

Pesticide (Theory)

Lecture (6)

Toxicity and Risks of Pesticides

Pesticide applicators should understand the hazards and risks associated with the pesticides they use. Pesticides vary greatly in **toxicity**. Toxicity depends on the chemical and physical properties of a substance and may be defined as the quality of being poisonous or harmful to animals or plants. Pesticides have many different modes of action, but in general cause biochemical changes which interfere with normal cell functions.

The toxicity of any compound is related to the dose. A highly toxic substance causes severe symptoms of poisoning with small doses. A substance with a low toxicity generally requires large doses to produce mild symptoms. Even common substances like coffee or salt become poisons if large amounts are consumed.

Toxicity refers to the ability of a poison to produce adverse effects. These adverse effects may range from slight symptoms such as headaches to severe symptoms like coma, convulsions, or death.

Toxicity can be either acute or chronic.

- **Acute toxicity** is the ability of a substance to cause harmful effects which develop rapidly following exposure, i.e. a few hours or a day.
- **Chronic toxicity** is the ability of a substance to cause adverse health effects resulting from long-term exposure to a substance.

There is a great range in the toxicity of pesticides to humans. The relative **hazard** of a pesticide is dependent upon the toxicity of the pesticide, the dose and the length of time exposed. The hazard in using a pesticide is related to the likelihood of exposure to harmful amounts of the pesticide. The toxicity of a pesticide can't be changed but the risk of exposure can be reduced with the use of proper personal protective equipment (PPE), proper handling and application procedures.

Measuring Acute Toxicity (LD50 And LC50 Values)

Acute toxicity of a pesticide refers to the effects from a single dose or repeated exposure over a short time (e.g. one day), such as an accident during mixing or applying pesticides. Acute toxicity is measured by LD50 and LC50 values.

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The LD50 value is the amount of pesticide (lethal dose) which kills 50% of the test animals. These treatments are through the skin (dermal) or through the mouth (oral). These values are given in milligrams per kilogram of body weight of the animal (mg/kg body wt.).

A pesticide with a lower LD50 is more toxic than a pesticide with a higher number because it takes less of the pesticide to kill half of the test animals.

The LC50 value is a measure of the toxicity of a pesticide when test animals breathe air mixed with pesticide dust, vapours or spray mist. The LC50 is the concentration of pesticide which is lethal to 50% of a population of test animals and is usually determined for a specific exposure period (e.g. inhalation for 4 hours). The length of exposure is important because shorter exposure periods generally require higher pesticide concentrations to produce toxic effects. LC50 values for pesticides in air are expressed as the ratio of pesticide to air, in parts per million (ppm) or parts per billion (ppb). LC50 values are also determined for fish and aquatic organisms based on the concentration of pesticide in water.

Important characteristics to note about LD50 and LC50 values:

- They are based on a single dose (LD50) or short exposure (LC50).
- They do not indicate cumulative effects of small doses.
- They are an indicator of the amount of chemical required to kill or severely injure animals, and do not indicate the amount of chemical causing less severe toxic effects.

The commonly used term to describe acute toxicity is LD50. LD means *lethal dose* (deadly amount) and the subscript 50 means that the dose was acutely lethal to 50% of the animals to whom the chemical was administered under controlled laboratory conditions. The test animals are given specific amounts of the chemical in either one oral dose or by a single injection, and are then observed for a specified time.

The lower the LD50 value, the more acutely toxic the pesticide, Therefore, a pesticide with an oral LD50 of 500 mg/kg would be much less toxic than a pesticide with an LD50 of 5 mg/kg. Milligrams per kilogram is the same measure as parts per million.

For example, if the oral LD50 of the insecticide parathion is 4 mg/kg, a dose of 4 parts of parathion for every million parts of body weight would be lethal to at least half of the test animals.

LD50 values are generally expressed on the basis of active ingredient. If a commercial product is formulated to contain 50 percent active ingredient, it would take two parts of the material to make one part of the active ingredient. In some cases, other chemicals mixed with

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the active ingredient for formulating the pesticide product may cause the toxicity to differ from that of the active ingredient alone. Values are usually not included on pesticide labels, but instead, signal words corresponding to toxicity values are provided.

Acute inhalation toxicity is measured by LC50. LC means *lethal concentration*. Concentration is used instead of dose because the amount of pesticide inhaled in the air is being measured.

There are four ways in which pesticides can enter the human body:

1. through the skin or (dermal).
2. through the mouth (oral).
3. Through the lungs (respiratory or inhalation).
- 4- Eyes (Ocular).

The seriousness of dermal exposure depends upon:

- The dermal toxicity of the pesticide.
- Rate of absorption through the skin.
- The size of the skin area contaminated.
- The length of time the material is in contact with the skin.
- The amount of pesticide on the skin.

Dose-response

Dose-response is the measure of the amount of a given substance an organism must absorb to produce an effect. The extensive amount of data developed about a given pesticide is often used against it because this key piece of information is ignored. For example, some acute toxicity studies, which are designed to include dosage levels high enough to produce deaths, are cited as proof of the chemical's dangers. Chronic effects seen at very high doses in lifetime feeding studies are misinterpreted and considered as proof that no exposure to the chemical should be allowed.

Frequently, this information neglects the issue of dose-response, the key principle of toxicology, which, simply stated, is "the dose makes the poison." The concentration of a chemical in any substance is meaningless unless it is related to the toxicity of the chemical and the potential for exposure and absorption. Chemicals of low toxicity such as table salt or ethyl alcohol can be fatal if consumed in large amounts. Conversely a highly toxic material may pose no hazard when exposure is minimal.

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Hazard:

Few products are subjected to the extensive and vigorous testing pesticides undergo before they are marketed. In fact, many promising pesticide products are not marketed because they do not pass the extensive toxicology testing. Older pesticide products that were registered before the current toxicology testing standards were established are being re-evaluated to ensure they meet current standards. Precautions and other safety information found on the product's label are based on information from these tests. By reading and following the directions on the label, users can minimize or eliminate hazards due to use of the pesticide to themselves and others.

Pesticide Cleanup and Disposal

If a pesticide spills, follow the three C's: **Control**, **Contain**, and **Clean up**.

1. **Control**, or stop the spill as quickly as possible.
2. **Contain** the spill by applying absorbent material such as sand, sawdust, newspaper, or pet litter.
3. **Clean** up the spill by sweeping and scooping up the absorbent material and placing it in a sealed plastic bag.

Prevent pesticide spills by safely storing and handling pesticides.

Always wear protective clothing when dealing with pesticide spills.

Pesticide labels include instructions for their disposal. Do not dispose of pesticides by flushing them down household drains. Dispose of empty pesticide containers as directed on the pesticide label. Unused or diluted pesticide materials can be used on application sites indicated on the label. Do not re-use a pesticide container for another purpose. Purchase only the amount of pesticide needed and that can be used in one season.