Environmental Fate of Pesticides

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Public Concerns

- Health
- Quality of Life
- Environment
- Toxic Waste
- Chemicals vs. Natural
- Right-to-Know

"Public Concerns" About Chemicals

- Cause cancer
- Not well tested
- Harm animals
- Last forever
- Not "natural"
- Used carelessly
- Contaminate water
- Any amount is dangerous

Use of Pesticides

- Overall, pesticide use in the U.S. has reached a plateau, but
- Use of certain specific chemicals is still increasing.

Use of Pesticides

- Proper selection and use of pesticides can be of prime importance in:
- Reducing pesticides' potential for causing environmental impacts.
- Optimizing their effectiveness.
- Reducing the expense of pest management.

Use of Pesticides

- **Selection and application rate of a pesticide depends on:**
  - Specific pest
  - Crop
  - Climate and temperature
  - Soil conditions
  - Management practices
  - Pesticide's chemical & physical properties

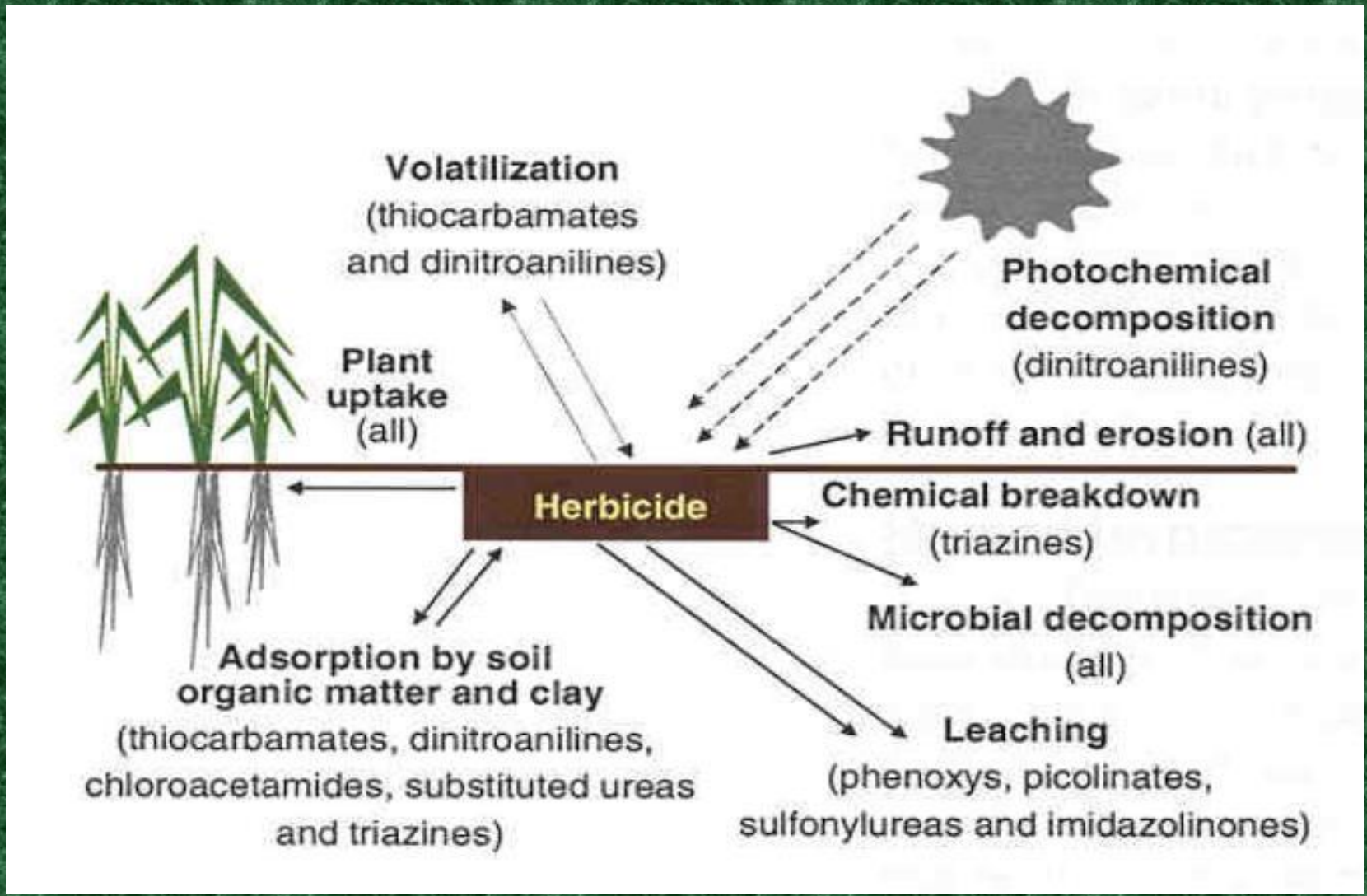
Fate of Pesticides Applied

- **Water solubility** the extent to which a pesticide will dissolve in water.
- **Sorption by clay colloids and organic matter:**
  - **Adsorption** binding of a pesticide to the surface of a soil particle .
  - **Absorption** penetrates into plant tissue.
- **Microbial degradation** influenced by herbicide concentration, temperature, moisture, pH, oxygen, microbial population.

Fate of Pesticides Applied

- **Chemical degradation and photodecomposition** Hydrolysis, oxidation, reduction, and photodecomposition under field conditions.
- **Volatilization and evaporation** loss due to an increase in temperature, vapor pressure, and wind movement.
- **Plant uptake and metabolism** by roots, shoots, leaves.

Environmental Fate of Herbicides



Pesticide Dissipation

- Dosage
- Affinity for binding
- Water solubility and Leaching
- Microbial and Chemical degradation
- Volatilization
- Photodecomposition
- Plant Uptake and Metabolism

Pesticide Fate in the Soil

- Pesticide Chemical Characteristics
- Soil Physical-Chemical Characteristics

Pesticide-Chemical Properties

- Ionic State (cation, anion, basic or acidic)
- Water solubility
- Vapor pressure
- Hydrophobic/hydrophilic
- Chemical, photochemical, microbial sensitivity

Pesticide Adsorption

- Soil texture
  - coarse, sandy soils have few binding sites.
- Permeability
  - highly permeable soils low in CEC have few binding sites.
- Soil OM and clay content
  - increase binding.
- Excessive moisture interferes with binding

Factors That Affect Leaching

Increase	Decrease
Coarse soils	Fine Soils
Low O.M.	High O.M.
Water soluble	Water insoluble
Non-binding	Readily bind
High rainfall	Normal rainfall

Pesticide Degradation

- Decomposition (degradation) of pesticides into simpler compounds is the result of:
  - Physical action
    - Photodegradation (breakdown of pesticide by sunlight, mainly UV).
  - Chemical action
    - Chemical or aqueous hydrolysis.
  - Biological action
    - Soil microorganisms.

Microbial Degradation

- Higher with high microbial populations.
- May use as food source or just degrade the pesticide.
- Faster under warm, moist conditions.
- Slower under cool, dry conditions.

Volatility

- Physical change of a liquid or solid to gas.
- Related to vapor pressure.
- Increases at high air temperatures.
- Increases under high soil moisture conditions
- Higher on coarse-textured, sandy soils.

Examples of Herbicide Loss

Postemergence Herbicide Volatility

Herbicide	Vapor Pressure (mm Hg)	Relative Volatility
2,4-D acid (amine)	1.4×10^{-7}	Low
2,4-D ester (isopropyl)	1.0×10^{-2}	Very high
Dicamba	9.2×10^{-6}	Low
Clopyralid (amine)	1.3×10^{-6}	Very low
MSMA	16.0	None
Manage	2.8×10^{-12}	Insig.
TranXit	--	insig.
Basagran	0	None

Mobility of Preemergence Herbicides in Soil

None to slight	Low	Moderate	High
DNA's	Ronstar	Aatrex	Kerb
Dimension	Betasan	Princep	
	Pennant	Sencor	
	Devrinol	Prograss	
	Rubigan		

Mobility of Postemergence Herbicides in Soil

None to slight	Low	Moderate	High
Diquat	Buctril	Image	MCPP
Roundup	Acclaim	Manage	2,4-D
MSMA	Vantage	Corsair	Vanquish
	Fusilade	Metsulfuron	Basagran
	TranXit	Monument	Triclopyr
	Revolver	Katana	Clopyralid
	Certainty		Finale

Residue of Pesticides

- 1 ppm = one second in 12 days
- 1 ppb = one second in 32 years
- 1 ppt = one second in 32,000 years
- 1 ppq = one second in 32,000,000 years
- 1.0 lb. Ai/acre = 1.0 ppm in upper 3 inches

Facts

- 30 yrs added to lifespan in 20th century
- 8 yrs added since use of pesticides
- about 33% of land farmed in 1950s is cultivated today
- deer, turkey, geese populations have increased in GA