

## HUMAN HEALTH

Pesticides are designed to kill or control pests like weeds, insects, fungi, or rodents. If not handled properly, pesticides can harm humans. Poor handling can result in exposure to the applicator, bystanders, food crops, non-target plants and the environment. Pesticide exposure can be dermal, oral, through inhalation, or through the eyes. Careful handling reduces risk. Always follow label directions and wear proper personal protective equipment (PPE). Pesticide applicators should know the toxicity of the chemical families of the pesticides they use.

### Learning Objectives

Completing this chapter will help you to:

- **Know why individuals using pesticides should have medical examinations.**
- **Understand what cholinesterase is and how exposure to pesticides can affect it.**
- **Know when, how and how often to get a blood for cholinesterase.**
- **Know the general health effects of the pesticides used in the landscape industry.**
- **Know that over time, exposure to low doses of organophosphate and carbamate pesticides can affect the nervous system.**
- **Know that repeated exposures to organophosphate and carbamate pesticides can result in sudden poisoning.**
- **Know that exposure to organophosphate and carbamate pesticides may not be reversible.**

## Before Working with Pesticides

Anyone planning to use pesticides should have a full medical examination. Explaining the nature and type of work to your physician will enable him/her to assess your “fitness” to work with pesticides. Individuals with certain medical conditions may not be able to work safely with pesticides: These include:

- Respiratory or heart disease that may preclude the use of respiratory protection
- Low levels of cholinesterase may preclude use of organophosphate or carbamate pesticides

Tell your employer/supervisor about any medical conditions that may make it unsafe for you to use pesticides.

Anyone using pesticides as part of their job should also have a regular medical examination.

## Organophosphate and Carbamate Pesticides and Your Health

Organophosphate and carbamate pesticides are the most acutely toxic landscape pesticides. Pesticides in these families can affect the nervous system. They can inhibit the cholinesterase enzyme. Excessive exposure to these pesticides can reduce the work of this enzyme. This will cause acute poisoning symptoms.

Check the toxicological information on the secondary label panel and/or MSDSs of the pesticides you will be handling in the coming use season. Watch for a notice that states, “This product may cause cholinesterase inhibition”. Follow the label recommendations for safe handling and personal protective equipment.

## The Role of Cholinesterase

When a message moves through the nervous system, a signal must pass from one nerve cell to the next, across gaps. When the message reaches a gap, a chemical called acetylcholine is released. This chemical carries the message to the next nerve cell (*see Figure 2-1*).

When the message arrives, cholinesterase breaks down the acetylcholine. This clears the gap and readies it for the next message. Organophosphate and

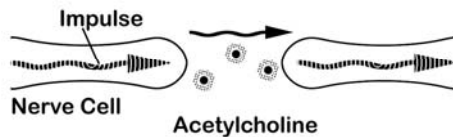
carbamate insecticides bind with the cholinesterase and make it unavailable. When there is not enough cholinesterase, messages are sent to nerve cells over and over again. This causes muscles to twitch without stopping (tremors). If muscle action becomes intense, the victim may have seizures. The entire nervous system can be affected. Quick and proper medical care is needed for organophosphate poisoning.

**Cholinesterase is an enzyme found in the blood. It allows the nervous system to control muscle movement. Organophosphate and carbamate pesticides may interfere with this enzyme.**

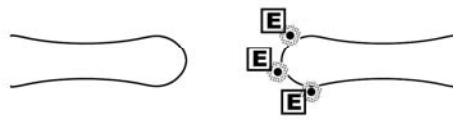
**Figure 2-1: Normal and Inhibited Nerve Function.**

### Normal and Pesticide Inhibited Nerve Function

A nerve impulse is sent down the nerve cell and carried across the gap to the next cell by acetylcholine.

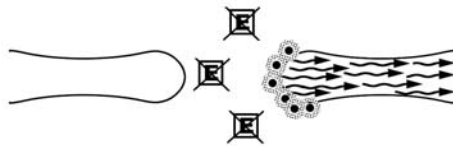


When the message has been received, the acetylcholine is degraded by an enzyme called acetylcholinesterase (E). This stops the message from continually firing.



### Enzyme Inhibition by Pesticide

Organophosphate or carbamate insecticides bind with acetylcholinesterase and prevent the removal of acetylcholine.

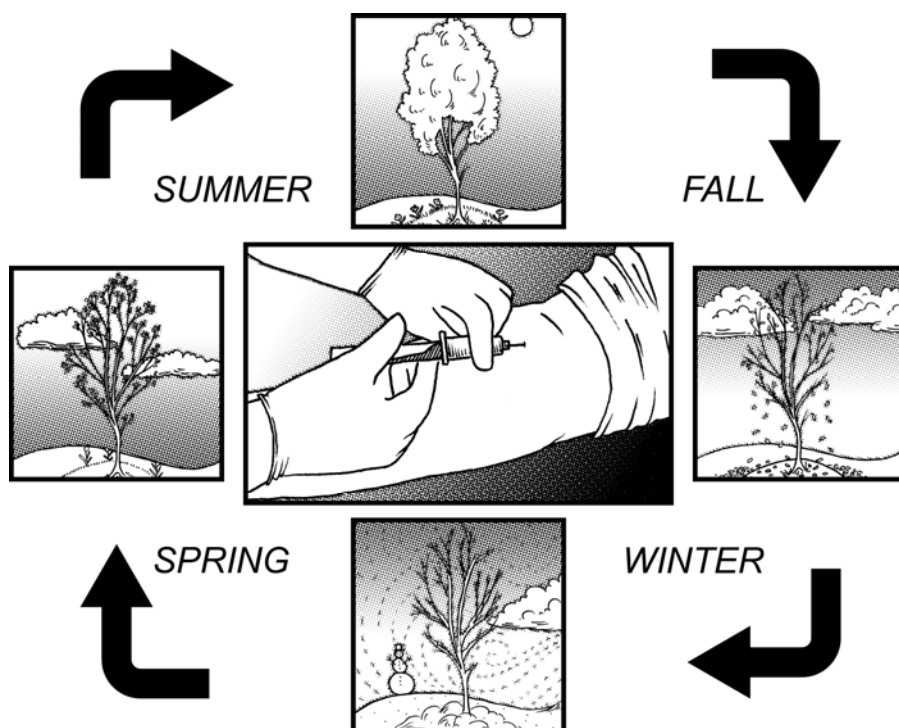


The messages keep on firing and the system is overstimulated, resulting in twitching, convulsions and even death.

## Cholinesterase Blood Test

A blood test which measures level of cholinesterase in a person's blood may allow medical personnel to tell if a patient's symptoms are the result of organophosphate or carbamate poisoning. Each person has a different normal baseline value of cholinesterase. The blood test that is done at the beginning of the season before any pesticides are used gives the person's normal value for cholinesterase (e.g., the baseline). When exposure occurs, the cholinesterase level in the blood may be reduced. Exposure can result from not wearing or taking care of personal protective equipment and clothing. It can also result from not washing after handling these products. Contact a doctor to find out about this blood test.

**Figure 2-2: Cholinesterase blood tests should be done at various times, to set baseline values, and determine if levels are acceptable.**



Blood tests should be done at the start of the season before handling or using these pesticides. Blood tests should then be taken at regular intervals throughout the spray season. They should also be taken if poisoning is suspected. In order to be useful, cholinesterase testing must be done right after exposure. This can then be compared to a person's baseline value. Any changes should be noted. A medical professional who is familiar with pesticide exposure must then analyze these blood test results.

The medical professional who checks the results will advise further action if required. The test is effective for carbamates and organophosphates only.

Blood testing results may indicate a need to prevent further exposure. Without further exposure, blood cholinesterase will return to normal levels in about 120 days (in the case of organophosphate poisoning). This will be more rapid for carbamate poisoning.

## Precautionary Steps

If cholinesterase inhibition is indicated on the pesticide label, consult medical personnel before the start of the season and arrange for blood tests. This will provide a personal baseline of cholinesterase activity for all applicators who will handle these pesticides.

Repeat blood tests at regular times throughout the spray season. Check this against the person's baseline value. A lower reading than this value may mean an exposure has occurred. The medical professional will advise if any required follow up action should be taken.

A person showing poisoning symptoms after handling carbamate or organophosphate pesticides should have the blood test repeated. This should then be checked against the baseline value.

### In Review

**Some pesticides used in the landscape industry are cholinesterase inhibitors. Those involved with handling pesticides need to check the secondary label panel of all pesticides. They should look for warnings such as: 'This product may cause cholinesterase inhibition'.**

**Every person has a different baseline value of cholinesterase. Workers are advised to have their blood tested for cholinesterase before handling pesticides. This test gives a person's baseline value. Blood tests taken later can be compared with this. A medical professional who is familiar with pesticide exposure must analyze the blood test results.**

**Follow-up blood tests can be done at any time in the use season. A blood test for cholinesterase should be performed if any symptoms of poisoning occur.**

## General Pesticide Effects on Human Health

Some pesticides used in the landscape industry are more toxic to humans than others. Pesticides in the organophosphate and carbamate chemical families require extra care. Workers in the landscape industry need to know the hazards of a single or repeated pesticide exposure. Knowing and using this information can minimize human health effects. Information on human toxicity for landscape industry pesticides is given below. **Table 2-1** shows some common ways that landscape applicators can be exposed.

**Table 2-1: Some common ways in which landscape applicators can be exposed to pesticides.**

<i>Point of Exposure</i>	<i>Common Ways of Being Exposed</i>
Dermal	<ul style="list-style-type: none"> <li>Not washing hands after handling pesticides, containers, or equipment</li> <li>Splashing /spilling pesticide on skin</li> <li>Not wearing gloves when removing pesticide- contaminated personal protective equipment</li> <li>Applying pesticides in windy weather</li> <li>Not wearing gloves when touching treated plants or when handling spray equipment</li> </ul>
Oral	<ul style="list-style-type: none"> <li>Not washing hands before eating, smoking, or chewing gum</li> <li>Splashing pesticide into mouth</li> <li>Storing pesticide in anything but the original container</li> </ul>
Inhalation	<ul style="list-style-type: none"> <li>Handling pesticides in confined or poorly ventilated areas without wearing a respirator</li> <li>Handling dusts or powders without wearing a respirator</li> <li>Using an inadequate or poorly fitting respirator</li> <li>Being exposed to drift without wearing a respirator</li> <li>Not washing hands before smoking</li> </ul>
Eye	<ul style="list-style-type: none"> <li>Rubbing eyes or forehead with contaminated gloves or hands</li> <li>Splashing pesticide in eyes</li> <li>Pouring dry formulations without wearing goggles</li> <li>Applying pesticides in windy weather without wearing goggles</li> </ul>

## Acute Pesticide Poisoning Symptoms

Acute pesticide poisoning symptoms are described in the core. The following section describes how different groups of pesticides commonly used in the turf and landscape can affect human health.

### Organophosphate Insecticides (OPs)

Many pesticides in this group are highly toxic to humans. They are quickly absorbed through the skin, lungs, or digestive tract. Even the least toxic of this group can cause poisoning.

Occasional mild exposure to these pesticides is not likely to produce toxic effects. However, repeated exposure to small doses of organophosphate insecticides is dangerous. These pesticides can affect humans and animals by interfering with an enzyme called **cholinesterase**. This enzyme is needed for proper nerve function.

Symptoms of poisoning can occur without warning if cholinesterase levels do not return to normal. There are often no serious long-term effects from small exposures, if exposure is then avoided until cholinesterase levels return to normal. If the exposure continues, there may be an irreversible inhibition of cholinesterase. This may cause either acute or long-term chronic health effects. This is a concern for workers in the landscape industry. Applicators may be exposed a number of times during routine handling of pesticides (see **Table 2-1**).

People who use organophosphate insecticides should have a blood test before each spray season. This gives a baseline cholinesterase level. Blood testing should be repeated at regular times during the season. This will detect any changes in blood cholinesterase levels. A decrease from the baseline level may show that exposure has occurred. This should be reported to the employer. Additional information on cholinesterase testing can be found later in this chapter.

### Acute Poisoning Symptoms

Symptoms of acute poisoning from organophosphate insecticides may occur at once or within 12 hours after exposure. Workers should know the following symptoms, and should be able to recognize them in themselves or others:

Mild symptoms include:

- Loss of appetite
- Headache
- Dizziness
- Weakness
- Anxiety
- Tremors of the tongue and eyelids
- Contracted pupils
- Vision problems

Contact a doctor if any of these symptoms are noticed.

Moderate symptoms include:

- Nausea
- Salivation
- Stomach cramps
- Vomiting
- Sweating
- Slow pulse
- Muscle tremors

Severe symptoms include:

- Diarrhoea
- Pinpoint and non-reactive pupils
- Breathing trouble
- Pulmonary fluid build-up
- Bluing of skin
- Loss of bowel control
- Convulsions
- Coma
- Heart trouble

Medical care should be sought at once for those showing moderate to severe symptoms of poisoning.

## Carbamates

Carbamates act in a similar way to organophosphates by inhibiting the cholinesterase enzyme. Unlike organophosphates, carbamates are quickly broken down in the body. Cholinesterase inhibition is brief. Unless special measures are



taken, readings of blood cholinesterase in humans exposed to carbamates are often inaccurate and may appear normal. Symptoms of carbamate poisoning are similar to the symptoms of acute organophosphate pesticide poisoning (listed previously), but last for a shorter time.

## Botanical Insecticides

Poisoning by botanical insecticides is rare. Botanical insecticides usually contain a low concentration of active ingredient. They have high LD<sub>50</sub> values for mammals. Botanical insecticides may include many of the mild acute poisoning symptoms listed previously. An allergic-type reaction can occur from dermal exposure. An irritation of the throat and lungs (causing wheezing or coughing) can occur from inhalation.

## Synthetic Botanical Insecticides

Poisoning by this group is rare. Synthetic botanical insecticides usually contain low concentrations of active ingredient. Like natural pyrethrins, synthetic pyrethroids have low to moderate acute toxicity to mammals. They have high LD<sub>50</sub> values for mammals (e.g., Cymbush LD<sub>50</sub> is 247 mg/kg body weight). These pesticides can irritate the skin and respiratory tract. Applicators should avoid breathing vapour or spray mist.

## Phenoxy Herbicides

The acute toxicity of phenoxy herbicides can be low to moderate. Exposure to the solvent in the formulated product can produce ill effects. Some solvents are moderately irritating to the skin, eyes, respiratory tract, and gut lining.

## Dithiocarbamate and Thiocarbamate Pesticides

This group has a low acute toxicity and does not inhibit cholinesterase. Some products in this group can irritate the skin, eyes, nose, throat, or lungs and must still be treated with caution. They can also cause nausea, vomiting, or muscle weakness (in very large doses).

## Petroleum-Based Products

Petroleum distillates (e.g., kerosene, solvent distillate, diesel oil) are used as solvents, carriers and diluents in pesticide formulations or as a pesticide themselves (e.g. dormant oils). Two types of petroleum products are found in pesticides and may affect human health:

- Petroleum distillates
- Aromatic hydrocarbons

### Petroleum Distillates

Petroleum distillates (e.g., kerosene, solvent distillate, diesel oil) are used as part of the pesticide formulation as a diluent or as a pesticide themselves. They have a wide range of toxicities. Symptoms of acute poisoning include:

- Nausea
- Vomiting
- Cough
- Lung irritation (This can cause bronchial pneumonia with fever and cough.)

If more than 1 mg of petroleum distillate for each kg body weight is ingested, central nervous system depression and irritation may occur. Symptoms include:

- Weakness
- Dizziness
- Slow and shallow breathing
- Unconsciousness
- Convulsions

Chronic or long-term poisoning can cause:

- Weakness
- Weight loss
- Anemia
- Nervousness
- Pains in the limbs
- Numbness

## Aromatic Hydrocarbons

Aromatic hydrocarbons (e.g., xylene) are used as part of the pesticide formulation. They have a range of toxicities. Symptoms of acute poisoning include:

- Dizziness
- Euphoria
- Headache
- Nausea
- Vomiting
- Tightness in the chest
- Staggering

Severe symptoms include blurred vision, rapid breathing, paralysis, unconsciousness or convulsions. Even the least toxic of this group may poison humans if it is used improperly. Repeated exposure to small doses is also a hazard. Symptoms of acute poisoning may occur at once or within 12 hours of contact.

### Summary

The risks and hazards from a single or repeated exposure to landscape pesticides will vary. All cases of exposure cause risk. Workers need to know the hazards. They must take all proper safety measures to reduce exposure including:

- Following label directions
- Wearing proper personal protective clothing
- Using good hygiene

People who work with landscape pesticides must guard against exposure and reduce risk. They must know the toxicity of the different chemical families of the pesticides being used. Symptoms may be mild, moderate, or severe. This depends on the amount of exposure and the pesticide's toxicity.

The more toxic organophosphate and carbamate families of pesticides are a toxicity concern. A single or repeated low dose may interfere with the cholinesterase enzyme. This enzyme regulates the flow of nerve signals to the muscles. This may cause serious poisoning.

Blood should be tested before handling cholinesterase inhibitors. This gives a baseline value. A medical professional may compare this value against later test results. This allows one to tell if there has been an exposure.

## Self-test Questions

*Answers are located in Appendix A of this manual.*

1. Repeated exposure to small doses of an organophosphate insecticide is not very dangerous. **True or false?**
2. An applicator exposed to an organophosphate insecticide may show a decrease in cholinesterase enzyme level. **True or false?**
3. There are often no serious long-term effects from small exposures to organophosphate insecticides. This is as long as added exposure is avoided until cholinesterase levels return to normal. **True or false?**
4. Like organophosphate compounds, carbamates are broken down slowly in the body. **True or false?**
5. Weakness in muscles used for chewing and swallowing may be a symptom of exposure to which chemical family?  
\_\_\_\_\_
6. List the two (2) symptoms of acute poisoning from petroleum distillates.  
\_\_\_\_\_
7. Exposure to organophosphate or carbamate pesticides can affect the nervous system by inhibiting the acetyl cholinesterase enzyme. **True or False?**
8. If organophosphate or carbamate insecticides are present in the body, there will not be enough cholinesterase to break down acetylcholine. List symptoms of poisoning that can occur when this happens.  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

LANDSCAPE

9. Organophosphate or carbamate insecticides are going to be used. Explain why it is important to have a pre-season blood test for cholinesterase.

---

---

10. Phenoxy herbicides are cholinesterase inhibitors. **True or False?**

