

PESTICIDE SAFETY

This information on safe pesticide use is summarized from the B.C. Pesticide Applicator Course for Agricultural Producers. The course is available from the Office Products Centre of the Ministry of Government Services. The toll free phone number is 1-800-282-7955.

Legislation

Laws protect applicators, bystanders, consumers and the environment. You can be fined for breaking the laws.

Canadian Laws

PEST CONTROL PRODUCTS ACT AND REGULATIONS

Every pesticide used or sold in B.C. must be registered by Health Canada. Each label must have a PCP Act number on it. Using pesticides without a PCP Act # (from other countries) is against the law unless you have a pesticide own use import permit. Each label must also list the crops and pests the pesticide can be used on. Using pesticides for uses not on the label is against the law. However, there are a few minor pesticide uses that may be registered but not be on the label. This guide includes these minor uses.

Pesticides are labeled as Domestic, Commercial or Restricted. Restricted products are more hazardous and have special restrictions on the label.

THE FOOD AND DRUGS ACT

All foods must be free of harmful amounts of substances. Health Canada sets levels of allowable pesticide residues on crops at harvest. These levels are called maximum residue limits or MRLs. Crops are tested for pesticide residues at the time of sale. If residues are more than the MRL the crop may be seized. If you follow the recommendations on the labels or in this production guide and wait the required days before harvest, residues should not be over the limit.

THE FISHERIES ACT AND MIGRATORY BIRDS REGULATIONS

You can be charged if you kill or harm fish or migratory birds with pesticides. This applies to creeks, rivers, and lakes on your own property as well as on public land. It is illegal to introduce pesticides into waters either directly or indirectly through spray drift or run-off.

TRANSPORTATION OF DANGEROUS GOODS ACT

Certain dangerous goods cannot be transported unless you use shipping documents, special labels, and vehicle signs. Ask your pesticide dealer if the product you have bought needs special transport procedures. Growers are usually exempt from this when they are transporting less than 500 kg of pesticide.

British Columbia Laws

PESTICIDE CONTROL ACT AND REGULATIONS

The Ministry of Environment, Lands and Parks also has rules about the sale and use of pesticides in B.C. Rules that apply to farmers include:

1. Pesticides labeled Restricted or Commercial must be kept in vented and locked storage which has a warning sign on the door.
2. Anyone buying or using pesticides labeled Restricted must have an applicator certificate. The Relative Toxicity table lists which pesticides (referred to in the tree fruit production guide) can only be purchased and used by certified applicators under the Pesticide Control Act (Environment column).
3. People applying pesticides to public land must have a Pesticide Use Permit.
4. Businesses selling pesticides must be licensed and their sales people must be certified.
5. Anyone applying pesticides in exchange for a fee must have an applicator certificate and a Pest Control Service License. But, if you spray your neighbor's crops you do not need a license if the work is done as a favour and no money is exchanged.
6. Everyone must dispose of containers and left over pesticides safely.

WORKERS' COMPENSATION BOARD

Workers' Compensation Board (WCB) Regulations for Occupational Health and Safety in Agriculture apply to farmers who must be registered by WCB. If you are unsure whether they apply to you, call WCB at 1-800-661-2112 local 6182.

The WCB regulations cover conditions of workplaces such as general safety procedures, hazardous substances, pesticides, confined spaces such as silos and storage bins, protective clothing and equipment, tools, machinery and equipment, and animal handling.

The WCB regulations on pesticides outline requirements for pesticide applicator certification, emergency medical care, washing facilities, personal protective clothing and equipment, application equipment, pesticide application, posting warning signs, re-entry into treated areas, record keeping, drift prevention, and aerial application. Copies of the regulations are available from any WCB office.

The WCB pesticide regulations states that workers must be over 16 years old and must have a valid pesticide applicator certificate from the Ministry of Environment, Lands and Parks if they mix, load or apply moderately or very toxic pesticides or if they clean or maintain application equipment for these pesticides. The Relative Toxicity table lists which pesticides require an applicator's certificate under the WCB regulations.

The WCB re-entry requirements are in the pesticide section under re-entry. The record keeping requirements have been incorporated into the grower's spray record in this book. Refer to the regulations for the rest of the WCB requirements.

Toxicity

Some pesticides are more poisonous or toxic than others. The toxicity of pesticides in this guide are listed in a table after the safety guidelines. The categories are: very toxic, moderately toxic and slightly toxic. They indicate short term toxicity and are based on the LD₅₀ of the active ingredient. The LD₅₀s which correspond to the categories are:

Toxicity	Oral LD ₅₀	Dermal LD ₅₀
Very Toxic	0 to 50	0 to 200
Moderately toxic	51 to 500	201 to 1,000
Slightly toxic	over 500	over 1,000

The values are only a guide to the toxicity to humans.

Hazard Shapes and Symbols

Shapes and symbols on pesticide labels indicate how harmful a pesticide can be. The shapes indicate how hazardous the product is. The symbols inside the shapes tell you the type of hazard. If symbols are not on labels, the pesticide has very low hazard.

Exposure

Pesticides can enter your body through the skin (dermally), the mouth (orally), the nose (inhalation), or the eyes. The skin is the most common route of poisoning for pesticide applicators. Skin contact may occur from a splash, spill or drift. Your skin is most likely to get contaminated when you are mixing and loading pesticides.

Hazard

The hazard of using a pesticide depends on both its toxicity and the amount of exposure. Reduce hazards by selecting pesticides with low toxicity and by reducing exposure. Wear protective gear and follow safety guidelines.

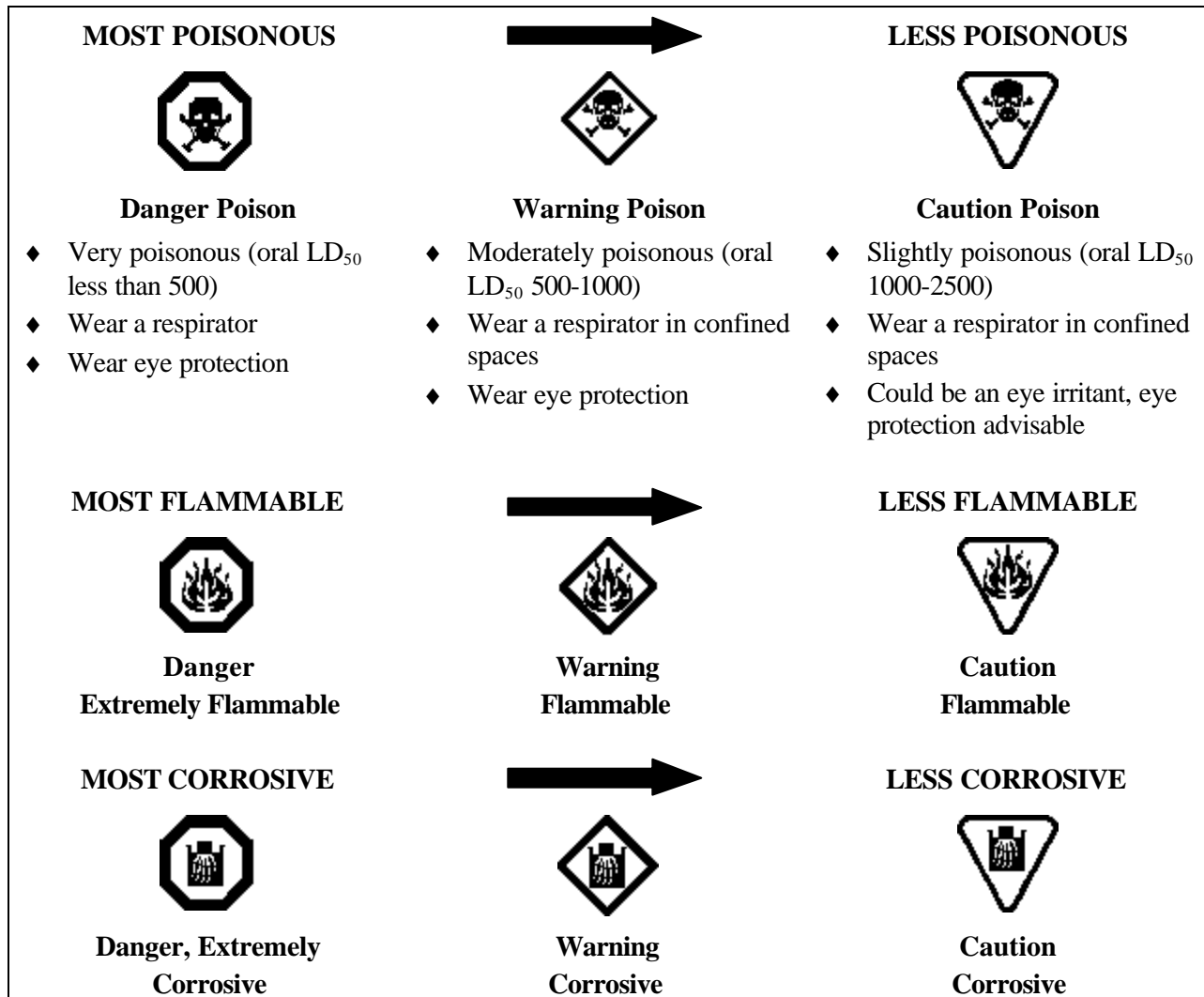
Poisoning and First Aid

Symptoms of Pesticide Poisoning

Know the poisoning symptoms of the pesticides you use. Read pesticide labels for symptoms. Effects from pesticide poisoning vary from person to person and are often hard to recognize. Some poisoning symptoms are headache, tiredness, nausea, dizziness, irritation of the skin or nose or throat, blurred vision, tiny pupils, trembling, perspiration, difficult breathing, vomiting, and unconsciousness. Call your doctor or Poison Control Centre immediately if you suspect poisoning. Follow their instructions.

Pesticide Warning Symbols

Pesticide warning symbols on chemical labels let you know the hazards of the product. They symbols you may see are:



Poison Control Centres

Poison Control Centres are open 24 hours a day. They give first aid information and treatments for poisoning.

The phone number of Poison Control Centre is in the front of the phone book under Emergency Numbers.

First Aid

Make sure you, and other people on the farm, know what to do in case of an emergency. Consider taking a first aid course and CPR course.

If someone has been poisoned:

1. Protect yourself.
2. Move the victim from the area of contamination.
3. Check if the victim is breathing. If breathing has stopped or is very weak, clear the airway and begin artificial respiration. Continue until the victim is breathing normally or until medical help arrives. When doing mouth-to-mouth resuscitation, use a plastic mask to protect yourself from poison.
4. Call the Poison Control Centre, doctor or ambulance. Be ready to tell them the pesticide name and PCP Act registration number.
5. Unless the doctor or Poison Control Centre tells you otherwise, follow the procedures listed below, then:
6. Transport the patient to the nearest hospital.

If a pesticide contacts the eyes put on waterproof gloves and hold the eyelids open and rinse with clean water for 15 minutes or more. Do not use an eye cup.

If pesticide contacts the skin put on waterproof gloves, remove the contaminated clothing, and wash the affected area of the skin with lots of soap and water.

If pesticide was breathed in, take the victim to fresh air as quickly as possible ; loosen tight clothing and watch for signs of unconsciousness or convulsions. Keep the airway open and begin resuscitation if breathing has stopped or is difficult. Use a plastic face mask to protect yourself.

If a pesticide is swallowed check the label to see if vomiting is recommended. Do not induce vomiting if:

- the label says not to,
- the substance swallowed contains a petroleum product,
- the victim is unconscious or convulsing, or
- if the substance is corrosive.

To induce vomiting, give the victim water and tickle the back of the throat and tongue with your finger. If the victim cannot sit, place the person face down on their side. Keep the airway free of vomitus.

If a corrosive substance was swallowed and the victim is conscious and able to swallow, give them a half to full glass of milk or water. Do not give them large amounts to drink as it may induce vomiting.

WARNING: Do not induce vomiting if an acid, alkali or petroleum product is swallowed.

Protective Clothing and Equipment

Wear protective clothing and equipment to minimize exposure to pesticides. Remember to wear safety equipment during mixing and loading, application, and clean-up. Always wear coveralls, waterproof boots, waterproof gloves, and proper hat. You may also need to wear eye or face protection, respirator,

waterproof apron, waterproof pants and jacket. The equipment you wear depends on the pesticide and type of application. Therefore, follow the safety recommendations on the pesticide label.

Coveralls

Wear long sleeved coveralls over full length pants and long-sleeved shirts. Make sure the coveralls are closed at the neckline and wrists. Remove your coveralls as soon as you have finished your pesticide activities. Remove them immediately if they become wet through with pesticide. Wear waterproof clothing if you might get wet during pesticide application.

Some disposable coveralls are suitable for pesticide use. Check with your supplier to see which ones can be used for pesticide application. When removing disposable coveralls, take care not to contaminate the inside if you will wear them again. Between wearing, hang them in a well ventilated area away from other clothing. Do not launder disposable coveralls but do wash clothing worn under disposable coveralls as you would other clothing worn during pesticide use. Replace with a new coverall when severe pilling (balls on the surface), rips or holes appear. To discard, place in a plastic garbage bag and take to a landfill site. Do not burn.

Gloves

Always wear gloves when handling pesticides. Many glove materials are available. Use unlined waterproof gloves unless the pesticide label recommends a specific material. Do not use gloves made of leather, cloth, or natural rubber or gloves with cloth linings. Make sure the gloves do not have holes or leaks. Keep your coverall sleeves over the gloves and fold down the tops of the gloves to make cuffs. Wash your gloves before removing them and after each use.

Boots

Wear waterproof, unlined knee-high boots of rubber or neoprene when you load, mix or apply pesticides. Wear your pant legs outside of your boots. Do not wear boots made of leather or fabric. Wash the outside of your boots after each use.

Goggles and Face Shields

Wear goggles if there is a chance of getting pesticide spray or dust in your eyes. Do not use goggles with cloth or foam headbands. Do not wear contact lenses when handling pesticides. Face shields provide extra protection when mixing and loading toxic pesticides. Wash goggles and face shields after use.

Hats

Wear a waterproof hat when pesticides may be splashed or when you could be exposed to drift. Wear a wide brimmed rubber rain hat when you will get wet with spray. Do not wear baseball caps, fabric hats, or hats with leather or cloth inner bands.

Aprons

Wear a waterproof apron when you pour and mix concentrated pesticides.

Respirators

Wear a respirator when the label says to wear one; or when the label says to avoid inhalation of dust, vapour, or spray mist; or if there is a danger poison symbol on the label; or if you are applying pesticides in an enclosed space. Make sure your respirator fits. Men should shave before using a respirator as facial hair prevents a proper fit.

Full face respirators give more protection and may be more comfortable than a half face mask and goggles.

Do not use dust masks when applying pesticides. They do not protect you from the fumes.

Specially designed, enclosed tractor cabs fitted with air-purifying devices can protect you from pesticide vapours. A regular enclosed cab is not adequate protection if a respirator is required.

Special respirators must be worn when using a highly toxic fumigant such as methyl bromide. Check the label for details.

Respirators must be approved by NIOSH or an agency sanctioned by the Workers' Compensation Board. The cartridges remove toxic fumes from the air. Cartridges labeled for organic vapours or pesticides are needed for most pesticides. Filters remove dust and mist. Both filters and cartridges must be replaced regularly for the respirator to work.

When you use your respirator:

- Check the intake and exhaust valves.
- Make sure there are no air leaks around the face mask. Do an inhalation or exhalation test.
- Change the dust filter after 4 hours of use or more often if breathing becomes difficult.
- Change the cartridges after 8 hours of use or sooner if you can smell the pesticide. Replace cartridges at least once a year, and more often if you use them frequently.

Cleaning Protective Clothing and Equipment

After application wash your gloves, boots, goggles, faceshield and apron. Wash your respirator face piece with soap and warm water. Then rinse it with clean water and dry it with a clean cloth. Keep the cleaned respirator in a plastic bag in a clean, dry place. Store the respirator and protective clothing away from pesticides and spray equipment.

Discard any clothing that has become soaked with a pesticide.

Launder all your clothing after each day of applying pesticides. Wash protective clothing separately from the rest of the laundry. Do not touch contaminated clothing with bare hands. Use rubber gloves. Pre-rinse clothing using the presoak cycle. Use a high water level and the hottest water setting on your machine. Use a heavy-duty detergent.

If clothes are heavily contaminated, run two complete cycles. Hang clothes outside to dry in the sunlight if possible. Clean the washing machine by running it through a full cycle with detergent and no clothes to remove any pesticide residue.

Personal and Environmental Safety Guidelines

Buying Pesticides

- Make sure the pesticide is registered for your specific use.
- Buy only what you can use up in a year.

Transporting Pesticides

- Never transport pesticides with food, feed, fertilizer, clothing, or household goods.
- Lock up the pesticides if you leave your vehicle.
- Never transport pesticides in the passenger section of any vehicle.
- Ask the supplier if you need shipping papers and vehicle warning signs.

Storing Pesticides & Shelf Life

Pesticides vary in their stability and response to storage conditions. Try to purchase only quantities of pesticides that can be used up in one growing season. However, under proper storage conditions most pesticides can be used after at least one year of storage. Follow these guidelines for storage:

- The law says Commercial and Restricted pesticides must be kept in locked and vented storage that has a warning sign on the door.
- Store pesticides in their original container with the original label.
- Never keep pesticides near livestock, food, feed, seed, wells, water supplies, or in your home.
- Keep herbicides separate from other pesticides.
- Return pesticides to storage when not in use.
- Keep a list of the pesticides in storage.
- Protect the pesticides from extreme temperatures. Some liquid pesticides are destroyed by freezing. Temperatures should not exceed 40° C.
- Close containers when not in use.
- Dispose of unwanted, unmarked and damaged containers.
- Keep containers above floor level to protect from dampness and flooding.
- Post emergency numbers near-by.
- Keep a fire extinguisher, broom and shovel, absorptive material, and protective clothing near-by in case of emergencies.

Mixing and Loading Pesticides

- Wear protective clothing and equipment.
- Read and follow label directions.
- Choose a mixing and loading site away from people, livestock, pets, wells, and water bodies.
- Measure accurately.
- Do not rip open paper pesticide bags. Slit them open with a sharp knife.
- Mix pesticides in still or low wind conditions. Stand up-wind of the pesticide.
- Hold the container below eye level when measuring or adding pesticide into the spray equipment.

- Only use mixing equipment for pesticides and return it to locked storage when not in use.
- Rinse pesticide containers as soon as they are empty. Rinse measuring and mixing equipment. Put rinse water into the sprayer.
- Use clean water. The pH of the water should be from 5.0 to 7.0.
- Prevent overflow. Don't leave the tank unattended.
- Prevent contaminating the water supply by leaving at least a 15 cm air gap between the end of the filler hose and the water in the spray tank. You can also use a backflow preventor valve or nurse tank.

Applying Pesticides

- Read and follow label directions.
- Use calibrated application equipment.
- Use the label or production guide rate.
- Wash before eating, drinking, smoking, or using the toilet.
- Have fresh water and emergency supplies on hand.
- Make sure the area to be treated is clear of people and animals.
- Don't work alone when handling very toxic pesticides.
- Post warning signs if necessary to keep people out of treated areas.
- Use separate equipment for applying herbicides.
- Cover or remove animal food and water containers near the treatment area.
- Wear gloves to replace or clean plugged nozzles. Do not blow out a plugged nozzle or screen with your mouth. Use a soft brush or toothpick.
- Shut off the spray nozzles when you turn and stop the flow of granulars at the end of rows.
- Pesticides must be registered for chemigation before they can be applied through irrigation systems. Therefore only apply pesticides through the irrigation system when the label has instructions for chemigation. If chemigation is used, follow "Chemigation Guidelines for BC". This publication is available from the Ministry of Agriculture and Food.
- Use and maintain the tractor speed chosen during calibration.
- Prevent pesticides from contaminating non-target areas. Leave an untreated area around lakes, streams, ditches, and wells. Spray down wind from sensitive areas. Minimize drift by:
 - spraying only when winds are less than 5-8 km/hr. There is usually less wind in the early morning and late evening.
 - not spraying when temperatures are greater than 30° C.
 - using boom sprayers with as low pressure as possible, the correct nozzles, large volumes of water, and setting the boom as near to the ground as possible to still get uniform coverage.
 - using a drift control agent.

- shutting off sections of the spray boom that are not needed.

After Applying Pesticides

- Clean equipment away from water supplies.
- Remove and clean protective clothing and equipment.
- Shower.
- Keep records of every application.

Disposal of Unwanted Pesticides

- Calculate the amount needed so none is left over.
- Do not re-spray an area to get rid of leftover spray.
- Apply left over material according to label directions on another site or crop listed on the label. Do not put unwanted pesticides into sewers, down drains, or on the land.
- Contact the regional office of the B.C. Ministry of Environment, Lands and Parks for information on the disposal of unwanted pesticides.

Disposal of Containers

- Drain the container into the spray tank for at least 30 seconds or shake out the bag.
- Triple or pressure rinse drums, glass bottles, plastic and metal containers. Single rinse plastic and paper bags.
- Put the rinse water into the spray tank.
- Crush, puncture or damage empty containers so they cannot be re-used.
- Return the containers to your pesticide storage until you can take them to a public dump, back to the supplier, or to a collection site. Containers can be buried on your land 0.5 metres below the surface. The burial site must be flat, not a bog, gravel or sandy soil and at least 200 metres from wells, lakes, rivers, streams or ponds.
- Do not burn pesticide containers.

Re-entry Restrictions

Poisoning may occur when people work in treated areas too soon after pesticides have been used. Such poisoning may be from breathing pesticide fumes or handling treated plants e.g. hand weeding, hand thinning. Warn farm workers of areas recently sprayed.

A few pesticide labels (e.g. Parathion and Guthion) tell when treated areas can be re-entered. Follow these directions.

The Workers' Compensation Board regulations say that people may not enter a treated field until they have waited the following re-entry or restricted entry intervals:

- 24 hours for slightly toxic pesticides
- 48 hours for moderately or very toxic pesticides

- the total of the re-entry intervals for tank mixes of moderately and very toxic pesticides.

Use the re-entry interval on the label if it is longer than above intervals.

If a person needs to re-enter a treated area before the re-entry period is over, wear protective gear.

Grazing Restrictions

If animals are to graze a treated area, check the pesticide label for grazing restrictions. Wait the required time before grazing.

Harvesting Restrictions

Wait the pre-harvest interval (days-to-harvest) before harvesting to avoid illegal pesticide residues on crops. Pre-harvest intervals are on labels.

Special Environmental Precautions

Protecting Fish and Other Wildlife

All insecticides, as well as some fungicides and herbicides, are very toxic to fish. Insecticides are toxic to birds and wildlife. Exposure to trace amounts of these pesticides may kill fish or birds. Destroying the vegetation along fish-bearing water harms fish by removing food and shelter.

Protect fish and wildlife from pesticide poisoning by following label precautions, safety guidelines in the guide, and the guidelines below.

- Use pesticides only when necessary.
- Select the least toxic and least persistent pesticides.
- Leave a buffer zone along all bodies of water to keep pesticides out of the water.
- Do not destroy vegetation along fish bearing waters and do not spray with pesticides.
- Incorporate granular insecticides.
- Use precautions to prevent drift, leaching and run-off.
- Store treated seed where it cannot be eaten by animals.
- Place baits in covered bait stations.

Protecting Bees and Beneficial Insects

Bees and other pollinating insects are essential for the production of many crops. Some other insects help control pests. Many pesticides, particularly insecticides, are very toxic to honeybees, wild bees, and beneficial insects. Protect these insects from pesticide poisoning by:

- Telling nearby beekeepers about your spray program.
- Not applying pesticides near hives.
- Not applying pesticides toxic to bees when plants are in bloom.

- Selecting formulations least harmful to bees. Microencapsulated formulations are very hazardous; dusts are more hazardous than sprays; wettable powders are more hazardous than EC and liquid formulations; granulars are least hazardous to bees.
- Reducing drift.
- Timing applications carefully. Evening sprays are less hazardous than morning sprays. Both are safer than midday.

Protecting Groundwater

Groundwater is the source of water for wells and springs. It is very difficult to clean contaminated groundwater. The best solution to groundwater contamination is prevention.

Groundwater contamination is most likely to occur where soils are gravelly or sandy, the water table is close to the soil surface, there is high rainfall or extensive irrigation, or the pesticide is injected or incorporated into the soil. Pesticides that are persistent in the soil, are weakly absorbed and leach quickly, or are highly soluble may contaminate groundwater.

Remember to avoid spills, drift, and irrigation run off and to properly dispose of unwanted pesticides and empty containers. Never store pesticides near wells or pumphouses and guard against leaking containers.

Well construction, maintenance and location can be factors in contamination. Maintain proper seals between pump and pump base, as well as seals between well casings.

Emergency Response

- Keep the phone numbers for Poison Control Centre, doctor, ambulance, and Provincial Emergency number 1-800-663-3456 nearby. The Poison Control Centre number is in the front section of the telephone book.
- Have protective gear and equipment easily available.
- Keep absorptive material, a container for contaminated waste, tools to pick up contaminated material, bleach, and hydrated lime available.

Spills

- Protect yourself.
- Keep bystanders away.
- Don't eat, smoke or drink during clean-up.
- Work upwind of the spill.
- Contain the spill. Surround and cover with absorbent material.
- Clean up the spill.
- Decontaminate the area using bleach or hydrated lime. Absorb excess liquid with absorbent material.
- Put absorbent material in the special waste container and seal it.

- Remove and wash protective gear. Shower.
- If you need help, call the Provincial Emergency number.

Fires

- Let your fire department know ahead of time where you store your pesticides.
- Call the fire department and keep people away from the area. Warn the firefighters that pesticides are in the building.

Relative Toxicity of Pesticides

Pesticides can be toxic to humans. The degree of toxicity (LD_{50}) is determined by feeding (oral LD_{50}) or applying to skin (dermal LD_{50}) the active ingredient to rats and rabbits. The lower the LD_{50} , the more poisonous the pesticide active ingredient. Pesticides are rated as to their toxicity by their LD_{50} values.

V = Very toxic **M** = Moderately Toxic

S = Slightly Toxic

Specific LD_{50} values can be found on Material Safety Data Sheets (MSDS's) available from chemical suppliers upon request.

Toxicity	Oral LD_{50}	Dermal LD_{50}
Very Toxic	0 to 50	0 to 200
Moderately toxic	51 to 500	201 to 1,000
Slightly toxic	over 500	over 1,000

The chemical class to which the pesticides belong is designated as follows:

C - carbamate **OP** - organophosphate
D - dithiocarbamate **M** - miscellaneous
N - nitro **SP** - synthetic pyrethroid
OC - organochlorine **B** - biological
DI - diamidide

INSECTICIDES

Trade Name	Common Name	Oral Toxicity	Dermal Toxicity	Class Chemical	Applicator Certificate Required by	
					Environment	WCB
Admire	imidacloprid	M	S	M	no	yes
Agri-Mek	abamectin	V	S	M	no	yes
Ambush	permethrin	S	S	SP	no	no
APM 50 ☠	azinphos-methyl	V	V	OP	yes	yes
Apollo	clofentezine	S	S	M	no	no
Basudin	diazinon	M	S	OP	no	yes
Belmark	fenvaleate	M	S	SP	no	yes
Bioprotec	<i>Bacillus thuringiensis</i>	S	S	B	no	no
Carzol ☠	formetanate hydrochloride	V	S	M	no	yes
Confirm	tebufenozide	N				
Cygon	dimethoate	M	M	OP	no	yes
Cymbush	cypermethrin	M	S	SP	no	yes
Diazinon	diazinon	M	S	OP	no	yes
Dipel	<i>Bacillus thuringiensis</i>	S	S	B	no	no
Decis	deltamethrin	M	S	SP	no	yes
Endosulfan ☠	endosulfan	V	M	OC	no	yes
Foray 48B	<i>Bacillus thuringiensis</i>	S	S	B	no	no
Guthion ☠	azinphos-methyl	V	V	OP	yes	yes
Imidan	phosmet	M	S	OP	no	yes
Lagon	dimethoate	M	M	OP	no	yes
Malathion	malathion	S	S	OP	no	no
Matador	cyhalothrin-lambda	M	S	SP	no	yes
Mitac ☠	amitraz	S	S	DI	yes	yes
Morestan	chinomethionat	S	S	M	no	no
Pirimor	pirimicarb	M	M	C	no	yes
Pounce	permethrin	S	S	SP	no	no
Pyramite	pyridaben	S	S	M	no	no
Ripcord	cypermethrin	M	S	SP	no	yes
Sevin	carbaryl	M	S	C	no	yes
Sniper ☠	azinophos-methyl	V	V	OP	yes	yes
Success	spinosad	S	S	M	no	no
Thiodan ☠	endosulfan	V	M	OC	no	yes
Zolone	phosalone	M	S	OP	no	yes

FUNGICIDES

Trade Name	Common Name	Oral Toxicity	Dermal Toxicity	Class Chemical	Applicator Certificate Required by	
					Environment	WCB
Aliette	fosetyl al	S	S	M	no	no
Benlate	benomyl	S	S	C	no	no
Botran	dichlora	S	S	M	no	no
Bravo	chlorothalonil	S	S	OC	no	no
Captan	captan	S	S	M	no	no
Dikar	mancozeb + dinocap	S	S	D + N	no	no
Dithane DG	mancozeb	S	S	D	no	no
Dithane M45	mancozeb	S	S	D	no	no
Easout	thiophanate- methyl	S	S	C	no	no
ferbam	ferbam	S	S	D	no	no
fixed copper	fixed copper	M	S	M	no	yes
Funginex	triforine	S	S	M	no	no
Kumulus DF	wettable sulphur	S	S	M	no	no
lime sulphur	lime sulphur	S	S	M	no	no
Manzate 200	mancozeb	S	S	D	no	no
Nova	myclobutanil	S	S	M	no	no
Nustar	flusilazole	S	S	M	no	no
Polyram	metiram	S	S	D	no	no
Ridomil	metalaxyl	S	S	M	no	no
Rovral	iprodione	S	S	M	no	no
streptomycin	streptomycin	S	S	M	no	no
Senator	thiophanate- methyl	S	S	C	no	no
Sovran	kresoxim-methyl	S	S	M	no	no
Topas	propiconazole	S	S	M	no	no
Vangard	cyprodinil	S	S	M	no	no
ziram	ziram	S	S	D	no	no

HERBICIDES – REGULATORS/THINNERS – RODENTICIDES/REPELLENTS

Trade Name	Common Name	Oral Toxicity	Dermal Toxicity	Class Chemical	Applicator Certificate Required by	
					Environment	WCB
Herbicides						
Basagran	bentazon	S	S	M	no	no
Casoron	dichlobenil	S	S	M	no	no
Dual	metolachlor	S	S	M	no	no
Fusilade II	fluazifop-p-butyl	S	S	M	no	no
Gramoxone ☠	paraquat	M	M	M	no	yes
Ignite	glufosinate	S	S	M	no	no
Laredo	glyphosate	S	S	M	no	no
Lexone	metribuzin	S	S	M	no	no
Lontrel	clopyralid	S	S	M	no	no
Poast	sethoxydim	S	S	M	no	no
Princep	simazine	S	S	M	no	no
Prowl 400	pendimethalin	S	S	M	no	no
Round-up	glyphosate	S	S	M	no	no
Sinbar	terbacil	S	S	M	no	no
Terraklene ☠	paraquat plus	M	M	M	no	yes
	simazine					
Touchdown	glyphosate	S	S	M	no	no
Wrangler	glyphosate	S	S	M	no	no
Growth Regulators and Spray Thinners						
Accel	gibberellins + benzyladenine	S	S	M	no	no
Activol	gibberellic acid	S	S	M	no	no
Amid Thin	naphthalene acetamide	S	S	M	no	no
Ethrel	ethephon	S	S	M	no	no
Fruit Fix	NAA	S	S	M	no	no
Fruitone N	NAA	S	S	M	no	no
NAA	NAA	S	S	M	no	no
Rodenticides and Deer Repellents						
Gopher Getter ☠	strychnine	V		M	yes	yes
Ground Force ☠	chlorophacinone	V		M	no	yes
Hinder	ammonia	S	S	M	no	no
Ramik Brown ☠	diphacinone	V	V	MV	no	yes
ZP ☠	zinc phosphide	V	S	M	no	yes
Rodent Bait ☠	zinc phosphide	V	S	M	no	yes
Rodent Pellets ☠	zinc phosphide	V	S	M	no	yes
Rozol ☠	chlorophacinone	V		M	no	yes

Pesticide Application Equipment

When pesticides must be used, be accurate and cautious. To accomplish this, growers should use proper equipment, maintained in good condition and calibrated regularly.

Tree Row Volume Spraying

Tree Row Volume (TRV) is a measurement of the volume of trunk, limbs and leaves in a hectare or acre of trees. Research in the Okanagan and elsewhere has shown conclusively that if the volume of spray mixture applied is not adjusted for tree size, over application can occur. For example, excessive pesticide, nutrient or thinning sprays may result in residues that exceed allowable levels, leaf and fruit burning, over thinning and unnecessary loss of beneficial insects and mites. To use TRV, an adjustment in sprayer calibration (i.e. change nozzles, pressure, travel speed) will be required to apply the calculated volume of spray mixture.

Older plantings with larger trees, on which most of the production guide recommendations are based, had roughly a 5.5 m x 3.6 m (18 ft x 12 ft) spacing that resulted in a foliage volume of approximately 24,000 cubic metres/ha (350,000 cubic feet/acre). This TRV is calculated as follows:

$$\begin{aligned} \text{TRV} &= \frac{\text{area of hectare (or acre)}}{\text{row width}} \times \text{tree height} \times \text{tree width} \\ &= \frac{10,000 \text{ sq m}}{5.5 \text{ m}} \times 3.6 \text{ m} \times 3.6 \text{ m} &= \frac{43,560 \text{ sq ft}}{18 \text{ ft}} \times 12 \text{ ft} \times 12 \text{ ft} \\ &= 24,000 \text{ cubic metres} &= 350,000 \text{ cubic feet} \end{aligned}$$

Because new plantings are between 20 and 75% of the foliage volumes of the older trees, spray mixture volumes must be reduced to match foliage volume of the smaller trees. For example, a 3.4 m x 1.2 m (11-ft x 4 ft) planting has the following Tree Row Volume:

$$\begin{aligned} \text{TRV} &= \frac{10,000 \text{ sq m}}{3.4 \text{ m}} \times 2.3 \text{ m} \times 1.2 \text{ m} &= \frac{43,560 \text{ sq ft}}{11 \text{ ft}} \times 7.5 \text{ ft} \times 4 \text{ ft} \\ &= 8200 \text{ cubic metres} &= 119,000 \text{ cu feet} \end{aligned}$$

To calculate the % reduction in TRV use the formulas:

$$\begin{aligned} &= \frac{\text{TRV smaller trees}}{24,000 \text{ cu m}} &= \frac{\text{TRV smaller trees}}{350,000 \text{ cu ft}} \\ &= \frac{8200 \text{ cu m}}{24,000 \text{ cu m}} \times 100\% &= \frac{119,000 \text{ cu ft}}{350,000 \text{ cu ft}} \times 100\% \\ &= 34\% &= 34\% \end{aligned}$$

These results indicate that if you commonly apply 560 L/ha (50 gal/acre) in a semi standard 5.5 m x 3.6 m (18 ft x 12 ft) planting, you would apply 34% of 560 L or 190 L/ha (17 gal/acre) in the 2.3 m x 1.2 m (11-ft x 4 ft) high density planting. Due to low humidity in the Interior of B.C., it is suggested that 190 L/ha (17 gal/acre) is the minimum water volume used in mature spindle plantings. For situations such as spray thinning where 2240 L/ha (200 gal/acre) or more is applied, 34% of that volume (760L/ha) (68 gal/acre) would be used, which will maintain the same chemical concentration. It is important that the

concentration of the chemical **must not** be reduced because the effectiveness of the chemical will be reduced.

For immature trees, use the same method of calculating Tree Row Volume. The reduced spray volume can be achieved with fewer and smaller nozzles, increased tractor ground speed and reduced pressures. For most sprayers, it is not recommended to go below 100 psi as spray droplet size changes too dramatically.

Because tree canopies change through the growing season due to growth and increased foliage density, the Tree Row Volume that was initially calculated for the beginning of the season should be increased by 10% to 20% (i.e., from 34% to 44% with a 10% increase) as the growth increases throughout the season. Therefore in the example above, the spray volume of 190 L/ha (17 gal/acre) would be increased to 246 L/ha (22 gal/acre).

Blow-through is another problem in high density plantings with our existing PTO driven sprayers. There are actual pesticide losses because the spray mix droplets and air are going so fast that they go around leaves instead of hitting a leaf. Therefore as much as it is practical with present equipment, air speed needs to be reduced so more spray hits the tree and leaves. To achieve this, various options are available for sprayers: smaller fans, two speed sprayer gear boxes and fans that allow adjustment of blade tilt to reduce or increase air speed. In addition, air speed can be reduced by reducing tractor engine speed. Speed can be slowed in a given gear, or use a higher gear and lower engine speed to achieve the same ground speed and reduce fan speed.

CUTTING OFF NOZZLES

Most of the time, with most sprayers, for proper calibration and TRV considerations, you must reduce the number of nozzles to fit the spray pattern with the tree size. Just cutting off the top nozzles used for spraying 560 L (50 gal) or 2250 L (200 gal) in old trees will not necessarily give the proper spray volume for high density trees. It is important to calculate TRV for the high density planting and use that water volume in the calculation for the sprayer calibration.

ALTERNATE ROW SPRAYING

When blow-through cannot be adequately reduced, some growers are using alternate row spraying. This can work well for 3.6 m (12 ft) rows and narrower spacings if the spray penetrates and swirls through the row well. The next time a spray is applied, start in the panel next to where spraying was started the first time and good practical control and coverage will be achieved in most high density plantings. Sometimes where uniformity of application is essential, such as spray thinning and perhaps for codling moth control, spraying should be carried out on every row.

Sprayer Calibration

Sprayers need to be calibrated to deliver and apply spray material accurately and uniformly. Not only does proper calibration ensure reliable pest control, but also minimizes the risks of crop injury, excessive chemical residues and environmental contamination. Tractor speed, row width, nozzles and pump pressure combined with tree row volume calculation, will determine the volume of spray mixture applied per hectare or acre. Substantial savings in chemical costs will be realized using properly calibrated sprayers and Tree Row Volume.

Mixing Chemicals

Chemicals should be added to the spray tank when it is partially filled with water. If combinations of spray materials are used, always add wettable powders to the tank first and then add emulsifiable concentrates or crop oils. Once the chemicals are added, the agitator should be kept running to keep the spray properly mixed. Without agitation, wettable powders may settle out.

For best results, wettable powders should be premixed before being added to the spray tank. Make a slurry of wettable powder and water and then pour it into the spray tank. Always follow manufacturers' directions when mixing chemicals.

Operation of Air-Blast Sprayers

Good control of orchard pests and diseases requires the intelligent use of efficient spray equipment. If you are not familiar with air-blast sprayers, you should study the bulletin *Air-Blast Orchard Sprayers - An Operation and Maintenance Manual*, published by the Research Station, Summerland.

Make sure you know the capabilities and short-comings of your sprayer so you can use it to the best advantage. Your district horticulturist is equipped to test your air-blast sprayer and advise you regarding its operation.

Attention to the following points will help to do a good spray job:

1. **Do not spray in the wind.** No sprayer will do as good a job in a wind as it will under calm conditions.
2. **Travel between 1.5 and 3 km per hour (25-50 m per minute).** The speed of travel is governed by density of foliage, tree size and spacing, and by sprayer efficiency. The speed must be slow enough to permit the spray-laden airstream to penetrate through the foliage.
3. **Keep the fan blades clean.** Dirty blades cannot pump air efficiently.
4. **Be sure the fan is operated at the correct speed.** A drop in fan speed means a drop in air velocity and volume.
5. **Use an accurate pressure gauge and read it frequently.** The gauge should be mounted where it can be seen readily from the tractor seat.
6. **Select suitable nozzles for the job.** For low-volume air-blast spraying 550-850 L/ha (220-345L/acre), the nozzle disk orifices should be between 1.2 mm and 2.4 mm in diameter and the swirl plates should have two openings not greater than 1.6 mm in diameter. For high-volume spraying, the nozzle dimensions are not as critical. To avoid excessive deposits in the lower portion of the trees, use smaller disks in the lower part of the nozzle boom than in the upper part. When spraying small trees, you can reduce waste of spray material by blanking off some of the upper nozzles.
7. **Calibrate the sprayer.** Put the right amount of spray chemical in the tank. Before putting spray material in the tank, calibrate nozzle output and tractor speed accurately so you know exactly what area you can cover with a tank of spray mixture. If the tank covers 0.64 ha, put enough chemical in the tank to treat 0.64 ha.
8. **Keep your sprayer clean.** Flush out the tank, pump, strainers and nozzles thoroughly after each day's spraying.
9. **Air shear nozzles** – To obtain adequate spray droplet break-up with air-shear nozzles, the air velocity must be at least 250 km/hr.

Sprayers Classified According to Volume of Spray Mixture Per Acre

ULTRA LOW VOLUME

The term “ultra low volume” is used when the total volume of spray applied per hectare is 5.5 L or less (2.2 L/acre) and the material is undiluted.

LOW VOLUME

In low-volume spraying the spray chemical is diluted, but the mixture is applied at a rate that will give no run-off from leaves and fruit. It is often referred to as “concentrate” spraying. The usual range is 550 - 850 L of spray mixture per hectare (220-345 L/acre), but may be as low as 110 - 175-L/ha (45-70 L/acre).

MEDIUM VOLUME

In medium-volume spraying there is considerable running together of the spray droplets but little actual run-off of spray mixture from leaves and fruit. It's often referred to as “semi-concentrate” spraying. The usual range is from 1100-2200 L spray mixture per hectare.

HIGH VOLUME

High-volume spraying is characterized by a running together of the spray droplets to thoroughly wet all parts of the trees. It always results in considerable run-off of the spray mixture. This method is often referred to as “dilute” spraying. Application rates up to 5600 L per hectare (2270 L/acre) are common.

Orchard Weed Sprayers

Orchard weed sprayers have special features that distinguish them from other sprayers.

1. Low pressure. To minimize spray drift, the pump pressure of herbicide sprayers should not exceed 280 kilopascals (kPa) or 40 lbs pressure per square inch (psi).
2. Boom features. To spray under branches in the tree row, orchard weed sprayers use a single boom with 2 - 4 nozzles. The end nozzle should have a special off-centre nozzle tip, or be a swivel nozzle directed at an angle to provide coverage of vegetation in the tree row. The boom should be hinged at the tractor end to prevent breakage when the boom strikes branches or tree trunks and the boom height should be easily adjustable to accommodate spraying of vegetation of different heights.

Other features of orchard weed sprayers are common to any chemical spraying equipment.

A detailed description of available orchard herbicide applicators, how they function, and precautions to be taken are included in the publication *Orchard Weedspraying* (see page ix).

WEED SPRAYER CALIBRATION

There are at least two good reasons why herbicide spraying equipment calibration is of utmost importance: (1) excessive rates can result in damage to trees; and (2) low rates can result in lack of control, wasting expensive time and chemicals. Calibration of weed sprayers is covered in *Orchard Weedspraying* (see page ix) or in the *Pesticide Applicator Course for Agricultural Producers* available from B.C. Ministry of Environment, Parks and Land.

SPRAYER CLEANING

Immediately after use, the sprayer should be flushed out with soapy water and rinsed with clean water.

Some herbicides are particularly hard on roller pumps and special care should be taken to rinse out those pumps after the use of these herbicides. After the system is thoroughly cleaned it is a good practice to add a small amount of oil (not diesel or stove oil) to the system to maintain the roller pump in good condition.

SPECIAL PRECAUTIONS

1. It is most important to ensure that the area treated is equal to the area used for calculating the rate. For example, if the rate for a granular application is calculated for 1.8 x 1.8 m around the tree, but only a 1.2 x 1.2 m area is actually treated, the calculated amount of herbicide covers 1.44 m² instead of 3.24 m², and the rate of application is more than doubled.
2. Uniform application is important to assure both crop safety and the desired weed control. For example, if a sprayer, calibrated to provide the right amount of chemical at 3.2 km/hr is slowed to half that speed at the ends of the rows, twice the amount of chemical is applied.
3. A herbicide sprayer should not be used for applying other pesticides or liquid fertilizers.
4. Do not apply herbicides by hand gun as their high operating pressures can cause drift and uneven application. Spray drift may injure tree foliage and fruit, and may be a hazard to the applicator, e.g., paraquat (Gramoxone)☠.
5. Portable spinning disc applicators (e.g. Herbi) apply chemicals in ultra low volumes of water. Droplet sizes are small and the spray is prone to drift even in situations of low wind or updrafts in hot, calm weather.