

1 **Pesticides and Pest Control**

Chapter 20

2 **pests**

- ⇒ Anything we don't like! May have niche, but niche isn't compatible w our needs or wants.
- ⇒ Competes w us for food
- ⇒ Destroys/disfigures lawns or gardens
- ⇒ Consumes wood in houses
- ⇒ Spreads disease
- ⇒ nuisance

3 **Pests and their niche**

- ⇒ Pests have "natural enemies"
- ⇒ Pests are part of the populations that make up an ecosystem, as such they have functions that contribute to the overall functioning of the ecosystem
- ⇒ The balances within an ecosystem (competition for food, habitat, predator/prey relationships, trophic levels or food webs) are disturbed when we introduce our own ecosystems eg. monocultures

4 **How many are there?**

- ⇒ there are nearly 10,000,000,000,000,000,000 (10 quintillion) insects in the world
- ⇒ More than one million different species of insects have been identified

5 **Geographic range of grass hopper and gypsy moth caterpillar**

6 **Geographic Distribution of European Red Mite**

7 **Distribution of pink bollworm and boll weevil**

8 **Pest control**

- ⇒ Insecticides
- ⇒ Herbicides
- ⇒ Fungicides
- ⇒ In ecosystems, there are herbicides (allelopaths) and insecticides (naturally produced toxins) due to the relationship of the pest to the affected species over time - coevolution

9 **First generation pesticides**

- ⇒ Extracting naturally produced toxins
- ⇒ Nicotine sulfate
- ⇒ Pyrethrum, from chrysanthemums
- ⇒ Rotenone, from roots of tropical forest legumes

10 **Second generation pesticides**

- ⇒ Synthetic pesticides
- ⇒ DDT diphenyldichlorotrichloroethane
- ⇒ Some is good, more is better since the 1950s more is better by 50x

- ⇒ More potent than early pesticides; 630 different chemicals used singly or in combinations
- ⇒ 75% of the 2.5 metric tons are used in developed countries

11 **Targets and persistence**

- ⇒ Broad spectrum target many species
- ⇒ Narrow range target few species
- ⇒ Some have low persistence (days to weeks) some may persist for years

12 **Why Pesticides could/should be used**

- ⇒ Save lives (malaria, bubonic plague, typhus, sleeping sickness)
- ⇒ Increase food supplies and lower food costs
- ⇒ Increase profits for farmers
- ⇒ Work faster and more effectively than alternatives
- ⇒ If used properly, pose insignificant health threats
- ⇒ Newer pesticides are safer than those in the 1950s

13 **Perfect Pesticide**

- ⇒ Kill only the target pest
- ⇒ Harm no other species
- ⇒ Persist briefly and decomposition products harmless
- ⇒ Not cause genetic resistance in target organism
- ⇒ Be more cost effective than doing nothing

14 **Case Against Pesticides**

- ⇒ Accelerate development of genetic resistance to pesticides
- ⇒ Broad spectrum insecticides kill natural predators and parasites that help control the populations of pest species
- ⇒ Pesticides do not stay put
- ⇒ Some pesticides harm wildlife (honeybees, birds, fish, other species)
- ⇒ Threaten human health (agriculture workers and accidents in home or work)

15 **Cotton boll weevil:
6 generations/growing season**

16 **Only .1-2% of pesticide sprayed reaches target from crop dusting**

17 **Pesticide Regulation in the US**

- ⇒ FIFRA Federal insecticide, fungicide and rodenticide act in 1947 (amended in 1972) requires EPA approval for use of all commercial pesticides
- ⇒ Biologically active ingredients are tested for toxicity to animals
- ⇒ EPA evaluates data and registers pesticide

⇒ EPA sets tolerance level for human consumption of residues on foods

18 **Banned or Restricted use of some pesticides**

- ⇒ Most chlorinated hydrocarbons insecticides
- ⇒ Several carbamates and organo phosphates
- ⇒ Systemic herbicides 2,4,5-T and Silvex
- ⇒ These can be made and sold in other countries
- ⇒ Carcinogenic effects have not been fully evaluated
- ⇒ Laws are inadequate and poorly enforced
- ⇒ Pre1972 pesticides are not properly assessed

19 **1996 Food Quality Protection Act**

- ⇒ FPQA
- ⇒ Requires new standards for pesticide tolerance levels in food for causing no harm to humans
- ⇒ 1 cancer case in a million exposed to lifetime (how test this!)
- ⇒ Manufacturers demonstrate active ingredients are safe for infants and children
- ⇒ Requires EPA to consider tolerance when there is exposure to several pesticides simultaneously
- ⇒ EPA develop rules for screening for hormonal effects

20 **Economic threshold**

- ⇒ Point at which the economic losses outweigh the cost of pesticide (time for pests to die)
- ⇒ Insurance spraying vs pest loss insurance
- ⇒ Additional spray is bad for many reasons, pest loss insurance will help pay for loss of money when crop value is reduced by pests

21 **Controlling Pests without Pesticides**

- ⇒ Cultivation practices: rotate crops, grow crops before after height of pest season, grow where there aren't pests, plant other crops to distract pests
- ⇒ Genetic engineering to speed up dev of pest and disease resistant crop strains
- ⇒ Biological pest control – natural predators, parasites, and disease causing bacteria and viruses can be imported to regulate pest populations
- ⇒ Insect birth control-sterilize males
- ⇒ Pheromones
- ⇒ Spray w hot water
- ⇒ radiate

22 **Rise of genetic resistance to pesticides**

23 **Keeping pests below economic threshold**

24 **Infection caused by screwworm fly larvae can be lethal**

25 **Pheromones could help control red scale mite**

26 **Applying synthetic hormones help disrupt life cycle at juvenile hormone & molting hormone times**

27 **Synthetic hormones prevented molting hormones on tobacco hornworm on left; normal worm on right**

28 **Integrated Pest Management**

- ⇒ Assess crop and pests as part of an ecosystem
- ⇒ Design a control program that includes cultivation, biological, and chemical methods applied sequentially and timed to meet life cycles of pest and crop
- ⇒ Advantages: reduce pesticide use, reduce preharvest pest induced losses, improve crop yields, reduce inputs of fertilizer and irrigation, & reduce genetic resistance
- ⇒ Disadvantages: requires time to develop and implement, has to be designed for each situation, initial costs may be higher