still reduction in damage

- c) decreases the need for pesticides
- 2) control with *physical barriers*
 - a) leafy hairs
 - b) sticky leafy secretions
- 3) control with sterile males: *eugenic control*
 - a) causing (inducing) reproductive sterility
 - b) ideal criteria for use
 - easy to mass-produce
 - females mate only once
 - males can be sterilized without loss of competitive vigor
 - low initial population
 - restricted geographic range
- 4) strategies using biotechnology
 - a) *autocidal control*—incorporating new and potentially deleterious genes or alleles into the genetic makeup of a pest population
 - b) *plant-incorporated protectants (PIPs)*
 - c) *genetically modified microbial pesticides*
 - d) *herbicide-tolerant crops*
 - e) *use of a powerful protein from “Bt” Bacillus thuringiensis*
- 5) challenges
 - a) impractical for developing countries
 - b) “superweeds” with very high resistance
 - c) increasing resistance of insects to Bt insecticide
 - d) needing to develop different varieties of crops to circumvent the resistance problem

E. **natural chemical control**—use of *insect hormones and/or pheromones* to disrupt the target organism’s life cycle

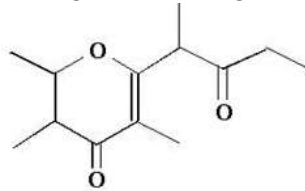
- 1) advantages
 - a) nontoxic
 - b) species-specific
- 2) examples
 - a) use of **juvenile hormone (JH)** to prevent pupation
example: methoprene



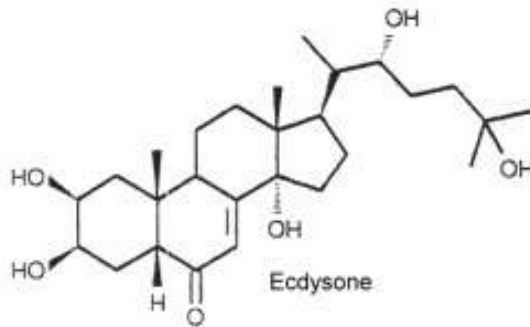
<i>Juvenile hormone 0</i>	
CAS methyl (2E,6E)-10R,11S-(oxiranyl)-3,7-diethyl-11-methyl-2,6-tridecadienoate	Formula: C ₁₉ H ₃₂ O ₃
<i>Juvenile hormone I</i>	
CAS methyl (2E,6E)-10R,11S-(oxiranyl)-7-ethyl-3,11-dimethyl-2,6-tridecadienoate	Formula: C ₁₈ H ₃₀ O ₃
<i>Juvenile hormone II</i>	
CAS methyl (2E,6E)-10R,11S-(oxiranyl)-3,7,11-trimethyl-2,6-tridecadienoate	

Formula: C ₁₇ H ₂₈ O ₃
<i>Juvenile hormone III</i>
CAS methyl (2E,6E)-10R-(oxiranyl)-3,7,11-trimethyl-2,6-dodecadienoate Formula: C ₁₆ H ₂₆ O ₃
<i>Juvenile hormone JHB3</i>
CAS methyl (2E,6E)-6S,7S,10R-(dioxiranyl)-3,7,11-trimethyl-2,6-dodecadienoate Formula: C ₁₆ H ₂₆ O ₄

- b) *prothoracicotropic hormone (PTTH)* used to prevent molting
- c) *pheromones*
- chemicals emitted by living organisms to send messages to individuals of the same species
 - used for confusion or luring into traps
 - example: stegobinone, drugstore beetle sex pheromone:



- d) **ecdysone**—a steroid which causes incomplete molting



16.4 Notes

IV. Socioeconomic Issues in Pest Management

A. Pressures to use pesticides

- chemical treatment is readily available and fast (“quick fix”)
- economic threshold**—the point at which *economic loss outweighs the drawbacks of using a pesticide*
- insurance spraying**—applying pesticide as a *preventative measure*
- cosmetic spraying**—applying pesticide to prevent blemishes (not real damage)

B. **IPM – Integrated Pest Management** (see section 3)

- background info from the EPA
from <http://www.epa.gov/pesticides/factsheets/ipm.htm#what>

“Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices. IPM programs use current, comprehensive information on *the life cycles of pests and their interaction with the environment*. This information, in combination with *available pest control methods*, is used to *manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment*. The IPM approach can be applied to both agricultural and non-agricultural settings, such as the home, garden, and workplace. IPM takes advantage of all appropriate pest management options including, but not limited to, the judicious use of pesticides...”

2) steps of IPM

a) Set Action Thresholds

“Before taking any pest control action, IPM first sets an action threshold, *a point at which pest populations or environmental conditions indicate that pest control action must be taken...*”

b) Monitor and Identify Pests – action done by **field scouts**

“...This monitoring and identification removes the possibility that pesticides will be used when they are not really needed or that the wrong kind of pesticide will be used.”

c) Prevention

“As a first line of pest control, IPM programs work to manage the crop, lawn, or indoor space to *prevent pests from becoming a threat*. In an agricultural crop, this may mean using cultural methods, such as rotating between different crops, selecting pest-resistant varieties, and planting pest-free rootstock. These control methods can be very effective and cost-efficient and present little to no risk to people or the environment.”

- **pest-loss insurance**—eliminates the need for **insurance spraying**

d) Control

“Once monitoring, identification, and action thresholds indicate that pest control is required, and preventive methods are no longer effective or available, IPM programs then evaluate the proper control method both for effectiveness and risk. *Effective, less risky pest controls are chosen first, including highly targeted chemicals, such as pheromones to disrupt pest mating, or mechanical control, such as trapping or weeding*. If further monitoring, identifications and action thresholds indicate that less risky controls are not working, then additional pest control methods would be employed, such as targeted spraying of pesticides. Broadcast spraying of non-specific pesticides is a last resort.”

3) IPM uses a *combination of chemical and ecological approaches*

(see 16.3, ecological control)

<i>crop rotation</i> <i>polyculture</i> <i>intercropping / mixed cropping</i>	<i>eliminating crop residue</i> <i>phenological asynchrony</i> <i>managed application of water or fertilizer</i>	<i>sanitation of planting area</i> <i>plowing and/or burning of plant residue</i>
<i>trap crops</i> —planting strips of a crop to lure pests, which are attracted and then destroyed		

4) from <http://www.communityipm.org/index.htm>

a) **FAO (U.N. FOOD AND AGRICULTURE ORGANIZATION)**

b) *IPM Program member countries: Bangladesh, Cambodia, China, India, Indonesia, Laos, Malaysia, Nepal, Phillipines, Sri Lanka, Thailand, Vietnam)*

c) **comments**

“The training approach which has been used to help rural people learn about IPM is called the *Farmers Field School (FFS)*. This entails weekly meetings by a group of farmers... these farmers observe, record and discuss what is happening in their own fields from the time of planting to the time of harvest... Since 1990 more than two million farmers have graduated from

FFS... In recent years, IPM farmers have started organizing themselves in order to carry out field experiments, train other farmers, and interact more effectively with government agencies. These developments have given rise to a new term, *Community IPM*.”

C. Organically grown food

- 1) general guidelines
 - a) no antibiotics or hormones used on animals
 - b) no synthetic chemical pesticides or fertilizers used on plants
- 2) comments from the EPA:

“In contrast [to IPM], organic food production applies many of the same concepts as IPM but *limits the use of pesticides to those that are produced from natural sources*, as opposed to synthetic chemicals.”

- 3) comments from MOFGA: Maine Organic Farmers and Growers Association (the oldest and largest state organic organization in the U.S.)

“Many people are aware that food that is grown according to organic principles is free from exposure to harmful herbicides and pesticides, but that is only one small aspect of organic agriculture...”

A larger part of organic agriculture involves the health of the soil and the ecosystem in which crops and livestock are raised. *Organic practices recognize that a healthy, vibrant, and live soils and ecosystems significantly benefit crops. Natural, undisturbed soil is alive with microbotic organisms which exist in harmony together with the native plant life and the inorganic minerals that provide the soil's substrate.*”

- 4) NOSB: National Organic Standards Board <http://www.ams.usda.gov/nosb/>

“*The Organic Foods Production Act of 1990*, part of the 1990 Farm Bill, authorized the Secretary of Agriculture to appoint a 15-member National Organic Standards Board (NOSB). The board's main mission is to assist the Secretary in developing standards for substances to be used in organic production. The NOSB also advises the Secretary on other aspects of implementing the national organic program...”

16.5 Notes

V. Pesticides and Public Policy

A. FIFRA – Federal Insecticide, Fungicide, and Rodenticide Act

- 1) established in 1947
- 2) amended by the *Food Quality Protection Act of 1996* and the *Pesticide Registration Improvement Act of 2003*
- 3) new pesticides must be tested and approved by the EPA
- 4) cancellations may be based on *potential risk to humans*
- 5) cancellations may be based on *damage to the environment*
- 6) *active ingredients, usage, and risks* must be listed on the label

B. FQPA – Food Quality Protection Act of 1996 (from the EPA)

“The pesticide re-registration program acquired significant new dimensions on August 3, 1996, when the Food Quality Protection Act was enacted. FQPA, which amends both FIFRA and the Federal Food, Drug, and Cosmetic Act (FFDCA), *establishes a new safety standard for pesticide residues in food and emphasizes protecting the health of infants and children.*

Under FQPA, all pesticide food uses must be ‘safe’; that is, EPA must be able to conclude with ‘reasonable certainty that no harm will result from aggregate exposure’ to each



pesticide from dietary and other sources. In determining allowable levels of pesticide residues in food, *the Agency must conduct a comprehensive assessment of each pesticide's risks, considering:*

- *Aggregate exposure of the public to residues from all sources including food, drinking water, and residential uses;*
- *Cumulative effects of pesticides and other substances with common mechanisms of toxicity;*
- *Special sensitivity of infants and children to pesticide; and*
- *Estrogen or other endocrine effects.*

...EPA is using re-registration to accomplish tolerance reassessment, the cornerstone of the FQPA... All pesticides will be re-examined periodically in the future through registration review. This new program created by FQPA requires EPA to *review every registered pesticide on a suggested 15-year cycle.*”

C. *USDA PDP: Pesticide Data Program*

- 1) a partnership between the federal government and states
- 2) federal laboratories providing testing services

From <http://www.ams.usda.gov>

“The Pesticide Data Program (PDP) is a national pesticide residue database program. Through cooperation with State agriculture departments and other Federal agencies, PDP manages the collection, analysis, data entry, and reporting of pesticide residues on agricultural commodities in the U.S. food supply, with an emphasis on those commodities highly consumed by infants and children.”

D. Later legislation...

- 1) Pesticide Registration Improvement Act of 2003
- 2) Harmful Invasive Weed Control Act of 2002
- 3) United States Toxic Mold Safety and Protection Act of 2002
- 4) International Code of Conduct on the Distribution and Use of Pesticides (adopted by the FAO Council in November 2002)

E. Pesticides in *developing countries*

- 1) chemical pesticide use has increased in the past 50 years
- 2) those countries will probably have similar or identical health problems and environmental damage like we had years ago
- 3) world market of pesticides is ~ \$30 billion, *1/3 of that for developing countries*
- 4) more than 1 million acute poisonings reported per year
- 5) **PIC: prior informed consent** <http://www.pic.int/>
 - a) 1998 Rotterdam Convention approved an international process to inform countries receiving imported goods about the pesticide restrictions used
 - b) ongoing training and awareness workshops
- 6) *factors why people in developing countries are more vulnerable to the effects of pesticides*
 - *“weak or absent legislative frameworks*
 - *climatic factors (which make the use of protective clothing while spraying pesticides uncomfortable)*
 - *inappropriate or faulty spraying technology*
 - *lower nutritional status (less physiological defense to deal with toxic substances)”*