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Understanding the Toxicity and Hazard Posed by Pesticides

Program ID – 002698 – expires 3/27/2026

Farmers use pesticides as one means of controlling the weeds, diseases and insects that threaten their crops. It is estimated that is many instances, food production would fall by some 40 per cent without pest control products. Pesticides are an important part of making sure Americans have access to an abundant supply of safe and healthy foods and agriculture will be able to meet the challenge of feeding a growing world population.

While farmers and consumers benefit from the use of crop protection products, pesticides do pose potential risks to users and consumers if not used correctly.

A pesticide may be defines as any substance used to control pests. Target pests may be insects, weeds, diseases, etc. Most pesticides control the pests by poisoning them. Pesticides can also be toxic (poisonous) to desirable plants and animals, including humans.

Some pesticides are so highly toxic that very small quantities can kill a person, while others are relatively non-toxic and almost any pesticide can make people ill if they are exposed to a sufficient amount. Because even fairly safe pesticides can irritate the skin, eyes, nose, or mouth, it is a good idea to understand how pesticides can be toxic so you can follow practices designed to reduce or eliminate your exposure and the exposure of others to them.

The most important thing to remember is that you should always use caution whenever you work with any pesticide!

Goals of This Module

- Understand what toxicity is and how it affects humans.
- Learn the three routes of entry (how pesticides enter the body) and the importance of each.
- Be familiar with how toxicity is measured and what is meant by label warning statements.
- Distinguish between acute and chronic toxicity.
- Realize that the RISK posed by a pesticide is a function of TOXICITY X EXPOSURE

Toxicity refers to the ability of a substance to produce adverse effects or injury to a living system including the human body, or organs or metabolic systems of the body, such as the lungs or respiratory system. These adverse effects may range from slight symptoms such as headaches to severe symptoms like coma, convulsions, or death. Poisons work by altering normal body functions. Most toxic effects are naturally reversible and do not cause permanent damage if prompt medical treatment is sought. Some poisons, however, can cause irreversible (permanent) damage.

Toxicity represents the kind and extent of damage that can be done by a chemical. In other words, if you know the toxicity of a pesticide, you know “how poisonous” it is.

The effect of a pesticide is dependent on a number of factors. The most important factor is the dose-time relationship. Dose is the quantity of a substance that a human, plant, or animal is exposed to. Time means how often the exposure occurs.

Toxicity is usually divided into two types, acute or chronic, based on the number of exposures to a poison and the time it takes for toxic symptoms to develop. Acute toxicity is due to short-term exposure and happens within a relatively short period of time, whereas chronic exposure is due to repeated or long-term exposure and happens over a longer period. It is important that pesticide applicators know and understand the difference between acute and chronic toxicity.

Acute toxicity refers to how poisonous a pesticide is to a human, animal, or plant after a single short-term exposure. Acute toxicity is used to describe effects which appear right away or within 24 hours of exposure. A pesticide with a high acute toxicity may be deadly even when a very small amount is absorbed by the body. Acute toxicity levels are used as a way to assess and compare how poisonous pesticides are. The acute toxicity of a pesticide is used as the basis for the signal words (DANGER, WARNING, and CAUTION) which appear on every pesticide label. Acute toxicity may be measured as acute oral toxicity, acute dermal toxicity, and acute inhalation toxicity.

Chronic toxicity is the delayed poisonous effect from exposure to a substance. Chronic toxicity of pesticides concerns the general public, as well as those working directly with pesticides because of potential exposure to pesticides on/in food products, water, and the air. It is measured in experimental conditions after three months of either continuous or occasional exposure.

Label Identification of Acute and Chronic Toxicity

To alert pesticide users to the acute toxicity of a pesticide, the Environmental Protection Agency requires signal words to be placed on the label. Signal words are used to tell the user whether the chemical is highly toxic (DANGER), moderately toxic (WARNING), slightly toxic, or relatively non-toxic (CAUTION). These label warnings are based on the chemical's acute toxicity. Pesticide products classified as toxicity category I based on acute oral, acute dermal, or acute inhalation toxicity studies will have the signal word DANGER on the label plus the word "POISON" and the skull and crossbones symbol. If the chemical is highly likely to cause severe skin or eye irritation, the label will bear the signal word DANGER but will not display the word POISON or the skull and crossbones symbol.

In some cases, the acute oral and acute dermal toxicity of a pesticide may be in the slightly toxic category. But if the acute inhalation toxicity is in the highly toxic category, the pesticide label will have the signal words for a highly toxic pesticide. The degree of eye or skin irritation caused by the pesticide also influences the signal word.

The following table indicates the four categories of pesticide toxicity:

Categories of Acute Toxicity

		Categories of Acute Toxicity			
		LD_{50}	LD_{50}	LC_{50}	
Category	**Signal Word Required on Label**	**Oral mg/kg**	**Dermal mg/kg**	**Inhalation mg/l**	**Oral lethal dose**
I Highly toxic	DANGER [Poison + Skull & Crossbones] *	0 to 50	0 to 200	0 to 0.2	A few drops to 1 teaspoonful [or a few drops on the skin]
II Moderately Toxic	WARNING	50 to 500	200 to 2000	0.2 to 2	Over a teaspoonful to one ounce
III Slightly Toxic	CAUTION	500 to 5000	2000 to 20,000	2.0 to 20	Over one ounce to one pint or one pound
IIV Relatively Non-toxic	CAUTION	5000 +	20,000 +	Greater than 20 +	Over one pint or one pound

** Not used for skin and eye irritation effects.*

For chronic toxicity, there is no comparable set of signal words like those used for acute toxicity. Instead, a statement identifying the specific chronic toxicity problem is sometimes used on the label. Such a statement might read "This product contains (name of chemical), which has been determined to cause tumors or birth defects in laboratory animals." Chronic toxicity warning statements may be accompanied by label directions to wear certain kinds of protective clothing when handling or working with the pesticide to minimize or eliminate exposure to the pesticide.

It is important to read the label to look for signal words identifying the product's acute toxicity and for statements identifying any chronic toxicity problem. A pesticide may be low in acute toxicity (signal word CAUTION), but it may have a label statement identifying potential chronic toxicity.

A material that has high acute toxicity does not necessarily have high chronic toxicity. Conversely, a chemical with low acute toxicity does not necessarily have low chronic toxicity. For many pesticides, the toxic effects following single acute exposures are quite different from those produced by chronic exposure.

For example, large amounts of the pesticide cryolite are eaten by rats at one time little or no harmful effects will be observed. It quickly passes through the intestinal tract and is eliminated without harmful effects. However, if rats are fed small amounts of cryolite every day in their feed, they become ill and die. Cryolite is a very insoluble compound, meaning that it does not readily dissolve. The small amount of chemical that is absorbed from a one-time exposure is not sufficient to cause illness, but absorption of the same small amount every day, day after day, can cause chronic illness and death. The effects of both acute toxicity and chronic toxicity are dose-related; the greater the dose, the greater the effect.

The hazard posed by pesticides or risk of harm from pesticide exposure is equal to how poisonous the pesticide

is, multiplied by the amount and route of exposure to the pesticide, or: RISK = TOXICITY X EXPOSURE

While you cannot change the inherent toxicity of pesticides, an applicator or handler can limit the possibility of poisoning by preventing and/or limiting exposure.

Pesticide users can limit exposure by using the personal protective equipment (PPE) proscribed by the label. Washing hands and exposed skin frequently when using pesticides especially before, eating, drinking, smoking or using the restroom. It is also important that pesticide applicators and handlers, change their clothing and shower immediately after working with pesticides to reduce the amount of time they may be exposed to pesticides.

How Toxicity Is Measured

All new pesticides are tested to establish the type of toxicity and the dose necessary to produce a measurable toxic reaction. In order to compare the results of toxicity tests done in different labs, there are strict testing procedures. Toxicity testing is extensive (involving many phases) and therefore expensive. Humans, obviously, cannot be used as test subjects, so toxicity testing is done with animals and plants. Since different species of animals respond differently to chemicals, a new chemical is generally tested in mice, rats, rabbits, and dogs. The results of these toxicity tests are used to predict the safety of the new chemical to humans.

Toxicity tests are based on two premises. The first premise is that information about toxicity in animals can be used to predict toxicity in humans. Years of experience have shown that toxicity data obtained from a number of animal species can be useful in predicting human toxicity, while data obtained from a single species may be inaccurate. The second premise is that by exposing animals to large doses of a chemical for short periods of time, we can predict human toxicity from exposure to small doses for long periods of time. Both premises have been questioned.

Chronic toxicity is tested using animal feeding studies. In these studies, the pesticide under investigation is incorporated into the daily diet and fed to animals from a very young to a very old age. These, as well as the reproductive effects studies, are designed to arrive at a No-Observable-Effect-Level (NOEL); that is, a level in the total diet that causes no adverse effect in treated animals when compared to untreated animals maintained under identical conditions. This NOEL is expressed on a mg/kg of body weight/day basis.

Types of Pesticide Exposures

A pesticide exposure is defined as coming in contact with a pesticide. There are two types of exposure that may occur, acute and chronic.

Acute Exposure

Acute exposure refers to a one-time contact with a pesticide. When experimental animals are exposed to a pesticide to study its acute toxicity, acute exposure is defined as contact for 24 hours or less. Acute effects can be readily detected and more easily studied than chronic effects. Immediate toxic effects are more likely to be produced by those pesticides that are rapidly absorbed. Because of the short time between exposure and the onset of symptoms, most people will recognize or associate acute effects with a pesticide exposure. Acute illness caused by a pesticide is typically treatable with prompt medical care.

LD_{50} is the term commonly used to describe acute toxicity. LD stands for 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 smaller the LD_{50} value, the less chemical required to kill half of the test animals, and the more poisonous or toxic the pesticide. So, a pesticide with a dermal LD_{50} of 25 (rabbit) is more poisonous than a pesticide with a dermal LD_{50} of 2000 (rabbit).

LD_{50}'s do not tell us how a chemical acts, nor do they tell us how sensitive different organs within an animal or human might be. They simply tell us how much of the chemical it takes to kill half of the test animals. LD_{50}'s for different chemicals can only be compared if the same test animal was used, and even then it cannot be taken as an indication of the full toxic potential of either chemical.

LD_{50} 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 the active ingredient for formulating the pesticide product may cause the toxicity to differ from that of the active ingredient alone.

Milligrams per kilogram (mg/kg)

Pesticide LD_{50} values are measured in units of weight called "milligrams" per "kilogram" (mg/kg). A single paper clip weighs about one gram. Cutting the clip into 1000 equal parts will make pieces that weigh one milligram each. There are approximately 28,000 milligrams in an ounce. A kilogram is about equal to 2.2 pounds. The LD_{50} value refers to the number of milligrams of pesticide that was needed to kill half of the test animals for each kilogram of the animal's body weight. For example, an acute oral LD_{50} of 5 mg/kg for pesticide A (rats) indicates that it is toxic when there are 5

mg of this chemical given orally for every kilogram (or 2.2 pounds) of the animal's weight.

Parts per million (ppm)

Another way of expressing how much pesticide is involved in toxic doses is referred to as "parts per million", abbreviated "ppm". One part per million means that for every million parts of a solution or mixture, there is one part of the substance being measured. The measures mg/kg and ppm are used interchangeably since a milligram is one millionth of a kilogram. Other measures that you might come across when looking at the toxicity of a pesticide include: "parts per billion" (ppb) and "parts per trillion" (ppt).

The following list may help you remember how small these concentrations are:

- parts per million (ppm) = 1 milligram (mg)/kilogram (kg)
- 1 inch in 16 miles
- 1 minute in 2 years
- parts per billion (ppb) = 1 inch in 16,000 miles
- 1 second in 32 years
- parts per trillion (ppt) = 1 inch in 16,000,000 miles
- 1 second in 32,000 years

Lethal Concentration Fifty (LC_{50})

Acute inhalation toxicity is measured by LC_{50}. LC means lethal concentration. Concentration is used instead of dose because the amount of pesticide inhaled in the air is being measured.

To figure out the "acute inhalation toxicity" of a pesticide, scientists add a known amount of the pesticide to air. The amount that causes half of the animals to die is the "Lethal Concentration Fifty" (LC_{50}) of the pesticide. LC50 values are measured in milligrams per liter (mg/l) or ppm and sometimes in milligrams per cubic meter (mg/m3). The lower the LC_{50} value, the more poisonous the pesticide.

Chronic Exposure

Chronic exposure refers to a repeated contact with a pesticide. The potential for a chronic effect is related to the level and frequency of exposure received. Chronic effects may take many years to manifest themselves and may include carcinogenic effects (cancers), teratogenic effects (birth defects), mutagenic effects (genetic mutations), hemotoxic effects (blood disorders), endocrine disruption (hormonal problems), and reproductive toxicity (infertility or sterility).

Less is known about the chronic toxicity of pesticides than is known about their acute toxicity, not because it is of less importance, but because chronic toxicity is gradual rather than immediate and is revealed in much more complex and subtle ways. While science indicates that some pesticides have the potential to cause serious long tem chronic conditions, the link is not well understood in many instances. There is no standard measure like the LD_{50} for chronic toxicity.

Two classes of pesticides, the organophosphates and carbamates, can slowly poison by attacking an essential body chemical called "cholinesterase". The chronic exposure to organophosphate pesticides can be measured by monitoring changes in blood cholinesterase levels. In humans, decreased blood cholinesterase levels are a sure sign that exposure to these types of pesticides should be avoided until the level is measured as being normal again.

While situations resulting in acute exposure (a single large exposure) do occur, they are nearly always the result of an accident or careless handling. On the other hand, persons may be routinely exposed to pesticides while mixing, loading, and applying pesticides or by working in fields after pesticides have been applied.

The signal words on a pesticide label: "DANGER", "WARNING" and "CAUTION" refer only to the acute toxicity of a pesticide and tell users nothing about the potential chronic effects posed by repeated exposure to a pesticide. In fact, in many instances, pesticide applicators or handlers may foolishly assume that because a pesticide has a low acute toxicity, it poses little or no harm to them and fail to use proper personal equipment and take other precautions to limit their exposure and hence may increase their risk of chronic long term effects.

This leads to the question, "Are you as a pesticide applicator willing to take a risk with possible chronic effects from pesticide exposure or will you use the PPE indicated on the label and take personal responsibility to limit your exposure to pesticides?"

In addition to producing long-term low-level effects, chronic exposure to pesticides may result in immediate, "acute" effects after each exposure. In other words, frequent exposure to a chemical can produce acute and chronic symptoms.

Routes of Entry

There are three specific ways in which pesticides may enter your body. You may be poisoned no matter how they enter. Sometimes you can even be poisoned without knowing it, especially if the pesticide enters through the skin or lungs.

Dermal Route

Wet, dry, or gaseous forms of pesticides can be absorbed through the skin. This may occur if pesticides are allowed to get on the skin while mixing or applying, or if pesticide-contaminated clothing is not removed promptly and properly cleaned before being worn again. Oil based, emulsifiable concentrated or paste forms allow greater absorption through the skin than water-based pesticides. Some pesticides do not pass through the skin very readily.

Others are quickly absorbed through the skin and can be just as dangerous as if they were swallowed. Skin varies in its capacity to act as a barrier to pesticide absorption. The eyes, ear drums, scalp and groin area absorb pesticides more quickly than other areas on the body. Damaged or open skin can be penetrated by a pesticide much more readily than healthy, intact skin. Once they are absorbed through skin, pesticides enter the blood stream and are carried throughout the body.

Pesticide residues may be on or in treated plants, soil, and water or on equipment used to apply pesticides. These residues are often invisible and not easily detected by applicators during exposure.

Studies show that dermal exposure is by far the most common route of exposure for applicators and handlers which suggests that pesticide applicators should cover their skin as much as possible and should wash their hands and exposed skin frequently throughout the day and should change clothes and shower immediately after working with pesticides.

Inhalation Route

Whether as dusts, spray mist, or fumes, pesticides can be drawn into your lungs as you breathe. Inhalation of pesticides can occur during the mixing of wettable powders, dusts, or granules. Poisoning can also occur while fumigating or spraying without a self-contained breathing apparatus or a proper respirator in enclosed or poorly ventilated areas such as greenhouses, apartments, or grain bins. The largest particles that are inhaled tend to stay on the surface of the throat and nasal passages, and do not enter the lungs. Smaller particles can be inhaled directly into the lungs. The number of particles needed to poison by inhalation depends upon the concentration of the chemical in the particles. Even inhalation of dilute pesticides can result in poisoning. Once they are absorbed through the surfaces of the lungs, chemicals enter the blood stream and are distributed to the rest of the body.

Oral Route

Pesticides can enter the body through the mouth (also called ingestion). This can occur when hands are not properly washed before eating or smoking. They may be swallowed by mistake, if they are improperly stored in food containers. Ingested materials can be absorbed anywhere along the gastrointestinal tract; the major absorption site is the small intestine. Once absorbed, they eventually enter the blood stream by one of several means, and circulate throughout the body.

You can be poisoned no matter which way pesticides enter your body. While there are few chemicals that are equally poisonous by all routes of entry, some pesticides can enter all three ways and poison you. (For example, parathion is toxic regardless of how it is absorbed).

The dermal and inhalation routes of pesticide entry are likely to be the most important routes of pesticide applicator exposure. It is unlikely that you would purposely eat or drink the chemicals you are using, but you may breathe them in, splash them on your skin, or expose yourself to pesticide "drift."

Healthy skin can slow the absorption of a pesticide when dermal contact occurs. Liquid pesticides containing solvents and oil based pesticides are absorbed quickly compared to dry pesticides. The applicator must know that damaged skin (chapped, cut, or abraded) has lost its ability to slow the entry of a pesticide into the body.

The Characteristics of the Exposed Individual

The age, health, physiology and other unique characteristics of the exposed individual influence the toxicity of a pesticide since different individual characteristics will affect how the person responds to a pesticide. Some examples of these individual qualities include:

- health conditions: heredity, pregnancy, and disease may cause individuals to respond differently.
- age: youngest and oldest individuals tend to be most sensitive.
- gender/sex: male and female individuals may respond very differently.
- environment: exposure to other toxic substances in food, air, water, etc.
- health behaviors: customs or habits such as smoking, dietary practices, drug use, personal hygiene, etc.
- body size: the effect of a dose is closely related to body weight. The heavier the individual, the more poison needed to cause an effect.

Effects of Toxicity

In addition to being acute or chronic, toxic effects can be any of the following: local or systemic (Both effects can occur with some pesticides.)

Local effects refer to those that take place at the site of contact with a material. Examples of this include: skin inflammation on the hand, in response to hand contact with a pesticide; or irritation of the mucous membrane lining the lungs, due to inhalation of toxic fumes.

Systemic effects are quite different because they occur away from the original point of contact. Systemic effects may occur when pesticides are distributed throughout the body, or "system". An example of a systemic effect is the blocking of an essential chemical of the nervous system,

called “cholinesterase” upon exposure to some types of pesticides.

Immediate toxic effects are those which are experienced upon or shortly after exposure. (For example, a sneezing attack in response to inhaling pesticides during mixing).

Delayed effects occur after some time has passed. While they may not be obvious, such as long term reproductive effects, delayed effects can result from a single exposure. Tumors may not be observed in chronically exposed people for 20 to 30 years after the original exposure to a cancer-causing or “carcinogenic” chemical.

Reversible or irreversible Effects

Reversible effects are not permanent and can be remedied. Skin rash, nausea, eye irritation, dizziness, etc. are all considered reversible toxic effects. Injury to the liver is usually reversible since this organ has an ability to regenerate itself.

Irreversible effects are permanent and cannot be changed once they have occurred. Injury to the nervous system is usually irreversible since its cells cannot divide and be replaced. Irreversible effects include birth defects, mutations, and cancer.

Additive, antagonistic, or synergistic effects

An additive effect is one in which the combined effect of two pesticides is equal to the sum of the effects of each (ie. 2 + 2 = 4.)

An antagonistic effect occurs when the toxic effect of the combination of pesticides is less than what would be predicted from the individual toxicities. Antagonism is like adding 2 + 2 and getting 3 as the result.

A synergistic effect occurs when the combined toxic effect of two pesticides is much greater, or worse, than the sum of the effects of each by itself. Synergism is similar to adding 2 + 2 and getting 5 as the result.

Exposure to pesticides may also result in the following:

- Reproductive effects: Some chemicals have effects on the reproductive system affecting fertility or on the ability to produce healthy offspring. Both men and women can be affected.
- Teratogenic effects: the production of birth defects. A teratogen is anything that is capable of producing changes in the structure or function of an embryo or unborn fetus resulting in birth defects. An example of a chemical teratogen is the drug thalidomide, which caused birth defects in children when their mothers used it during their pregnancies. Measles virus infection during pregnancy has teratogenic effects.
- Carcinogenic effects: refers to the production of malignant tumors or cancer in living animal tissues.
- Oncogenic effects: Oncogenesis is a generic term meaning the production of tumors which may or may not be carcinogenic. The terms tumor, cancer, or neoplasm are all used to mean an uncontrolled progressive growth of cells
- •Mutagenic effects: refers to the production of changes in genetic structure. A mutagen is a substance that causes a genetic change. Many mutagenic substances are oncogenic, meaning they also produce tumors.
- Neurotoxicity: poisoning of the nervous system, including the brain.
- Immunosuppression: blocking of natural responses of the immune system responsible for protecting the body.

Hazard

Hazard is the risk of danger posed by a pesticide. It is the chance that harm will come to the applicator (bystanders, consumers, livestock, wildlife, crops) from the use of a pesticide. Hazard is often confused with toxicity, but they are not the same. Hazard is a function of the toxicity of a pesticide and the potential for exposure to it. We do not have much control over the toxicity of a pesticide because toxicity is a given characteristic of a particular pesticide; however, we can have control over our exposure to pesticides. We achieve control over exposure by following several safety practices including the use of protective clothing and equipment (PPE).

Usually, the more concentrated a formulation is the more hazard it poses. Dilute the concentrated pesticide and you reduce the hazard. For example, one ounce of pesticide A contains a lethal oral dose. If the same one ounce of pesticide A is diluted in ten gallons of water, each ounce of the dilute mixture will contain 0.0008 ounces of pesticide A. The handling of the dilute mixture is thus reduced when compared to the concentrate.

Use good judgment when figuring out the concentration and dosage of a pesticide; try to use the lowest concentration and/or dosage that is necessary to control the target species.

All pesticides may be hazardous if misused, no matter what their toxicity. All pesticides can be handled safely by using safety practices that minimize or eliminate exposure to them.

Federal laws regulating pesticides have placed the burden of proving safety of pesticide usage on the manufacturer. Hazard evaluation studies are generally done by scientific laboratories maintained by the manufacturer or through outside contract laboratories. 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.

For example, a highly toxic pesticide is usually considered "hazardous" because of the risk that it poses to the public or the environment. However, with proper handling, a highly toxic pesticide can actually pose a low risk or low hazard. Many factors besides a pesticide's actual toxicity can make it hazardous. These include: the skill of the applicator; the target pest involved; the type of pesticide; the formulation chosen; the other chemicals involved in the formulation; and the concentration and dosage used.

Applicator

A skilled, experienced applicator using a highly toxic material will be less of a hazard to himself and others than perhaps a homeowner who applies pesticides on his/her property. A certified applicator should have the skill and knowledge to handle all pesticides safely.

Target

The site of application is called the target. It can consist of plants, soil, insects, animals, structures and many other things. The intended use of a pesticide on a target is to control specific target pests without harming "non-target species." The ideal pesticide controls the target pest and poses little or no hazard to non-target species, as well as the target area itself.

Formulation

The hazard of a pesticide is also influenced by the way a pesticide is put together, or made into a formulation for use. Depending on the original toxicity of the pesticide, formulations that are easily absorbed or inhaled may pose more of a hazard than those that are less easily absorbed or inhaled. Keeping in mind all the factors that influence the toxicity of the pesticide, formulations generally pose the following toxicity hazard in decreasing order: emulsifiable concentrate > oil solution > water emulsion > water solution > wettable powder/flowable (in suspension) > dust > granular. Choose the safest formulation available to do the job.

All pesticides can be hazardous. Use caution whenever you handle them!

Before using any pesticide:

- Read the Label thoroughly and become familiar with all precautions.
- Put on the proper Personal Protective Equipment (PPE). The pesticide label will list the minimum amount of protective equipment, like gloves or goggles, necessary to reduce your exposure. Consider using additional protective equipment to decrease your exposure even further
- Review the product signal word and active ingredients, and then choose the product lowest in toxicity that will provide control of the target pest.
- Choose products with formulations least likely to lead to exposure.
- Avoid splashing, spilling, leaks, spray drift, and contamination of clothing.
- Never eat, smoke, drink, or chew while using pesticides.

By taking proper precautions and exercising personal responsibility, it is possible to reduce the risk posed by pesticides and to use them safely and effectively.

Adapted from:

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