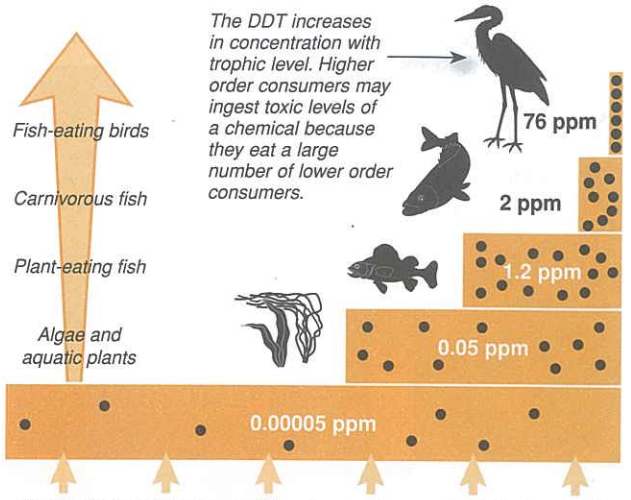
Chemical Pest Control

Pest control refers to the regulation or management of a species defined as a pest because of perceived detrimental effects on other species, the environment, or the economy. Pests can be managed through **biological controls**, which exploit natural existing ecological relationships, and **chemical controls** (pesticides). Opponents of pesticide use believe that the harmful effects of pesticides outweigh the benefits, especially given an increasing resistance to pesticides by target organisms. When pesticide resistance develops, more frequent applications and larger doses are often recommended. This leads to a **pesticide treadmill**, where farmers pay more and more for a pest control program that becomes less and less effective.

Biomagnification of DDT in an aquatic ecosystem



DDT enters the lake as runoff from farmland sprayed with the insecticide.

Pesticides, radioactive isotopes, heavy metals, and industrial chemicals such as PCBs can be taken up by organisms via their food or be absorbed from the surrounding medium. The **toxicity** of a chemical is a measure of how poisonous it is to both target and non-target organisms. Its **specificity** describes how selective it is in targeting a pest, while its **persistence** describes how long it stays in the environment. Many highly persistent pesticides show progressive concentration in food chains. This undesirable feature of their use is called **biomagnification**.

Pesticide type	Examples	Environmental persistence	Bioaccumulation
Insecticides			
Organochlorines	*DDT*, dieldrin*	2-15 yrs	Yes
Organophosphates	*Malathion*	1-2 weeks/years	No
Carbamates	*Carbaryl*	Days to weeks	No
Botanicals	*Pyrethrum, camphor*	Days to weeks	No
Microbials	*Microorganisms*	Days to weeks	No
Fungicides			
Various chemicals	*Methyl bromide*	Days	No
Herbicides			
Contact§ chemicals	*Paraquat*	Days to weeks	No
Systemic¶ chemicals	*2,4-D, 2,4,5-T, glyphosphate*	Days to weeks	No
Soil sterilants	*Butylate*	Days	No
Fumigants			
Various chemicals	*Methyl bromide*	Years	Yes

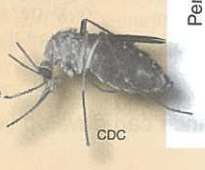
* Now banned in most developed countries
¶ Systemic chemicals: Effective when absorbed into general circulation
§ Contact chemicals: Effective after contact with surface tissue

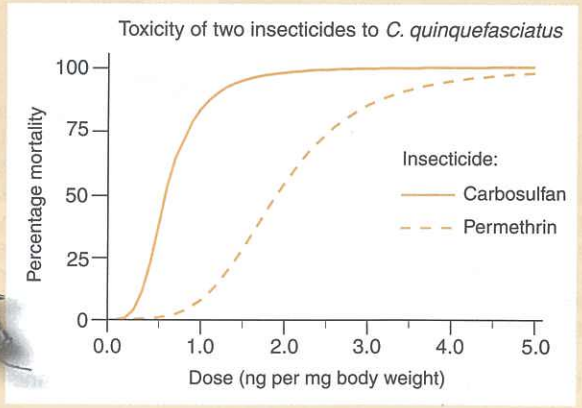
Source of data: Miller (2000) Living in the Environment, Brooks/Cole

LD50

The **LD50 (Lethal Dose 50%)** is a test to determine how much of a specific substance is required to kill 50% of a test population. The lower the figure, the more toxic the substance. The species tested, their relative health, and the mode of administration (oral, intravenous, or surface) can all influence the outcome. LD50 is calculated over a specific test period, so it does not provide information about low level, long term exposure to a substance.

The mosquito *Culex quinquefasciatus* (right) can carry the West Nile virus, which is fatal in up to 15% of cases. In 2009, 663 cases were reported in the United States. LD50 testing is routinely carried out to calculate the effectiveness of current and new insecticides against *C. quinquefasciatus* (graph right).


CDC



C. Bertcat et al, Evolutionary Biology 104(8), 8 April 2008

1. Explain why top consumers are most at risk of the toxic effects of pesticide **biomagnification**: _____

_____

2. Explain why persistence is an important property to consider when using a pesticide: _____

_____

3. (a) State the LD50 for the insecticide carbosulfan against *C. quinquefasciatus*: _____

   (b) State the LD50 for the insecticide permethrin against *C. quinquefasciatus*: _____

4. Identify which insecticide *C. quinquefasciatus* has a greater chance of developing resistance to and explain why:

_____

_____

Related activities: *The Impact of Farming, Integrated Pest Management*
Weblinks: *Biocontrol Information Center, Integrated Pest Management*