

# Pesticides, Groundwater and Endangered Species

## Learning Objectives:

Upon completion of the study of Pesticides, Groundwater and Endangered Species, the trainee should be able to:

- Know where, how and why pesticides can enter the hydrologic system.
- Understand the differences in pesticide and soil properties.
- Have a general understanding of soil, water and pesticide terms.
- Know how to find out which endangered species may be in the area the applicator is working.

## Pesticides and Groundwater

Most of the drinking water in the United States is groundwater; however, Arkansas has numerous lakes and reservoirs and that is where the majority of Arkansans receive their drinking water. Arkansas' rural residents and small communities rely on groundwater for their drinking water sources.

The amount of groundwater affected by pollution (all forms) is about 2 percent in the U.S.; however, an increasing amount of surface water is becoming at least somewhat contaminated (EPA, 1990).

More than 4.5 billion pounds of pesticides are used in the U.S. annually. Of this volume, agriculture accounts for two-thirds of this usage. This includes nursery and greenhouse production systems. The home and garden sector used 135 million pounds of pesticides in 1995 (EPA, 1997).

Pesticides can contaminate water throughout the hydrologic system. The amount of water contamination is directly related to the degree of pollution in our environment. Rainwater flushes airborne pollution from the skies. The pollution is then washed over the land before running into rivers, aquifers and lakes. The pollution also seeps into underground aquifers. Irrigation and drinking water come from both surface and groundwater. Eventually, all chemicals we use can pollute our water supplies.

There are many materials that endanger our water quality. Most come from urban and industrial activity. Some, however, come from agriculture and urban pest control uses. Whether utilized in agricultural operations or in urban environments, the improper application, handling or disposal of pesticides can lead to water pollution. It is very important for the pest control operator to understand how to properly use pesticides to avoid not only pesticide exposure to humans but to protect our water sources.

When selecting pesticides for use in structures, the pesticide applicator needs to be keenly aware of when and where pesticides can enter the hydrologic system. The two primary routes of entry are through drains and exposure to soil or paved surfaces. Regarding soil exposure, the applicator needs to be knowledgeable of the pesticide's water solubility. This can be obtained from the pesticide label and the pesticide's Material Safety Data Sheet (MSDS). Additional water data is often available from the Arkansas State Plant Board, University of Arkansas and the chemical company. An applicator should build their own file on pesticides and water contamination. This will allow the applicator ready access to the information.

## Ways Pesticides Can Contaminate Water

### Entry via Drains

Structures have drains that go to wastewater treatment plants. These are called sanitary drains and are represented by kitchen sinks, toilets, bathtubs, etc. Pesticides discharged down these drains go directly to the wastewater treatment plant. Many of these pesticides will either disrupt the microorganisms used to break down the sewage or affect the organisms used by the plant as bioassays of the effluent (water released after treatment). In either case, the wastewater treatment plant can be severely limited in the amount of sewage it can treat. When bioassay organisms are affected, the plants are required to either remove the offending pesticide or build plants that can withstand the pesticide(s). The construction of new wastewater treatment plants is extremely expensive and is not a viable option to a contamination problem.

The other drain involved can be the storm drains. These drains are often found in the streets but can be in lawn areas. As their name implies, they drain water from storm events such as rain and melted snow. In most cities, storm drain water is not treated and directed into a drainage system such as a creek or river. Pesticide spills or runoff into storm drains can have environmental effects on aquatic organisms living in the creeks or streams in which the drains deposit.

### **Entry via Soil**

Pesticides used in the General Pest category can be exposed to soil by spills or direct application to the perimeter of the structure. In both cases, the applicator needs to be knowledgeable of the pesticide's ability to move with water, either down or over the soil surface. As mentioned above, this information is often found on the pesticide's MSDS. The applicator must also be aware of drainage systems around a structure's foundation. Often there are French drains or other systems employed to move water away from the foundation. These drainages will also move a pesticide that leaches into the drain.

Improperly cleaning pesticide containers and sprayers often leads to pesticide runoff or contamination of the soil at the mixing/loading site. Pesticide sprayers should be loaded and cleaned on an impervious pad. By mixing/loading and cleaning a sprayer on an impervious pad, there is not a concern about spills causing runoff or leaching problems. This avoids the potential contamination of the soil and nearby wells from constant small spillages at the same site.

When filling any sprayer, either an air gap or an anti-back siphoning device is to be used. This prevents back siphoning of the pesticide mix into the water line if water pressure is lost. If using anti-back siphoning devices, periodically inspect the device to ensure it is functioning properly. Mechanical back siphoning devices have been known to stick in the open position.

Pesticide containers should be pressure or triple rinsed immediately after emptying to rinse all excess pesticide from the container. The rinsate is to be rinsed directly into the sprayer so the rinsate can be sprayed on the labeled site. This provides a clean container that can then be recycled.

## **Pesticide Properties**

The applicator must know the type of pesticide and its properties prior to purchasing and using the pesticide. This is an extremely important aspect to know. The applicator needs to know the pesticide's formulation, persistence, volatility, solubility in water and its soil adsorption.

### **Formulation**

Pesticides come in several physical forms or formulations. Common formulations include emulsifiable and flowable concentrates, wettable powders, granules, and water dispersible granules. Granules, water dispersible granules and emulsifiable concentrates tend to be more water-soluble than wettable powders and microencapsulated formulations.

### **Persistence**

Persistence describes how long a pesticide remains active. Half-life is one measure of persistence. The half-life of a substance is the time required for that substance to degrade to one-half its original concentration. In other words, if a pesticide has a half-life of 10 days, half of the pesticide has been broken down or lost 10 days after application. After this time, the pesticide continues to breakdown at the same rate. The half-life of a pesticide is not an absolute factor. Soil moisture, temperature, organic matter, microbial activity, soil pH and sunlight all affect the breakdown of pesticides. In general, the longer a pesticide persists in the environment, the more likely it is to move from one place to another and be a potential water contaminant.

### **Volatility**

Many pesticides including several herbicides and soil fumigants can escape from soils/medias as gases. Some can distill from soil and enter the atmosphere with evaporating water. Pesticide particles in the atmosphere can come back to earth in rain or snow, and they can either leach into groundwater or be carried by runoff into surface water.

### **Water Solubility**

The water solubility of a pesticide determines how easily it goes into solution with water. When a pesticide goes into solution with water, the pesticide will move wherever the water goes. Solubility is usually given in parts per million (ppm) or, in some cases,

as milligrams per liter (mg/l). The solubility of a substance is the maximum number of milligrams that will dissolve in one liter of water.

Simply being water-soluble does not mean that a pesticide will leach into groundwater or runoff into surface water. However, solubility does mean that if a soluble pesticide somehow gets into water, it will probably stay there and go where the water goes. Water solubility is often viewed as an indicator of the pesticide's mobility in water. Water solubility and adsorption to soil particles for most compounds are inversely related. However, like most rules there are exceptions. Water solubility greater than 30 ppm indicates that significant mobility is possible if the  $K_{oc}$  value is low (less than 300-500). EPA considers pesticides with solubility greater than 30 ppm and  $K_{oc}$  values less than 100 to be a concern in sandy soil.

Pesticides with solubilities of 1 ppm or less are believed to have a higher likelihood of runoff. Likewise, pesticides with high  $K_{oc}$  values have a higher likelihood of runoff than leaching. Pesticides with  $K_{oc}$  values of 1,000 or higher have a strong soil attachment.

### Soil Adsorption

Soil adsorption is the tendency of materials to attach to the surfaces of soil particles. If a substance is adsorbed by the soil, the substance stays on or in the soil and is less likely to move into the water system unless soil erosion occurs. A soil's texture, structure and organic matter content affect the soil's ability to adsorb chemicals.

The  $K_{oc}$  describes the relative affinity or attraction of the pesticide to soil material and, therefore, the pesticide's mobility in soil. Pesticides with small  $K_{oc}$  values are more likely to leach than those with high  $K_{oc}$  values.

### How Pesticides Enter Surface and Groundwater

Pesticides can enter water through surface runoff, leaching and/or erosion. Water that flows across the surface of the land – whether from rainfall, irrigation or other sources – always flows downhill until it meets a barrier, joins a body of water or begins to percolate into the soil.

Wind and water can erode soil that contains pesticide residues and carry them into nearby bodies of water. Even comparatively insoluble pesticides and pesticides with high soil adsorption properties can move with eroding soil. A number of the sulfonyleurea herbicides have warning statements regarding movement of treated soil.

With increasing frequency, soil applied pesticides are being found in groundwater where the water table is close to the soil surface and/or the soil is a sand.

### Point and Non-Point Source

Pesticides that enter water supplies can come either from point sources or from non-point sources. Point sources are small, easily identified objects or areas of high pesticide concentration such as tanks, mixing/loading sites at wellheads, containers, or spills. **Non-point sources** are broad, undefined areas in which pesticide residues are present.

### Water Quality Protection

Most pesticide contamination does not come from normal, correct usage. Problems arise from misuse or careless handling. A checklist is provided to use when applying any pesticide. Use this guideline to help safeguard water sources near your accounts.

- Consider vulnerability of the site; be sure that weather and irrigation will not increase the risk of water contamination.
- Evaluate the location of water sources.
- Read and follow pesticide label directions.
- When possible use pesticides with less potential for surface runoff and leaching.
- Store pesticides properly.
- Make sure pesticide containers do not leak.
- Use IPM practices.
- Calibrate all pesticide application equipment at least after every third use.
- Prevent back flow during mixing operations by use of an air gap or mechanical anti-siphoning device.
- Pressure or triple rinse pesticide containers upon emptying and pour rinsate into spray tank.
- Always mix, handle and store pesticides down slope and at least 50 feet from water wells.
- Do not apply pesticides when conditions are most likely to promote runoff or excessive leaching.

<b>Table 10-1. Insecticide Water Quality Data</b>			
<b>Insecticide Common Name</b>	<b>Relative Runoff Potential</b>	<b>Relative Groundwater Leaching Potential</b>	<b>Half-Life in Days</b>
Diazinon	Medium	Large	30
Acephate	Low	Low	3
Chlorpyrifos	Large	Small	30
Carbaryl	Medium	Small	10
Malathion	Small	Small	1

- Do not spray pesticides on windy days (winds in excess of 10 mph).
- Prevent pesticide spills and leaks from application equipment.
- Do not water pesticide treated areas immediately after application unless indicated on label instructions.
- Dispose of excess pesticides by applying them to labeled sites.

**Note:** See glossary for more detailed description of soil, water and pesticide terms.

## Endangered Species

Applicators in the General Pest category should not encounter federally threatened or endangered species inside structures; however, you may encounter them outside structures.

The Endangered Species Protection Program started in 1988. It is largely voluntary at the present time and relies on co-operation between the U.S. Fish and Wildlife Service (USFWS), EPA regions, the states and pesticide users. Arkansas has a voluntary Endangered Species Protection Program with bulletins for 30 counties, which is on the EPA web site (<http://www.epa.gov/espp/usa-map.htm>). A user can go to this site and get information about an endangered species habitat found in their area. This information can be found on pesticide labels if the products being used will cause harm to the endangered species or its habitat.

The Endangered Species Act is intended to protect and promote the recovery of animals and plants that are in danger of becoming extinct due to the activities of people. Under the Act, EPA must ensure that the use of pesticides it registers will not result in harm to the species listed as endangered and threatened by the U.S. Fish and Wildlife

Service, or to habitat critical to those species' survival. To implement the Endangered Species Protection Program, labels of certain pesticides will direct users to bulletins with information on the endangered species habitat. This program will protect endangered and threatened species from harm due to pesticides use.

The Endangered Species Protection Act has two goals:

1. Provide best protection for endangered species from the use of pesticides.
2. Minimize the impact of the EPA's Endangered Species Protection Program on pesticide users.

This program will be successful if everyone will follow information found on the pesticide labels.

It is the applicator's responsibility to know which species may be in the area the applicator is working. In Arkansas, most of the federally threatened and endangered species occur outside of towns and cities.

Applicators may cause harm to these species through pesticide spills, runoff or leaching. It is highly unlikely that one perimeter application would cause an adverse affect to an endangered species; however, multiple perimeter treatments that find their way into water systems could affect certain species.

Once again, it is the applicator's responsibility to know if a threatened or endangered species is within the area. An applicator can obtain this information from the Arkansas County Extension offices, Pesticide Coordinator's office, Arkansas State Plant Board and Arkansas Wildlife Conservation offices.

<b>Table 10-2. Arkansas Endangered/Threatened Animal and Plant Species – Total 29</b>	
<b>Animals – 23 species</b>	
<b>Status</b>	<b>Animal</b>
T	Alligator, American ( <i>Alligator mississippiensis</i> )
E	Bat, gray ( <i>Myotis grisescens</i> )
E	Bat, Indiana ( <i>Myotis sodalis</i> )
E	Bat, Ozark big-eared ( <i>Corynorhinus (=Plecotus) townsendii ingens</i> )
E	Beetle, American burying ( <i>Nicrophorus americanus</i> )
T	Cavefish, Ozark ( <i>Amblyopsis rosae</i> )
E	Crayfish, cave ( <i>Cambarus aculabrum</i> )
E	Crayfish, cave ( <i>Cambarus zophonastes</i> )
T	Darter, leopard ( <i>Percina pantherina</i> )
T	Eagle, bald (lower 48 states) ( <i>Haliaeetus leucocephalus</i> )
T	Fatmucket, Arkansas ( <i>Lampsilis powelli</i> )
E	Mapleleaf, winged (mussel) Entire; except where listed as experimental populations ( <i>Quadrula fragosa</i> )
E	Mucket, pink (pearlymussel) ( <i>Lampsilis abrupta</i> )
E	Mussel, scaleshell ( <i>Leptodea leptodon</i> )
E	Pearlymussel, Curtis ( <i>Epioblasma florentina curtisii</i> )
E	Pocketbook, fat ( <i>Potamilus capax</i> )
E	Pocketbook, Ouachita rock ( <i>Arkansia wheeleri</i> )
E	Pocketbook, speckled ( <i>Lampsilis streckeri</i> )
T	Shagreen, Magazine Mountain ( <i>Mesodon magazinensis</i> )
T	Shiner, Arkansas River (Arkansas R. Basin) ( <i>Notropis girardi</i> )
E	Sturgeon, pallid ( <i>Scaphirhynchus albus</i> )
E	Tern, least (interior pop.) ( <i>Sterna antillarum</i> )
E	Woodpecker, red-cockaded ( <i>Picoides borealis</i> )
<b>Plants – 6 species</b>	
<b>Status</b>	<b>Plant</b>
T	<i>Geocarpon minimum</i> (No common name)
E	Bladderpod, Missouri ( <i>Lesquerella filiformis</i> )
E	Pondberry ( <i>Lindera melissifolia</i> )
T	Orchid, eastern prairie fringed ( <i>Platanthera leucophaea</i> )
E	Harperella ( <i>Ptilimnium nodosum</i> )
E	Clover, running buffalo ( <i>Trifolium stoloniferum</i> )