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Pesticides

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Introduction

A Pesticide can be defined as any chemical used to directly control pest populations or to prevent or reduce pest damage. Pesticides also include compounds intended for use as plant growth regulators, defoliants, or desiccants, even though they are not normally used as pest control agents, nor are they usually effective as such. It is important to remember that the

"-cide" in pesticides means "to kill". These products can be dangerous if not used properly.

History

Since before 500 BC, humans have used pesticides to prevent damage to their crops. The first known pesticide was sulfur. By the 15th century, toxic chemicals such as arsenic, mercury and lead were being applied to crops to kill pests. In the 17th century, nicotine sulfate was extracted from tobacco leaves for use as an insecticide. The 19th century saw the introduction of two natural pesticides, pyrethrum and rotenone.

In 1939, Paul Muller discovered that DDT was a very effective insecticide. It quickly became the most widely - used pesticide in the world. However, in the 1960s, it was discovered that DDT was preventing many fish - eating birds from reproducing which was a huge threat to biodiversity.

Pesticide use has increase 50-fold since 1950, and 2.5 million tons of industrial pesticides are now used each year.

Methods of classifying pesticide:

I. The group of pests controlled by the pesticide.

II. **Mode of action (How a Pesticide works)**

III. The chemical nature of pesticide.

IV. The pesticide formulation.

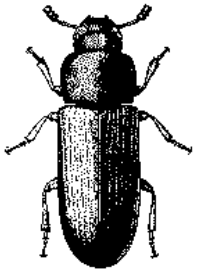
V. Reentry intervals (REI).

VI. LD50.

VII. signal word.

I. The group of pests controlled by the pesticide:

1- Insecticides



- **Insecticides are chemicals used to control insects.**

  M.O.A: 1- Touching

  2- Swallowed

  3- Systemic may be absorbed, injected, or fed into the plant or animal to be protected. When the insect feeds on this plant or animal, it ingests the systemic chemical and is killed.

- **Broad Spectrum.**

  killing a wide variety of animals by attacking a system common to all, such as the nervous system much more selective.

  " the broad spectrum" insecticides are used when several different kinds of insects are a problem. One chemical can kill them all. No broad spectrum insecticide kills all insects; each varies as to the kinds of insects it controls.

Narrow spectrum:

- **Chitin synthesis inhibitors:** only effect animals with chitin in their exoskeleton, Chitin is the primary structural chemical in an insects body wall. An **immature** insect treated with a chitin inhibitor dies.

- **Insect growth regulators or IGRs:** more specific. They affect certain groups of species that have a particular hormones. They interfere with certain normal processes and **prevent immature insects from completing development into normal reproductive adults**. IGRs attack a growth process found only in insects, thus there is a great margin of safety for humans and other vertebrates. However, one disadvantage is that growth regulators act slowly, since they do not kill the insect until it molts into an adult.

- **Pheromones:** most restrictive because they react with **only one species or one sex of single species**. They are naturally produced chemicals used by animals to communicate to each other. There are three basic types of pheromones.

1- Aggregation pheromones attract many individuals together, for example, a site where food may be plentiful.

2-Sex pheromones are used by one sex of a species to attract a mate.

3-Trail pheromones are deposited by walking insects.

Insecticide Examples

- Organophosphates (malathion, diazinon)
- Carbamates (sevin)
- Pyrethroids (mavrick, ambush)
- Microbials (BT)
- Petroleum oils(horticultural oils)
- Natural organics

2- Miticides (or Acaricides)

are chemicals used to control mites and ticks. The chemicals usually must contact the mites or ticks to be effective. Miticides are very similar in action to insecticides

- **Broad spectrum**
- **Narrow spectrum**

3- Fungicides

- **Fungicides** are chemicals used to control the fungi which cause molds, and plant diseases.
- Two basic approaches in the use of fungicides:

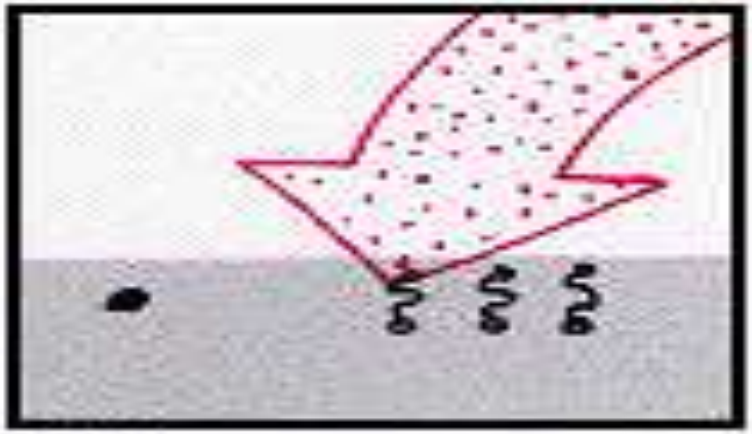
  1- Protectants: to prevent the plant from getting the disease.
- They are applied before the disease gets a start.
- Most protectant fungicides are fungistatic.

  2- Eradicants**:** kill the disease after it appears on (or in) the plant.
- Less common than protectant because once the fungus is established in a plant, **it is often difficult to destroy.**

- **Fungicide examples**

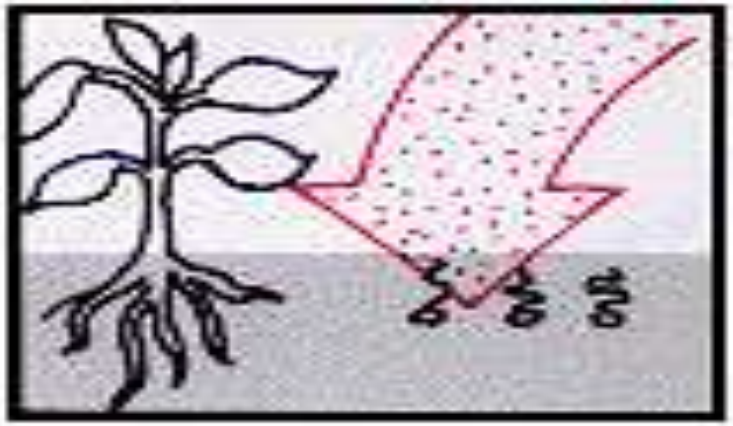
- Inorganic
- Sulfur
- Copper
- Organic
- Aromatic (Deconil)
- Strobilurins (Heritage)

4- Herbicides



Pre-emergence

post-emergence



post-emerged plant
pre-emerged weeds

Herbicides are chemicals used to control unwanted plants. they are used to kill or slow the growth of some plants, rather than to protect them.

- **Nonselective herbicides** are toxic to all plants.

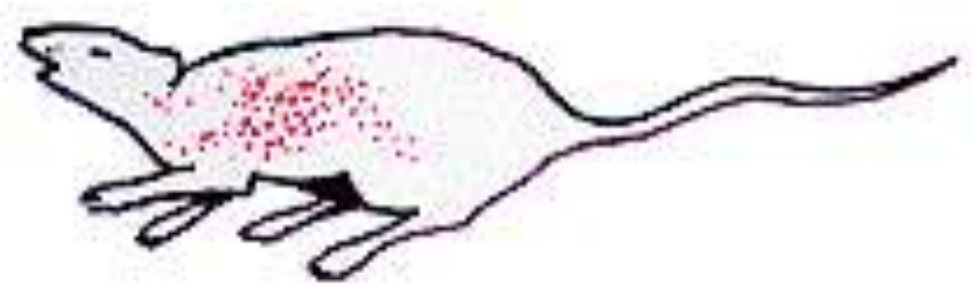
These are often used when no plants are wanted in an area.

- **Selective herbicides** kill some plants with little or no injury to other plants.

Types of treatment:

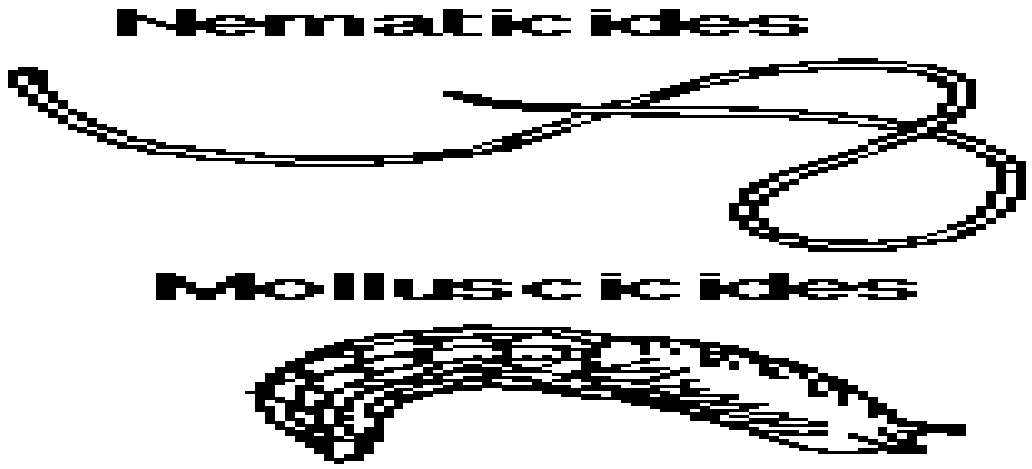
1. **Preplanting** treatments are made before the crop is planted.
2. **Preemergence:** Any treatment made before the crop and weed appears
3. **Postemergence:** When the herbicide treatment is made after the crop or weeds appear.

5- Rodenticides



Rodenticides are chemicals used to control rats, mice, bats and other rodents. Chemicals which control other mammals, birds, and fish are also grouped in this category by regulatory agencies. Most rodenticides are stomach poisons and are often applied as baits. Even rodenticides which act by contacting the pest are usually not applied over large surfaces because of the hazard to domestic animals or desirable wildlife.

6- Nematicides Molluscicides Repellents



Nematicides are chemicals used to control nematodes.

Molluscicides are chemicals used to control snails and slugs. Usually the chemicals must be eaten by the pest to work.

II. Mode of action (How a Pesticide works)

- 1-Contact poisons
  - Kill pest simply by touching
- 2- Stomach poisons
  - Kill when ingested
- 3-Systemic
  - Kill pest by being taken into the blood or the animal or sap or plant upon which the pest is feeding.
- 4- Translocated
  - (herbicide) move from the point of initial application to circulate throughout the plant.
- 5- Fumigants
  - Gasses which kill when inhaled or absorbed by pests.
- 6-Selective pesticides
  - Kill only certain kinds of plants, animals, or pathogens
- 7- Nonselective pesticides
  - Kill most plants or animals

III. The chemical nature of pesticide:

Pesticides can be divide into chemical groups: the in organic and organic compounds.

a- **Inorganic** compounds are of mineral origin and therefore do not contain carbon.

- Not very specific in their activity and may be toxic to a wide range of organisms.
- Less effective than organic compounds.
- Low acute toxicity to humans. Examples include copper & sulfur.

b- Organic compounds or those that do contain carbon.

- **Botanical:** Rotenone, pyrethrum, nicotine and strychnine.
- **Synthetic:** They are after extremely effective & easy to use, as well as relatively in expensive & specific in their activity.

C-Biological origin:

Microbial pesticides. These are simply bacteria, viruses, or fungi which disease in given pest species. The best known example is the bacterium bacillus thuringiensis or Bt which has been used effectively against some species of caterpillars.

IV. The pesticide formulation:

Pesticide formulation = active ingredient + inert ingredient

Formulation make an active ingredient more convenient to handle, safer, easier and more accurate to apply and in some cases, more attractive to the pest.

a- Liquid formulations:

- **An emulsifiable concentrate** or EC, is a liquid formulation of a pesticide that can be mixed with another liquid to form an emulsion. Ecs usually contain two to six pounds per gallon of active ingredient. The usual liquid is water.
- **High concentrate liquids** usually contain a high concentration of the active ingredient, often eight or more pounds per gallon. Most are designed to be mixed with water and oil.
- **Low concentrate liquids** contain low amounts of the active ingredient and are usually solutions prepared to be used as purchased, with no need for further dilution. This type of formulation is most often used for controlling house hold pests.
- **Flowable:** some active ingredients can be manufactured only as a solid or at best, a semi-solid material. They usually have relatively low solubility in water or organic solvents. This formulation is mixed with water or liquid fertilizer to form suspensions which require moderate agitation in the spray tank. There are fewer phytotoxicity problems with flowables than with Ecs.

- **Solutions** are formulations of as active ingredient, which are completely soluble in water or organic solvents and in their original state, are liquids.
- The active ingredient in **water-soluble concentrates** is soluble in water and is formulated either with water or a solvent such as alcohol that mixes readily with water. Water- soluble concentrates are often salt or amine solutions.
- **Aerosols:** is a liquid formulation in a can, under pressure. The percentage of active ingredient is usually very low. Mainly used in the garden and home.
- **Microencapsulated pesticides** new method of formulating pesticides. The active ingredient is encased in extremely small capsules made of inert synthetic substances; the capsules are then suspended in a liquid. Application is made with conventional sprayers after diluting the formulation with water. The pesticide is released gradually over a period of time similar to a slow-release cold medicine. safety and are effective for a longer time than other formulations of the same active ingredient.

b- Dry formulation:

- **Dust formulation** usually consists of the active ingredient mixed with an inert material such as a talc, clay.

Dusts are always used dry and should never be mixed with water!

Problems:

1- the very small particles dusts make them subject to drift into non-target areas during application. Never apply them under windy conditions.

2- Also dusts can be easily inhaled so personal protective equipment should be used.

– **Granular formulations** produced by applying a liquid formulation of the active ingredient to particles of clay or other porous materials.

- **Wettable powders** are dry powdered pesticide formulations that look like dusts, they contain wetting and dispersing agents. Wettable powders are usually much more concentrated than dusts. They are made to mix with water, and when mixed form a suspension.
- **Soluble powders,** when soluble powders are added to water they will dissolve and form true solutions.
- **Water dispersible granules (**also called dry flowables) are finely divided powders that are formulated into concentrated, dustless granules. The formulation is a relatively new one and is increasing in popularity. The principal of this formulation is that, although it is sold in the dry form.

c- **A bait formulation** is an active ingredient mixed with an edible substance or some other attractant. Baits are useful in controlling mice, rats, and other rodents

V. Reentry intervals (REI)

– The amount of time required to stay out of a treated area following pesticide application.

- Agrimycin – 12 hours REI
- Daconil – 48 hour REI
- Malathion – 24 hour REI

VI. LD50

- The dosage which will kill 50% of the pest population.
- The lower the amount, the more toxic the substance is:

Class	LD_{50} rat mg/kg			
	Oral		Dermal	
	Solids	Liquids	Solids	Liquids
Ia extremely hazardous	<5	<20	<10	<40
1b highly hazardous	5-50	20-200	10-100	40-400
II moderately hazardous	50-500	200-2 000	100-1 000	400-4 000
III slightly hazardous	>500	>2 000	>1 000	>4 000

VII. Signal word

- Describe the relative safety of the pesticide product.
- DANGER (very toxic)
- WARNING (moderately toxic)
- CAUTION (slightly toxic & relatively nontoxic)

Adjuvant: are chemicals added to a pesticide principally to increase its effectiveness, to reduce phyto-toxocity.

- **Wetting agents**
- **Emulsifiers**
- **Spreaders**
- **Stickers**
- **Penetrates**

Pesticide Exposure

There are four ways you can be exposed to pesticides:

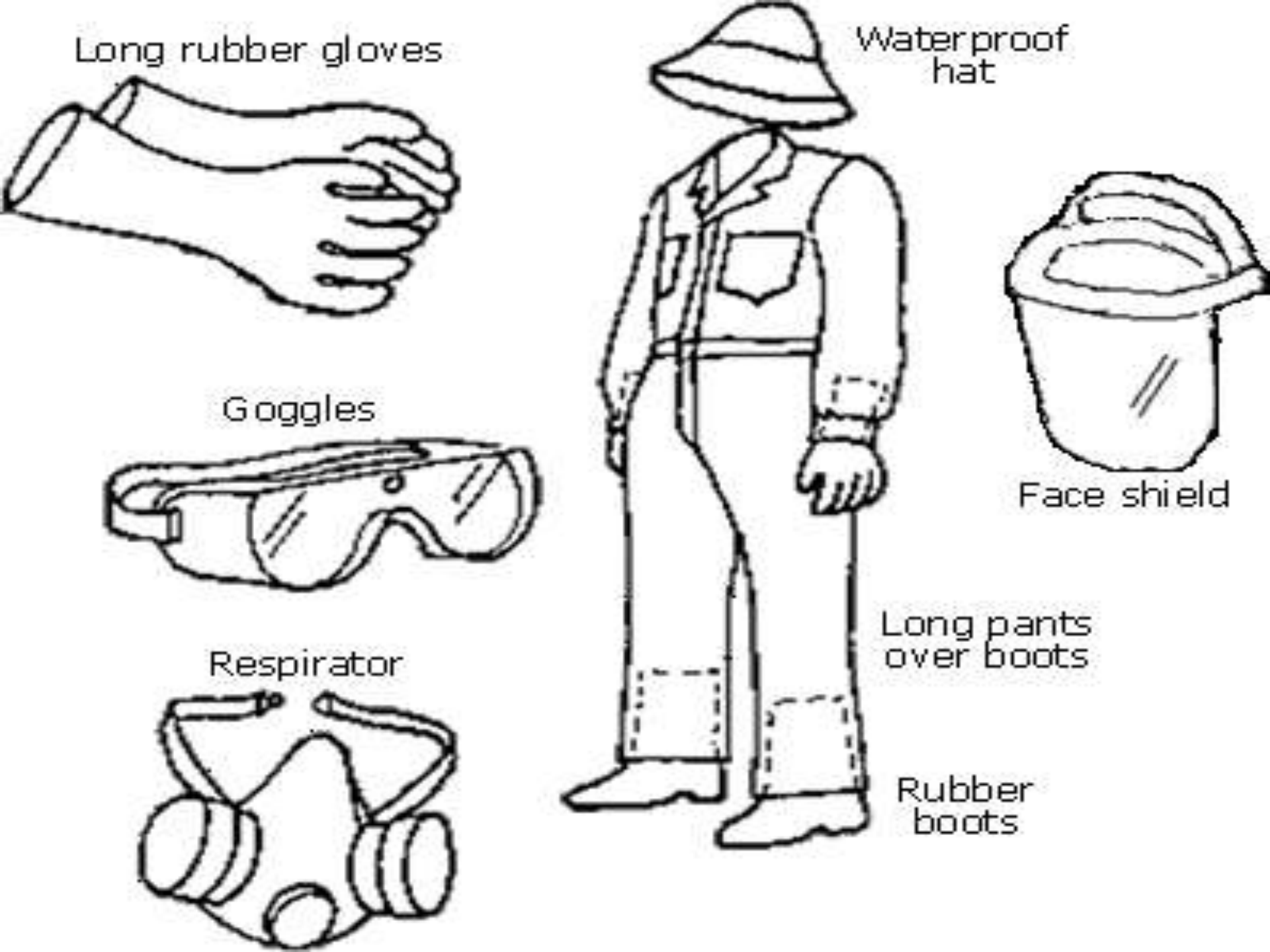
- **Oral exposure**
- **Dermal exposure**
- **Inhalation exposure**
- **Ocular exposure**

Type of Exposure	Cause of Exposure
Oral exposure	• **Swallowing pesticide** • **Not washing hands before eating, drinking, using tobacco.** • **Eating or drinking a pesticide by mistake.** • **Getting pesticide on food.** • **Splashing pesticide into the mouth**
Dermal exposure	• **Getting pesticides on bare skin.** • **Applying pesticides in windy weather** • **Wearing inadequate PPE. (personal protective equipment)**
Inhalation exposure	• **Prolonged contact in poorly ventilated areas.** • **Not using proper PPE.** • **Breathing vapors after application** • **Using the wrong respirator** • **Using an improperly fitted respirator**

Ocular exposure	• **Getting pesticides in the eyes**
	• **Not using proper eye cover when:**
	  - **Spraying pesticide**
	  - **Handling pesticide**
	• **Rubbing the eye with tainted gloves or hands**

Prevention of exposure

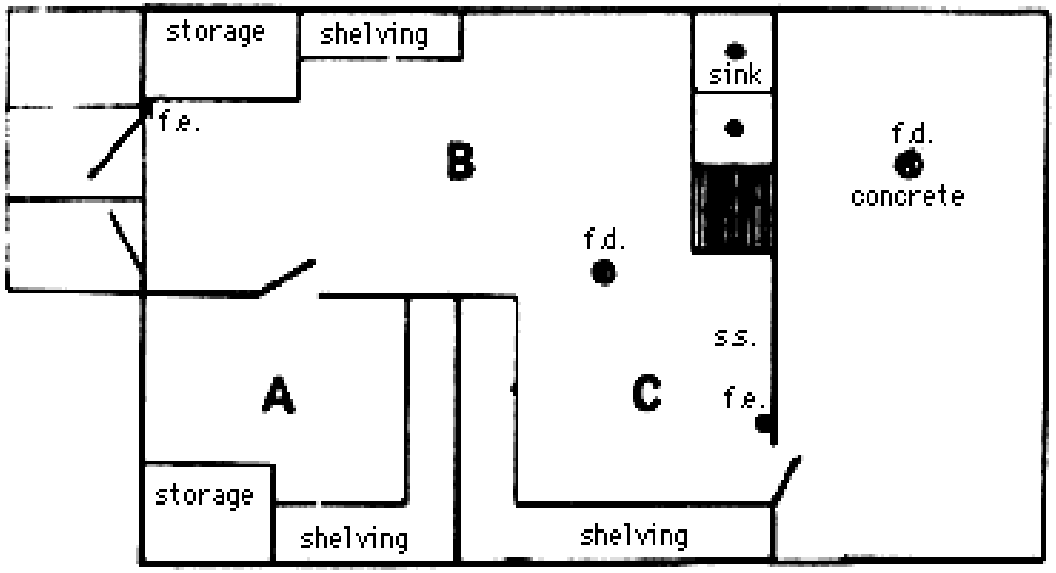
- Use strictly according to manufacturer’s direction.
- Mix or dilute outdoor.
- Apply only in recomended quantities.
- Read pesticides labels.
- Wear proper PPE.
- Wear proper eye cover.
- Use respirators whenever needed.
- If you breathe a pesticide, move away from the area quickly. Get fresh air.
- Use a closed handling system.
- Maintain and clean PPE.
- Launder clothing after handling pesticides.
- Wash exposed body parts often to reduce dermal exposure.
- Always storing a pesticide in its original labeled container.
- Always keeping pesticide in a locked storage area.
- Never eating, drinking, or smoking until after leaving the work area.
- Never to clear a nozzle with mouth.
- Safe disposal of pesticides.


Long rubber gloves
Waterproof hat
Goggles
Face shield
Respirator
Long pants over boots
Rubber boots

Warning - Pesticides In Use

All contact with the portion of the treated property upon which the pesticide application has taken place must be avoided.

Pesticide PCP#: _____
Common Name: _____
Trade Name: _____
Date Used: _____
Contact Phone#: _____
Company Name: _____
(If commercially applied)



- **US Pesticide use:**
  - –4.5 billion pounds chemicals per year.
  - –890 active ingredients, 30,000 formulations
- **Uses**
  - 75% agricultural
  - 25% home, garden ... etc

Potential problems associated with pesticide

I. RESISTANCE OF PESTS TO PESTICIDES
II. ENHANCED DEGRADATION
III. DAMAGE TO BIOLOGICAL CONTROL ORGANISM
IV. DAMAGE TO POLLINATING INSECTS
V. HAZARDS TO WILDLIFE AND ENDANGERED SPECIES

I. RESISTANCE OF PESTS TO PESTICIDES

- Methods to manage pesticide resistance include:
  - Using new compound with different mode of action
  - Use mixture
  - Add synergists

II. ENHANCED DEGRADATION

Enhanced degradation occurs when there is an increase in soil microorganisms that break down a pesticide, causing it to become ineffective. This happens after a pesticide has been used too many times in the same location.

III. DAMAGE TO BIOLOGICAL CONTROL ORGANISM

Use of pesticide can severely diminish the performance of biological control organism such as natural predators and parasites.

Secondary pests

When pest species that are normally not economically harmful increase and reach a level of significance. These are called secondary pests. Many of the problems with spider mites in fruit and field corn are secondary pest problems.

Pest Resurgence

When a pest species is reduced by pesticide application, and their natural enemies are also reduced, the pest may increase rapidly after pesticide residues diminish. This is called pest resurgence or rebound.

IV. **DAMAGE TO POLLINATING INSECTS**

Pollinating insects, such as honeybees and leafcutter bees, are vital to the production of fruit and seed crops. Crop yields and quality depend on and are improved by the activities of these pollinators.

Protection of honeybees must be an important consideration of pesticide applicators.

V . HAZARDS TO WILDLIFE AND ENDANGERED SPECIES

The use of pesticides in the past has caused the reduction in numbers of birds, certain mammals.

Damage to Wildlife

pesticides directly applied to wildlife habitats can directly kill plants and animals.

Pesticides can run-off a site and contaminate water that is ingested or inhabited by wildlife.

Pesticides can eliminate food used by wildlife.

Pesticides can accumulate in predators that feed upon plants or animals that have been exposed to pesticides.

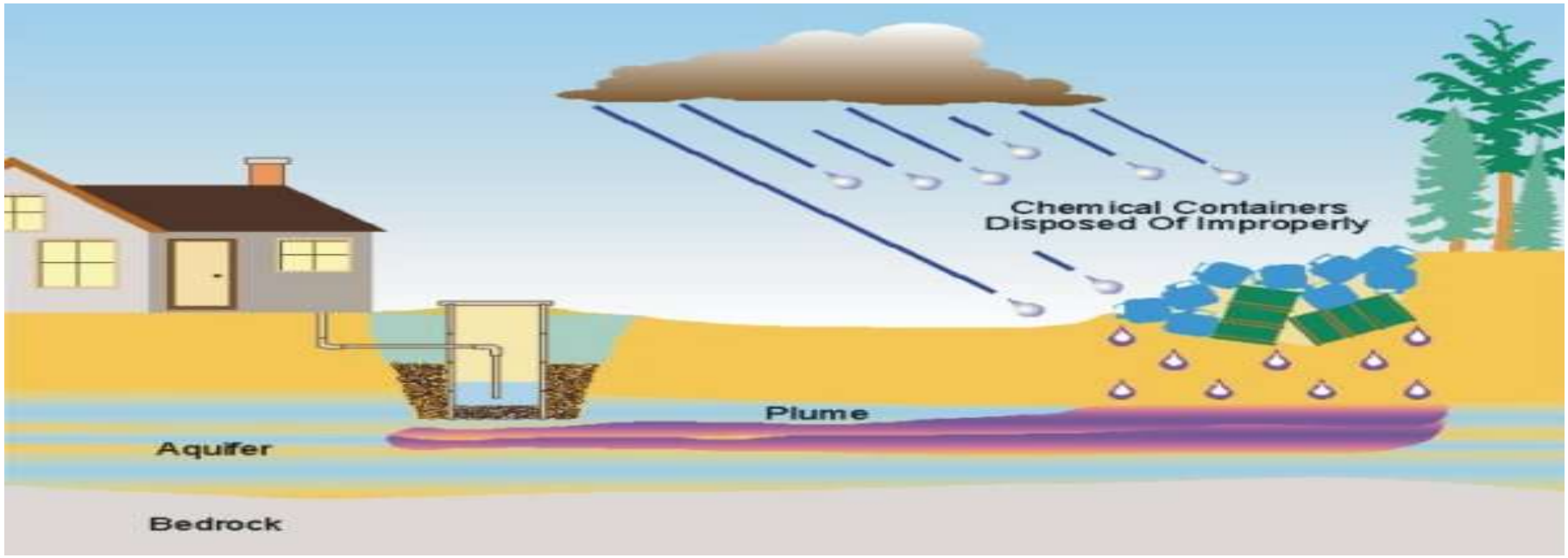
Pesticides can damage or eliminate habitat required for the survival of wildlife.

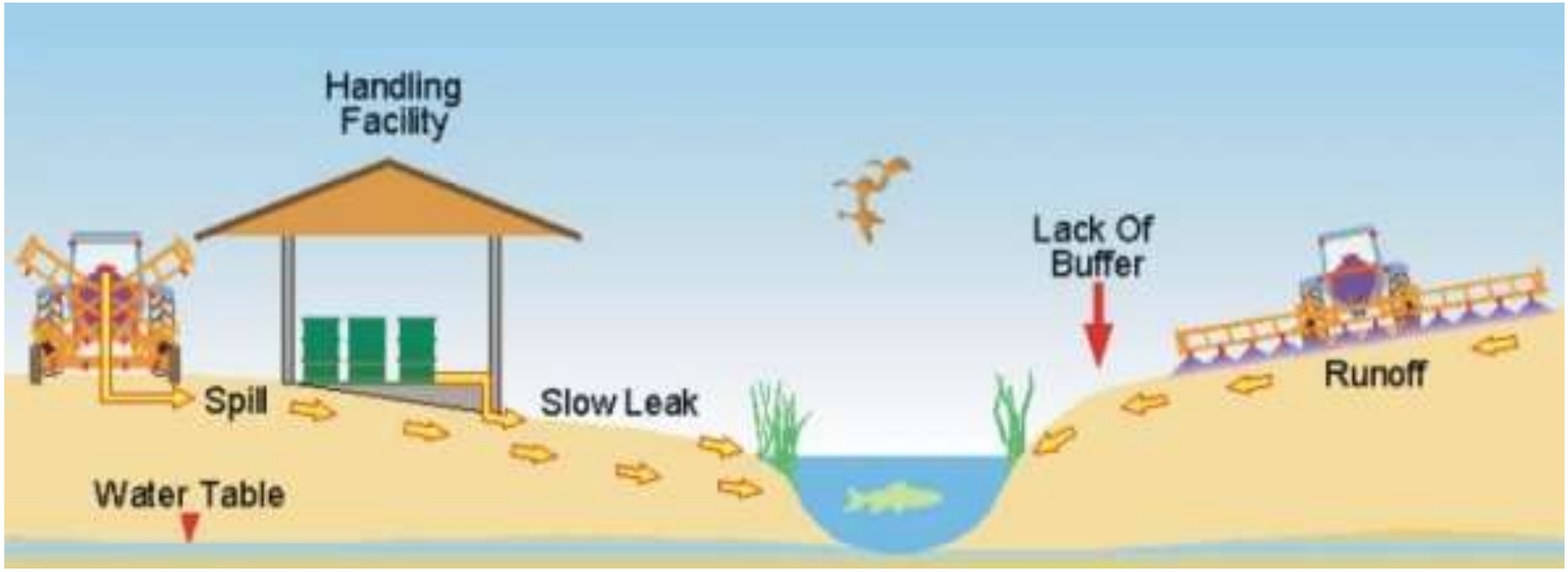
PESTICIDE DRIFT

Pesticide drift is the movement of a pesticide to areas other that the intended area of application. Some drift is expected during applications, the effectiveness of pesticides at the application site can be reduced by drift. Humans may also be exposed to pesticides because of drift.

POLLUTION OF WATER RESOURCES

- **Erosion: water** may be contaminated by pesticides during runoff from irrigation or rainfall. The potential for contamination from the sources is greater if there is rain or strong wind shortly after a pesticide application.
- **Ground water: I**t may be too expensive or impossible to clean it up. Since pesticides degrade very slowly in ground water, contamination may last for years.


Chemical Containers
Disposed Of Improperly
Plume
Aquifer
Bedrock


Handling
Facility
Lack Of
Buffer
Spill
Slow Leak
Runoff
Water Table

- ***Plant contamination***:

Degradation of pesticide inside the plant with time.
Storage of organic pesticide inside cells .

➢ PHYTOTOXICITY

Inadvertent crop injury can result from certain pesticide applications. Because they are less toxic to the crop than to the weed.

Soil contamination:

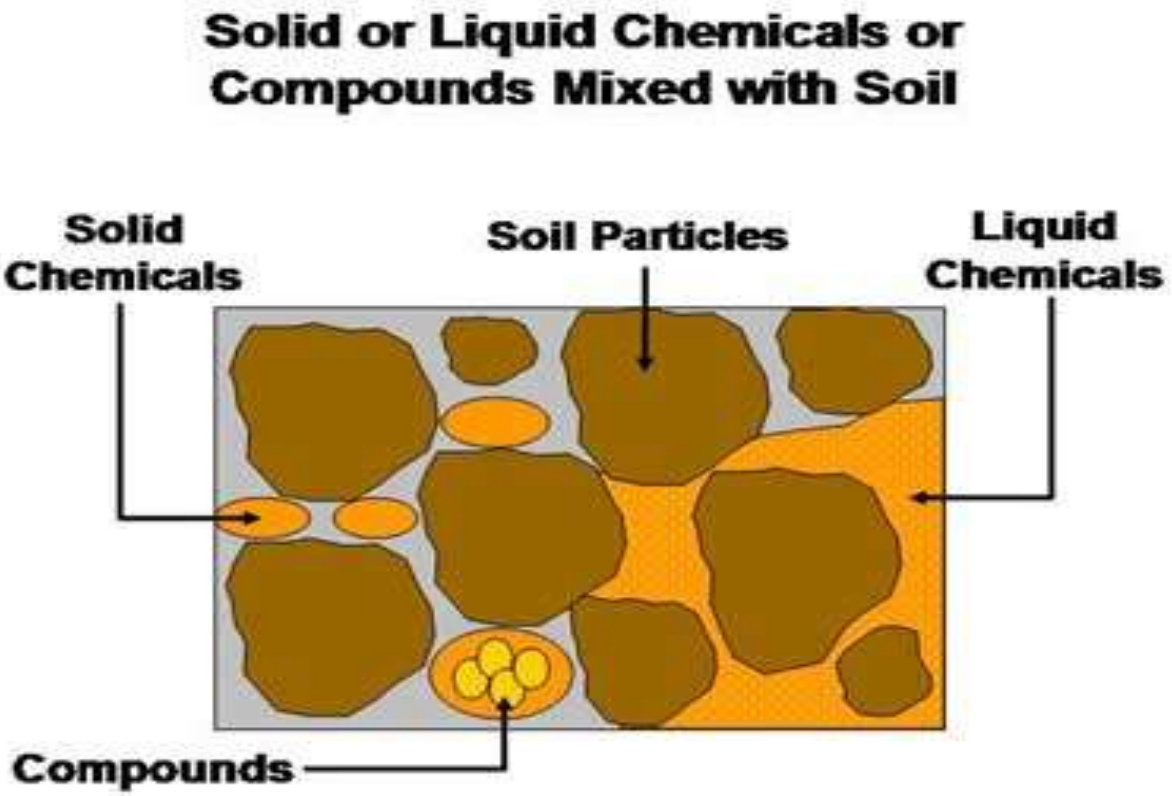
- Move with wind and adsorped on soil particles.
- Run off with running surface water .
- Leaching with rain water to soil.
- Metabolized by microorganisms with soil.
- These will change :

1)soil texture.

2)soil permiability.

3)soil organic matter.

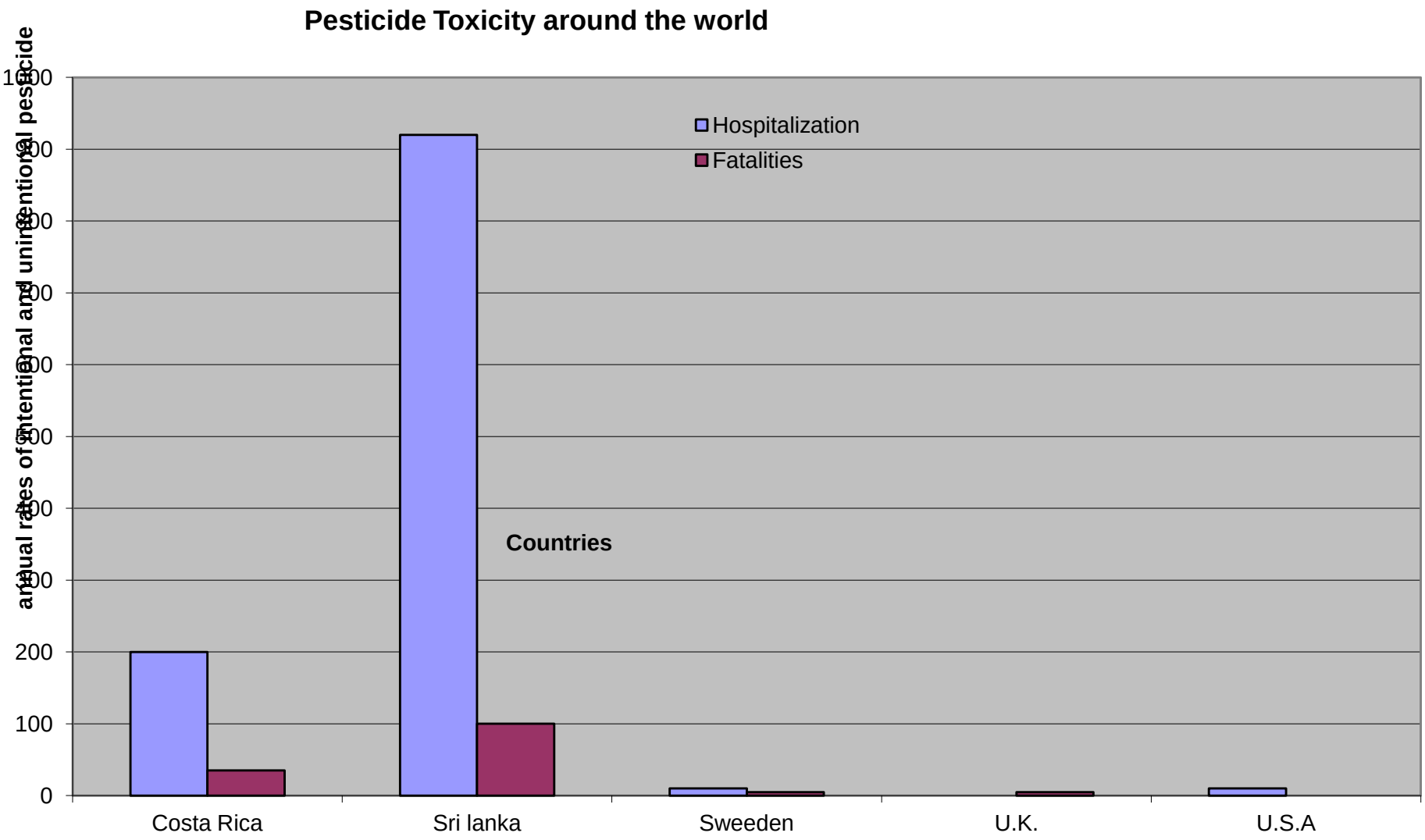
4)soil pH.



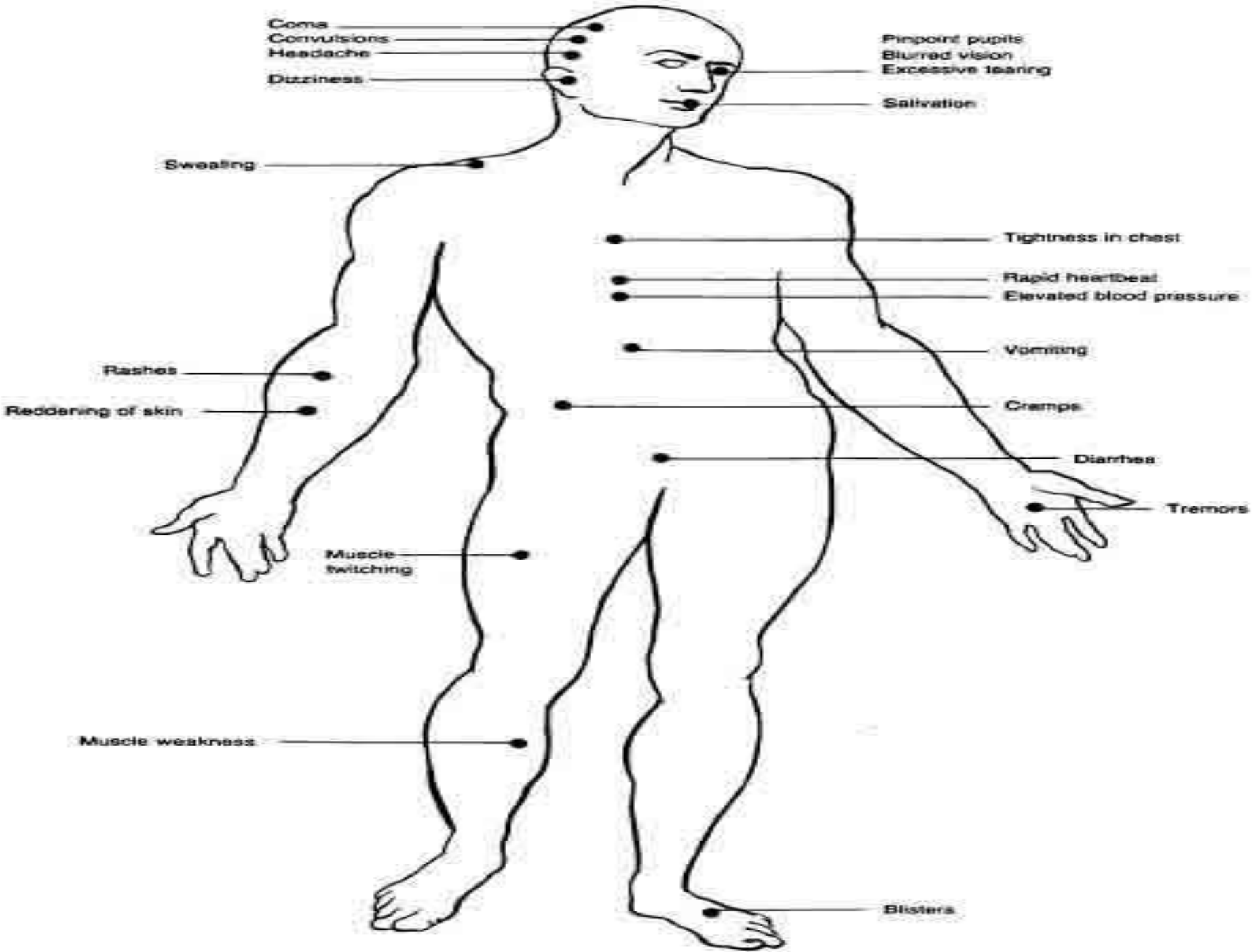
Indoor air pollution:

75 percent of U.S. households used at least one pesticide product indoors during the past year.. Another study suggests that 80 percent of most people's exposure to pesticides occurs indoors. The amount of pesticides found in homes appears to be greater than can be explained by recent pesticide use in those households; other possible sources include contaminated soil or dust that floats or is tracked in from outside, stored pesticide containers, and household surfaces that collect and then release the pesticides

Human


Pesticide Toxicity around the world
annual rates of intentional and unintentional pesticide
1000
800
600
400
300
200
100
0
Hospitalization
Fatalities
Countries
Costa Rica
Sri lanka
Sweeden
U.K.
U.S.A

Symptoms of pesticide poisoning



- **Pesticides and Parkinson’s**

  However, the new study provides cause for concern among farmers, pesticide applicators, and people who live in farming communities where regular exposure to pesticides is unavoidable. Since the late 1980s, a steady stream of studies from around the world has shown again and again that a common thread among victims of Parkinson's is a history of exposure to insecticides and herbicides.
- **Pesticides and pancreatic cancer**

  The researchers looked at 51 patients with pancreatic cancer and compared blood concentrations of the pollutants and the levels of mutation of a gene called K-Ras, believed to cause pancreatic cancer, It is also the first time that a mutation of a Ras gene has been associated with serum concentrations of organochlorines in any group of cancer patients." Professor Porta said that the results "suggest new roles for organochlorines in the development of cancers in human beings".
- **Pesticides and lymphoma**

  Children who have been exposed to household insecticides and professional extermination methods within the home are three to seven times more likely to develop non-Hodgkin lymphoma (NHL) compared with children who have not been exposed to pesticides. The study indicated that a child's risk of developing NHL was similar for both maternal exposure to pesticides during pregnancy (in utero) and direct (postnatal) exposure to pesticides

Population at risk :

1- Children are at the highest risk of accidental ingestion:

small developing bodies.

- their activity
- children's tissues may absorb chemicals more readily and be less able to break them down.
- Children produce very little paraxonase enzyme until they are about of a year old. (HDL associated plasma enzyme paraxonase provide protection from the effects of exposure to organophosphate)

2- Workers involved in the manufacture of chemicals

3- Applicators exposed to high levels of pesticides over many years

4- Applicators who do not follow directions and fail to wear protective equipment increase their risk of developing chronic effects

The End