University of Idaho
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Quality Water for Idaho

Pesticides in Idaho Groundwater:
Monitoring, Protection, and Prevention

by Robert L. Mahler, Ronda E. Hirnyck, and Alex Colter

Groundwater supplies more than 90% of the drinking water consumed in Idaho and almost 20% of the irrigation water used by Idaho farmers. To protect groundwater, the implementation of best management practices (BMPs) for agricultural management is increasingly important.

ISDA monitoring, prevention programs, and action plans

The Idaho State Department of Agriculture (ISDA) implements groundwater monitoring and protection programs associated with agriculture throughout the state of Idaho. The department measures groundwater quality in areas that may be impacted by agriculture. If monitoring indicates a potential water quality problem, the department takes measures to help reduce land-use practices that contribute to the problem.

With the cooperation and support of the Environmental Protection Agency (EPA), the ISDA has developed the Pesticide Management Plan (PMP). The plan outlines methods to safeguard Idaho's aquifers in areas that may be impacted by pesticide application practices. The key elements of the PMP are groundwater assessment and planning, groundwater monitoring, contamination prevention programs, and responses to groundwater contamination based on the geographic concentration of detections. This publication emphasizes pollution prevention.

Groundwater contamination in Idaho

Since 1994, the ISDA has collected approximately 3,000 groundwater samples in agricultural areas of the state. Although pesticide detections have been frequent, the vast majority do not approach or exceed the levels that EPA has set as health standards (levels that adversely affect human health), known as the maximum contaminant levels (MCL). Even so, rural well owners should test their drinking water wells at least once every two years to make sure pesticide levels are not approaching or exceeding the EPA health standards.

The Idaho State Department of Agriculture (ISDA) has developed a process for handling various levels of pesticide detections in groundwater. This process is shown in table 1.

Fewer than 3.5 percent of the 3,005 water samples collected since 1994 have exceeded the 20 percent limit (action level I). Only four locations tested since 2005 had pesticide contamination that exceeded action level I. These locations are in Fremont, Nez Perce, Owyhee, and Payette counties.

The pesticide most commonly found in Idaho's groundwater is atrazine (AAtrex, Atrazine, various other trade names and premix formulations), which was detected in 22% of the samples taken since 1994. The breakdown product of atrazine, desethyl atrazine, was found in 19.5% of the wells sampled. DCPA (Dacthal) was detected in 8.2% of the samples collected.

Simazine was found in 6% of the wells sampled, and bromacil (Hyvar, Krovar, various other trade names and premix formulations) was found in 2.7% of the wells sampled since 1994 (table 2). These five pesticides represent 80% of the pesticide detections that exceeded the ISDA level I response parameter.

Table 1. The process for handling various levels of pesticide detections in Idaho groundwater developed by the Idaho State Department of Agriculture.

Action Level	Detection amounts (ppm)	Action
I	Less than 20% of MCL	Notify well owner and consumer; assess historical data; provide pesticide applicator education.
II	20% to less than 50% of MCL	Establish area of pesticide concern, monitoring programs, source assessment, voluntary BMPs, chemical-specific management plans, and pesticide inspections.
III	50% to less than 100% of MCL	Establish area of pesticide restriction, monitoring, and assessment.
IV	Detections exceeding MCL	Establish area of pesticide prohibition; periodic regulatory evaluation.

Note: MCL = maximum contaminant level set by EPA.

Table 2. Detections since 1994 of the five pesticides most commonly found in groundwater in agricultural areas of Idaho.

	Well detections		Detections exceeding MCL	
Pesticide	number	%	number	%
Atrazine	665	22 .0	0	0.0
Desethyl Atrazine	585	19.5	0	0.0
DCPA	241	8.2	5	0.17
Simazine	179	6.0	0	0.0
Bromacil	80	2.7	0	0.0

Source: Idaho State Department of Agriculture (ISDA) groundwater monitoring program.

How pesticides reach groundwater

Groundwater is found in the pores and cracks of underground sand, gravel, and rocks. The formation through which groundwater slowly flows is called an *aquifer*. The top of the water-saturated zone is the *water table*, and water percolating down to it is called *recharge*.

Pesticides reach groundwater through agricultural and industrial uses, spills and improper disposal, and homeowner uses (e.g., lawn and garden pesticides).

Pesticides start breaking down naturally as soon as they are applied. This normal pesticide breakdown, or transformation to other products, happens in several ways. Pesticides can undergo hydrolysis (breakdown by water), volatilize (go into the air in vapor form), be broken down by sunlight, be absorbed by plants, be metabolized and transformed by soil microorganisms, be oxidized in the soil, or undergo adsorption (attachment to soil particles). Pesticide breakdown occurs most rapidly in well-aerated, moist topsoil and slowest in groundwater (figure 1). Some pesticides are water soluble and can be transported through the soil by irrigation or rain water.

How to prevent groundwater contamination

Cleaning a contaminated aquifer is extremely difficult. Treatment is complicated, time consuming, and expensive. The best approach is to prevent contamination in the first place through careful pesticide handling, storage, and use. The following pesticide management and handling practices can help you reduce the potential for groundwater contamination.

Practice integrated pest management (IPM). Apply pesticides only when and where necessary to protect the crop. Accurately identify the pest and apply the lowest labeled rate and least toxic product that gives adequate pest control. Use spot treatments or band applications if possible, to reduce the amount of pesticide applied. Minimizing pesticide use makes good economic sense and reduces the potential for pests to develop resistance to pesticides.

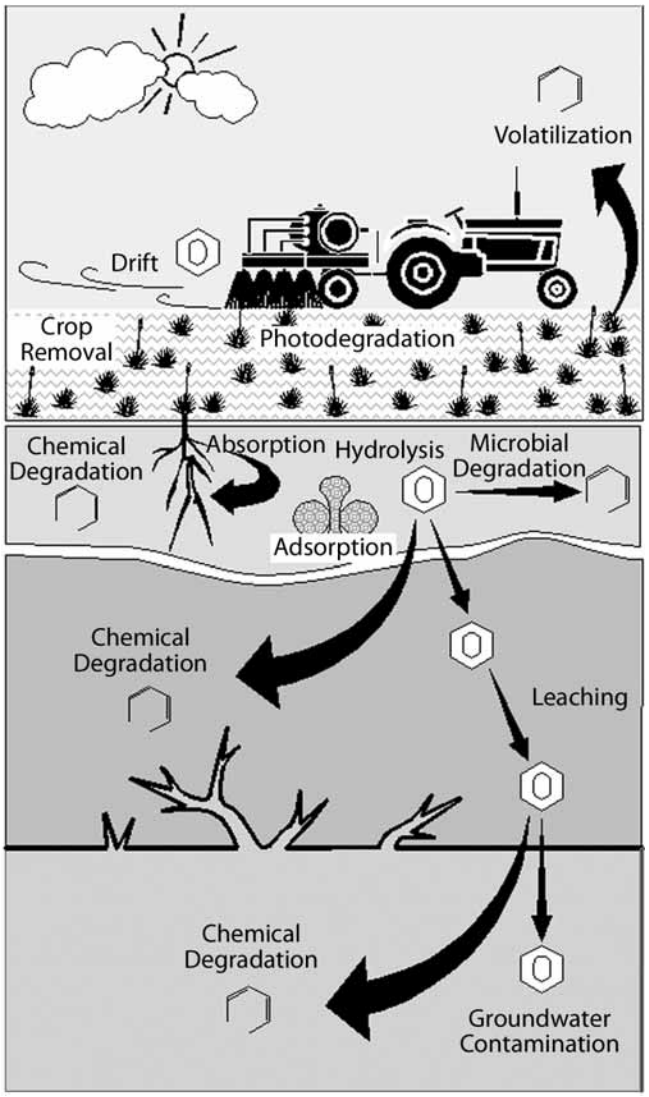

Figure 1. Once pesticides reach a field they are broken down or transformed via many different mechanisms, some of which are shown in this figure.

Select pesticides carefully. Pesticides that are not adsorbed to soil particles can easily move in water, may not vaporize easily, may be relatively stable, and thus may have the greatest potential to leach into groundwater. Read the pesticide label carefully for information and restrictions on pesticide rate, timing, and placement. All these factors can influence a pesticide's potential for leaching. Also note any groundwater advisories or other water protection guidelines on the label. If you have several choices, choose a pesticide that is least likely to leach through the soil or run off to nearby surface waters. Information about pesticide choice can be found in the University of Idaho publication *Pesticides and Their Movement in Soil and Water* (CIS 865).

Consider the vulnerability of the area. Determine the relative susceptibility of the soil to leaching. Soil texture, organic matter content, and permeability affect pesticide movement. To the extent possible, determine the depth of the water table and the relative permeability of the geologic layers between the soil surface and the groundwater. Sinkholes (sinks) can be especially troublesome because they allow surface water to reach groundwater quickly with little natural soil filtering. Avoid spraying ditches and waterways along the field.

Consider the location and condition of wells. Cap and seal wells properly to prevent groundwater contamination. Slope the surrounding ground away from the wellhead to keep runoff away from the well. Pesticides spilled near wells can move directly and rapidly into groundwater. Therefore, do not mix, store, or dispose of pesticides within 100 feet of a well. Close all abandoned wells properly and never dispose of wastes in unused wells.

Measure accurately. Carefully calculate how much pesticide you need to treat the specific site with the equipment you plan to use. Careful calculations will save money by reducing the amount of pesticide you use and will help eliminate disposal problems associated with excess mixture. Prepare only enough pesticide for immediate use. If your measuring equipment needs rinsing, put rinsate in the spray tank and apply it to labeled crops or sites at labeled rates.

Calibrate accurately. Calibrate equipment carefully and often to be certain that it will apply the proper amount of pesticide. To minimize the potential for pesticide accidents or spills, check the equipment for leaks and malfunctions with only water in the tank. Repair or replace faulty equipment.

Mix and load carefully. Handle pesticides carefully to avoid spills. Mix and load pesticides on a concrete surface to avoid saturating the soil with pesticide. In some areas of the country, applicators loading and cleaning their equipment in the same spot year after year have caused pesticide-contaminated aquifers.

Fill the spray tank as far from the water source as possible. You can increase the length of the water hose or fill the tank in the field using an alternative water source. Never leave a spray unit unattended during filling.

Prevent back siphoning. To prevent pesticides from siphoning back into the water supply, keep the end of the fill hose above the water level in the spray tank, leaving a distinct air gap between the two. If water is pumped directly from the source, use a check valve or some other type of anti-siphoning device. Check valves are a necessity when filling a spray tank directly from a well and when using chemigation.

Do not overlap. Turn off the sprayer or granular applicator device on turns, especially at the bottom of an irrigated field. This will eliminate overapplication especially in areas that are susceptible to pesticides leaching through the soil or running off.

Check the weather forecast. Delay pesticide application if you expect heavy or sustained rain or plan a heavy irrigation. Rainfall soon after application increases pesticide runoff and leaching. When you apply chemicals through irrigation systems (chemigation), carefully control the quantity of irrigation water to minimize the potential for pesticide leaching and runoff.

Prevent chemigation backflow. Idaho's chemigation law requires antipollution devices to prevent backflow into the water source when applying chemicals through the irrigation system. A chemical injection line check valve and an interlock are needed to shut off the chemical injection when the water supply fails. A sprinkler system will need an irrigation line check valve, an automatic low pressure drain, and an inspection port. Idaho law also requires using a combination air and vacuum relief valve. A gooseneck pipe loop is an alternative. Read Idaho's chemigation laws and regulations and consult with the Idaho State Department of Agriculture web site for possible variances:

http://www.agri.state.id.us/Categories/Pesticides/chemigation/indexChemigationmain.php

Store pesticides safely. Minimize your pesticide inventory by buying only what you need for the current season or specific application. Construct the pesticide storage area on a concrete floor or other impervious material, located away from all water sources. This will make pesticide cleanup easier in the event of a spill or leak. Inspect containers regularly for leaks and corrosion.

Use the pesticides that have been stored longest before using those just purchased. Inspect bulk pesticide storage tanks frequently. Place tanks on concrete pads surrounded by dikes to contain pesticides if a leak develops or a spill occurs. Keep storages locked so unauthorized people do not have access to pesticides.

Dispose of wastes carefully. Dispose of pesticide containers according to state, federal, and local laws. The pesticide label will have directions on it, but state law may be more restrictive.

Triple rinse or pressure rinse pesticide containers as soon as they are emptied and pour the rinsates into the spray tank. Excess spray mix and rinsates from equipment cleaning can be sprayed on another site listed on the label as long as the rates do not exceed what the label allows. A water source, such as a water tank, at the application site makes it easier to rinse equipment and spray rinsates in the field.

Never dispose of pesticides or pesticide containers near a water source, over a shallow water table, in sinkholes, or in abandoned wells. Such disposal violates both federal and state laws.

You may give away general use pesticides. However, restricted use pesticides must be disposed of at legally approved sites. You can safely store excess, unwanted pesticides in their original containers.

The ISDA collects unusable pesticides for disposal at various times and locations throughout Idaho. More information about this program can be found at ISDA's pesticide disposal website:

http://www.agri.state.id.us/Categories/Pesticides/pdp/indexdisposalmain.php

Triple-rinsed and pressure-rinsed containers are not considered hazardous waste and may be disposed of according to the label directions and state, federal and local laws. The ISDA does have a pesticide container recycling program for triple-rinsed and pressure-rinsed containers. Be sure to check ISDA's website for more information:

http://www.agri.state.id.us/Categories/Pesticides/container/indexcontainermain.php

Prevent spills. Anyone hauling pesticides is responsible for their safe transport. Anchor the containers so they do not tip or spill. If a spill occurs, contain and clean it up immediately. You should always carry clean-up supplies with you, including personal protective equipment, absorbent material (such as cat litter), a shovel, and empty containers to contain the spill. If spills occur on roads or other public areas, notify the appropriate authorities.

Remember the three C's: control, contain, clean up. Repeated pesticide spills in the same area can exceed the capacity of the soil to adsorb or degrade the chemical and increase the likelihood of groundwater contamination.

Leave buffer zones around sensitive areas. When mixing, applying, or storing pesticides, consider sensitive groundwater and surface waters locations. These include sandy soils, springs, streams, ponds, wetlands, and other surface waters. Also consider wells and groundwater recharge areas. Establish a buffer zone between a pesticide use or handling site and a sensitive area by planting vegetation or leaving an untreated border in the field. USDA-NRCS service centers have useful information for establishing buffers and riparian zones.

Checklist for protecting water from pesticides

1. Do you select pesticides that are least likely to leach into groundwater?
2. Do you use pesticides only when necessary and at the lowest label rate needed to control a pest. Do you choose the least toxic product?
3. Do you always read and follow directions given on pesticides for irrigation practices, rates, and application methods?
4. Do you delay the pesticide application if rain is forecast or if a major irrigation is scheduled?
5. Do you leave a border of untreated vegetation between treated and sensitive areas?
6. Do you calibrate your pesticide equipment regularly?
7. Do you have information about the geologic features in your area and about the depth of the groundwater?
8. Does your storage facility have a concrete floor?
9. Do you clean your pesticide application equipment so that you can easily collect rinsates?
10. Does your water hose have a check valve to prevent back siphoning?
11. Have you sealed your wellhead?
12. Have you sloped the area around your well to divert surface runoff away from the well?
13. Have you properly closed all abandoned wells near a pesticide handling or application site?
14. Are there dikes around your bulk tanks to prevent off-site pesticide movement?
15. Do you load your sprayer at least 100 feet away from a well?

The fate of a pesticide and the likelihood of its movement into groundwater are affected by its chemical and physical properties and those of the soil. Geology and climate, as well as the applicator's pesticide handling practices, are also important factors. Consider each factor when determining the susceptibility of groundwater to pesticide contamination.

Be sure to understand how your activities, including pesticide handling and usage, can affect groundwater.

Need more information?

Seek assistance from your local extension office or USDA-NRCS service center. Obtain pesticide recommendations for various crops and pests from your local extension office.

The following websites contain useful information:

USDA Natural Resources Conservation Service, Idaho state office. http://www.id.nrcs.usda.gov/

One Plan. http://www.oneplan.org

Idaho State Department of Agriculture. http://www.agri.state.id.us

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The authors–Robert L. Mahler is a Soil Scientist and Extension Water Quality Specialist in the University of Idaho Department of Plant, Soil and Entomological Sciences. **Ronda Hirnyck** is the Extension Pesticide Coordinator located in Boise (Extension District II). **Alex Colter** is a Graduate Student in Environmental Sciences.

University of Idaho Extension

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