Toxic Organic Chemicals

Pesticides -

   A) Insecticides

      1) Organochlorines –

         Favorable(?) properties

      2) Properties of some typical organochlorines

| Compound | Lipid solubility (g/L) | Aq solubility (mg/L) | Log $K_{OW}$ |
|---|---|---|---|
| DDT | | | |
| Heptachlor | | | |
| Dieldrin | | | |
| Lindane | | | |

3) Specific examples

   a) DDT

     Analogs/metabolites of DDT

       DDE

       DDD

       Methoxychlor

b) Toxaphene

c) 1, 2, 3, 4, 5, 6-hexachlorocyclohexane

d) Cyclodienes

4) Toxicology

  Acute vs chronic

  a) Determination of toxicity

    $LD_{50}$ (Fig. 7-7)

        NOEL and its relation to threshold

        NOEL (from animals) / safety factor (100 or 1000)

Ames Test

Mutagenic vs carcinogenic

Ames + liver extract
Toxic cabbage?

Environmental estrogens

5) Organophosphates

Type A: $O_3P=O$                                      $LOD_{50}$ (mg/kg)

volatile (flea collars, fly strips)

Type B: $O_3P=S$                                      $LOD_{50}$ (mg/kg)

Parathion, Diazinon

Type C: $O_2SP=S$                                     $LOD_{50}$ (mg/kg)

Malathion

Target the nervous system (acetylcholine)

| Compound | Log $K_{OW}$ | Solubility (mg/L) |
|---|---|---|
| Malathion | | |
| Parathion | | |
| Dimethoate | | |

6) Carbamates

Derivatives of carbamic acid

7) Organochlorine substitutes

Disadvantages - acute toxicity

| TABLE 7-4 | | LD$_{50}$ Ranges for Some Common Natural and Synthetic Substances, Including Pesticides | | |
|---|---|---|---|---|
| | LD$_{50}$ (approximate) (mg/kg) | LD$_{50}$ (approximate) (g/kg) | Natural substances | Synthetic substances |
| Direction of increasing toxicity | >10,000 | >10 | Sugar | |
| | 1,000 | 1 | Salt; ethanol; pyrethrins | Malathion; atrazine; HCB; mirex; glyphosate; aspirin |
| | 100 | $10^{-1}$ | Caffeine; rotenone | DDT; 2,4-D; toxaphene; dimethoate; carbaryl; 2,4,5-T; paraquat; cyanazine; codeine; Tylenol |
| | 10 | $10^{-2}$ | | Dichlorvos; denitrothion; carbofuran; diazinon; NaCN; As$_2$O$_3$ |
| | 1 | $10^{-3}$ | Nicotine | Parathion; aldicarb; strychnine |
| | $10^{-1}$ | $10^{-4}$ | Rattlesnake toxin | |
| | $10^{-2}$ | $10^{-5}$ | Aflatoxin-B | |
| | $10^{-3}$ | $10^{-6}$ | | 2,3,7,8-TCDD |
| | $10^{-4}$ | $10^{-7}$ | | |
| | $10^{-5}$ | $10^{-8}$ | Tetanus and botulism toxins | |

8) Natural Insecticides

Pyrethrins

Rotenone

Inhibits mitochondrial electron transport

$t_{0.5} =$

$LC_{50} =$

$LOD_{50} =$