

Pesticide Movement

There are two routes of movement of pesticides into water sources

- **Runoff** - physical transport of pesticides over the ground surface by rainwater which does not penetrate the soil or carried with transported sediment
- **Leaching** – movement of pesticides downward through the soil by rain or irrigation water

Pesticide Movement

- Potential for pesticide movement by runoff or leaching varies with:
 - Properties of the soil
 - Properties of the pesticide
 - Climatic variables
 - Conditions of the site
 - Management practices
- Movement of pesticides in soil depends on:
 - Soil characteristics
 - Organic matter content
 - Texture
 - Soil moisture
 - Permeability
 - Pesticide characteristics
 - Adsorption coefficient
 - Water Solubility
 - Half-life
- Interaction of soil and pesticide properties determines the potential for a pesticide to reach surface or groundwater

Soil—Water Relations

- As rainfall soaks into soil some fills soil pores, the remainder percolates toward water table
- Amount of water held in upper profile is dependent on organic matter and soil structure and texture
 - More organic matter → more water soil can hold
 - Soil structure influences porosity; clayey and well structured soils retain more water than sandy and poorly structured soils
 - Rate of percolation depends on soil permeability. Water percolates slower through clayey soils than sandy soils.
- Coarser-textured soils like loamy sand and sandy loams have high infiltration capacities
 - Water tends to infiltrate and percolate rather than run off
 - Higher risk for pesticides to leach to groundwater
 - Lower risk for surface loss to streams and lakes

- Finer-textured soils like clay and clay loams have lower infiltration capacities
 - Surface runoff is high compared to percolation
 - Higher risk for pesticide loss by surface runoff
 - Lower risk for leaching to groundwater
 - *Exception* - large pores may be formed through cracks or root channels that act as conduits for chemical leaching

Water Movement

- Seasonal, Climatic Variations
 - Precipitation either runs off to surface water, evaporates, is taken up by plants, or enters the soil
 - Amounts into these various pathways depend on climate, topography and soil conditions
- Seasonal, Climatic Variations (continued)
 - Seasonal water table is highest in spring and fall
 - Groundwater levels are down in summer (evaporation and plant uptake), and in winter (frozen soils)
 - Spring rains shortly after pesticide applications can affect movement into groundwater

Pesticide Properties

- Sorption – process by which pesticides are dispersed between solid matter and water in soil (*adsorption* or *retention*)
 - Expressed as an adsorption coefficient
 - Important in regulating concentration of pesticides in soil water
 - Organic matter plays significant role in pesticide dispersion and sorption
 - Retention of water and dissolved chemicals in the root zones is greatest in high organic matter soils
- Pesticide persistence – “lasting-power”
- Most pesticides break down or degrade over time by:
 - Sunlight
 - Soil microorganisms
 - Chemical pathways
- Measured as “half-life”, the time it takes for half of the initial amount applied to break down (in days)
- Water Solubility of pesticide is another factor influencing movement
 - Solubility and sorption on soil are usually inversely related;
 - less soluble materials are more adsorbed on soil surfaces.
 - More water soluble → less sorption
 - Measured in parts per million (ppm)

Summary of groundwater contamination potential

	Risk of groundwater contamination	
	Low risk	High risk
Pesticide characteristics		
Water solubility	Low	High
Soil adsorption	High	Low
Persistence	Low	High
Site characteristics		
Texture	Fine clay	Coarse sand
Organic matter	High	Low
Depth to groundwater	Deep (>100 ft)	Shallow (<20 ft)
Rain / irrigation	Small volumes, infrequent intervals	Large volumes, frequently

Best Management Practices

Practices which reduce the potential for pesticides moving into water by surface runoff or leaching

- Practice Integrated Pest Management (IPM)
 - Field scouting
 - Using non-chemical control measures
 - mechanical, cultural and biological, sanitation, plant resistance
- Field management using grass waterways and buffer strips, contouring and terracing, reduced tillage
- Create buffer zones around sensitive areas
- Consider weather before making applications
- Evaluate farm field by field; maintain records
 - Scout fields to identify weed species and population levels
 - Select herbicides and application rates based on soil type, organic matter, permeability, pH and depth to groundwater
 - Identify highly erodible fields and their drainage patterns
- Reduce off-target drift
- Prevent back-siphoning and spills
- Maintain application equipment, measure and calibrate accurately
- Dispose of pesticide containers and chemical wastes safely
- Store pesticides properly
- Mixing and Loading
 - Ideally; mix and load on impervious surface (containment pad)

- Mix, load and rinse equipment in the field if no containment pad available. Vary location and stay away from any well, stream or sinkhole
- Do not mix or load near public drinking sources
- Clean up all chemical spills immediately
- Container and Equipment Cleaning
 - Mix only enough product for job
 - Start with clean, calibrated sprayer with appropriate agitation
 - Clean at site if no pad, spray rinsate evenly over field or dispose of as label specifies
 - Pressure or triple-rinse product containers immediately after emptying
 - Participate in container recycling when available
- Read and Follow Guidelines on the Label
 - Labels often contain special instructions with regard to protecting water resources

Summary:

We rely upon pesticides to control pests in our homes, businesses, and agriculture. Wise use of the chemicals can enhance our lives and enterprises. But like any tool, if not used properly, it can become a problem. By following the pesticide label instructions, using Integrated Pest Management techniques, and being aware of the human and environmental effects will allow the use of pesticides to benefit our endeavors and maintain the integrity of our environment.

The pesticide dealers of Iowa are commended for submitting their detailed sales report forms to the Pesticide Bureau annually since 1989. Their diligence has allowed the sales data to be transformed into the approximate pounds of active ingredients that has provided the water quality researchers with one of the tools needed to characterize water quality for Iowa.