CHAPTER 7

Pesticides in the Environment

Chapter 7

National Pesticide Applicator Certification Core Manual

WASHINGTON STATE UNIVERSITY EXTENSION

CHAPTER 7

Pesticides in the Environment

This module will help you:

- Understand the environmental consequences of pesticide application
- Understand how to prevent drift and runoff
- Identify pesticide-sensitive areas
- Understand how to adjust your methods to minimize environmental impact and maximize effectiveness

Label Warnings
Environmental Hazards Section

- EPA requires pesticides be tested to assess their potential for harming the environment
  - Pesticide characteristics
  - Fate of pesticides in the environment
    - Off-target movement
    - Degradation pathways
  - Impacts on non-target organisms
- EPA makes some products restricted use due to environmental concerns

The Environment:

everything that surrounds us

- Air, soil, water, plants, animals, people, in/outside buildings
- Beneficial organisms, endangered species
- There is public concern about the effect of pesticides on the environment

Understand How Pesticides Impact the Environment

- Chemical characteristics of pesticides
- Degradation methods
- Pesticide movements during and after application
- Special environmental considerations

Pesticide Characteristics:
Solubility

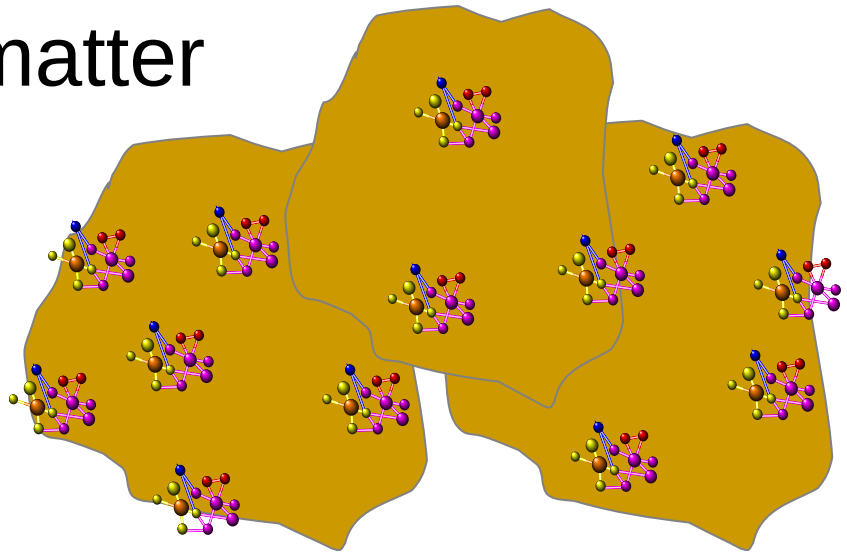
- The ability of a pesticide to dissolve in a solvent, usually water
- Soluble pesticides are more likely to move with water in surface runoff or through the soil to groundwater

Pesticide Characteristics:

Adsorption

binding of chemicals to soil particles

- Higher with oil-soluble pesticides
- Clay and organic matter increase binding
- Decreases the potential for a pesticide to move through soil



Pesticide Characteristics:
Persistence

- Ability of a pesticide to remain present and active for a long time
- Provides for long-term pest control, but may harm sensitive plants and animals
- May lead to illegal residues on rotational crops

Pesticide Characteristic:

Volatility

the tendency of a pesticide to turn into a gas or vapor

Temperature ↑

Wind ↑ = **Higher Volatility**

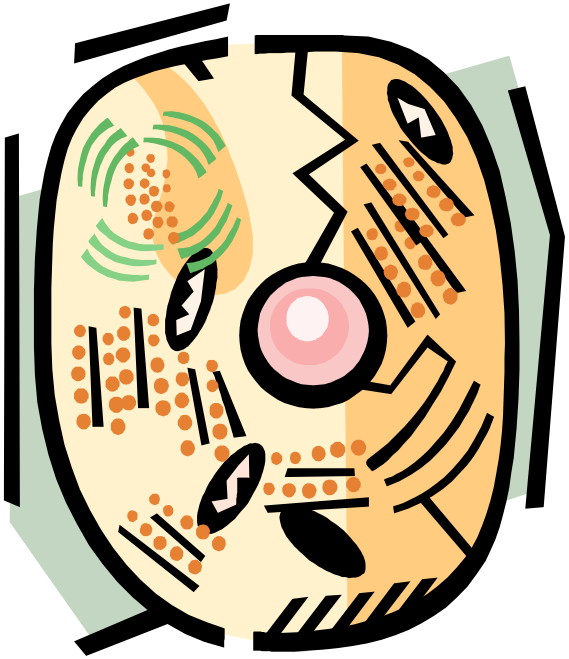
Humidity ↓

Pesticide Characteristics: Volatility

- Fumigants volatilize and move gas through soil, structures or stored commodities
- Several herbicides are quite volatile and pose harm when the vapor moves off target
  - Labels may state cut-off temperatures for application
  - Labels may require pesticide to be incorporated into the soil

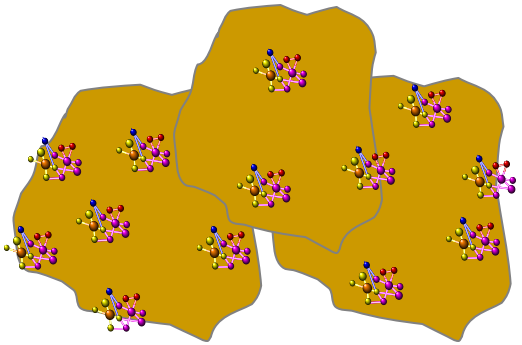
Degradation: Microbial

- Important means for destroying pesticide in soils
- Some soil microorganisms use pesticides as food
  - bacteria and fungi

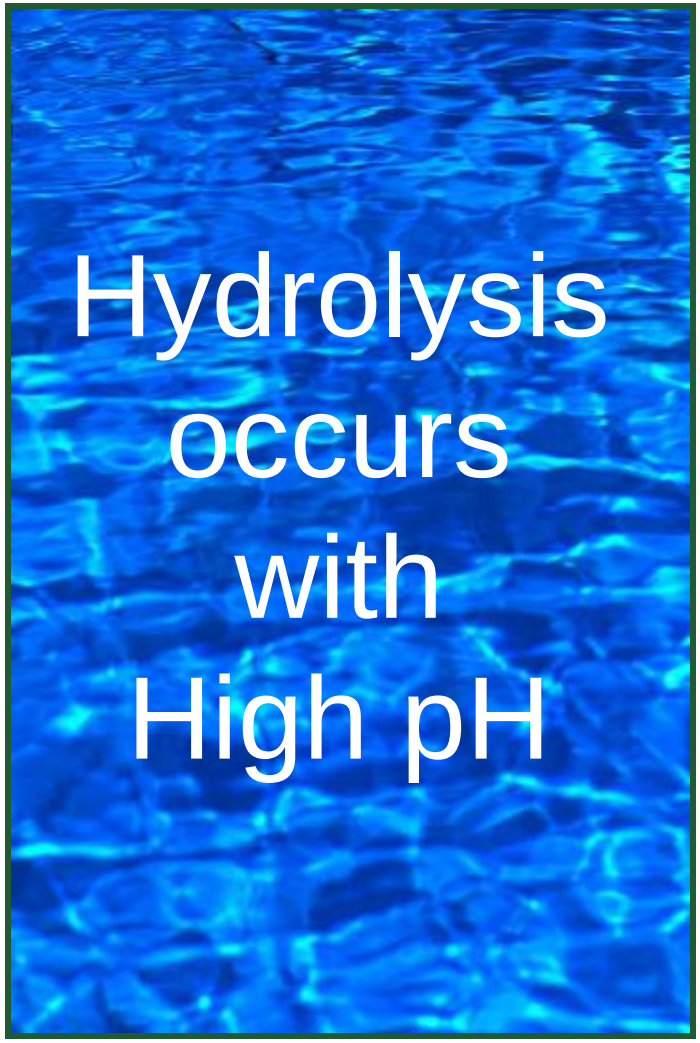


Soil Conditions that Favor Microbial Degradation

- warm soil temperatures
- adequate soil moisture
- favorable pH
- aeration
- fertility
- adsorption



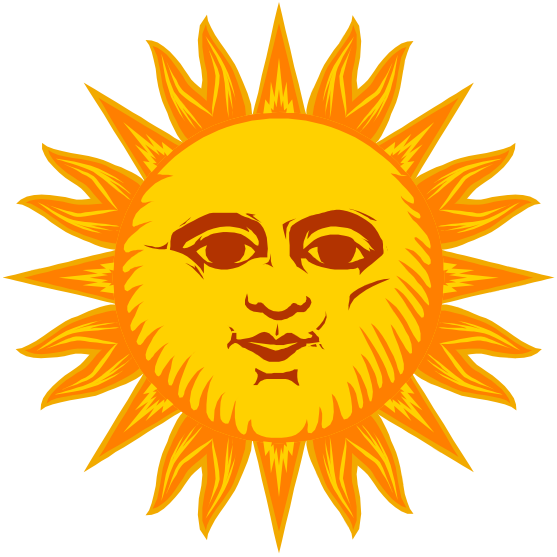
Degradation: Chemical



- Non-living processes
- Hydrolysis: a chemical reaction with water, typically with a high pH (alkaline)
- Soil properties and conditions affect the rate and type of chemical reactions

Photodegradation

- Breakdown of pesticide by sunlight
- May be reduced by soil incorporation



Pesticide Movement

- By air
  - Vapor, particle, spray drift
- By water
  - Surface runoff
  - Movement through soil
- By other objects
  - Residues on plants and animals

Pesticide Movement: in Air

Spray Drift

- Movement of airborne pesticide droplets from the target area
- Check the label for precautions
  - mandatory no-spray buffers
  - spray droplet size requirements
  - wind speed restrictions
  - application volume requirements
  - aerial application restrictions
  - warnings for sensitive crop or sites

Spray Drift Factors

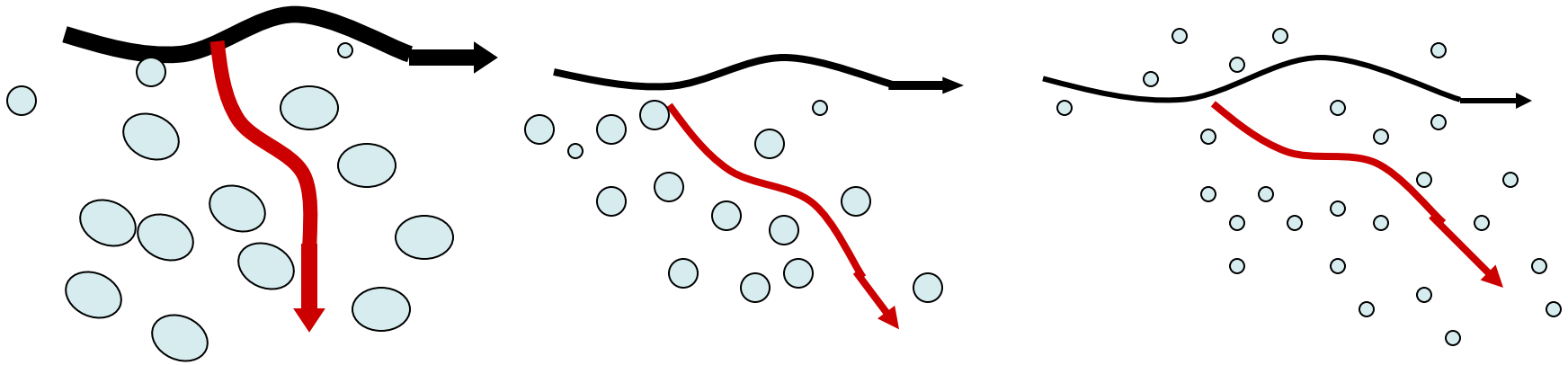
1. Applicator attitude
2. Equipment set-up
3. Viscosity of spray
   - ❖ a liquid's resistance to flow
4. Weather conditions

Spray Drift Factors

- **Applicator Attitude**
  - Assess what sensitive sites are near the application area
    - No-spray buffer necessary?
  - Assess weather conditions: air stability, wind direction and speed
  - Set up equipment with appropriate boom height, nozzles, and pressure
  - Make decision to spray or not to spray

Equipment Set Up: Droplet Size

The Larger the Spray Droplet Size



The Less Distance the Droplet Drifts

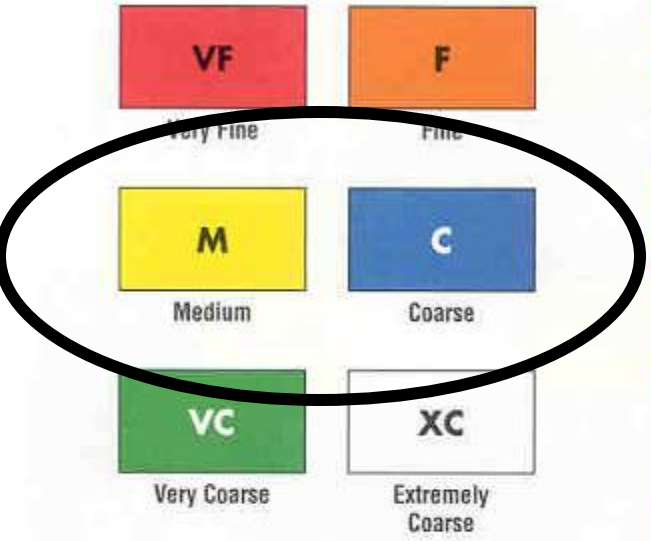
Spray Drift Factors

- **Equipment Set Up**
  - Nozzle size and pressure set to give an appropriate size droplet to reduce drift
    - Use nozzles that produce medium and coarse droplet sizes
      - Smaller orifice = smaller droplet
    - Use lower pressures
      - except with certain nozzles
  - Boom height - drift potential increases as distances increase

Driftable Droplets*

Nozzle Type (.50 GPM Flow)	Approximate Percent of Spray Volume Less Than 200 Microns	
	15 PSI	40 PSI
XR TeeJet® 110°	14%	22%
XR TeeJet 80°	6%	12%
DG TeeJet® 110°	N/A	11%
DG TeeJet 80°	N/A	7%
TT – Turbo TeeJet®	<1%	<6%
TF – Turbo FloodJet®	<1%	<1%
AI TeeJet® 110°	N/A	<1%

Data obtained by spraying water at room temperature under laboratory conditions.



Droplet size classifications are based on BCPC specifications and in accordance with ASAE Standard S-572 at the date of printing. Classifications are subject to change.

XR8005	C	C	C	C	C	M	M
XR8006	C	C	C	C	C	C	C
XR8008	VC	C	C	C	C	C	C
XR11001	F	F	F	VF	VF	VF	VF
XR110015	F	F	F	F	F	VF	VF
XR11002	M	F	F	F	F	F	F
XR11003	M	M	M	F	F	F	F
XR11004	M	M	M	M	F	F	F
XR11005	M	M	M	M	M	M	F
XR11006	C	M	M	M	M	M	M
XR11008	C	C	M	M	M	M	M

TP8005	C	C	C	M	M		
TP8006	C	C	C	C	C		
TP8008	C	C	C	C	C		
TP11001	F	VF	VF	VF	VF		
TP110015	F	F	F	VF	VF		
TP11002	F	F	F	F	F		
TP11003	M	F	F	F	F		
TP11004	M	M	F	F	F		
TP11005	M	M	M	M	F		
TP11006	M	M	M	M	M		
TP11008	M	M	M	M	M		

TwinJet® (TJ)

	PSI				
	29	36	44	51	58
TJ60-8001	F	VF	VF	VF	VF
TJ60-8002	F	F	F	F	F
TJ60-8003	F	F	F	F	F
TJ60-8004	M	M	M	M	F
TJ60-8006	M	M	M	M	M
TJ60-8008	C	C	M	M	M
TJ60-8010	C	C	C	M	M
TJ60-11002	F	VF	VF	VF	VF
TJ60-11003	F	F	F	F	F
TJ60-11004	M	F	F	F	F
TJ60-11006	M	M	M	F	F
TJ60-11008	M	M	M	M	M
TJ60-11010	M	M	M	M	M

DG TeeJet® (DG E)

	PSI				
	29	36	44	51	58
DG95015E	M	M	F	F	F
DG9502E	C	M	M	M	M
DG9503E	C	C	M	M	M
DG9504E	C	C	C	M	M
DG9505E	C	C	C	C	M

Turbo FloodJet® (TF)

	PSI				
	29	36	44	51	58
TF-2	XC	XC	XC	XC	XC
TF-2.5	XC	XC	XC	XC	XC
TF-3	XC	XC	XC	XC	XC
TF-4	XC	XC	XC	XC	XC
TF-5	XC	XC	XC	XC	XC
TF-7.5	XC	XC	XC	XC	XC
TF-10	XC	XC	XC	XC	XC

DG TeeJet® (DG)

	PSI				
	29	36	44	51	58
DG80015	M	M	M	F	F
DG8002	C	M	M	M	M
DG8003	C	C	M	M	M
DG8004	C	C	C	C	M
DG8005	C	C	C	C	C
DG110015	M	F	F	F	F
DG11002	M	M	M	M	M
DG11003	C	M	M	M	M
DG11004	C	C	M	M	M
DG11005	C	C	C	M	M

Spray Drift Factors

- **Viscosity of Spray Mix**
  - Thickness of spray batch
  - Invert emulsions – thick like mayonnaise – low drift formulation
  - Water-based formulations affected by evaporation: temperature and humidity
  - Drift-reducing adjuvants may form an increased number of larger droplets

Spray Drift Factors

- **Weather Conditions** – Read the Wind
  - What's downwind?
    Direction
  - How far will it move?
    Speed

    - 0-3 mph:
      could be very stable with airflow, just not sure which direction the air is moving
    - 3-7 mph:
      manage for off-target movement downwind
    - >7 mph:
      carries more material off-target

Spray Drift Factors

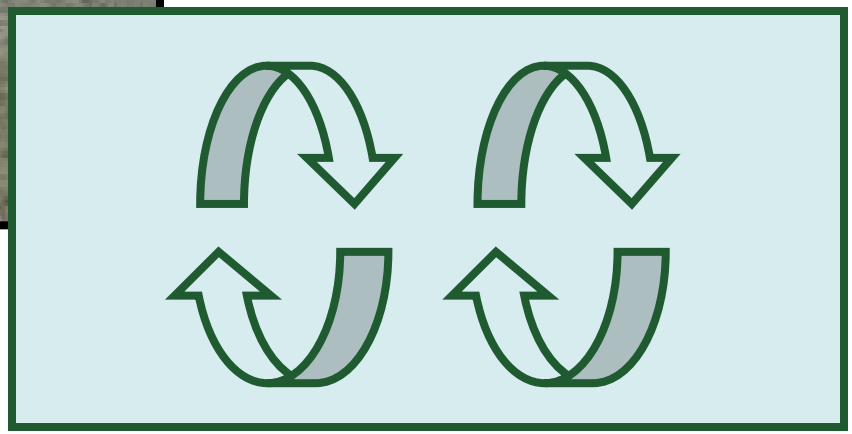
- **Weather Conditions**
  - Temperature – droplet evaporates to smaller droplets as temperatures increase
  - Humidity – droplets do not evaporate as humidity increases

Spray Drift Factors

- **Weather Conditions**
  - Temperature Inversion – air is STABLE with minor air flow
    - air at ground has cooled (heavier air)
    - warm air as risen (lighter air)

    - result is stagnant, stable air = inversion
    - long distance drift can result from applications made during inversions

Normal Conditions



Vertical air mixing – dilution of material through the air mass

Stable Air Conditions: Temperature Inversion

When can a temperature inversion occur?

- Can occur anytime
- Usually develops at dusk
- May continue through night
- Breaks up when ground warms up in morning
- It may appear ideal, but is not

Pesticide Movement: in Air

Vapor Drift

- Certain products volatilize and move with airflow off-target under warm weather conditions (above 85°F)
- Check the label for precautions for cut-off temperatures
- Select low-volatile formulations

Pesticide Movement: in Air

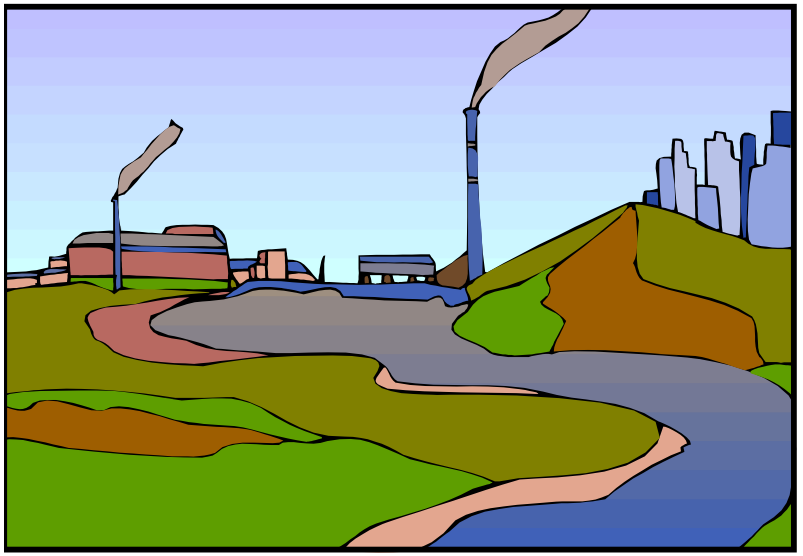
Particle Drift

- Dust applications can drift
- Certain pesticides attach to soil particles, remain active and can blow off-target

- Check the label for soil incorporation precautions

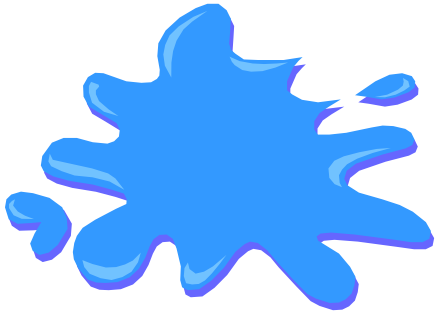
Pesticide Movement: in Water

- Pesticides can move into water from a identifiable occurrence or from general contamination
  - Point Source
    - identifiable source
  - Non-point Source
    - wide area contamination



Pesticide Movement: in Water

- **Point-source Pollution** is from an identifiable point
  - Spills and leaks
    - into sewer
    - at mix/load sites
    - wash sites
  - Backsiphoning when filling sprayer or chemigation
  - Improper handling and disposal near water sources



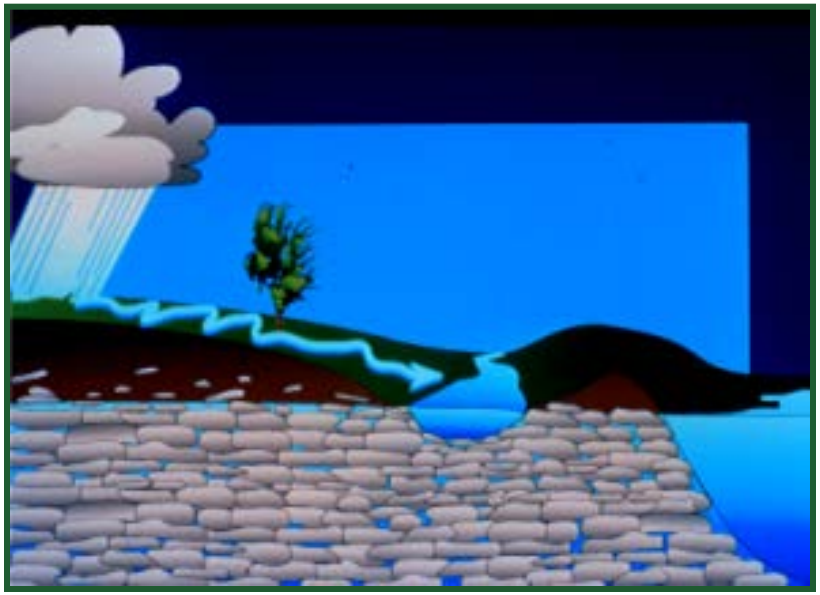
Pesticide Movement: in Water

- **Non-point Source Pollution** originates from a wide area
  - pesticide movement into surface water from any number of sources
  - commonly blamed for contaminated water

Pesticide Movement: in Water

Runoff

- Pesticides move in water over soil into surface water
- Contaminated ditches, streams, rivers, ponds, and lakes
- Surface water used for drinking and livestock water, irrigation, etc.



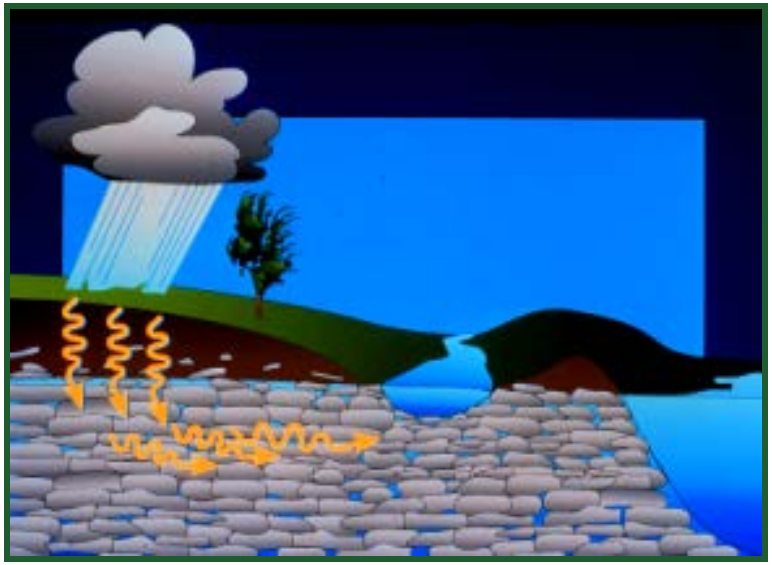
Runoff amount depends on:

- grade or slope of the area
- soil texture
- vegetation
- soil moisture
- amount and timing of irrigation/rainfall
- pesticide characteristics

Pesticide Movement: in Water

Leaching

- Movement of pesticide by water <u>through</u> soil
- Move horizonatlly to nearby roots or vertically toward groundwater
- Chemical characteristics that pose concern: high solubility, low adsorption, persistence



Leaching depends on…

- Geology – how permeable is the soil?
- Soil texture and structure
  - Sandy: fast percolation, few binding sites
  - Silt, clay or organic matter: slower percolations and many binding sites
- Depth to groundwater: shallow water tables pose a concern
- Amount and timing of rainfall or irrigation

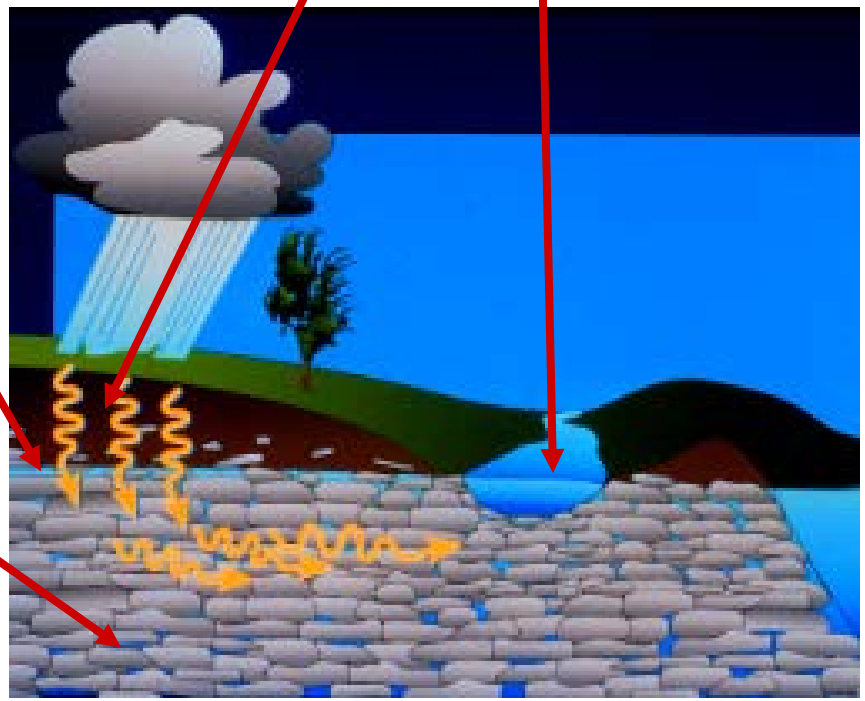
Special Environmental Considerations

- Groundwater protection
- Protect sensitive areas
- Protect non-target organisms
  - Pollinators, beneficials
  - Fish, livestock, and wildlife
  - Protect endangered and threatened species

Protect Our Groundwater

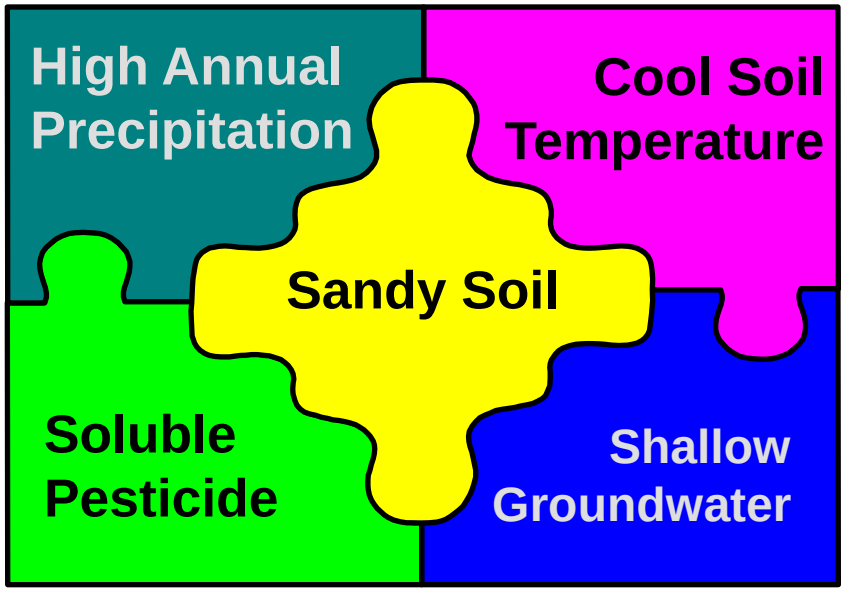
Groundwater

- **Surface Water:** lakes, rivers and oceans
- **Recharge:** water that seeps through the soil from rain, melting snow or irrigation
- **Water Table:** upper level of the water-saturated zone
- **Aquifers:** permeable zones of rock, sand, gravel, or limestone that are saturated with water



Select Product after Assessing the Application Site

- Concern for leaching or the site is vulnerable
  - select a product that does not pose a concern



- Little or no concern for leaching
  - product selection is not a concern

Keep Pesticides Out of Groundwater!!

- Use IPM
- Consider the geology
  - Where is the water table?
  - Are there sinkholes nearby?
- Consider soil characteristics
  - Is it susceptible to leaching?
- Select pesticides carefully
  - Is it susceptible to leaching?
- Follow label directions

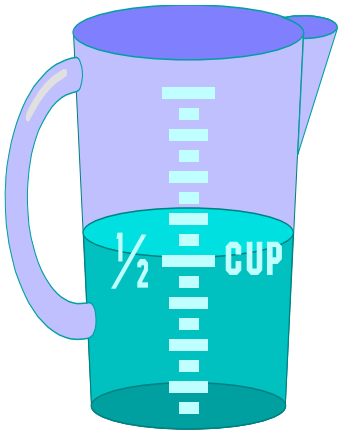
Keep Pesticides Out of Groundwater!!

- Identify vulnerable areas
  - Sandy soils
  - Sinkholes
  - Wells
  - Streams
  - Ponds
  - Shallow groundwater

- Handle pesticides to ensure pesticide or wastes do not contaminate soils

Keep Pesticides Out of Groundwater!!

- Calibrate accurately and check for leaks!
- Measure accurately and do not overapply

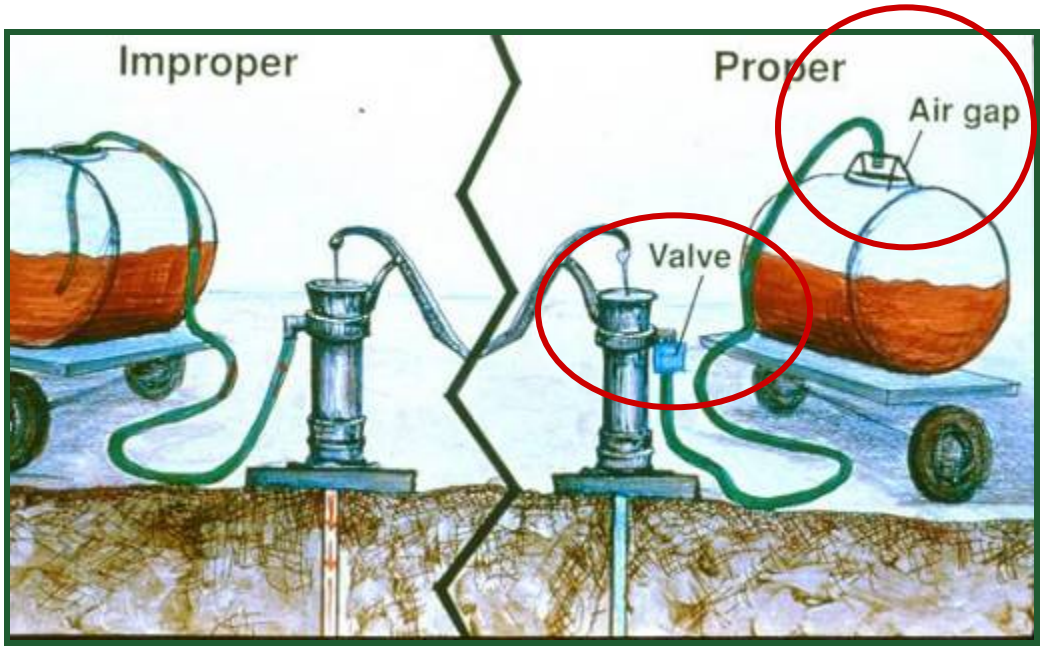


Keep Pesticides Out of Groundwater!!

- Mix Location
  - Do not mix and load near water or drains; consider a mix/load pad
  - Don’t mix at the same location each time; unless you have a mix/load pad

Keep Pesticides Out of Groundwater!!

- Air gap: keep the water supply above the level of the mixture
- Install a back-siphon valve (check valve)



Keep Pesticides Out of Groundwater!!

- Clean up and avoid spills
- Dispose of wastes properly
  - Triple rinse containers; use the rinsewater in spray tank
- Store pesticides away from water sources

DO NOT apply pesticides if heavy rain is in the forecast!

Protect Sensitive Areas

- Schools, playgrounds, parks, hospitals
- Wildlife refuges, bee hives
- Yards, gardens, crop fields
- Indoors: homes, offices, stores, clinics, restaurants, factories, animal facilities
- Endangered/threatened species and their habitats

Protect Non-target Organisms

- Plants
- Bees, other pollinators
- Other beneficial insects
- Fish and other wildlife
- Humans

Plants can be nontarget organisms!

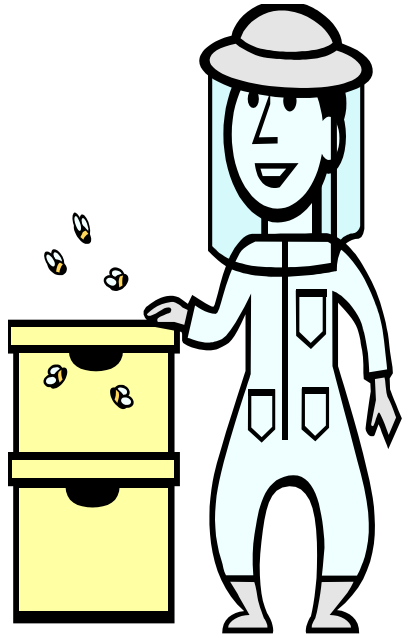
- Herbicides are the primary cause of non-target plant injury
- **Phytotoxicity:** plant injury from a chemical application
- Symptoms of pesticide injury are similar to other problems
- Read the label
- Avoid drift!

Protect Bees and Other Pollinators

- Do not apply toxic pesticides if there is bloom in the target area or in nearby areas
- Mow cover blooming crops and weeds
- Reduce drift
- Apply early or late when they are not foraging

Protect Bees and other Pollinators

- Select pesticides least harmful to bees
  - Use low hazard formulations, avoid microencapsulated formulations, dusts and powders
  - Check the label for toxicity
  - Spot treat if appropriate
- Cooperate with beekeepers!



Protect Beneficial Insects

- Recognize beneficial insects
- Valuable allies in pest management
- Minimize insecticide usage
- Use selective insecticides or least toxic insecticides

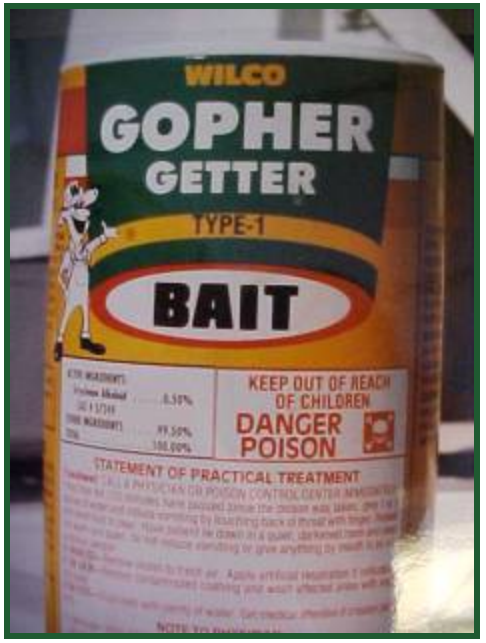
Protect Fish

Keep pesticides from entering surface waters

- Fish kills may result from pesticide pollution
- Manage spills, drift, runoff, leaching
- Dispose of wastes properly

Protect Livestock and Wildlife

- Bird and mammal kills can result from…
  - ingestion of granules, baits or treated seed
  - direct exposure to spray
  - consumption of treated food
  - drinking contaminated water



- Secondary poisoning: feeding on pesticide-contaminated prey

Endangered & Threatened Species

- **Endangered:** on the brink of extinction
- **Threatened:** likely to become endangered
- Destruction of **habitat** is an equal concern
- Pesticide labels tell applicators to consult county bulletins for special precautionary measures

CHAPTER 7

Summary

- Understand how the pesticides you use might move in the environment
- Reduce drift by applying at the right time, in the right place, with the right technique
- Prevent groundwater and surface water contamination
- Protect sensitive areas, non-target organisms, and endangered species

CHAPTER 7

Protect Yourself, Family, Neighbors and Pets

Be a responsible applicator!

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Q1. Which of the following techniques would reduce spray drift?

1. increasing nozzle size
2. decreasing pressure
3. decreasing distance between the boom and the target site
4. decreasing the viscosity of the spray solution

A. 1 only	C. 1, 2, and 3 only
B. 1 and 2 only	D. 1, 2, 3, and 4

Q2. You need to control aphids in a blooming alfalfa field and the product lists a bee toxicity hazard. What application precaution can you make to protect bees?

A. apply mid-morning when temperatures are warming
B. apply a dust formulation instead of an emulsifiable concentrate
C. use a systemic, granule formulation
D. move hives that are next to the field to 300 yards away

Q3. Surface and groundwater contamination occur most frequently with water-soluble pesticides. Which of the following events would be a concern with a water-soluble pesticide?

1. a rain event following an application
2. applying to dry, clay soils with a well 150 feet away
3. pouring container rinsewater on the ground
4. using an air gap instead of a check valve when filling a spray tank

A. 1 and 2 only	C. 2 and 3 only
B. 1 and 3 only	D. 3 and 4 only

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