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Using Pesticides Safely: A Guide for the Applicator

Michigan State University

Cooperative Extension Service

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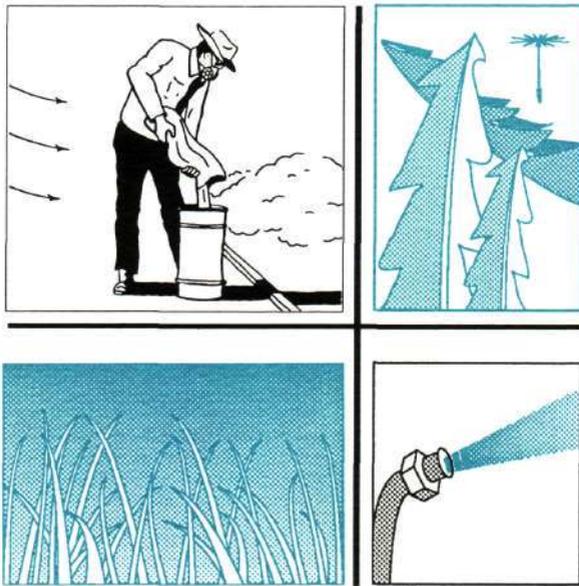
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USING PESTICIDES SAFELY: A Guide for the Applicator

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Pesticides are chemicals that, if improperly used, can affect humans and non-target organisms just as they do the pests they are designed to kill. These adverse effects on humans and the environment can be avoided if proper care is taken in using pesticides correctly according to label instructions. Correct use of pesticides starts with proper selection and includes proper transportation, storage, handling, mixing, application and disposal of containers and unused chemicals.

In case of an accident or emergency with pesticides, get help! The phone number of several organizations who can help are listed in *Appendix B (AM-37)*. They tell you what medical treatment to seek for human exposure, how to contain and cleanup accidental spills, and how to dispose of chemical containers.

Effects of Pesticides on Human Health

The toxic effects of pesticides on people depend on the type of pesticide, the amount of exposure, and the individual who is exposed. The more toxic the pesticide and the greater the exposure, the more severe the effects. However, everyone reacts differently so only a fraction of the people exposed may show symptoms. In addition, common symptoms of pesticide poisoning, such as headache and nausea, may be caused by other agents, such as bacteria or viruses. However, it is usu-

ally possible to identify pesticide related effects from the pattern and timing of symptoms that appear. Symptoms of pesticide poisoning usually appear within 12 hours after pesticide work.

In general, insecticides such as the organophosphates and the carbamates, are the most acutely toxic. Both of these classes of pesticides attack the nervous system and can cause sweating, dizziness and vomiting in addition to headache and nausea. At higher exposure levels, there are other symptoms such as salivation and abdominal cramps. In even more severe cases, breathing difficulty and unconsciousness can occur.

Other pesticides can produce a variety of symptoms at moderate exposures although headache and stomach problems are still the most common. For example, nitrophenols and pentachlorophenol can cause redness, burning and blistering of skin. Fumigants can produce poor coordination, confusion and sleepiness. If any of the symptoms mentioned here occur while using pesticides, see a physician immediately.

Appendix A lists a variety of pesticides as to type, whether a herbicide, fungicide, or insecticide, their toxicity rating and their affect on humans. Be familiar with the character of the pesticide you are using. At the time the pesticide is purchased, ask the chemical dealer for a complete specimen label of the product. This label and labeling information is an exact duplicate of the label information

affixed to and accompanying the pesticide container.

In addition to explaining how to apply the pesticide, the label also tells how toxic the pesticide formulation is. The three toxicity classifications are:

DANGER: Pesticides in this classification are *highly toxic*. Death can result from ingestion of as little as a taste to a teaspoon.

WARNING: This classification indicates *moderate toxicity*. Death may result from ingestion of a teaspoon to a tablespoon of the pesticide.

CAUTION: Pesticides with this label have much *lower toxicity*. It is estimated that a considerably larger quantity, one ounce to more than a pint, is required to kill a person.

The label tells what steps to take if the pesticide is swallowed, inhaled, or splashed into the eyes or onto the skin. Make absolutely certain that everyone involved in the operation of the farm knows and can carry out the Statement of Practical Treatment provided on the front panel of the label. Different pesticides require different medical treatments. Follow label directions for treatment. If a poisoning occurs and medical attention is needed, it is important to take along a specimen label for the attending physician to use.

To be certain that a specimen label can be easily found in the event of a medical emergency, establish a file that contains labels of

all materials that you use. Place these in alphabetical order to speed up retrieval.

Medical Screening

Although not required, establishing a medical supervision program can provide an early warning of poisoning by certain pesticides in the organophosphate group. The operator should have pre-season blood cholinesterase test performed as a basis for later comparison. Blood tests done throughout the spraying season, monthly or even bi-monthly, can detect changes in cholinesterase

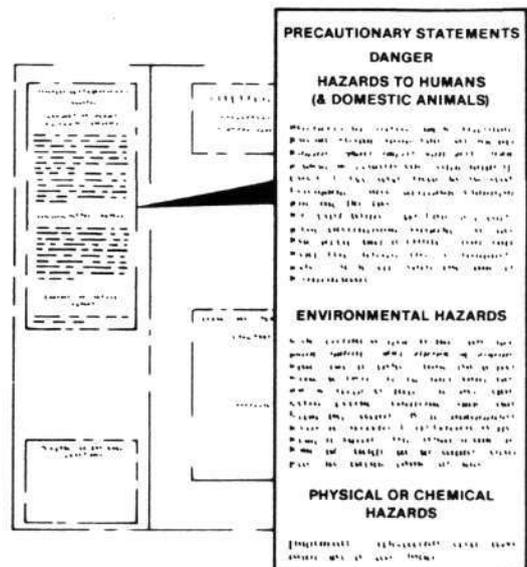


Figure 1 Read the product label each time before use, and follow the directions exactly. Check the label for precautions.

levels indicating that pesticide exposure has occurred. This might result from a nonworking respirator, contaminated clothing, accidental exposure or normal activities. In addition, in the event of an illness, a blood test checked against the base test will help determine if the illness is indeed related to the pesticide.

Environmental Effects of Pesticides

Pay particular attention to the environmental hazards information on all pesticide labels (*Fig. 1*). Under the Endangered Species Act, all pesticide labels are required to indicate if a particular product is prohibited for use in certain areas of the U.S. If a farm lies within the habitat range of an endangered species, use of that pesticide on that farm is prohibited.

Attention has also been focused on possible groundwater contamination from pesticides. Users of these chemicals should understand the factors that influence the movement of a pesticide down through the

soil. The most important factors are the characteristics of the pesticide (water solubility, persistence and soil binding capacity); the frequency and method of application; the soil type (texture, permeability and organic matter content); the depth of the water table and vulnerability of the aquifer. Decide which pesticide to use and how to apply it with these factors in mind.

Contamination can occur from both "point source" and "nonpoint source" origins. Point source contamination results from chemicals spilled or dumped on the ground when mixing, loading, or rinsing sprayers, or from dump sites of chemical containers. The chemicals move directly into the groundwater, well or stream from these point sources. Nonpoint source contamination results from chemicals moving from the target in normal spraying operations to the soil and eventually percolating thru the soil to the groundwater (*Fig. 2*).

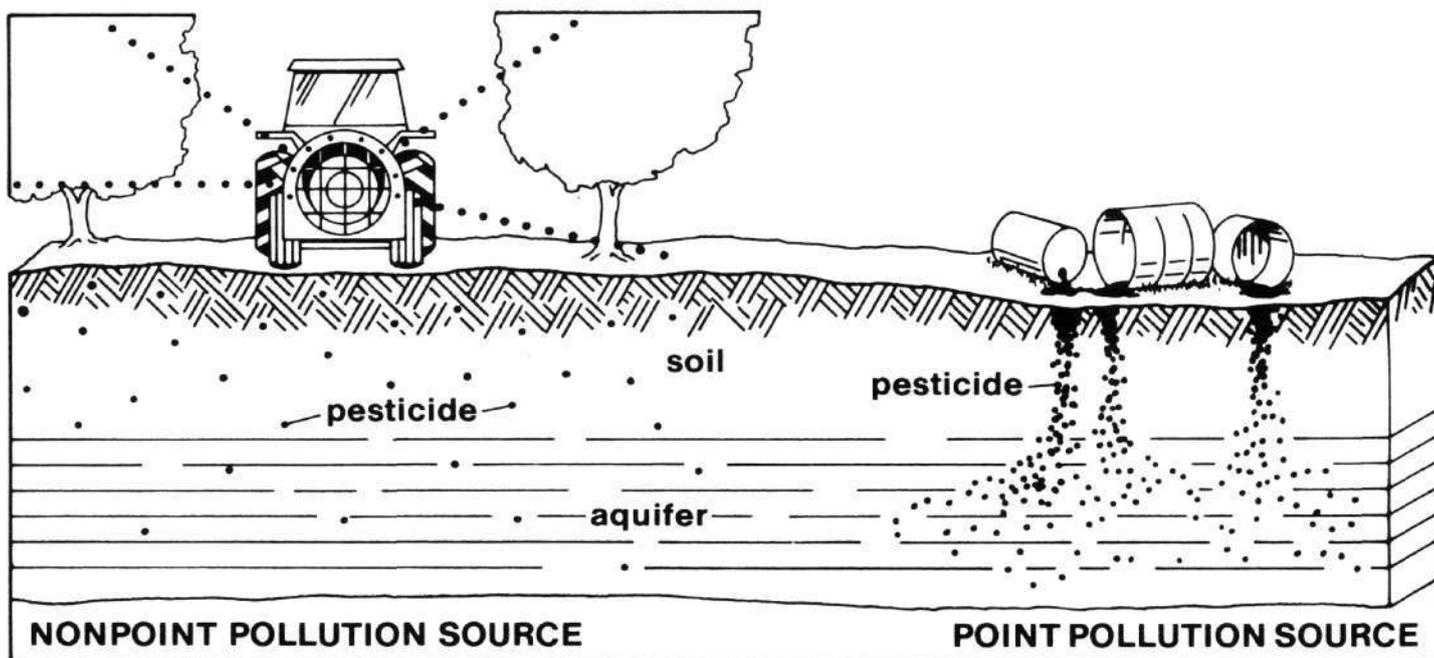


Figure 2 Pollution can occur from both point sources and nonpoint sources.



Figure 3 Confine pesticide spills and prevent spreading.

Selecting Pesticides

Before purchasing any pesticide, thoroughly *read the label* and any supplemental labeling material. Make certain that you will be using the pesticide only for the purposes listed and in the manner directed on the label. Select only those pesticides labeled for the crop you wish to use it on and the pests you wish to control. Buy only the amount of chemical you need to eliminate storage and disposal problems. In addition, be sure you have the equipment to properly apply the pesticide. These precautions are important for effective and economical product performance as well as for protecting human health and the environment.

Transporting Pesticides

Take care when hauling pesticides. You are legally responsible for safely transporting these chemicals. If possible, have agricultural chemicals delivered by your dealer directly to your pesticide storage facility. Department of Transportation rules must be followed in transporting large quantities of pesticides, including proper signs and labels on the vehicle, liability insurance, any special handling requirements, or rules to be followed.

For small quantities, the safest way to transport chemicals is in the back of a pick-up truck, with the tailgate closed. All containers must be fastened down. Never haul pesticides in the passenger compartment, or in the back of a truck where feed is also being transported. Clean up any spills in the vehicle immediately. A quantity of absorbent material, such as Oil Dry or cat box filler, should be on hand to absorb minor spills.

If you have a pesticide spill en route, have someone contact a law enforcement officer while you remain at the site until the officer arrives. If the spill starts to spread, build a dike from sand or dirt to contain it (*Fig. 3*). Do not hose down the area because this spreads the chemical. State and local laws have established a trained group of local people designated to clean up chemical spills, including pesticides. Get help. Don't do it alone!

Storing Pesticides

Pesticides must be stored in a facility that will protect them from temperature extremes, high humidity, and direct sunlight. It should be dark, cool, dry, well-ventilated and meet fire codes for storing flammable/combustible materials (*Fig. 4*) and be insulated to prevent freezing. Some liquid chemicals must be protected from freezing to preserve quality. Check the label for instructions on this point. Some formulas will drop out of solution at low temperatures but may be reconstituted by vigorous shaking prior to use. If the pesticide storage is subject to freezing, try to com-

pletely use freezable pesticides and avoid over winter storage problems. In no case should the chemicals be stored in the basement or similar area of the home to avoid freezing. The risk of human exposure is too high. Design the storage area for easy handling of pesticide spills, make it out of materials that will not absorb any pesticides that leak from containers or are spilled; e.g., cement floor and metal shelving.

Store only pesticides in this facility and in their original container. Do not store feed, seed, food or fertilizer with pesticides. Do not

store protective clothing or equipment in the pesticide storage facility. Try to store herbicides separately from insecticides and fungicides to avoid cross contamination.

Keep the pesticide storage facility locked at all times when not in use to prevent animals, children and unauthorized adults from entering. Remember, young children getting into stored pesticides account for most of the pesticide poisonings in the U.S., so keep that storage locked! The storage area should also be posted as a PESTICIDE STORAGE FACILITY. Include a warning to keep people away.

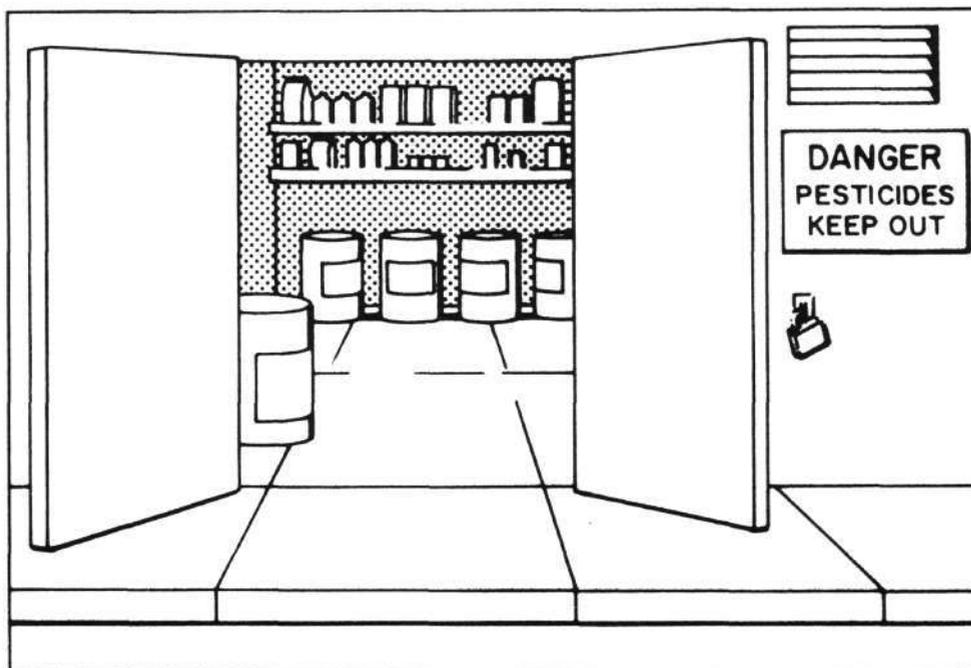


Figure 4 Lock and label the pesticide storage area.

HANDLING AND MIXING OF PESTICIDES

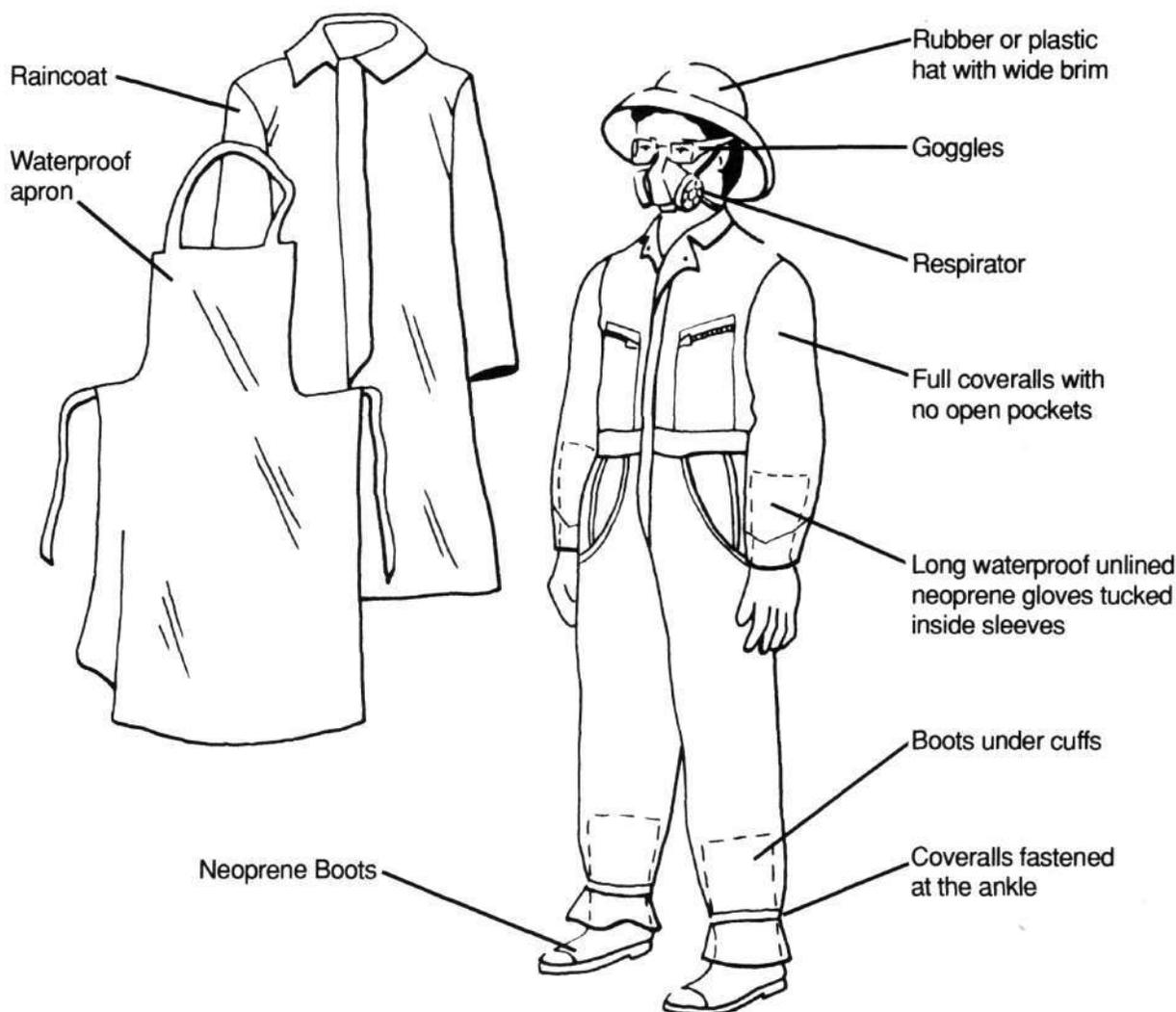


Figure 5 Protective clothing for highly toxic chemicals

Protective Clothing

Always wear protective clothing and equipment when handling, mixing, and applying pesticides and cleaning up application equipment. At a minimum, when handling pesticides, wear a long-sleeved shirt, long-legged trousers (or a coverall), chemical-resistant gloves, a hat (preferably a hard hat) and chemical-resistant footwear. Wear shirt sleeves outside of gloves and pant legs outside of footwear to prevent chemicals from running down into the gloves or boots (*Fig. 5*).

The clothing should be made of tightly woven fabric to resist chemical passage. Avoid cloth or leather linings in gloves, hats, and boots because they absorb pesticides and are difficult to clean. When handling pesticide concentrates, wear a chemical-resistant apron. Remember that pesticides can often enter the body through the skin. Select protective clothing to prevent skin contact with pesticides.

Specialized clothing, such as one piece coveralls and two piece jacket and pants units, are available for pesticide users. These are

made from a variety of fabrics and may have hoods. One popular material is *Tyvek*[®], a spunbound fabric that is not woven and has no pore spaces between yarns to pass chemicals. This material is relatively low cost, and lightweight, but it is uncomfortable in hot weather as it does not “breathe”. Clothing made from these materials may be disposed of after use or may be laundered a few times.

Saranex[®] is a laminated *Tyvek*[®] and gives better protection than *Tyvek*[®], but is more expensive. *Gortex*[®] is a fabric that has a microprorous film laminated between two layers of fabric. This material has comfort equivalent to a cotton shirt and jeans and gives excellent protection. Cost is relatively high. Rubberized cotton, the slicker, provides good protection, but is relatively expensive, heavy, and is uncomfortably warm in hot weather. However, it can be easily hosed off for cleanup.

Tests have shown that while specialized fabrics and clothing do give excellent protection from pesticides, ordinary denim work clothes in good condition also provide reasonably good protection. Also, they cost less and can be laundered for reuse.

Gloves that are chemically resistant are a must for the person working with pesticides. Gloves should be a gauntlet style, long enough (14") to protect the wrists from spills. They should be unlined to allow easier cleaning and to reduce chemical buildup and skin contact inside the glove (*Fig. 6*).



Figure 6 Gloves must be chemical resistant, unlined and waterproof.

Hats - suitable head protection for the applicator is very important. The hat should be water resistant and have a brim that protects the neck and face area from splashes or drift from airblast sprayers. Nonabsorbent rain hats or “hard hats” usually work well, are easily cleaned and have a brim to protect face and neck. Do not use a typical farm cap. Typically they have mesh tops and are made from fabric that absorbs chemicals and sweat. They provide almost no protection and become a “source of contamination” to the applicator.

Boots - waterproof foot covering is an essential part of the chemical applicators protective equipment. Boots should be comfortable, reasonably lightweight and easy to put on and off. They must protect the feet from splashes and walking in spilled chemicals. Wear the boot tops under pant cuffs so spilled chemicals do not fall in them. Hose off the boots before removing them. *Do not* wear leather shoes, boots or canvas sneakers. These materials will absorb water and spray chemicals and will eventually become a source of contamination.

Care of Pesticide Clothing

Because the clothing an applicator wears during a spray operation can be a source of chemical poisoning (by absorption through the skin), proper care and laundering is essential. Wear clean clothing every day you spray. This protects you from cross-contamination and makes the pesticide easier to remove. After spraying, first wash your waterproof gloves with soap and water to avoid contamination during removal. Then remove outer garments outdoors, or in an area that will prevent pesticide residues from being tracked into common-use areas. Pull pockets inside-out and unroll cuffs (these are common gathering places for powders and granular formulations). Shake the garments in an area where residues will not cause harm (this will help dislodge material embedded in the fabric fibers).

Pre-rinse the garments. There are three preferred methods:

1. Agitate in a separate tub or pail,
2. Agitate in an automatic washing machine, or
3. Rinse the garments outdoors with a hose.

Always launder clothing contaminated with agricultural chemicals separately from the family wash. Limit the load to a few garments, keeping those contaminated with the same chemical together. Set the machine for the full water level and the "normal" 12-minute cycle. HOT water (140°F or hotter) and a heavy-duty liquid detergent work best. Cold water is ineffective. Adding chlorine bleach or ammonia has not proven beneficial. **NEVER USE BOTH AT ONE TIME.** Line dry the clothing or use an automatic dryer.

Run a complete but empty cycle after laundering heavily contaminated garments to remove residues from the washing machine. Use the same heavy-duty liquid detergent and hot water. An alternative is to have a washer dedicated to only the washing of pesticide contaminated clothing.



Figure 7 Use a "chemical" respirator and protect the eyes and face from chemicals.

Garments with moderately severe contamination require two or three rewashings. Clothing that has been severely contaminated with highly toxic chemicals should be destroyed by incineration or burial. This is necessary as severe buildups of pesticide material are nearly impossible to remove.

If the contaminated garments must be stored, a separate plastic container should be adequate.

Protective Equipment

To keep from breathing pesticides, use a MSHA/NIOSH* approved respirator with a chemical absorbent material appropriate for the pesticide being handled. There are two types of respirators available, a chemical cartridge respirator and a chemical canister "gas mask" style respirator (*Fig. 7*). Choose the correct one for your situation and remember that *neither* respirator will protect you during fumigation, or when the oxygen supply is low, such as in a silo.

When using a respirator, change filters or canisters when pesticide can be smelled or if you notice resistance to air flow when breathing. The respirator must fit the face well to protect the wearer. Long sideburns, a beard or glasses may prevent a good seal. Due to the wide variation in the shape and size of heads and faces, some people may have difficulty obtaining a good fit and seal of the respirator. If you have trouble properly fitting your respirator, try another make or style with a softer sealing surface. Most of the major manufacturers of respirator equipment provide assistance in getting a good tight fit.

When being stored for extended periods, thoroughly clean and dry the respirator and place it in a sealed plastic bag. This preserves its chemical absorbing ability. Read the manufacturers directions on care and use of the respirator before using it.

*Mine Safety and Health Administration, National Institute of Occupational Safety and Health.

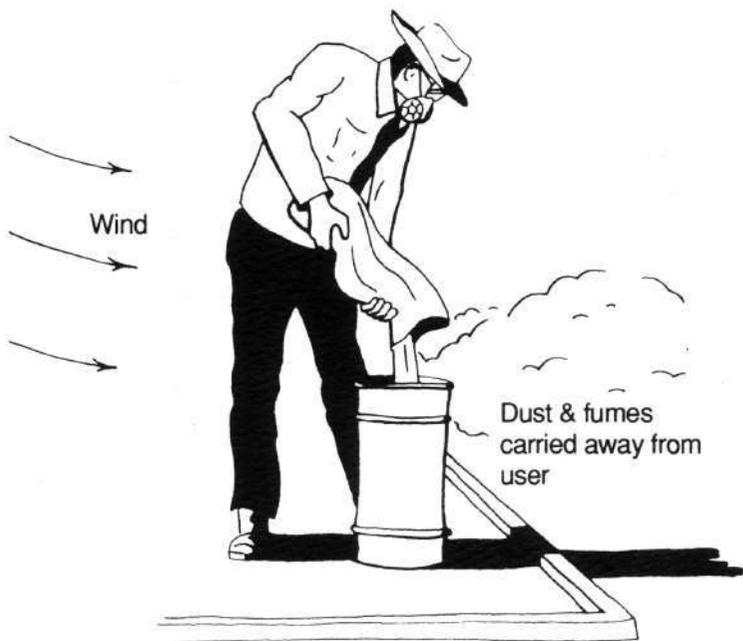


Figure 8 Keep chemicals downwind.

Wear goggles or a face shield if there is a chance of getting pesticides in your eyes. Goggles with shielded vents for chemical splash protection are preferred in place of open vented goggles.

Although hearing protection is not generally associated with pesticides, it may be an important part of the applicator's protective equipment considering the noise level of some sprayers. If you operate an air blast sprayer with high noise levels or any equipment that has potential for hearing damage, use either muffs or ear plugs for protection.

Minimizing Exposure

Protective clothing and equipment are essential to the life and the health of the pesticide applicator. But in addition to the protection they provide, there are a number of techniques and practices associated with pesticide handling that can reduce pesticide exposure substantially. Never rip open bags of wettable powder pesticides. Cut open carefully with a sharp knife. A clean opening makes pouring easier, and reduces the possibility of billowing clouds of concentrated powder that can be accidentally inhaled. Carefully open metal containers to avoid splashing. Try

to use closed handling/mixing systems when appropriate.

Always mix pesticides downwind and below shoulder height (*Fig. 8*). If pesticides are spilled on you, wash them off immediately with lots of water and then change your clothing. If you splash a pesticide in your eyes or mouth, rinse with plenty of water and visit a physician immediately. Take the pesticide label with you to the physician or poison treatment center. Follow label instructions on treatment.

Never eat, smoke, drink or chew tobacco when mixing, loading or applying pesticides (*Fig. 9*). Always wash your hands after using pesticides, especially before using the toilet. Pesticides are absorbed more readily by certain parts of the body than others. The head and scalp absorb pesticides 4 to 5 times faster than the forearm or hand; the genital area, 11 to 12 times faster. Be particularly careful to protect these sensitive areas of the body.

It may be helpful to have two or more pair of pesticide gloves. Keep one pair at the chemical mixing point, and another pair on the tractor or spray rig. The gloves used for



Figure 9 Chemical residues from unwashed hands can easily get into the mouth when eating, smoking or touching the face.

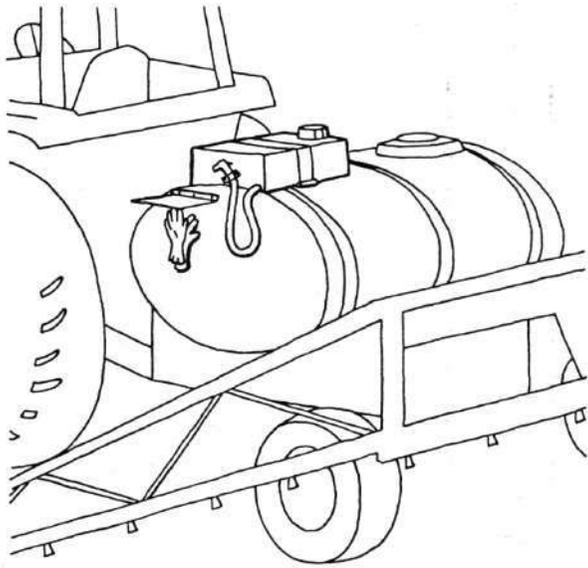


Figure 10 Example of a sprayer with glove holder and auxiliary water tank for cleanup.

mixing should be washed off when mixing is completed. Hang them up to dry and leave them at the loading point. This removes the heavy contamination potential of these gloves from the operator and equipment. Use another pair of gloves for work while actually applying the pesticide.

Use care when removing gloves to avoid contaminating the inside. Work each glove off part way by gripping the outside surface with the other glove. At this point a clothes pin type spring catch mounted on the wall or the side of the sprayer can be used to catch and hold the glove by the finger tips, allowing the hands to be withdrawn downward. Leave the gloves in this position, the opening facing down, so nothing will run inside the gloves. When needed, the hands can be reinserted and the spring clip released.

A supplemental 5 gallon tank of water on the spray rig is cheap insurance against pesticide contamination. Mount the water tank so it will have gravity flow and provide a suitable hose and outlet valve. Use the clean water to wash gloves, boots and nozzle parts or even yourself when out in the field and exposed to the pesticide (*Fig. 10*).

When applying sprays make every effort to start on the leeward side of the field or orchard, and work toward the wind. With this practice the wind carries any drift away from you and you work upwind into the "clean" area of the field. This is particularly important with sprayers that use an "air carry" system as there may be considerable spray drift in the air for a short time.

Cabs on tractors and trucks provide much greater protection to the operator than does an open tractor, even when the operator is equipped with protective clothing (*Fig. 11*). However if a tractor or truck has a ventilation system to draw in outside air, it should be equipped with a filtering system suitable for pesticides.

Mix only what is required for the area (lb/acre) to be sprayed according to label di-

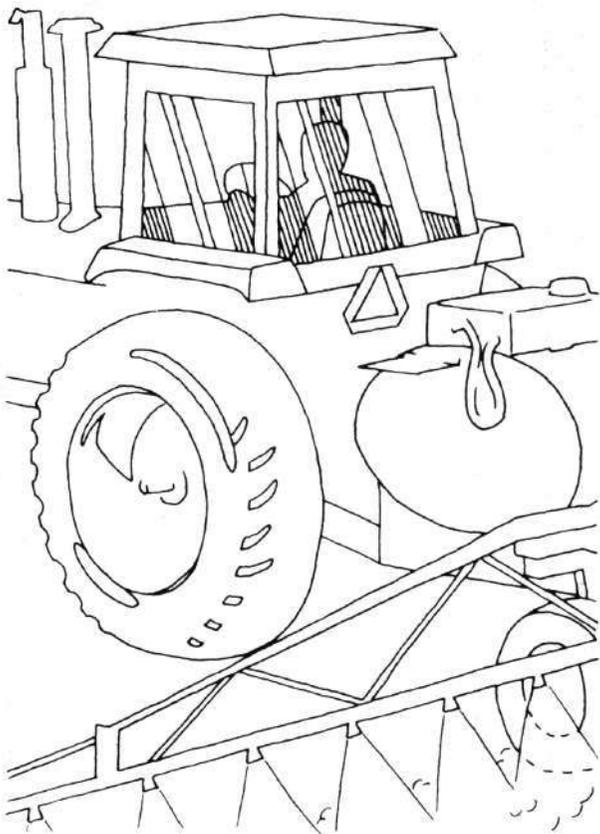


Figure 11 Tractor cabs provide excellent operator protection from chemical application exposure.

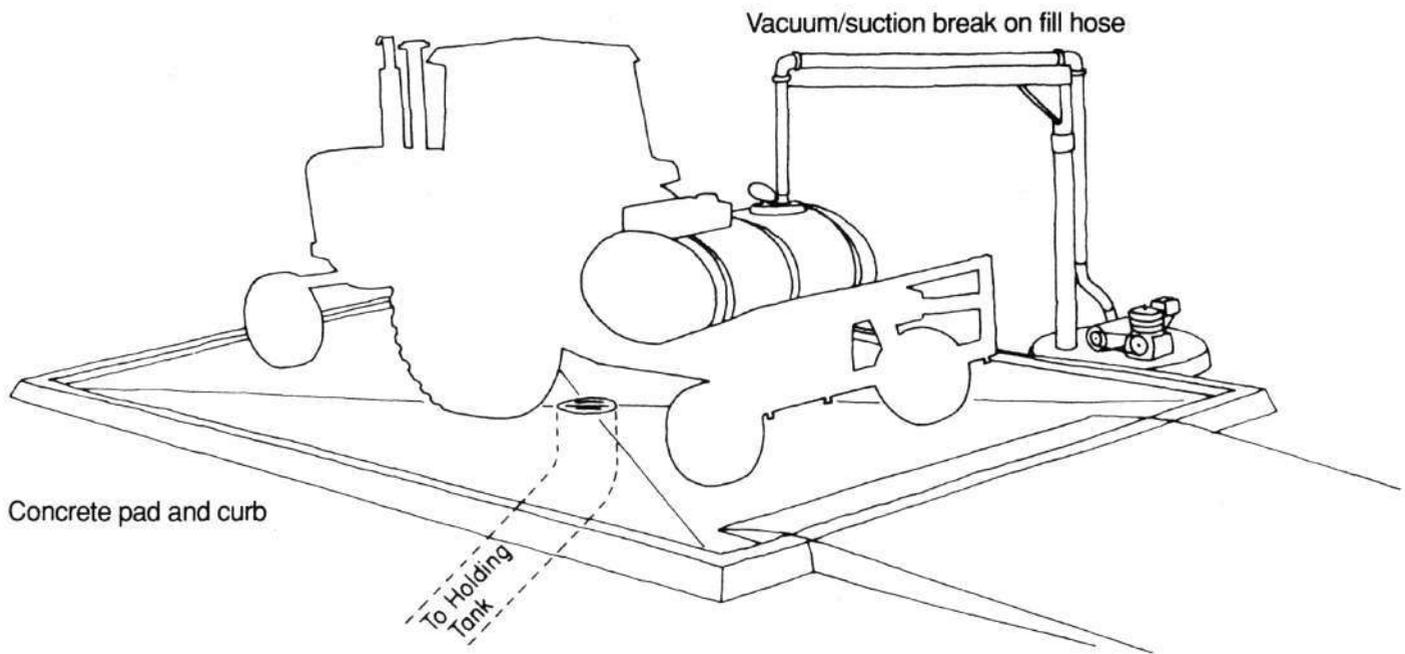


Figure 12 Containment loading area.

rections. Avoid mixing excessive amounts since this may create a hazardous waste which is difficult and expensive to dispose of properly and legally. Keep unauthorized persons out of the area where you handle and store pesticides.

If substantial amounts of chemicals are mixed for application, provide a suitable mixing place to park the sprayer and do the mixing. The mixing area should have a concrete

pad with curbs to prevent runoff and suitable drains to a holding tank or evaporation area (*Fig. 12*). The fill hose should be elevated and equipped with a vacuum break to prevent back flow into the well water (*Fig. 13*). The loading point should be located a minimum of 150 feet from the well or surface water supply to eliminate potential contamination.

Applying Pesticides

Before applying pesticides, the equipment used must be thoroughly checked for sound operation and accurate calibration. Poor maintenance and calibration practices can lead to excessive residues on crops, poor pest control and/or harm humans, animals, plants and the environment. Inspect the application equipment during use to prevent the unintentional release of chemicals. If the equipment needs repairs, stop the application operation and fix the problem before completing the job.

When checking a sprayer at the beginning of the season, use clear water, instead of pesticides, to determine if the sprayer is operating properly. This will eliminate the risk of

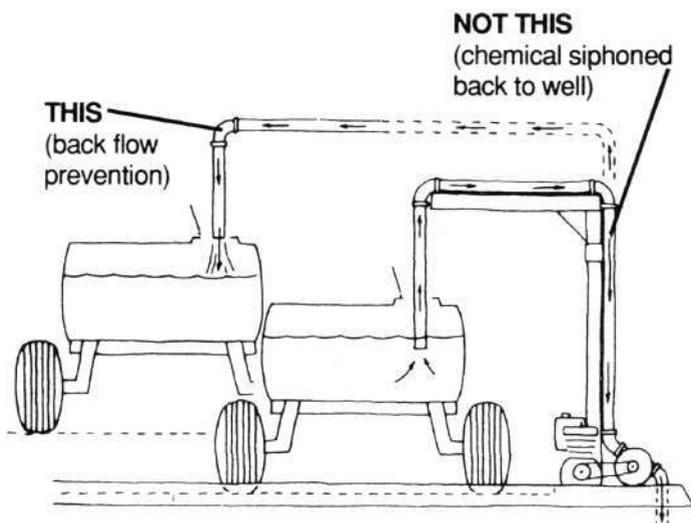


Figure 13 Prevent backsiphoning by providing a vacuum break.

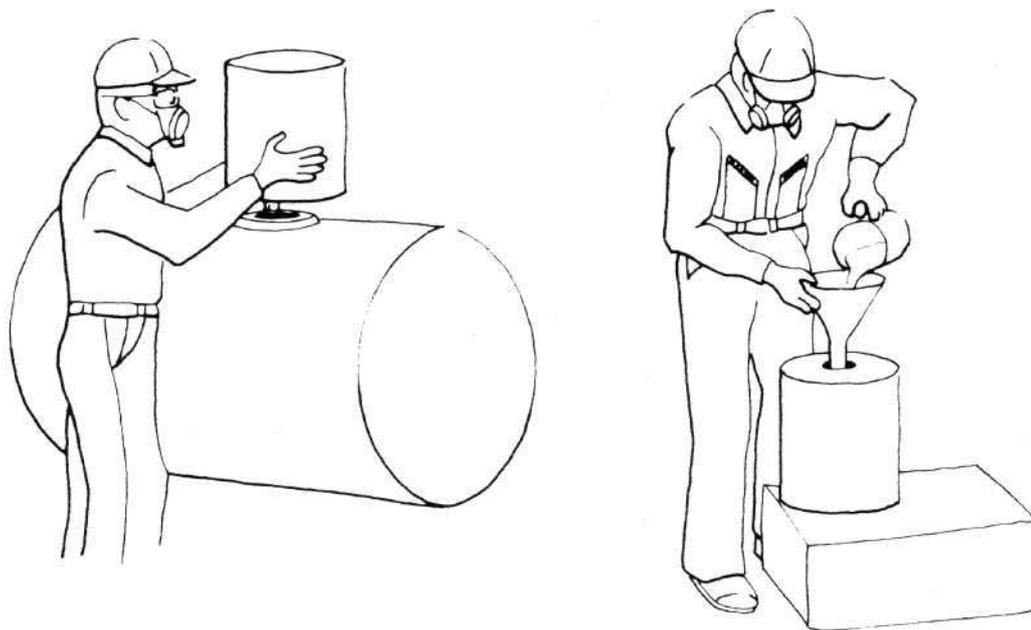


Figure 14 Triple rinse containers to remove residue.

pesticide poisoning or harm to the environment.

When pouring liquid pesticides into the sprayer tank, let the container drain for at least an extra 30 seconds after emptying. Fill the empty container about one-quarter full of water, replace the closure and slosh the water inside to mix any remaining chemical with the water. Add this to the sprayer tank, allowing it to drain for 30 seconds after emptying. Repeat the rinse twice more (*Fig. 14*). Then puncture or destroy the container and dispose of it in an approved sanitary landfill or bury it on site.

A more convenient and faster method for rinsing uses a power or jet rinse (*Fig. 15*). This device punctures the bottom of the inverted can. A garden hose is connected to it. When the self-contained valve is turned on, water is sprayed throughout the inside of the can and drained out into the spray tank. A 60 second jet rinse is equivalent to triple rinsing and the can is punctured to prevent reuse.

Before applying pesticides, all humans and livestock must be removed from the area to be treated. If you must spray near dwellings, warn the occupants to stay away from

the treated area at least until the spray has dried or for the length of the “no reentry” time specified on the label.

Do not spray on days when the wind is greater than 10 miles per hour and/or weather conditions (e.g., inversions) are conducive to pesticide drift away from the target area. Make every effort to avoid pesticide drift. Use low pressure nozzles that reduce the number of fine droplets. Note that on hot days the active ingredient may vaporize during or after the application. These vapors can drift and cause injury far from the application site. Vaporization can be reduced by using a nonvolatile chemical formulation and by spraying during the cooler hours of the day.

The severity of injury due to accident can generally be reduced if help is available. Thus, it is advisable to *not work* alone when spraying. This is not always practical. If it is necessary to mix and apply chemicals alone, especially at night, advise someone of your whereabouts, what you’re doing and your expected time of return. They will then know where to find you if you are delayed for any reason.

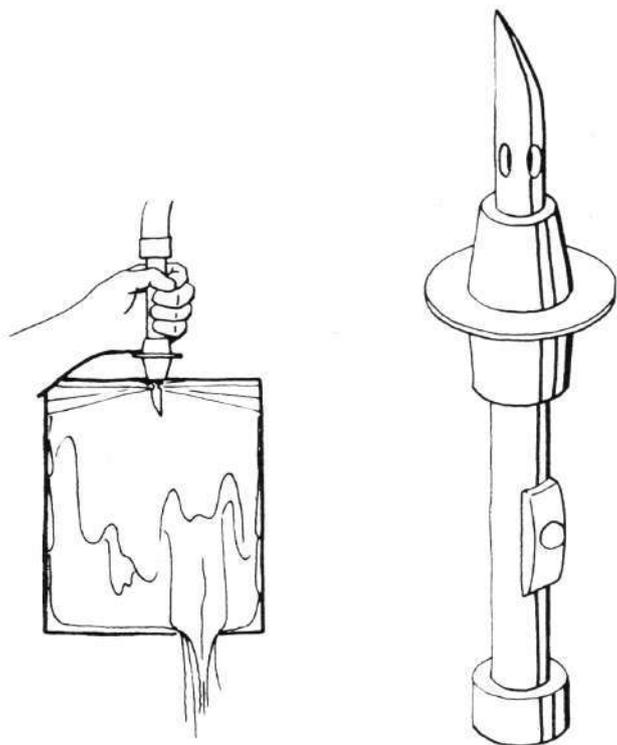


Figure 15 A jet rinse for rinsing chemical containers.

Reentry into the Application Area

Read and follow the label instructions on reentry for every pesticide used. Post areas that have been treated to warn others not to enter until the specified reentry time has elapsed. Take down any postings within 3 days after the reentry time is over. Any person who has to go into a treated area before the elapse of the reentry period must wear protective clothing. Farm workers should not work in the treated area until the reentry time has elapsed. There should be no excuses for farm worker exposure to pesticides during or immediately after a pesticide application.

Handling and Disposing of Pesticide Containers

All pesticide containers are considered hazardous waste unless they are triple rinsed and the rinsate is used as additional dilution to the spray mixture. After triple rinsing all emptied pesticide containers, perforate both ends so the container cannot be reused. All metal and plastic triple rinsed containers should be offered for recycling. If this option is not available, dispose of them in a state licensed sanitary landfill or bury them on site. Dispose of all paper containers in a sanitary landfill or municipal waste incinerator. If you dispose of paper containers by burning in the field, observe the following precautions: burn no more than one days accumulation at one time; burn containers downwind so smoke does not drift on people, buildings or roads; burn only in the daytime and follow local regulations on this practice. Do not reuse empty pesticide containers for any purpose.

Cleaning Pesticide Application Equipment

Always try to end the day with an empty tank. Mix only enough chemicals for the days job. Clean mixing, loading and application equipment as soon as you are finished using it. When cleaning a sprayer that will soon be used again for similar application and with chemicals that are compatible, a thorough rinse is all that is necessary. If a more complete cleaning is needed to remove chemical residues that could damage crops during the next use, follow all label directions. If none are on the label, triple rinse the entire inside of the application equipment, spraying the rinsate on a labeled site at or below label rates. Wash off the outside of the equipment in an area where runoff will not be a hazard. Only after rinsing the equipment out with fresh water should you clean the spray system with an appropriate cleaning solution. In the event that there are no specific label instructions for cleaning, refer to *Table 1* for an effective

tive cleaning procedure. Do not spray the cleaning solution on the crop; dispose of the cleaning solution as a municipal waste. Follow manufacturer's recommendations for the end of season cleaning and maintenance.

Unused and Unwanted Pesticides

Unused and unwanted pesticides are considered hazardous by both federal and state regulations. To be exempt from the stringent requirements for disposal of such waste, make every effort to purchase the exact amount of pesticides that will be needed during the growing season. Take extreme care in calibrating and applying any pesticide so that leftovers are not generated at the end of the job. Use any pesticide-containing rinsates and

unused pesticides according to the label. If the procedures cannot be met, contact the Michigan Department of Natural Resources Hazardous Waste Division (517-373-2730) for instructions on proper disposal of pesticide waste.

For more information

There are many more bulletins available from your Cooperative Extension Service that deal with pesticides and how to apply them. Included are certification and recertification manuals for commercial applicators. To obtain copies of these bulletins, contact the county Extension office nearest you. Just look in the white pages under "county government."

TABLE I. Sprayer cleaning solutions and methods.*

Pesticide used	25 Gallon Cleaning Solution	2.5 Gallon Cleaning Solution	Instructions
Hormone herbicides, salt or amine formulations (2,4-D, dicamba, MCPA)	1 quart household ammonia	1/2 cup household ammonia	Thoroughly agitate, flush small amount through system, and let remainder stand in sprayer overnight. Flush and rinse.
	1 lb washing soda (sal soda)	3 Tbsp washing soda (sal soda)	Same as above except let stand for at least 2 hours.
	2 lbs trisodium phosphate	1/4 lb trisodium phosphate	
	1/2 lb fine activated charcoal + 1/2 cup powder detergent ¹	2 Tbsp fine activated charcoal + 1 - 2 oz powder detergent ¹	Agitate, operate sprayer for 2 minutes, let remainder stand for 10 minutes, then flush through sprayer. Rinse
Hormone herbicides, ester formulations (2,4-D, brush killers, MCPA)	1 lb washing soda (sal soda) + 1 gal kerosene + 1/4 lb powder detergent ¹	4 oz washing soda (sal soda) + 1 - 1/2 cup kerosene + 1 Tbsp powder detergent ¹	Rinse inside of tank and flush small amount through system. Let stand at least 2 hours. Flush and rinse.
Other herbicides (atrazine, simazine, alachlor)	1/4 lb powder detergent ¹	1 Tbsp powder detergent ¹	Rinse with clean water before and after using sudsy solution.
Insecticides² and/or fungicides	1/4 lb powder detergent ¹	1 Tbsp powder detergent ¹	Agitate, flush, and rinse.

¹Liquid detergent may be substituted for powder detergent; mix at a rate to make a sudsy solution.

²Organophosphate and carbamate insecticides may be detoxified by adding household ammonia to the cleaning solution (1 qt./25 gallons or 1/2 cup/2.5 gallons).

*From Boom Sprayers, NRAES-19, Pennsylvania State University, 1983

Appendix A: Agricultural Chemical Poisoning

CHEMICAL	TOXICITY	COMMON NAME	TRADE NAME	ACTION OR SITE OF POISON	ROUTES OF ABSORPTION	SYMPTOMS
INSECTICIDES						
CHLORINATED HYDROCARBONS	Low to highly toxic	Aldrin	Aldrin	Neurotoxic	Ingestion	Twenty minutes to four hours
		Benzene Hexachloride	BHC	CNS	Inhalation	1. Nausea
		Chlordane	Chlordane	Kidney	Dermal	2. Dizziness
		Chlorodecone	Kepone	Liver		3. Headache
		Dicofol	Keltane			4. Vomiting
		Dieldrin	Dieldrin			5. Restlessness
		Endosulfan	Thiodan			6. Disorientation
		Lindane	Lindane			7. Weakness
		Pentachlorophenal	PCP			8. Twitching eyelids
		Toxaphene	Toxakil, Toxaphene			9. Apprehension
						10. Paresthesiae
						11. Convulsions
						12. Tremor
						13. Coma
			14. Respiratory failure			
ORGANOPHOSPHORUS COMPOUNDS	Low to highly toxic	Temephos	Abate	Anticholinesterase (irreversible)	Ingestion	MILD:
		Acephate	Orthene		Inhalation	1. Anorexia
		Azinphos-Methyl	Guthion		Dermal	2. Headache
		Carbophenothion	Trithion			3. Dizziness
		Chlorpyrifos	Dursban, Lorsban			4. Weakness
		Diazinon	Diazinon			5. Anxiety
		Dichlorvos, DDVP	Vapona			6. Tremors of tongue & eyelids
		Dimethoate	Cygon, Dimethoate			7. Miosis
		Disulfoton	Disyston			8. Impairment of visual acuity
		Fonofos	Dyfonate			MODERATE:
		Ethion	Ethion			1. Nausea
		Fensulfothion	Dansanit			2. Salivation
		Fenthion	Baytex			3. Lacrimation
		Tetrachlorvinphos	Gardona			4. Abdominal cramps
		Malathion	Malathion			5. Vomiting
		Methamidophos	Monitor			6. Perspiration
		Methyl Parathion	Methyl Parathion, Permcap M			7. Slow pulse
		Methidathion	Supracide			8. Muscular tremors
		Mevinphos	Phosdrin			SEVERE:
		Naled	Dibrom			1. Diarrhea
		Parathion	Parathion			2. Pinpoint, non-reactive pupils
		Phorate	Thimet, Phorate			3. Respiratory difficulty
		Phosphamidon	Dimecron, Phosphamidon			4. Pulmonary edema
						5. Cyanosis
						6. Loss of sphincter control
						7. Convulsions
						8. Coma
						9. Heart block

CHEMICAL	TOXICITY	COMMON NAME	TRADE NAME	ACTION OR SITE OF POISON	ROUTES OF ABSORPTION	SYMPTOMS
CARBAMATTES	Low to highly toxic	Aldicarb	Temik	Anticholinesterase (reversible)	Ingestion	1. Headache
		Bendiocarb	Ficam		Inhalation	2. Dizziness
		Carbaryl	Sevin		Dermal	3. Blurred or "dark" vision
		Carbofuran	Furadan			4. Constriction of pupils
		Formetanate Hydrochloride	Carzol			5. Salivation
		Metalkamate (d), Bufencarb	Bux			6. Profuse sweating
		Methomyl	Lannate, Nudrin			7. Lassitude
		Mexacarbate	Zectran			8. Muscle incoordination
		Propoxur	Baygon			9. Nausea
		10. Vomiting				
		11. Diarrhea				
		12. Epigastric pain				
		13. Tightness in chest				
		14. Twitching				
HALOCARBON & SULFURYL FUMIGANTS	Moderate to highly toxic	Chloroform	Chloroform	CNS	Ingestion	SYMPTOMS ARE DELAYED 4 TO 12 HOURS AFTER EXPOSURE:
		Dichloropropene	Telone	Exzyme systems	Inhalation	1. Dizziness
		Ethylene Dibromide	EDB	Liver & kidney	Dermal	2. Headache
		Ethylene Dichloride	Ethylene Dichloride	Lungs		3. Anorexia
		Methyl Bromide	Methyl Bromide			4. Nausea
		Methylene Chloride	Methylene Chloride			5. Vomiting
		Para-Dichlorobenzene	PBD			6. Abdominal pain
		Sulfuryl Flouride	Vikane			7. Weakness & slurred speech
		Trichloroethane	Trichloroethane			8. Mental confusion
		9. Tremors				
		10. Epileptiform convulsions				
		LATE SYMPTOMS:				
		1. Bronchopneumonia				
		2. Pulmonary edema				
		3. Respiratory failure				
		BROMIDES CAUSE IN ADDITION:				
		1. Salivation				
		2. Coma				
		3. Areffecia				
		4. Respiratory failure				
		5. Circulatory failure				
		6. Cutaneous blisters				
		7. Dermal exposure to methyl bromide may be lethal				

CHEMICAL	TOXICITY	COMMON NAME	TRADE NAME	ACTION OR SITE OF POISON	ROUTES OF ABSORPTION	SYMPTOMS
CYANIDE FUMIGANTS	Highly toxic	Acrylonitrile	Acrylonitrile	Cell metabolism	Ingestion	ONE OF THE FASTEST ACTING KNOWN POISONS
		Calcium Cyanide	Cyanogas		Inhalation	MASSIVE DOSE: 1. Unconsciousness 2. Death without warning
		Hydrogen Cyanide	Hydrocyanic Acid			SMALLER DOSE: 1. Increased blood pressure 2. Slowing heart beat followed by rapid & irregular pulse 3. Palpitation 4. Constriction of chest 5. Variable respirations 6. Salivation 7. Nausea without vomiting 8. Anxiety, confusion 9. Dizziness 10. Unconsciousness 11. Convulsions FOLLOWING INGESTION: 1. Bitter burning taste 2. Constriction of throat membrane 3. Odor of bitter almonds in breath and vomiting
PHOSPHINE FUMIGANTS	Highly toxic	Aluminum Phosphide	Phostoxin	Enzyme systems	Inhalation	MILD:
				Liver	Dermal	1. Sensation of cold 2. Pulling pains in diaphragm region 3. Diarrhea 4. Vomiting
				Kidney		MODERATE: 1. Fatigue 2. Vertigo 3. "Furred" tongue 4. Thirst 5. Tinnitus 6. Anxiety 7. Dyspnea 8. Cough 9. Tightness in chest SEVERE: 1. Gastric pain 2. Reeling 3. Cyanosis 4. Vomiting 5. Pains in limbs 6. Enlarged pupils 7. Choking attacks 8. Rapid stupor

CHEMICAL	TOXICITY	COMMON NAME	TRADE NAME	ACTION OR SITE OF POISON	ROUTES OF ABSORPTION	SYMPTOMS
HERBICIDES						
UREAS, URACILS & TRIAZINES	Low toxicity	Atrazine	Atrazine, AAtrex	Respiratory	Ingestion	During handling may cause irritation of eyes, nose, throat & skin.
		Bensulide	Betasan	Eyes	Dermal	INGESTION MAY CAUSE:
		Bromacil	Hyvar	Skin		1. Gastroenteritis
		Diuron	Karmex	Mucous membranes		2. Nausea
		Fenuron-TCA	Urab, Dozer			3. Vomiting
		Monuron	Telvar			4. Diarrhea
		Propazine	Milo-Pro, Primatol			
Metribuzin	Sencor, Lexone					
ORGANIC ACIDS & DERIVATIVES	Low to highly toxic	Simazine	Aquazine, Princep, Simazine	Liver	Ingestion	1. Weakness
		Cacodylic acid	Phytar 560	Skin	Dermal	2. Lethargy
		Chlorthal-Dimethyl, DCPA	Dacthal	Respiratory & G.I. lining		3. Anorexia
		Dalapon	Dalapon, Revenge	Kidney		4. Emesis
		Dicamba	Barvel	Eyes		5. Muscle weakness—may involve muscles of mastication & swallowing
		Dichlorophenoxyacetic Acid	2,4-D			6. Chest pain
		Disodium Methanearsonate	DSMA			7. Abdominal pain
		Endothall	Endothall, Herbicide 273			8. Myotonia
		Pronamide	Kerb			9. Irritation of exposed skin
		Monosodium Methanearsonate	MSMA			10. Inhalation causes burning & cough
		11. Irritation of mouth & throat				
		12. Fibrillary muscle twitching				
		13. Dizziness				
		14. Diarrhea				
QUATERNARY AMMONIUM SALTS (DIPYRIDYLS)	Low to highly toxic	Diquat	Aquacide, Diquat	Respiratory & gastric mucosa	Ingestion	ORAL INGESTION: Early symptoms may be mild but vigorous treatment should not be delayed
		Paraquat	Paraquat	Kidney	Inhalation	1. Pain (oral, substernal & abdominal)
Lungs	Dermal			2. Ulceration of the tongue, throat and esophagus		
Skin				3. Vomiting, diarrhea		
CNS				4. General muscle ache		
Liver				48 TO 72 HOURS AFTER EXPOSURE:		
Eyes				1. Oliguria		
	2. Jaundice					
	3. Cough					
	4. Dyspnea					
	5. Tachypnea					
	6. Pulmonary edema					
	7. Convulsions					
	8. Coma					
	INHALATION:					
	1. Nose & throat irritation					
	2. Nosebleeds					
	DERMAL EXPOSURE:					
	1. Skin irritation, drying, cracking					
	2. Eye—severe irritation with corneal stripping & conjunctivitis.					

CHEMICAL	TOXICITY	COMMON NAME	TRADE NAME	ACTION OR SITE OF POISON	ROUTES OF ABSORPTION	SYMPTOMS
FUNGICIDES						
THIOCARBAMATES	Low to moderately toxic	Triphenyltin Acetate	Batasan	Enzyme systems in liver & CNS	Ingestion	NO ALCOHOL INGESTED:
		Benomyl	Benlate, Tersan 1991		Inhalation	1. Itching-redness
		Chlorothalonil	Daconil, Bravo		Dermal	2. Dermatitis
		Dithiocarbamate	Dithane M-45			3. Hoarseness
		Ferbam	Ferbam			4. Coughing
		Etridiazole	Koban			5. Nausea
		Thiram	Thiram			6. Vomiting
		Metam-Sodium	Vapam			7. Diarrhea
		Ziram	Ziram			8. Ataxia
			9. Muscle weakness			
			10. Paralysis			
				FOLLOWING ALCOHOL INGESTION:		
				1. Flushing		
				2. Sweating		
				3. Dyspnea		
				4. Hyperpnea		
				5. Chest pain		
				6. Hypotension		



Appendix B: PESTICIDE EMERGENCY INFORMATION

(Please post in an appropriate place)

For any type of emergency involving a pesticide, the following Emergency Information Centers should be contacted immediately for assistance.

Current as of August 1989



HUMAN PESTICIDE POISONING

Eastern Half of Michigan

within the Detroit city proper:

***(313) 745-5711**

within the 313 area code:

***1-800-462-6642**

Poison Control Center

Children's Hospital of Michigan
3901 Beaubien
Detroit, MI 48201

Western Half of Michigan

within the Grand Rapids city proper:

***(616) 774-7854**

Statewide

***1-800-632-2727**

Blodgett Regional Poison Center

Blodgett Memorial Medical Center
1840 Wealthy, S.E.
Grand Rapids, MI 49506

Upper Peninsula of Michigan

within the Marquette city proper:

***(906) 225-3497**

Upper Peninsula only:

***1-800-562-9781**

U.P. Poison Control Center

Marquette General Hospital
420 West Magnetic Street
Marquette, MI 48955



Cooperative Extension Service
Michigan State University
Extension Bulletin **AM-37**

PESTICIDE EMERGENCY INFORMATION:
Revised by Larry G. Olsen, *Pesticide Education Coordinator, Michigan State University.*
Current as of August 1989* (**Revised-destroy previous editions**)

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SPECIAL PESTICIDE EMERGENCIES

Animal Poisoning

Your personal veterinarian:

and/or

Animal Health Diagnostic Laboratory, Michigan State University:
(517) 353-1683

Pesticide Fire

Local fire department:

and

Fire Marshal Division, Michigan State Police:
(517) 322-1924

Traffic Accident

Local police department or sheriff's department:

and

Operations Division, Michigan State Police:
***(517) 337-6102**

Environmental Pollution

Pollution Emergency Alerting System (PEAS), Michigan Department of Natural Resources:
***1-800-292-4706**
(Toll free for environmental emergencies)

For information on pesticide disposal and local pick-up days:

Michigan Department of Natural Resources,
Waste Management Division:
(517) 373-2730

*** Telephone Number Operated 24 Hours**



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