

GENERAL PESTICIDES AND SAFETY

This information on safe pesticide use is summarized from the British Columbia Pesticide Applicator Course for Agricultural Producers. The course is available from Office Products Centre in Victoria, telephone 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 (PCP) ACT AND REGULATIONS**

Every pesticide used or sold in British Columbia must be registered by Health Canada (PMRA). 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 approved but not be on the label. This guide includes these minor uses.

Pesticides are labelled 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 runoff.

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 Water, Land and Air Protection also has rules about the sale and use of pesticides in British Columbia Rules that apply to farmers include:

- Pesticides labelled Restricted or Commercial must be kept in vented and locked storage which has a warning sign on the door.
- Anyone buying or using pesticides labelled Restricted must have an applicator certificate. The table after the safety section indicates what pesticides (referred to in this guide) can only be purchased and used by certified applicators.
- People applying pesticides to public land must have a Pesticide Use Permit.
- Businesses selling pesticides must be licensed and their sales people must be certified.
- Anyone applying pesticides in exchange for a fee must have an applicator certificate and a Pest Control Service Licence. But, if you spray your neighbour's crops you do not need a licence if the work is done as a favour and no money is exchanged.
- 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 came into effect April 1993. The regulations apply to farmers who are registered or are required to be registered by Workers' Compensation Board. If you are unsure whether they apply to you, call Workers' Compensation Board at 1-800-661-2112.

The Workers' Compensation Board regulations cover conditions of work places 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 Workers' Compensation Board 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. Free copies of the regulations are available from any Workers' Compensation Board office.

One of the Workers' Compensation Board pesticide regulations states that workers must be over 16 years old and must have a valid pesticide applicator certificate from the British Columbia Ministry of Water, Land and Air Protection 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 in this guide indicates which pesticides are moderately or very toxic.

The Workers' Compensation Board re-entry requirements are listed in the pesticide section under re-entry and the record keeping requirements have

been incorporated into the grower's spray record. Refer to the regulations for the rest of the WCB requirements.

Toxicity

Some pesticides are more poisonous or toxic than others. Pesticides listed in this guide are rated, according to their toxicity (see Table 18, pages 87). The ratings are: very toxic, moderately toxic and slightly toxic. They indicate short term toxicity and are based on the LD₅₀ of the active ingredient. The LD₅₀ which correspond to the categories are:

Toxicity	Oral LD ₅₀	Dermal LD ₅₀
Very Toxic	less than 50	less than 200
Moderately toxic	50 to 500	200 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

FIGURE 24. Pesticide warning symbols



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 mixing and loading pesticides.

HAZARD

Remember, 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 are using. Read pesticide labels for symptoms. Effects from pesticide poisoning vary from person to person and are often difficult 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.

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 any 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:

- Protect yourself.
- Move the victim from the area of contamination.
- 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.

- Call the Poison Control Centre, doctor or ambulance. Be ready to tell them the pesticide name and *PCP Act* registration number.
- Unless the doctor or Poison Control Centre tells you otherwise, follow the procedures listed below, then:
- 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 cleanup. Always wear coveralls, waterproof boots, waterproof gloves, and proper hat. Sometimes you will 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.

Clothing

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.

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.

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.

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.

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.

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 labelled 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 AND 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.
- Store in a dry, well ventilated place.
- 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 nearby.

For a factsheet on building a pesticide storage shed, go to the following web address:

<http://www.agf.gov.bc.ca/resmgmt/publist/300series/373130-2.pdf>

- Keep a fire extinguisher, broom and shovel, absorptive material, and protective clothing nearby 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 upwind 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.

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.
- Apply pesticides through the irrigation system only when the label has instructions for chemigation.
- 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

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 respray an area to get rid of leftover spray.
- Apply left over spray mixture 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 British Columbia Ministry of Water, Land and Air Protection 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 reused.
- Return the empty containers to your pesticide storage until you can take them to a public dump, or to a container collection site which may be at your suppliers. 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 Worker's 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 a 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.

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.
- Do not destroy vegetation along fish bearing waters.
- Incorporate granular insecticides.
- Minimize drift, leaching and runoff.
- Store treated seed where it cannot be consumed by animals.
- Place baits in covered bait stations.

The hazard of specific pesticides to fish or wildlife may be obtained from the British Columbia Ministry of Water, Land and Air Protection.

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 runoff 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 number is in the front of the phone 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 cleanup.
- 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.

Pesticide Application Equipment

Calibration helps ensure good pest control. It also helps prevent crop damage from pesticides, high pesticide residues, and environmental contamination. Calibrate all application equipment to ensure a pesticide will be applied accurately and uniformly at the recommended rate. Calibration involves preparing the equipment so it is working properly, measuring the delivery rate, adjusting the equipment to change the delivery rate, and calculating the amount of pesticide to add to the equipment. Calibrate equipment regularly (at least once per year) to make sure the output is not changing. Also calibrate equipment when it is new and when making changes that affect the delivery rate. Proper calibration will minimize, if not eliminate, left over mixed pesticides in the sprayer tank which can be very difficult to properly dispose of.

OPERATION OF SPRAYERS

Essential components of any chemical spraying equipment are the power source, pump, tank and nozzles. Others which must be considered are agitators, screens, filters, valves, pressure regulators, booms, hoses, gauges and hand-guns.

POWER SOURCE

The power-sprayer is normally driven by the PTO (power take-off) of the tractor or by an auxiliary engine, the power rating of which should be double the theoretical power required by the pump.

PUMPS

A pump creates the pressure required for atomization and penetration of the spray.

Choose a pump having the characteristics required for your job. Common pumps include the following:

- roller pump; excessive wear can occur with wettable powder
- piston pump
- diaphragm pump

Ginseng sprayers should use piston or diaphragm pumps to develop enough pressure to use hollow cone nozzles. Hollow cone nozzles are more effective in penetrating 3 and 4 year old ginseng plants.

The capacity of the pump should be determined by the highest rate of application the sprayer is expected to deliver, an adequate volume for agitation and an additional 25% volume to account for the pump's wear. During operation there should always be flow in the bypass line indicating the pump has sufficient capacity to send some excess to the tank. Note the maximum revolutions per minute (RPM) allowed for the pump and always operate the tractor throttle so that the maximum is not exceeded. Be aware that increasing the pump's RPM will also increase its output, therefore the tractor's throttle setting must be fixed during calibration and sprayer operation.

TANKS

The size of the spray tank will depend on the intended rate of application and the mounting space available. It should be equipped with a large screened opening for easy filling and cleaning. Tanks may be constructed of steel, stainless steel, epoxy-coated steel, fiberglass, polyethylene, or aluminum. Fibreglass, stainless steel and polyethylene tanks are preferred because of their rust and corrosion resistance.

The herbicide "Roundup" and liquid nitrogen fertilizers must not be put in galvanized steel tanks, as a hazardous chemical reaction can result.

The rusting of steel tanks can be reduced by proper draining, cleaning and airing of the tank after use and by the use of rustproofing compounds. Either hydraulic or mechanical agitation must be provided. If hydraulic agitation is used in the spray tank, additional pump capacity is required. Mechanical agitation is preferred if wettable powders are to be used.

Mechanical agitation, with paddles, gives the most positive mixing for wettable powder formations. If hydraulic agitation is used, $1/10$ to $1/20$ of the tank capacity should be recirculated per minute. This should be supplied from a separate pressure line, not from the relief valve bypass.

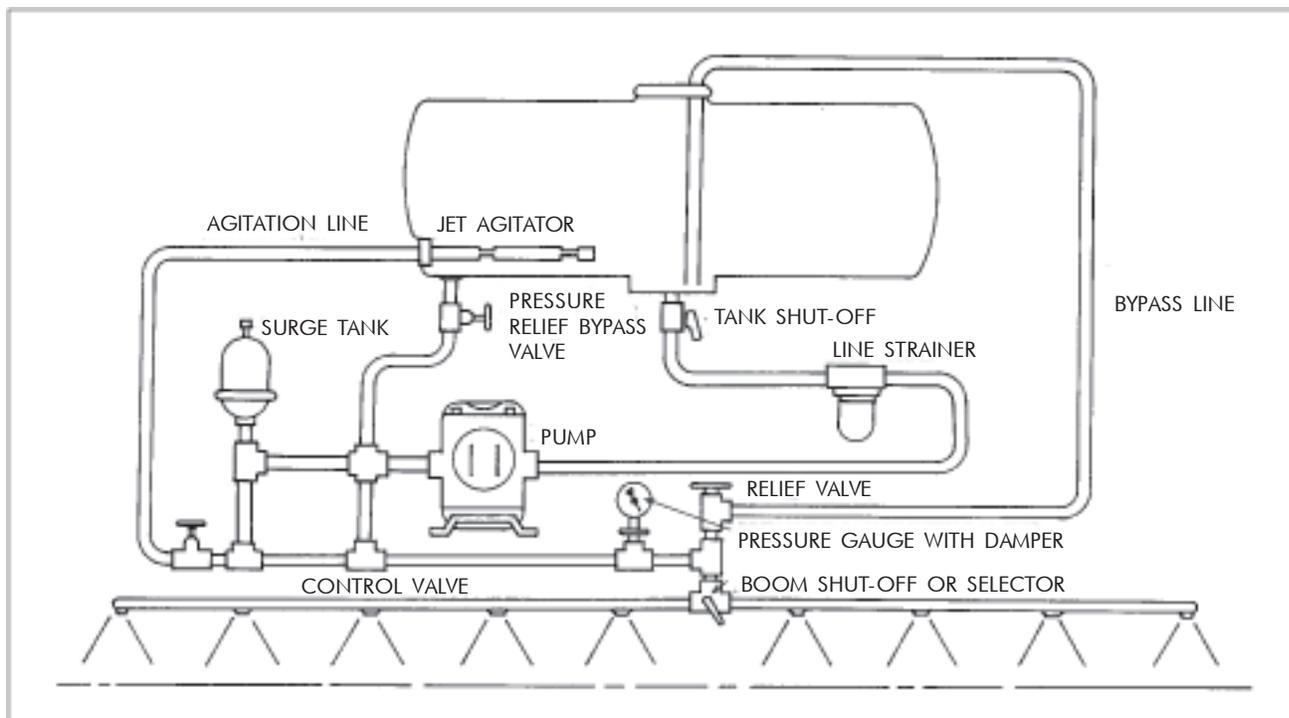
Tanks should be equipped with drains in the lowest part of the tank to allow complete emptying of the tank. Drains should be easy to operate to encourage operators to drain the tank at the end of each day.

For proper mixing of pesticides, it is important to know the volume capacity of your spray tank.

HOSES

Suction hoses (drawing from the tank) should be reinforced so they will not collapse, be resistant to

FIGURE 25. Components of field spraying equipment



chemicals and oils, and be of the same diameter as the pump inlet hole. The same type of hose can be used for the bypass line.

Hoses on the pressure side of the pump must be able to handle pressures higher than the intended use and preferably as high as the maximum pressure the pump can develop. To avoid excessive pressures on the hose the relief or unloading valve should be released before the boom is shut off.

NOZZLES

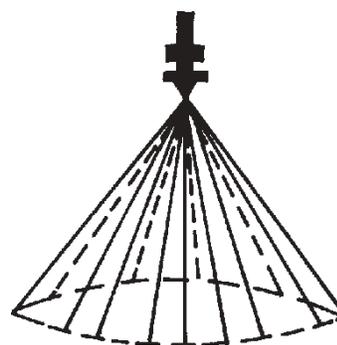
The size of droplet produced by various nozzles depends upon operating pressures and nozzle design. The droplet size decreases with a higher pressure and with a smaller nozzle tip opening. Droplets that are too big give poor coverage and droplets that are too small drift easily.

The main nozzle types used for chemical application are the:

1. Flat spray nozzles (also called fan type or TeeJets) are used for low-pressure spraying such as the application of herbicides and insecticide drenches. They produce a fan-type pattern with less material applied along the edges of the spray pattern. By properly overlapping the spray, a uniform application is produced across the spray boom. Offset flat spray nozzles at an angle of 10 degrees to the boom to prevent interference of the overlapping spray patterns. Nozzle spacing on the boom and height of the boom above the

target are critical to obtain a uniform application. Sprayer equipment suppliers and nozzle manufacturers' catalogues can advise growers as to the correct height of the boom at different nozzle spacings and for different nozzle spray angles.

FIGURE 26. Flat spray nozzle spray pattern



2. Cone nozzle tips are used for high-pressure spraying (mostly fungicides and insecticides). These nozzles produce a good swirling mist so the spray material can reach the undersides of leaves. They are available as either hollow cone or solid cone types - both produce the same swirling mist but the solid cone nozzles are used when larger volumes are required. The cone nozzles most commonly used in the ginseng industry are two-piece disc-core nozzles which must be installed correctly with the rear nibs facing the nozzle body.

FIGURE 27. Even spray Nozzle spray pattern

**Solid cone nozzle
spray pattern**

**Hollow
cone nozzle
spray pattern**

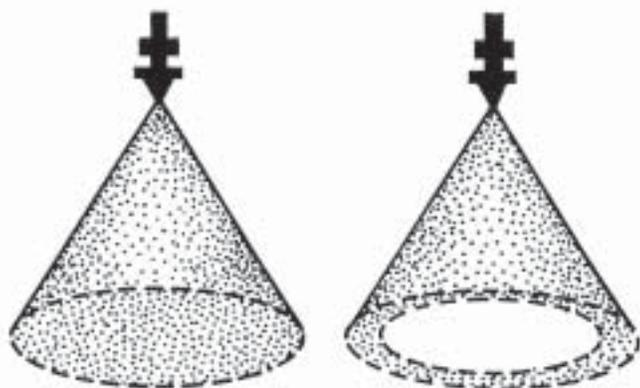
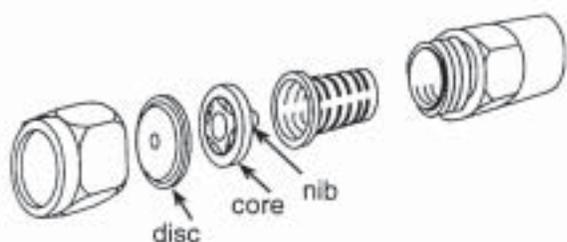


FIGURE 28. Assembly of disc-core cone nozzles



NOZZLE SIZES

Various sizes of flat and cone nozzle tips may be used to obtain the volume of water desired. Consult with your sprayer equipment supplier as he has information on nozzle outputs for the various nozzle sizes. Ask for a catalogue with nozzle outputs in litres per minute.

NOZZLE TIP MATERIALS

Nozzle tips are made from a variety of materials. Choice of material depends upon the abrasiveness of the spray mixture. Wettable powders are more abrasive than emulsions. Brass tips are cheap but the metal is softer and the tips wear faster. In increasing order of durability the following materials are used: plastic, brass, stainless steel, hardened stainless steel, ceramic and tungsten carbide. By making flat spray tips out of colored plastic with a small amount of stainless steel or ceramic in the

center with the spray orifice, the durable tips can be made at a very reasonable cost. These nozzles are more cost-effective than nozzles made entirely of brass.

As nozzle tips wear out, the rate of application increases. Tests have shown that some wettable powders wear nozzle tips sufficiently to increase the rate as much as 12% after spraying only 20 ha. For this reason, frequent calibration of equipment is necessary. Also, very worn nozzles should be replaced because their spray pattern is distorted and uneven application will result.

SCREENS

Screens prevent foreign material from entering the system, clogging the nozzles and wearing out the sprayer.

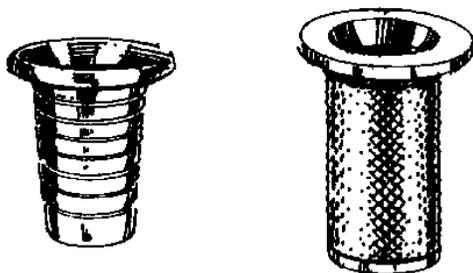
Suction strainers, line strainers and nozzles should all be equipped with 50 mesh or coarser screens when wettable powders are to be used. Some pesticides may require coarser suction strainers. It may be necessary to have more than one suction strainer for the sprayer.

Screens finer than 50 mesh (100 mesh, for example) will plug with most wettable powders.

Screens are generally used in fine nozzles, but slotted strainers can be used in those which have a larger opening. Consult the nozzle manufacturer's catalogue for recommendations on specific screen mesh sizes for specific nozzles. Generally for flat spray nozzles with small holes (TeeJet 80015 or smaller) a 100 mesh nozzle is recommended. Generally larger nozzles (TeeJet 8002 to 8008) should use a 50 mesh screen. Disc-core cone nozzles should normally be used with a slotted strainer equivalent to a 16 mesh screen (any Spraying Systems D3 or larger disc and No. 25 and larger core).

Clean screens and strainers are essential to the efficient operation of the spray system. They should be cleaned often and checked for breaks in the screen. If the nozzle screens are plugging too often check to make certain the chemicals are properly mixed, the spray tank and plumbing system are properly rinsed and cleaned between sprays and that the suction and tank screens are in place when filling and using the sprayer. If plugging problems persist, consider changing to an alternative pesticide formulation. Also check to see if you can use a larger nozzle which has a larger recommended screen size. **DO NOT OPERATE THE SPRAYER WITHOUT THE RECOMMENDED NOZZLE SCREENS.**

FIGURE 29. Nozzle Screens and Strainers



**Slotted strainer
strainer**

Screen

SPRAY VOLUME

Spray volume is the recommended amount of spray mixture to be applied to a specific area. This spray mixture is usually a pesticide diluted in water. Before mixing a pesticide in water in a sprayer, the delivery rate (actual amount of spray mixture applied to a specific area) should be measured. Once the delivery rate is measured it should be compared to the spray volume to see if it is suitable.

The measured delivery rate and sprayer tank volume is used to calculate how many acres are sprayed with one tank. Then the amount of pesticide to add to the sprayer tank can be calculated.

The amount of water to use will depend on the stage of plant growth, the severity of the pest or disease, the pesticide and the method of application.

When spraying foliage with protectant fungicides Bravo, Dithane, Dyrene and Rovral, thorough uniform coverage is essential for good disease control. Aliette is a systemic fungicide and thorough, uniform coverage is not essential as it will be translocated within the plant to all plant parts. All of these products indicate that they can be used as a concentrate (reduced spray volume) spray in their general instructions or instructions for crops other than ginseng.

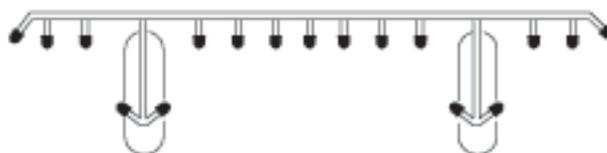
Tests at the Delhi Research Station in Ontario used a boom sprayer equipped with overhead nozzles and drop-pendants with nozzles directed into the sides of the beds from the wheel track (refer to Figure 30). The tests measured good fungicide spray coverage in three year old Ontario ginseng with spray volumes as low as 700 L/ha (270 L/acre). To achieve the lower spray volumes, smaller nozzles were used which produce finer droplets at similar forward speeds and nozzle pressures.

Some of the label spray volumes are high enough to cause runoff on mature crops of ginseng. Growers with regular booms may wish to reduce the spray volume to prevent runoff. More concentrated sprays may be attempted if the spray booms are equipped with drop-pendants. Spray volumes for one and two year old ginseng could be half of the rate for mature (4 year old) gardens. Refer to Table 1, page 149 for guidance on spray volumes for use in spraying ginseng.

Using less than label rates of water is not itself a violation of the Pest Control Products Act. However, if problems such as poor performance or spray drift occur the applicator could be held liable. Growers should carefully monitor the foliage including the lower stems and undersides of lower leaves to ensure thorough coverage. Water sensitive spray cards are available to assist in carrying out this task. Also monitor spray drift.

Roundup is used to control weeds when preparing fields for ginseng. The label spray volume is 50-300 L/ha (20-120 L/acre).

Figure 30. Boom Sprayer with Drop-pendants



RECOMMENDED PRESSURES

Herbicides are generally applied with standard flat fan nozzles at low pressures (200 to 275 kPa or 30 to 40 psi) to keep drift to a minimum. Do not use higher pressures unless they are specifically recommended. Some new nozzles are available which work at lower and over extended pressure ranges (100 to 225 kPa or 15 to 40 psi).

Insecticides and fungicides are generally applied with hollow cone nozzles at pressures up to 2000 kPa (300 psi) depending upon the pest to be controlled and the density of the foliage. While higher pressures increase the spray penetration, pressures over 1000 kPa (150 psi) may damage the ginseng leaves. Soil drenches are generally applied using large flat fan or solid cone nozzles at low pressures of 200 - 400 kPa.

Many nozzle manufacturers have chosen to report nozzle outputs with pressures in “bar” not kilopascals (kPa). The bar unit is equal to 100 kPa. Pesticide labels report pressures in kPa. Use a pressure gauge on the sprayer marked in both psi and kPa (or bar) so both units can be read directly from the gauge. The maximum pressure on the pressure gauge should be twice the maximum spray pressure used to protect the gauge from damage and allow it to be read accurately.

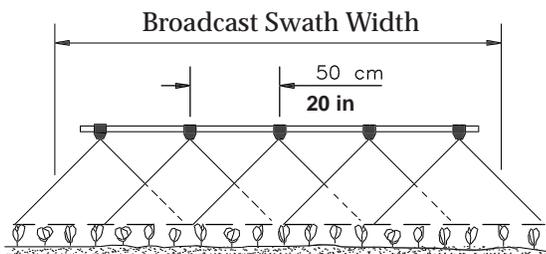
If the pump’s maximum pressure is greater than that of the gauge, be careful to set the pressure relief properly to avoid damaging the pressure gauge when the boom valves are closed.

SPRAYER SWATH WIDTH

Swath width is the width over which spray droplets or granules are distributed in one pass of the applicator.

In ginseng gardens the swath width will be a multiple of the bed width of 6 ft. Sprayers should cover the entire width between garden posts and will be 24, 30 or 36 ft wide under plastic shade cloth. Thus the sprayer swath width should be 24, 30 or 36 ft. as well.

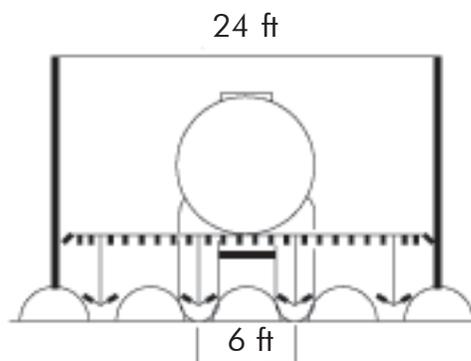
Figure 31. Broadcast Swath Width



Broadcast swath width

- = # of nozzles x spacing
- = 5 nozzles x 20 in.
- = 100 in.
- = 8.3 ft.

Figure 32. Ginseng Swath Width



Ginseng swath width

- = # of beds x bed width
- = 4 beds x 6 ft.
- = 24 ft.

SPRAYER BOOM

For spraying three and four year ginseng plants, droparms should be attached to the spray boom to direct spray in from the sides under the main leaf canopy. This nozzle arrangement will provide better coverage to the underside of the ginseng leaves. Pointing the nozzles forward by about 30° into the direction of travel may help in moving the foliage and covering the undersides of leaves as well. The end section of the booms should be hinged and deflect when it hits an obstruction. End nozzles may also be shielded to protect them from damage. Usually the end nozzles are mounted on a swivel angled outwards so that the boom can be shorter to avoid posts.

The boom should be easily adjusted for height to place the nozzles at least as high above the crop canopy as the distance between nozzles on the boom to allow the full width pattern to develop.

Calibrating Equipment

There is a “Calibration Worksheet” at the back of this production guide (pages 169 – 176) to assist you in carrying out a thorough check of your sprayer.

CALIBRATING BOOM SPRAYERS

There are four basic procedures to be carried out when calibrating boom sprayers (more details are provided in the “Pesticide Applicator Course for Agricultural Producers”):

1. set-up
2. measuring delivery rate
3. adjusting delivery rate (if different from recommended rate)
4. calculating how much pesticide to add to the spray tank

Set-Up

During set-up check that the sprayer nozzles, forward speed and spray pressure are correct for the pesticide that you are applying and the weather and crop conditions. Check the equipment to ensure all parts are in good condition and working properly (see your sprayer's operating manual). The sprayer must apply the pesticide uniformly across the width of the boom and over the whole field.

Measuring Delivery Rate

There are two basic methods used to measure sprayer delivery rates; the test area method and the timed output method. The test area method uses less calculations, however, it can take longer to carry out. If an entire acre or hectare is used as the test area, the measured discharge of water is the delivery rate per acre or hectare and no calculations are required. The most common problem with the test area method is measuring the amount of spray water discharged. If too small a test area is used or it is not covered with enough passes the actual amount of water discharged is too small to accurately measure in the tank. The tractor and sprayer tank should be parked in the exact same location and you must wait for the water to settle in the tank after stopping before measuring the tank level again. The timed output method can avoid these problems, however it will require more calculations. Refer to the Calibration Worksheet for the steps to be carried out and the formulas to use – pages 169 - 176.

Adjusting Delivery Rate

If the measured Delivery Rate of the sprayer is different than that listed on the pesticide label or recommended in the production guide, it can be adjusted in three ways:

1. **Nozzle size** should be changed if you wish to make large changes in delivery rate. The Calibration Worksheets on pages 169 - 176 provide a formula that can be used to calculate the nozzle output required for the desired delivery rate and forward speed. Check with your nozzle supplier or agricultural advisor for assistance. Obtain a catalogue listing nozzles and nozzle outputs in liters per minute (L/min).

2. **Forward speed changes** will adjust the delivery rate. Slower speeds increase the amount sprayed in a field, and faster speeds reduce it. If your delivery rate is 112 L/acre at 6 mph, then by halving your speed to 3 mph you'll double the delivery rate to 224 L/acre.

Speed changes are usually made by using a different gear in order to keep tractor RPMs and spray pressure constant and within the range recommended for the sprayer pump.

3. **Spray pressure should be set for the correct droplet size.** Changing pressure is recommended only for very small changes in delivery rates. Otherwise your droplet size will change and cause drift or runoff problems. Since pressure must be increased four times to double the delivery rate, this is not a good way to adjust delivery rate.

After making the adjustments, measure the delivery rate again.

Calculating The Amount Of Pesticide To Add To A Spray Tank

When the sprayer delivery rate is known, you can calculate how many acres can be sprayed by a full tank and how much pesticide to add to the spray tank. Formulas are also provided in the Calibration Worksheets – pages 169 - 176 – for when only a partial spray tank is used. Be very careful to accurately measure the area to be covered by the last tank to minimize left over spray mixture in the tank when you are finished spraying.

Example: Sprayer Calibration (Acres)

A grower has set-up a 1000 L sprayer with a 30 ft boom to spray Dithane DG at the recommended rate of 1.78 kg/acre. After spraying a 330 ft test strip with one pass (to discharge enough water from the spray tank to accurately measure it), 135 L of water were required to refill the tank.

- a) What is the rate (litres per acre) of spray applied?

Follow Steps 1 – 8, Measuring Delivery Rate - Test area Method, from the Calibration Worksheet

$$\text{Test area} = 330 \text{ ft} \times 30 \text{ ft} \times 1 \text{ runs} = 9900 \text{ ft}^2$$

Follow Step 9, Measuring Delivery Rate - Test area Method, from the Calibration Worksheet

$$\begin{aligned} \text{Delivery rate} &= 135 \text{ L} \div 9900 \text{ ft}^2 \times 43,560 \text{ ft}^2 / \text{acre} \\ &= 594 \text{ L/acre} \end{aligned}$$

The sprayer is operating at a delivery rate of 594 L/acre. The grower decides the delivery rate is okay.

- b) How many acres will be covered with one full tank of spray?

Follow Pesticide Use Calculations – per Area Rate – Full Tank, from the Calibration Worksheet

$$\text{Area} = 1000 \text{ L} \div 594 \text{ L/acre} = 1.68 \text{ acres}$$

One full tank of spray will cover 1.68 acres.

- c) How much Dithane DG must be added to a full tank of water?

Follow Pesticide Use Calculations – per Area Rate – Full Tank, from the Calibration Worksheet

$$\text{Pesticide} = 1.78 \text{ kg/acre} \times 1.68 \text{ acres} = 2.99 \text{ kg}$$

Add 2.99 kg of Dithane DG to make one full sprayer tank of spray mixture.

CALIBRATING GRANULAR APPLICATORS

Calibration of granular applicators involves the same first three steps as a boom sprayer:

1. set-up
2. measuring delivery rate
3. adjusting delivery rate

Granular pesticide applications are normally broadcast in ginseng. See the “Pesticide Applicator Course for Agricultural Producers” available from Office Products Centre at 1-800-282-7955 for more complete information and information on other types of equipment. There are several factors that can cause variation in output including, size of meter openings, roughness and slope of the garden, forward speed, and granule flowability.

Set-up

Set-up includes inspecting the equipment to make sure it is cleaned, lubricated and operated properly according to the operators manual. Set the equipment to the approximate settings to deliver the recommended application rate.

Swath width on tractor mounted spinning disc and oscillating spout spreaders is going to depend on the PTO (and engine) RPM. Proper spreading width, overlap of tapered patterns and swath width will require several test runs to determine settings that will work in your ginseng garden. The settings will be dependent of crop canopy height as well and uniformity in the garden will be difficult to ascertain. The applicator swath width is based on the driving pattern and is typically identical to the span between posts (tractors driven down rows midway between posts).

Pneumatic spreaders which use air to carry the granules through hoses to individual distributing nozzles will drop the granules directly over the ginseng bed. These units can be calibrated for

output and uniformity of application even in the irregular shape of the ginseng crop canopy. On a smaller scale, gravity drop granular pesticide applicators with distributing nozzles could be used as well with a similar ease of determining uniformity.

Measuring Delivery Rate

Delivery rate is generally determined by measuring the amount of granules discharged while the applicator is run over a test area. It is usually necessary to capture the output and weigh it.

- Mark out a measured test strip at least 60 m or 200 ft long.
- Fill the applicator hopper(s) about half full of granules.
- Choose a tractor gear and throttle setting.
- Attach bags or other containers under each downspout to catch the granules during calibration. For granular equipment that uses air flow for distribution, either use porous mesh bags (e.g. nylons) or shut off the air flow and catch the granules from directly under the metering device.
- Drive towards the first stake at the correct speed and discharge granules over the test strip only.
- Repeat until enough granules are discharged to allow for accurate weights to be measured. Record the number of runs.
- Weigh the granules from each bag or container and record the amounts. Compare the individual weights and then add them together. Check for uniform distribution across the swath. Make adjustments and retest.

Determine the delivery rate using the following formula:

$$\begin{aligned} \text{Delivery rate (kg/acre)} \\ = \text{amt collected in test (kg)} \times 43,560 \left(\frac{\text{ft}^2}{\text{acre}} \right) \div \text{test area (ft}^2) \end{aligned}$$

Example:

You want to apply 55 kg/acre of fertilizer. After driving over a 330 ft test strip once using a 30 ft swath width, 10.5 kg of granules were collected. What is the delivery rate?

Answer:

$$\begin{aligned} \text{Test area} &= 330 \text{ ft} \times 30 \text{ ft} \times 1 \text{ run} = 9900 \text{ ft}^2 \\ \text{Delivery rate} &= 10.5 \text{ kg} \times 43,560 \text{ ft}^2/\text{acre} \div 9900 \text{ ft}^2 \\ &= 46.2 \text{ kg/acre} \end{aligned}$$

Adjusting Delivery Rate

Increase the meter opening to discharge more granules and retest.

CALIBRATING HAND-OPERATED SPRAYERS

Sprayer Set-up

Hand-operated sprayers should be checked to make sure there are no leaks, especially where the hose enters the tank and around the trigger valve. The nozzle should deliver a uniform spray pattern. Many nozzles can be adjusted to produce the desired droplet size. Adjust the nozzle to produce a coarse spray (larger droplets) for herbicides and medium to fine spray (smaller droplets) for insecticide and fungicide applications.

For uniform spray application it is important that you maintain constant spray pressure and coordinate your walking speed with uniform back and forth movements of the nozzle. The back and forth movements determine your swath width.

Most pesticide labels for ginseng give instruction as a specific amount of pesticide per unit area (e.g., apply 2.4 L/ha). Some pesticides like Roundup give directions to dilute an amount of pesticide in water and apply with thorough and complete coverage (e.g., Roundup; 1 L of product in 100 L of water).

Application Rate Given as a Dilution With Water

When the application rate is given as a dilution rate, then the amount of pesticide to mix in a full tank can be calculated directly.

Example:

A label recommends mixing 1 L of pesticide in 100 L of water and applying to foliage with thorough coverage. You have a 12 litre backpack.

Answer:

The amount of pesticide to add to the tank can be calculated with the following formula:

$$\begin{aligned} \text{Amount of pesticide} \\ &= \text{label rate (product amount} \div \text{water volume)} \times \\ &\quad \text{sprayer volume} \end{aligned}$$

$$\begin{aligned} \text{Amount of pesticide} \\ &= 1 \text{ L product} \div 100 \text{ L water} \times 12 \text{ L tank} \\ &= 0.12 \text{ L product/tank} \end{aligned}$$

If only a partial tank (e.g. 8 L) of pesticide mix is required, use that figure as the “sprayer volume” input in the formula.

You must also estimate how much spray mixture is needed so tank mix is not left over. Do this by applying water to a measured test area and determine the total mix needed. Use the same procedures that follow for pesticide application rates given as an amount of pesticide per unit area.

Application Rate Given as Amount of Pesticide per Area

Measuring delivery rate of a hand-operated sprayer follows the same basic steps as with a tractor mounted boom sprayer but on a smaller scale. Remember during set-up of your sprayer that you must practice a steady walking speed and swath width.

Mark out a measured length of test strip at least 20 m or 60 feet long.

Fill the tank about half full with water and record the volume of level of water. Pump the tank to the pressure level you'll be using.

Carefully spray the measured test strip while maintaining a steady forward speed and pumping action. Repeat enough runs over the test strip until at least 10% of a full tank has been sprayed.

Measure the volume of water sprayed in the test strip by refilling the tank to the starting level.

Calculate the test area:

$$\begin{aligned} \text{Test area (ft}^2\text{)} \\ &= \text{strip length (ft)} \times \text{swath width (ft)} \times \# \text{ runs} \end{aligned}$$

Calculate the delivery rate:

$$\begin{aligned} \text{Delivery rate (L/acre)} \\ &= \text{water sprayed (L)} \div \text{test area (ft}^2\text{)} \times 43,560 \text{ (ft}^2\text{/acre)} \end{aligned}$$

Adjust the delivery rate as necessary by changing the walking speed. After measuring delivery rate calculate the amount of area sprayed by a full tank:

$$\begin{aligned} \text{Area sprayed (by full tank)} \\ &= \text{Tank volume} \div \text{Delivery rate} \end{aligned}$$

Next, calculate the amount of pesticide to add to the spray tank as follows:

$$\begin{aligned} \text{Amount of pesticide to add to tank} \\ &= \text{application rate} \times \text{area sprayed by one tank} \end{aligned}$$

Example:

You want to spray Bravo 500F at a rate of 1.0 L/acre in about 600 L/acre of water. A test strip of 60 ft long covering one half width of ginseng bed (3 ft) is sprayed with one pass with water. To refill the spray tank, 2.6 L of water is required. Determine the delivery rate, area sprayed by a full tank and the amount of pesticide to add to a 12 L tank.

Answer:

1. Test area = 60 ft X 3 ft X 1 run = 180 sq ft
2. Delivery Rate = 2.6L ÷ 180 ft² X 43,560 sq ft/acre = 629 L/acre
3. Area sprayed by 1 tank = 12 L ÷ 629 L/acre = 0.0191 acre

4. Amount of pesticide to add to one tank = application rate X area
 = 1.0 L/acre x 0.0191 acres
 = 0.0191 L
 = 19.1 mL

Mixing Chemicals

When mixing the chemical in the sprayer tank, NEVER put the chemical in first and then top with water. Always fill the tank 1/3 to 1/2 with clean water, start the agitator and then add the required quantity of chemical. Continue agitating while filling the tank. For tank-mixes of two or more chemicals, first check the product label for compatibility information. Add the first chemical at the 1/3 to 1/2 full stage and the second chemical at the 2/3 to 3/4 full stage. Mixing by this method will ensure that the chemical is completely mixed in the water. To keep the chemical completely mixed keep the agitator on until you are finished spraying. Never turn off the hydraulic agitation to get enough pump pressure to spray - the chemical will not stay mixed in the water.

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. Always keep the agitator running once the spray materials have been added to the tank.

Excess Pesticide Spray Tank Mixtures

Avoid mixing surplus spray by carefully calculating rates, calibrating your sprayer and carefully measuring the area of your fields. If you do mix too much, use that material according to label directions on another crop or site listed on the label. If no such area can be found, spray the mixture over an area on your property where it will cause no damage. Never re-spray the treated field with extra tank mix. Spraying an area twice will double the rate and may cause high residues in the crop or soil.

Cleaning of Sprayer Equipment

SPRAYER CLEANING (INTERIOR)

Immediately after use, any excess spray mixture should be drained and collected. This excess material can be very difficult to dispose of properly, therefore sprayers should be properly calibrated to

avoid any excess. Then flush the sprayer out with soapy water and then rinse with clean water. Talk to your equipment dealer to have a new drain installed if the current drain is hard to use. Select a cleaning area where water will not contaminate wells, streams or crops.

Separate equipment is recommended for applying 2,4-D, MCPA or similar hormone-type herbicides. If this is not possible, use separate sprayer hoses when using these chemicals as they cannot be properly washed out of the hose lines. To thoroughly clean equipment after applying 2,4-D, MCPA, etc., follow these steps:

1. Drain and collect any excess spray mixture from the tank.
2. Rinse tank, lines, screens, pumps and nozzles thoroughly with warm water.
3. Remove pressure chamber and line strainer and drain.
4. Fill tank with 100L of warm water and then add one of the following:
 - 1 L household ammonia or Agri-Kleen
 - OR
 - 500 g washing soda, lye or Nutrasol.
5. Spray out a small amount of solution and leave remainder in tank overnight.
6. Drain and rinse the equipment several times with warm soapy water. Rinse out the soapy water with clean water.

Even stainless steel nozzles will rust if left in the sprayer. Nozzles and nozzle screens should be removed and cleaned each fall and stored in a can of light oil or diesel fuel for the winter. After a spray application the nozzles should be cleaned and coated with a light coat of oil to prevent corrosion. Ceramic nozzles are not subject to corrosion.

Before winter storage, remember to drain the pump, boom and all lines to prevent frost damage. Add light oil or antifreeze during the last rinsing to leave a protective coating on all parts.

SPRAYER CLEANING (EXTERIOR)

The following material can be used to sanitize the exterior of tractors, sprayers or any equipment before it is moved from one garden to another.

- BLEACH (HYPOCHLORITES) 5.5 to 6.0% active at 1 part to 9 parts water
- QUATERNARY AMMONIUM 10% active at 1.0 ml to 300 ml water
- FORMALIN (37%) 3.0 L in 100 L water

Tips on Spraying Equipment

- Use only chemicals recommended in this Guide.
- Repair or replace leaking hose fittings, collapsed or kinked hoses.
- Clean nozzles and screens with a soft brush, not a wire.
- Use ceramic cone nozzles to avoid rusting of the hardened stainless steel discs
- Use a pressure gauge with nozzle adapter to check actual nozzle pressures
- Check all nozzles to make sure they are all delivering the same spray volume.
- Be sure your tractor speed is accurately calibrated. Make a table showing speeds obtained with different gears and engine RPM. A speed of 2 to 4 mph is usually satisfactory for ginseng spraying.
- Make an accurate measuring stick for your spray tank for use in measuring sprayer delivery rate.
- To get uniform application, and to avoid drift, do not spray when it is windy.
- Flush out the sprayer tank, pump, and plumbing thoroughly after each day's spraying.

Pesticide Toxicity

The following table 18 gives some information on the toxicity of the chemicals used in and around a ginseng garden. The label is the final authority on information regarding chemicals. Please — always refer to labels when using chemicals.

TABLE 18. List of pesticide common names, trade names and relative toxicity

Toxicity data are based on tests with rats and rabbits and are considered relevant to all mammals including humans. The principal source of information for this table is Acute Toxicity Data for Pesticides (1970), R. Ben-Dyke, D.M. Sanderson and Diana N. Noakes. For more recently registered pesticides, toxicity information is taken from the manufacturer's Material Safety Data Sheets (MSDS). For more specific acute toxicity (LD₅₀) information for a particular product consult the MSDS available from the manufacturer.

The following categories have been used: Dermal — LD₅₀, 0 – 200, very toxic; 200 – 1,000, moderately toxic; 1,000 up, slightly toxic. Oral – LD₅₀, 0 – 50, very toxic; 50 – 500, moderately toxic; 500 up, slightly toxic.

These ratings refer to the active ingredient, not the product formulation. Trade names are capitalized and common names are not capitalized.

V = Very Toxic M = Moderately Toxic S = Slightly Toxic

		Oral/ Tox.	Dermal Tox.	Applicators Certificate Reqd.
FUNGICIDES/BACTERICIDES				
Aliette	fosetyl Al	S	S	no
anilazine	Dyrene	S	S	no
Bravo	chlorothalonil	S	S	no
chlorothalonil	Bravo	S	S	no
Dithane DG	mancozeb	S	S	no
Dyrene	anilazine	S	S	no
fosetyl Al	Aliette	S	S	no
iprodione	Rovral	S	S	no
mancozeb	Dithane DG,	S	S	no
metalaxyl	Ridomil 2G	S	S	no
Ridomil 2G	metalaxyl/ Rodimil 240 EC	S	S	no
Ridomil 240 EC	metalaxyl/ iprodione	S	S	no
Rovral	iprodione	S	S	no
MOLLUSCICIDES				
metaldehyde	Slug Bait	S	S	
FUMIGANTS				
Basamid	dazomet	S	S	
dazomet	Basamid	S	S	
dichloropropene	Telone II B	M	M	yes
formaldehyde	Formalin	M	M	yes
Formalin	formaldehyde	M	M	yes
metam	Vapam	S	M	yes
methylisothiocyanate/ dichloropropene	Vorlex	M	M	yes
Telone II B	dichloropropene	M	M	yes
Vapam	metam	S	M	yes
Vorlex	methylisothiocyanate/ dichloropropene	M	M	yes
HERBICIDES				
glyphosate	Roundup	S		no
glyphosate	Touchdown	S		no
fluazsfp-P-Butyl	Venture L	S		no
INSECTICIDES				
Dipel 2X DF	Bacillus Thuringiensis	S	M	no
Pounce		S		no
Permethrin		S		no
RODENTICIDES				
chlorphacinone	Rozol, KsC5	V		yes
diphacinone	Ramik Brown	V	V	yes
Gopher Getter	strychnine	V		yes
KsC5	chlorphacinone	V		yes
Mouse-Bait 2	zinc phosphide	V		yes
Niagara Waxed Mouse-Bait	zinc phosphide	V		yes
Ramik Brown	diphacinone	V	V	yes
Rozol	chlorphacinone	V		yes
strychnine	Gopher Getter	V		yes
zinc phosphide	Mouse-Bait 2			
	Niagara Waxed Mouse- Bait, Z-Phos ZPP	V		yes
Z-Phos	zinc phosphide	V		yes
ZP P	zinc phosphide	V		yes

Definition of Terms

ACTIVE INGREDIENT:	That portion of a pesticide formulation that is toxic to pests.	NEMATICIDE:	A pesticide used to control nematodes.
ADJUVANT:	an ingredient in a solution (spray mix) that modifies the action of the principle ingredient; an aid to the overall effectiveness.	PEST CONTROL PRODUCTS ACT:	A Federal Act administered by PMRA, Health Canada. The <i>Act</i> provides that, in order to be registered for sale in Canada, a pesticide must be accompanied with evidence of effectiveness for the purposes claimed, and it must be accurately labelled as to composition and hazards. The seller must also provide adequate directions for use. Registration is authorized by the Plant Products Division of Agriculture Canada.
CARRIER:	An inert material mixed with active ingredients to make a pesticide formulation. Example: finely divided clay or talc.	PESTICIDE:	A chemical or chemical formulation used to control or destroy weeds, insects, mites, nematodes, rodents, fungi and other types of organisms injurious to plants or animals, including man.
COMPATIBILITY:	Materials in a spray or dust mixture are compatible if one does not reduce the effectiveness of the other and if crop injury does not result from use of the combination.	PESTICIDE RESIDUE:	A deposit that remains in, or on, a product following application of a pesticide.
DETERGENT:	A cleaning agent. Because of their surface active property, detergents have a variety of other uses. (See Surfactant).	RESIDUE TOLERANCE:	The maximum amount of a pesticidal residue that may lawfully be present in, or on, a food product offered for sale. It is expressed in parts per million.
DRENCH:	To “drench,” spray the insecticide plus water (at least 1,000 L/ha) on the soil 10 cm on each side of the plants in the row.	SPRAY:	A pesticidal formulation dissolved or suspended in a liquid (usually water or oil), so that it can be applied in fine droplets.
DUST:	A finely divided carrier containing an active ingredient, usually of low concentration, to be used without dilution.	SPREADER STICKER:	An adjuvant used to improve the efficiency of a pesticide formulation. It may have active properties that facilitate the spreading of a liquid over the leaf and plant surface; it may also enhance the ability to adhere to the plant surfaces.
EMULSIFIABLE CONCENTRATE:	A liquid pesticide consisting of active ingredient solvent and emulsifier that mixes with water to form an emulsion (e.g., Diazinon 50 EC).	SURFACTANT:	Compounds which reduce the surface tension of a liquid (e.g., emulsifiers, soaps, wetting agents, detergents and spreader stickers).
FERTILIZER TERMS:	see page 45	SYSTEMIC PESTICIDE:	A pesticide which is absorbed by and flows through the “system” of a plant or animal so that the plant or animal becomes toxic to the pest to be controlled.
FLOWABLE OR PASTE:	Sometimes referred to as a colloidal suspension or colloidal formulation. The solid particles in the material are very small and remain in a suspended state for almost an indefinite period of time. They mix readily with water and do not “settle out” as do wettable powders. (E.g., Furadan P 4.8 F.)	TOXICITY:	The degree to which a substance is injurious to a plant or animal.
FOOD AND DRUGS ACT:	The Federal Act which regulates the purity of foods and drugs sold to the public.	WETTABLE POWDER:	Dry formulation which is normally mixed with water to form a sprayable suspension (e.g., Benlate 50W).
FUMIGATION:	The use of chemicals in gaseous form to destroy pests or disease organisms.	WETTING AGENT:	(See Surfactant.)
GRANULAR PESTICIDE:	A pesticide formulation in the form of relatively coarse particles which are applied dry with a spreader, seeder or special applicator (e.g., Diazinon 5 G).		