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Pesticide Management To Protect Water Quality Using Pesticides On The Farm: From Selection To Disposal

Using pesticides safely will protect your family's health and prevent surface water and groundwater contamination. Safe use requires careful planning before, during, and after application. Pesticides must be handled safely from initial purchase through ultimate use or disposal.

Planning For Pesticide Use

When selecting a pesticide, consider the four major factors which determine whether a pesticide is likely to reach groundwater: pesticide properties, soil properties, site conditions, and management practices.

Pesticide Properties. Become familiar with pesticides that may leach. Pesticides with a high potential for leaching are more likely to contaminate groundwater. For example, some carbamate pesticides are more likely to leach and cause groundwater contamination than other pesticides. Check the pesticide label for warnings about potential to leach to groundwater. In addition, your Cooperative Extension System or U.S. EPA can provide information on the leaching potential of different pesticides.

Soil Properties. Identify vulnerability of the soil. Well-drained or sandy soils low in organic matter have a high potential for groundwater contamination. Evaluate your soil and site conditions based on information from your local Cooperative Extension agent or USDA-Natural Resources Conservation Service.

Site Conditions. Consider the location of the pesticide application site in relation to surface water and groundwater. Wells are the most common source of present day contamination. Grade the area around your well to divert surface runoff away from the well-head. Do not handle, store, or use chemicals where pesticides can enter a well or any water. Maintain a buffer zone around all water sources.

Keeping pesticides away from water sources helps to prevent their introduction into groundwater. Consult your Cooperative Extension System, Natural Resources Conservation Service, State Water Quality Agency, U.S. Geological Survey, or State Geological

Survey agency to determine the depth to groundwater in your area.

Management Practices. Select pest management strategies to prevent groundwater contamination. Seriously consider the environmental impacts for all potential pest control practices. Use pesticides only when necessary and only in amounts that will adequately control pests. Use alternative control methods where feasible.

Choose application methods that are least likely to contaminate groundwater. Generally, avoid soil injection and soil incorporation of the more soluble, weakly adsorbed pesticides if other alternatives are available. Make the fewest applications at the lowest rate that will achieve acceptable pest control. Proper application rates are critical in prevention of soil overloading.

Maintain records, by date, of the identity and quantity of pesticides applied to each area. Include which chemical, how much, application rate, date, time, temperature, wind conditions, which field, and reason for spraying.

Transporting Pesticides

An accident while transporting a product can spill a large amount of concentrated pesticide over a small area and can cause a substantial threat of leaching to groundwater. Consequently, the transport of pesticides is becoming increasingly regulated. The Hazardous Materials Transportation Act of 1990 requires the U.S. Department of Transportation (DOT) to regulate the training of all employees involved in handling hazardous materials, which include pesticides and some fertilizers. Since farmers are considered to be self-employed, they are responsible for their own training.

If you transport pesticides over public highways, you are required to be trained in hazardous materials handling (as of April 1, 1993). Part of the training should include safe handling of pesticides: how to handle an emergency, how to prevent accidents, and what protective clothing is required. Simply having a commercial drivers license will not satisfy training regulations.

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Visit our Web site at: www.aces.edu

For more information on DOT's hazardous material training rules, write The Fertilizer Institute, 501 Second St., NE, Washington, DC 20002. Or, call DOT's Transportation Safety Institute at 405-954-4824.

To prevent accidents while transporting pesticides:

- Inspect containers for tightly closed caps and plugs.
- Make sure labels are legible.
- Handle containers carefully to avoid rips or punctures.
- Carry concentrated pesticides on a steel truck bed with solid side walls and endgate.
- Firmly secure containers against movement during transit.
- Equip truck with spill cleanup materials: personal protective clothing, shovel, plastic, absorbent material, and empty containers larger than the pesticide packaging.

Cleaning Up A Spill

In case of a spill, use personal protective equipment and act immediately. Follow the three C's for spill cleanup:

Control The Spill: Place torn or punctured containers into larger empty ones. Stand overturned containers upright.

Contain (Confine) The Spill: Limit chemical spread by using a dike or dam. Seal off all entry points into water or sewers, no matter how small the spill. Add an absorbent (dirt, sawdust, cat litter) to liquids.

Clean Up The Spill: Quick cleanup minimizes entry into surface water or sewer water and leaching to groundwater. Be sure to clean up any contaminated absorbent material. Call the manufacturer for advice on clean-up of their chemical.

After a spill, properly dispose of the drenched soil or absorbent material:

- Excavate as much soil as necessary.
- Decontaminate or neutralize the contaminated area.
- Clean equipment.
- If possible, apply spilled material and contaminated soil to a labeled site or crop, at or below the recommended application rate. This will depend on what and how much was spilled and the rules for disposal in your state. If this is not an option, the soil or absorbent material may need to be disposed of in a landfill that handles such material.
- If the spill is a hazard to people or to the environment or if it may enter water, call your state environmental agency about handling or cleaning up the spill. Some states now have state spill hotlines and state emergency response numbers for pesticide emergen-

cies. Alabama and most southeastern states do not have these available at this time. In Alabama, call The Alabama Department of Environmental Management (Field Operations Division) 334-260-2700.

For 24-hour emergency service call Chemtrec (800-424-9300) regarding proper cleanup and safety procedures of roadway spills. Chemtrec is staffed by chemical experts who provide information on whom to call or what procedures to use for handling or cleaning up a spilled agricultural chemical. They also contact the chemical manufacturer and give you the phone number for follow-up.

Storing Pesticides

Proper storage protects chemical life, people, and the environment. Follow these suggestions:

- Provide a secure location, out of reach of children, pets, livestock, and irresponsible people.
- Lock Category I pesticides (Danger, Danger/ Poison) in a posted enclosure, such as a separate building or storeroom.
- Know which chemicals must be stored in a heated area to prevent loss of effectiveness because of freezing.
- Locate storage facility at least 100 feet from and, if possible, down slope from any water source (well, ditch, stream, etc.) to keep spilled material from the water source. Some states require a 200-foot distance.
- Construct a well-ventilated, cool, and fire-resistant facility.
- Install a concrete floor and concrete curbing around the perimeter. Slope the floor toward a liquid-proof sump where any pesticide spill or leak can easily be cleaned up.
- Include an adjacent mix/load/rinse containment area (if feasible).
- Consider building a dike around the storage and mixing center, especially in areas that might flood.
- Equip the facility with cleanup materials.
- Inventory and monitor pesticide stocks regularly to discover and clean up spills and leaks.
- Keep duplicate records of amounts and types of chemicals in storage. Keep one set some place other than your chemical storage building. (The extra record is useful in case of fire.)

Handling Pesticides And Pesticide-Contaminated Clothing

For your own personal safety, follow these suggestions:

- Wear one of the new types of disposable coveralls when mixing or applying chemicals. They are not very expensive and protect well.

- Use rubber gloves and boots when handling chemicals. (Leather absorbs chemicals and keeps them in contact with your skin for days.)

- Use Cooperative Extension System recommendations for washing pesticide contaminated clothing:

- Assume that clothes worn while working with pesticides are contaminated. Keep them separate from other clothes before and during washing.
- Pre-rinse or pre-soak the contaminated clothing in a washing machine filled with hot water and heavy-duty liquid detergent. Then spin out and drain the contaminated water before running the wash cycle. Wash just a few items at a time using hot water and heavy-duty detergent.
- Clean the empty machine after washing contaminated clothing by running a complete wash cycle with detergent and hot water.
- Line dry the clothing to avoid possible dryer contamination.
- Apply starch to the clothing as an added protective measure. Research by textile scientists has found that a starched finish traps pesticides and helps prevent their transfer to skin. The starch-bound chemicals can then be rinsed away in the wash.

- Keep clean water on your tractor to rinse splashed chemicals off skin or eyes.

- Drive your tractor into wind or at right angles to the wind whenever possible while spraying to prevent drift from getting on you.

Maintaining Equipment

Maintain pesticide application equipment in good condition. Repair leaks. Replace or recondition worn parts, especially those that affect pesticide delivery.

Hoses. Check the hoses and hose clamps for splits and leaks by running the pump with various combinations of valves closed or partially closed to increase the line pressure. If sprayer hoses are worn, replace them. Use proper hose fasteners.

Valves. Use **check valves** on nozzle bodies to prevent the chemical that remains in the hose from leaking when the sprayer is turned off. Diaphragm check valves allow the sprayer to keep up to 10 pounds of pressure in the lines without leaking chemical from the tips.

Check your **shutoff valve** on the tank. If it is a gate valve, consider switching to a ball valve. Ball valves can be closed quickly if an accident happens during application.

Pressure Gauge. Check to see if the pressure gauge is working properly. The pressure gauge should move as you turn the throttling valve. Have the pressure gauge tested to make sure that it indicates accurate psi.

Nozzle Bodies. Check nozzle bodies for signs of wear. If they are worn, replace them. Some new nozzle

bodies have caps that quickly snap into place and hold the tips.

Nozzle Tips. Examine the tips for obvious signs of clogging or damage. Use only a soft bristled toothbrush to clean the tips. A wooden toothpick or paper clip can severely damage the finely machined thin edges around the spray tip orifice.

Brass tips can wear rapidly especially with fungicides and wettable powders, which are really abrasive. Consider using the new color-coded variety of nozzle tips. The colors help the operator to use the right size tip for the job.

Instead of brass tips, consider using stainless steel, which cost \$1 more per tip but wear 3 to 4 times longer. Or, consider using ceramic tips instead of brass. Ceramic tips cost \$1.50 more per tip but wear 15 to 20 times longer.

Pumps. Check the casing of the centrifugal pump for cracks caused by freezing of water left in the pump over winter.

Screens. Clean the line strainer and all tip screens.

Calibrating Equipment

Calibrating equipment and calculating how much pesticide to apply are two of the most important tasks for minimizing environmental harm. Inaccurate calibration or calculations and excessive overlap cause over application. For simple, accurate calibration of the ag chemical sprayers generally used in farming, follow these steps:

- Fill your sprayer tank with water. Only use clean water to calibrate.
- Measure the distance between the nozzles on your spray boom.
- Choose the test course length (in feet), which corresponds to your nozzle spacing, from Table 1. For

Table 1. Selecting A Test Course Length Based On Nozzle Spacing.

Nozzle Spacing (inches)	Test Course Length (feet)
14	291
16	255
18	227
20	204
22	185
24	170
26	157
28	146
30	136
32	127
34	120
36	113
38	107
40	102

Source: Calibration And Maintenance Of Spray Equipment, 1993.

directed and band rigs use the row spacing of the field you plan to spray. Carefully measure the appropriate course distance in the field and mark for easy visibility.

- Drive the test course at your normal spraying speed. Be sure to operate all equipment. Record the seconds required to drive the measured distance. For greatest accuracy, do the speed check with the spray tank half full. Be sure to take a “running start” at the starting flag so that your tractor/sprayer reaches the desired spraying speed before you begin timing.

- Park your tractor/sprayer, but keep the engine rpm at the same setting used to drive the test course.

- Set the desired pressure on your sprayer. (This will vary with the type of spray tips you use and the gallons per minute you wish to spray through them. Consult the spray chart for tips you have chosen.)

- Using a plastic container marked in ounces, collect the water sprayed from one nozzle during the same amount of time that it took you to drive between the flags on your test course.

- Measure the flow of each nozzle on the boom to assure uniform distribution. If the flow rate of any tip is 10 percent greater or less than that of the others, replace it. If two or more are faulty, replace all tips on the entire boom. At about \$3 each, the total cost is small compared to the avoided problems and dollars you will be saving by replacing defective tips. Whatever type of spray tip you choose, be sure to use all the same type on your boom.

- The amount of water collected in ounces per nozzle equals gallons per acre applied. Vary the sprayer pressure slightly to fine tune your overall sprayer output.

- Mix chemical in appropriate water volume. For example, if you wish to apply chemical at the rate of 1 pound per acre and you are spraying 20 gallons of water per acre, then simply add 10 pounds of chemical to your 200 gallon tank. If you are able to spray 10 acres, then your calibration is correct. Be sure to read the product label for proper application information.

In addition, consider these other equipment calibration tips:

- Check spray pattern and nozzle flow each day.

- Keep your spray boom at the recommended height for your nozzle spacing during all full-coverage spraying. This will help control drift and give uniform coverage.

- Know the pH of your spray water. High pH and hard water reduce spray potency. Optimum pH for glyphosphate and phoxys is 3 to 4. Some chemicals decompose readily at a pH greater than 8.

Mixing And Loading

A major source of groundwater contamination is mixing and loading near the primary water source—a well. Many in the agricultural community believe improper pesticide activities at or near wells are causing most pesticide contamination. Keep pesticides from reaching the soil, well, or any water source when mixing and loading.

- Mix in the field to be treated to avoid concentrating all spilled material from mixing and to avoid the chance for accidents on the way to the site. (Portable mixing/containment facilities are available.)

- If you must mix and load pesticides near a water source, or if you regularly mix at the same site, build a liquid-tight, curbed concrete mixing/containment pad.

- Measure accurately for proper concentration.

- Mix only the amount needed.

- Read the label thoroughly before mixing. Never exceed label application rates. “Overdosing” will not do a better job of controlling the pests; it will only increase both the cost of pest control and the chance that the material may reach groundwater.

- Avoid backsiphoning. If the well pump stops, the filler hose can suck the tank mixture back into the well. Observe these precautions:

- Attend your sprayer during the entire filling operation.

- Keep the fill hose above the liquid level in the tank.

- If possible, fill the tank with water before adding pesticides.

- Install and maintain anti-backsiphoning valves on all pumps and water valves, including residential sill-cocks and chemigation equipment. The valves prevent liquids from moving backwards through water lines.

- If possible, use a “closed” application system to reduce spill potential when mixing.

- Triple rinse or pressure rinse containers immediately upon emptying.

Applying Pesticides

- Delay an application to avoid periods of heavy rain or irrigation.

- Leave a no-spray buffer strip at least 100 feet wide along surface waters and at least 50 feet wide near abandoned wells and irrigation ditches.

- Spray left-over chemical on the treated site if feasible. Do not spray it in roadways, grassed waterways, or ditches where surface runoff rates are high.

- Pay close attention to soil and environmental conditions when introducing pesticides into the soil

with soil injection or incorporation. These methods reduce soil surface degradation processes and may increase groundwater contamination risk.

- Use contact pesticides that do not have to be incorporated into the soil when possible.
- Use row banding application techniques where appropriate to limit the amount of pesticide applied.
- Be prepared for spills. Have cleanup materials available.
- Control application overlap with swath markers, such as dyes or foam generators.

Cleaning Equipment

Equipment cleaning can concentrate chemicals in a small area and can heavily contaminate soil and, potentially, groundwater.

- Carry a nurse or saddle tank of clean water for an initial equipment rinse in the field; spray the rinse on the site. After this rinse, little residue is brought to the mix/load/rinse site.

- Unless you plan to use the same chemical for the next application, rinse and clean the sprayer after each use.

- Use pressure rinsers. Pressure rinsers are easy to use and can be conveniently attached to the pump on your nurse tank.

- Place the empty container in a vertical position so that it will drain into your spray tank.
- Thrust the nozzle of the pressure rinser through the side of the container and rinse for 30 seconds. It is normally not necessary to repeat this procedure.

- Unless you are equipped to pressure-rinse empty containers, make sure that each container is triple rinsed.

- Drain the container into your spray tank by holding it vertically for at least 30 seconds.
- Add enough water, or other recommended diluent, to fill the container about a quarter of the way.
- Shake or roll the container to rinse all interior areas and drain the container again into the spray tank.

Repeat the rinsing procedure two more times, and then puncture and crush the container, unless recycling, so that it cannot be reused for other purposes. If they are to be recycled in Alabama, containers must be completely dry (no liquid) so they can be inspected individually prior to chipping.

- Follow label instructions for cleaning if listed.
- Wash the entire sprayer system, inside and outside.
- Do not wash equipment near wellheads, ditches, streams, or other water sources.

- Construct a site for regular equipment cleaning that can virtually eliminate generating hazardous waste materials. Build a combination mixing/loading/washing containment pad:

- Install a liquid-tight, sloped concrete floor with concrete curbing around the perimeter.
- Slope the floor toward a liquid-proof sump with a pump.
- Install a dike around the pad. Include your pesticide storage facility if it is adjacent. Make the dike high enough to keep out all surface and possible floodwater.
- Pump liquids from the sump to one or more labelled holding tanks. Use collected liquids as diluent for later spray batches. Re-use of rinse-water usually requires a separate holding tank for each group of pesticides.

A simple, efficient design for an agricultural chemical rinse pad is available by writing to Alliance For A Clean Rural Environment for a fact sheet titled “Constructing And Using A Chemical Rinse Pad.” Their address is Suite 900, 1155 15th Street, NW, Washington, DC 20005. Phone 202-872-3864 or 1-800-545-5410. This pad was designed by Ronald T. Noyes, Extension Agricultural Engineer at Oklahoma State University. He provides detailed design specifications and cost information in his publication, “Modular Farm Sized Concrete Agricultural Chemical Handling Pads.” His address is: Oklahoma Cooperative Extension Service, 224 Ag Hall, Oklahoma State University, Stillwater, OK 74078.

Disposing Of Pesticides And Containers

Dispose of chemicals safely. Careless disposal can concentrate materials in the soil, causing a potential threat to groundwater.

- Dispose of triple-rinsed containers at designated landfills. Check with local landfills for disposal acceptance and procedures.

- Have excess pesticides and nonrinsed containers transported to a hazardous waste facility by a licensed hazardous waste transporter.

- Find someone who can legally use your excesses to avoid generating waste.

- Do not purchase more pesticide than you need.

Recycling Containers

Collection and recycling programs are being organized in a number of states as pilot programs. Alabama initiated a collection, rinsing, disposal, and recycling training program in 1992. The Alabama Department of Agriculture and Industries, the Alabama Soil Fertility Society, and the Alabama Agricultural Chemical Association participated. Properly rinsed plastic containers from ten counties were col-

lected and processed to ensure cleanliness. The shredded plastic was recycled for molding into new plastic containers.

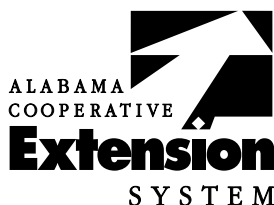
The success of any collection and recycling program hinges on the guarantee that only properly rinsed containers will be taken to the disposal facilities. Without this guarantee, landfill operators and recyclers, wary of handling hazardous waste, will not accept the containers.

Tips For Using Pesticides Safely

- Select pesticides carefully. Consider environmental impact; know which pesticides are likely to leach.
- Understand site vulnerability: soil type, geology, topography, and climate.
- Be prepared for spills and leaks with clean-up equipment and personal protective equipment: while transporting, storing, mixing and loading, and applying.
- Store pesticides safely away from water sources.
- Follow label directions and precautions.
- Calculate and measure accurately. Be especially careful around wellheads and water sources.
- Do not use pesticides if conditions exist for potential groundwater contamination.
- Calibrate equipment accurately and often. Check equipment operation and spray patterns at least daily.
- Monitor weather and irrigation schedules carefully.
- Triple rinse pesticide containers; crush unless recycling; then dispose of containers and unused pesticides legally.

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For more information, call your county Extension office. Look in your telephone directory under your county's name to find the number.

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