

# 5. E2 Pesticides in the Environment



# Potential Negative Impacts on the Environment

## Potential negative impacts on the environment and non-target species

- Contamination of ground water and surface water
- Reduction of bee, other pollinator, and bird populations
- Damage to aquatic organisms

# Potential Negative Impacts on the Environment

## Potential negative impacts on the environment and non-target species

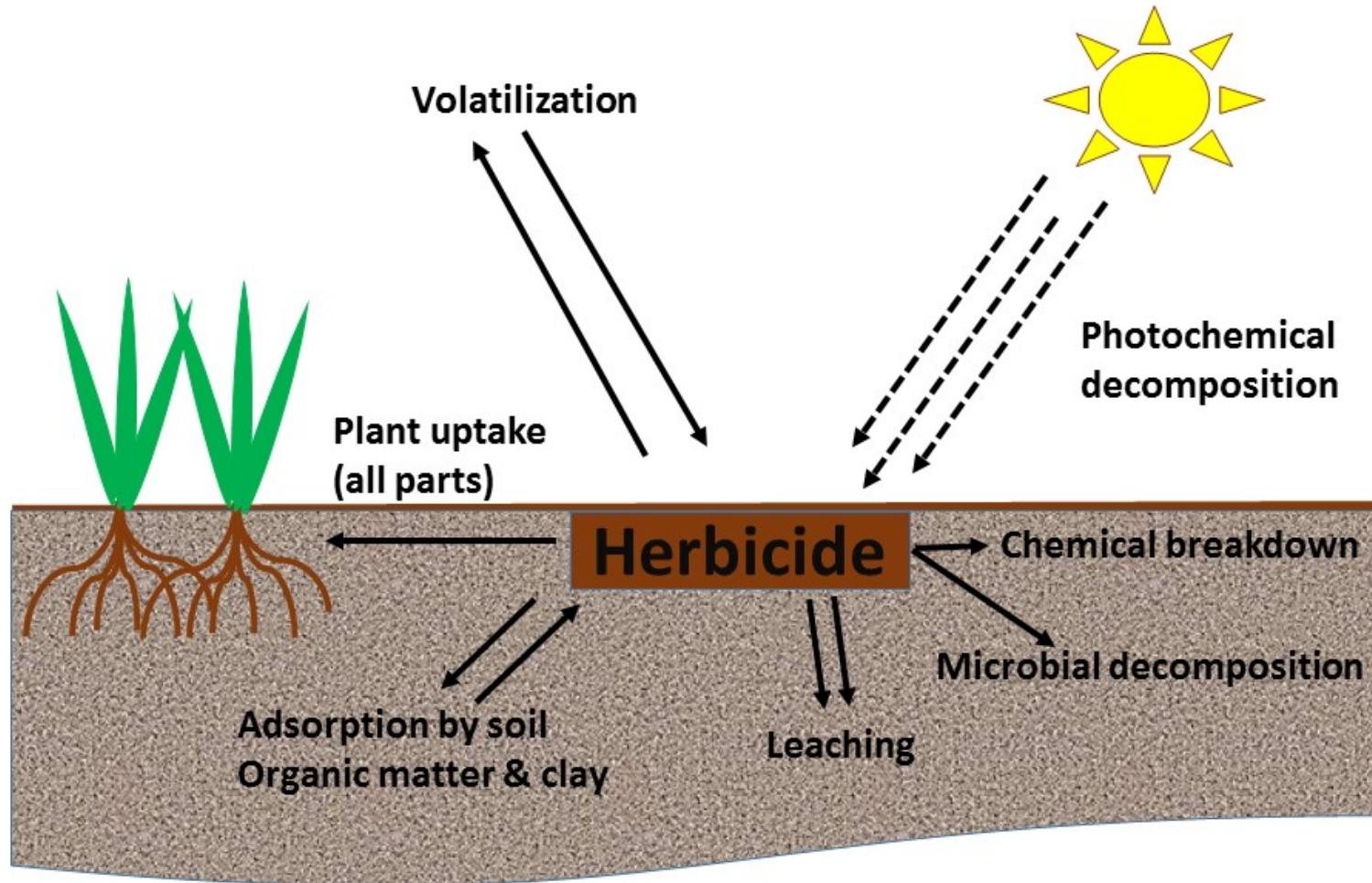
- Persistent pesticide causing long term soil contamination
- Some pesticides may be potential carcinogens.
- Potential harm to **non-target species**, organisms not intended to be managed
- Pesticide-resistant weeds, insect and diseases

# Environmental Fate of Pesticides

## Pesticides can be

- **Absorbed** thru plant uptake
- **Adsorbed** by soil
- Transported offsite. **Transportation** the movement of a pesticide away from its intended site of action.
- Leached
- Runoff

# Environmental Fate of Pesticides



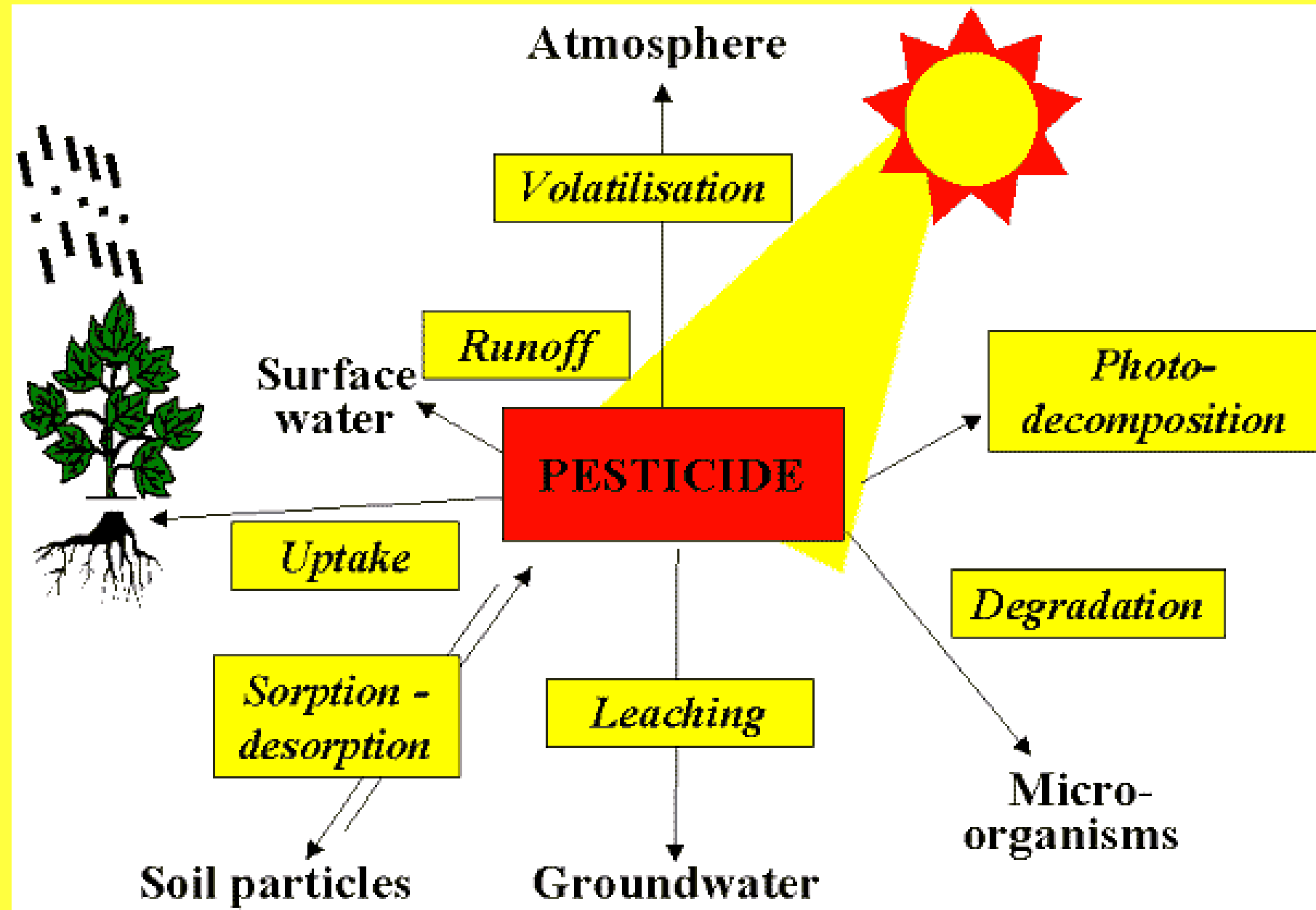
Adapted from the 3<sup>rd</sup> of three Grain Research Development Corporation weekly webinars  
Presented by Dr. Dale Shaner, USDA (retired)

# Environmental Fate of Pesticides

## Pesticide Movement can occur by

- **Runoff**
- **Leaching**
- **Particle Drift**
- **Volatilization Drift**

# Environmental Fate of Pesticides



# Environmental Fate of Pesticides

Transportation factors that determine pesticide potential to contaminate water

- **Solubility** ability of a pesticide to dissolve in water
- **Adsorption** how strongly the pesticide binds to soil surface



# Environmental Fate of Pesticides

Transportation factors that determine pesticide potential to contaminate water

- **Persistence** how long the pesticide is active in soil
- **Volatility** the vaporization potential of a pesticide. Volatile pesticides may be carried offsite.

# Environmental Fate of Pesticides

## Adsorbed vs. absorbed

“In the presence of water with many contaminants, water is **adsorbed** on the surface of mineral matter, whereas, contaminants are **absorbed** into the organic matter by a partition process.”



# Environmental Fate of Pesticides

## Pesticide transportation processes **Runoff**

- **Runoff** the movement of water and associated materials over the top of the soil or impervious surfaces.
- Runoff occurs when the rate of precipitation exceeds the rate of water infiltration or when precipitation lands on impermeable surfaces such as driveways.

# Environmental Fate of Pesticides

## Runoff and Misapplication

Pesticide runoff and misapplication are more likely to occur when pesticides are applied

- To hard surfaces
- Too soon before rain events
- At too high a rate
- To frozen ground
- Above label rates

*Misapplication* causes pesticide pollutants and sediments can be carried offsite to streams, rivers, lakes, or wetlands

# Short Summary

## Potential negative environmental impacts of pesticide applications

- Contamination of ground water and surface water.
- Reduction of bee, other pollinator, and bird populations.
- Effects on non-target organisms

# Quick Questions

**What is photodecomposition?**

*Breakdown of pesticides by the ultraviolet light in sunshine.*

**What is runoff?**

*Runoff is the movement of water and associated materials over the top of the soil or impervious surfaces.*

**What is volatilization?**

*Volatility the vaporization potential of a pesticide.*

# Environmental Fate of Pesticides

## Pesticide Transportation Processes Leaching

**Leaching** is the downward movement of particles and nutrients through the soil



# Environmental Fate of Pesticides

## Pesticide Transportation Processes

### Leaching

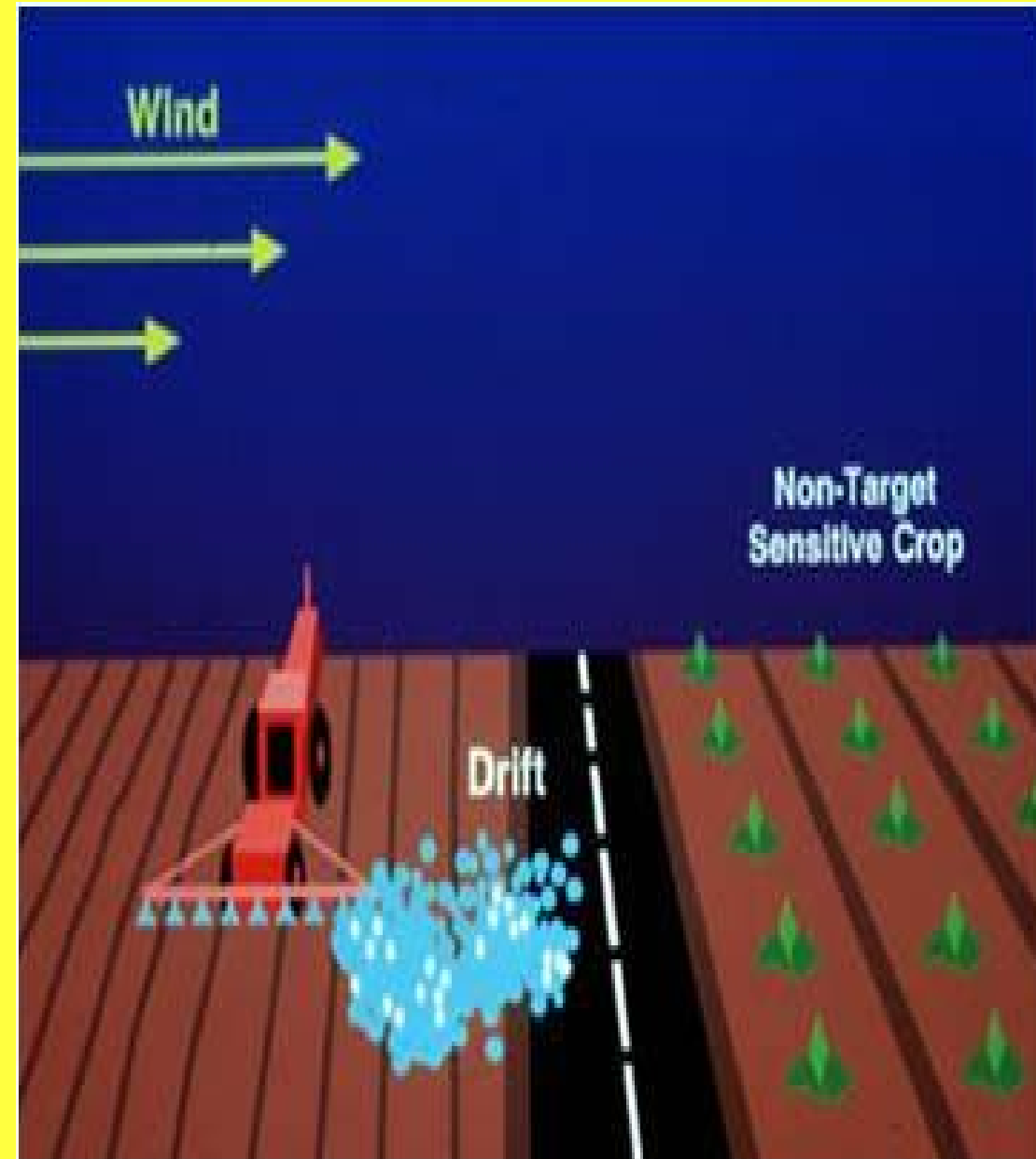
**Turfgrass studies** confirm that there appears to be minimal downward movement when pesticides are properly applied.



# Environmental Fate of Pesticides

## Pesticide Transportation Processes

- **Pesticide Particle Drift** the air movement of pesticide droplets off the site of application.
- Drift occurs when applications are made in windy conditions or in no or low wind conditions during temperature inversions.



# Environmental Fate of Pesticides

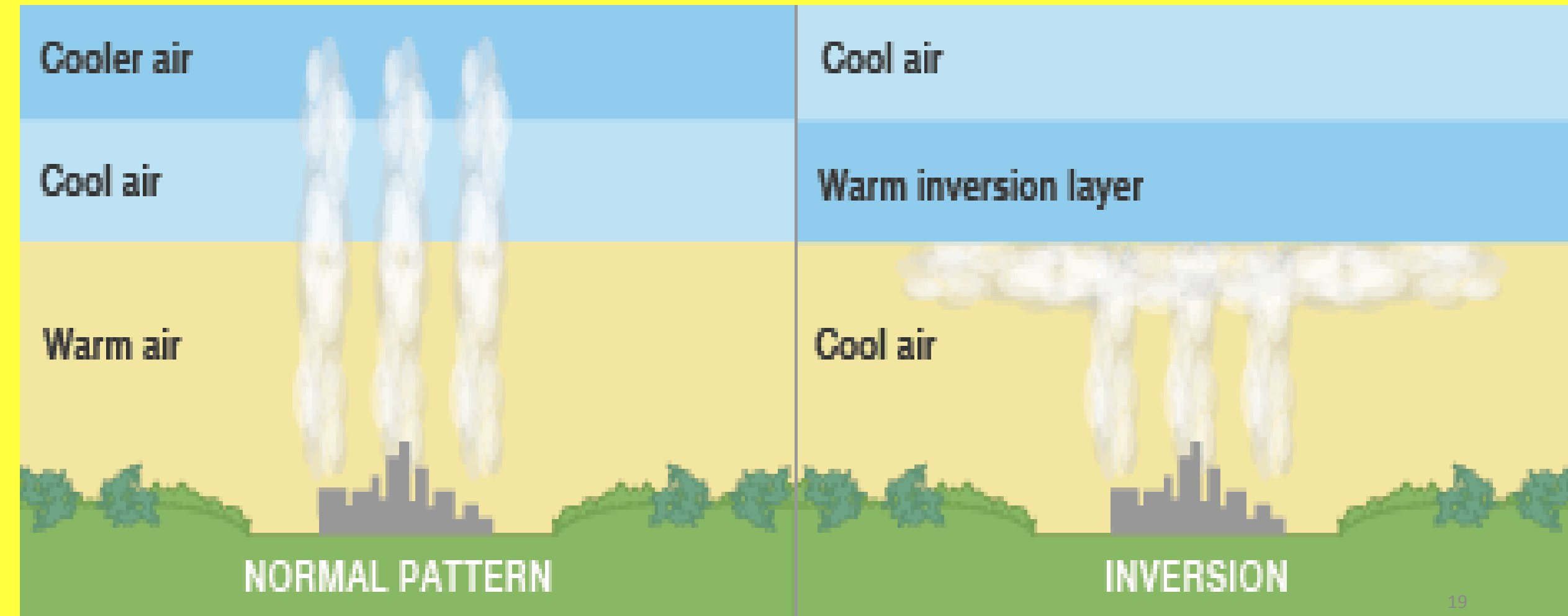
## Pesticide Transportation Processes

### Pesticide Particle Drift

**Temperature inversions** occur when warmer upper air traps cooler air at ground level. An inversion acts like a lid and traps airborne particles such as pesticide droplets at the surface.

# Environmental Fate of Pesticides

## Temperature inversion



# Environmental Fate of Pesticides

## Pesticide transportation processes

### Pesticide Volatilization Drift

**Pesticide volatilization drift** occurs when the spray droplets applied to foliage and surrounding surfaces change phase from liquid to gas.

# Environmental Fate of Pesticides

## Esters

- Herbicides formulated for broadleaf weeds formulated as **esters** have a greater volatilization potential than amine formulations.
- “Ester formulations should never be applied when **temperatures** are above 80 to 85 degrees F and the relative humidity is low.”

# Environmental Fate of Pesticides

## Pesticide Transformation

**Pesticide transformation** is *usually* desirable because it **usually** results in less toxic breakdown products.

There are, however, instances where the *breakdown products are more toxic* than the initial pesticide. An example of this occurs with DDT which breaks down into DDE which is more toxic than DDT. DDT and DDE accumulate and are retained by body tissues in mammals.

# Environmental Fate of Pesticides

## Ways Pesticides are Transformed in the Environment

- **Absorption**
- **Photodecomposition**
- **Microbial decomposition**
- **Chemical breakdown**

# Environmental Fate of Pesticides

## Pesticide Transformation Processes

*Absorption* the uptake of the pesticide into plant tissues. Once **absorbed**, most pesticides are broken down into by-products within the plant.



# Short Summary

**Drift occurs when applications are made in windy conditions or in no or low wind conditions during temperature inversions.**

**Soil microorganisms can breakdown some pesticides, the process is called microbial degradation.**

**Herbicides formulated as esters have greater volatilization potential than amines.**

# Quick Questions

**What is pesticide particle drift?**

*Pesticide Particle Drift is the air movement of pesticide droplets off the site of application.*

**What is leaching?**

*Leaching is the downward movement of particles and nutrients through the soil.*

**Ester herbicides should not be applied above what temperature?**

*80 to 85 degrees F*

# Environmental Fate of Pesticides

## Pesticide Transformation Processes

**Photodecomposition** sunlight breaking down pesticides thereby altering the chemical characteristics of the pesticide frequently resulting in less toxic breakdown products.

Once pesticides are watered off plant surfaces and into the soil they are often not affected by further photodecomposition.

# Environmental Fate of Pesticides

## Pesticide transformation processes

### **Microbial decomposition** soil

microorganisms utilize pesticides as food source and thereby degrade the pesticides.

- Warm, moist soil that is well aerated and has a pH of 6.5 to 7.0 encourages high microbial activity.
- Enhancing the level of biological activity results in faster decomposition.

# Environmental Fate of Pesticides

## Pesticide transformation processes

### Chemical Breakdown

**Hydrolysis** the way pesticides can react with water can result in breakdown.

Environmental conditions, application methods, mixing and storage can be factors in the likelihood of **water contamination**.

# Potential Environmental Impacts of Pesticides used in T & O Applications

## Impact

**“Impact. A change in the chemical, physical including habitat, or biological quality or condition caused by external forces.”**

- **Impacts to surface waters**
- **Impacts to ground waters**

# Potential Environmental Impacts of Pesticides used in T & O Applications

## Impacts to Surface Waters

The Minnesota Department of Agriculture MDA and the Minnesota Pollution Control Agency MPCA partner to monitor pesticide presence in sampled streams and lakes annually.

Pesticides and breakdown products were found as follows

2009---16

2010---33

2011---38

# Potential Environmental Impacts of Pesticides used in T & O Applications

## Impacts to Surface Waters

Although these pesticide residue levels are detectable they were not at concentrations detrimental to **aquatic life**, organisms that spend all or part of their life in surface waters.



# Potential Environmental Impacts of Pesticides used in T & O Applications

## Impacts to Surface Waters

- Pesticides are formulated containing a mixture of one or more **active ingredients AI**, **carriers inert ingredients**, and other **additives** diluted for safety and ease of application.
- Sometimes the AI is not the concern, the herbicide glyphosate AI is labeled as “practically non-toxic” a surfactant commonly formulated with glyphosate is labeled as ‘moderately toxic” to aquatic life.

# Potential Environmental Impacts of Pesticides used in T & O Applications

## Impacts to Surface Waters

**Follow setback requirements on the pesticide label to protect water quality!**

# Potential Environmental Impacts of Pesticides used in T & O Applications

## Pesticides in groundwaters

- Groundwater is located in aquifers beneath the soil surface from which well water is obtained or surface springs are formed.
- In 2011 MDA and other agencies found 14 pesticide '**degradates**' breakdown products in groundwater samples.

# Potential Environmental Impacts of Pesticides used in T & O Applications

## Pesticides in groundwaters

Backflow contamination is one source of water contamination.

Factors that make a site more susceptible to groundwater contamination

- Sandy soils,
- Low organic content
- Soluble pesticides
- Pesticides with longer half-lives
- Pesticides with low adsorption to soils

# Potential Environmental Impacts of Pesticides used in T & O Applications

## Impacts to non-target species

- Shared root zones
- Impacts on pollinators
- Impacts on aquatic and other life
- Impacts influenced by weather conditions

# Potential Environmental Impacts of Pesticides used in T & O Applications

## Impacts to non-target species

### Shared root zones

- Turf, trees and shrubs can share root zones.
- Turfgrass pesticide treatment can impact trees and shrubs.

# Short Summary

**Hydrolysis is the way pesticides can react with water and result in chemical breakdown.**

**Environment impacts are potential changes in the chemical, physical including habitat, or biological quality caused by external forces.**

**Turf, trees, and shrubs can share root zones.**

# Quick Questions

Does photodecomposition continue after the pesticide is washed off the foliage?

*Usually not*

Is the active ingredient ai. the only potential source of negative environmental impact?

*No, some inert ingredients can cause impact*

What are pesticide breakdown products called?

*Degradates*



# Potential Environmental Impacts of Pesticides used in T & O Applications

## Impacts to non-target species

Some pesticide formulations are more likely to result in movement and damage to non-target plants e.g. 'dicamba', used for broadleaf weed control, is very water soluble and has low soil adsorption

# Potential Environmental Impacts of Pesticides used in T & O Applications

## Impacts to non-target species

Pesticide use is thought to be a factor in the decline of bee populations.

- Bees can carry pesticides with pollen back to the hive.
- Some fungicides can alter bee foraging behavior, reduce bee pollination potential or affect the conversion of pollen to feed for bees in the hive.

# Potential Environmental Impacts of Pesticides used in T & O Applications

## Impacts to non-target species

- Impacts of pesticides on aquatic and other life
- Fish and aquatic invertebrates are sensitive to pesticides at specific concentrations. Some pesticides may be toxic to fish at higher concentrations.
- Fish kills are more likely to occur from pesticide spills than from normal applications.
- Many fungicides can kill earthworms, even at label rates.

# Potential Environmental Impacts of Pesticides used in T & O Applications

## Impacts influenced by weather conditions

When planning pesticide applications take weather conditions into account

- In windy conditions or during temperature inversions pesticide droplets and volatilized pesticides may drift on to adjoining properties
- A pesticide is considered *rainfast* after it has been absorbed by plant tissues so that it will still be effective after rainfall or irrigation Prior to being rainfast it can wash off.

# Potential Environmental Impacts of Pesticides used in T & O Applications

## Impacts influenced by weather conditions

- High temperatures and low humidity may result in pesticide volatilization.
- 'Dicamba' is likely to volatilize in conditions above 80 degrees F and low humidity. It is also highly soluble and therefore mobile in soil.

# Preventing and Minimizing Environmental and Non-Target Impacts

## How Landscape or Design Affects Pest Management

### Turfgrass role in reducing runoff

- Runoff from turfgrass areas can be <10% of rainfall compared with 55-100% for paved areas.
- Well managed turfgrass can have 15x less runoff than a lower quality lawn.

# Preventing and Minimizing Environmental and Non-Target Impacts

## How Landscape or Design Affects Pest Management

### Turfgrass role in reducing runoff:

- A healthy turf rootzone will improve water processes that facilitate the breakdown of various organic pollutants, air contaminants, and pesticides used in lawn care.
- A 150 acre golf course can absorb 12 million gallons of water.

# Preventing and Minimizing Environmental and Non-Target Effects

## How Landscape or Design Affects Pest Management

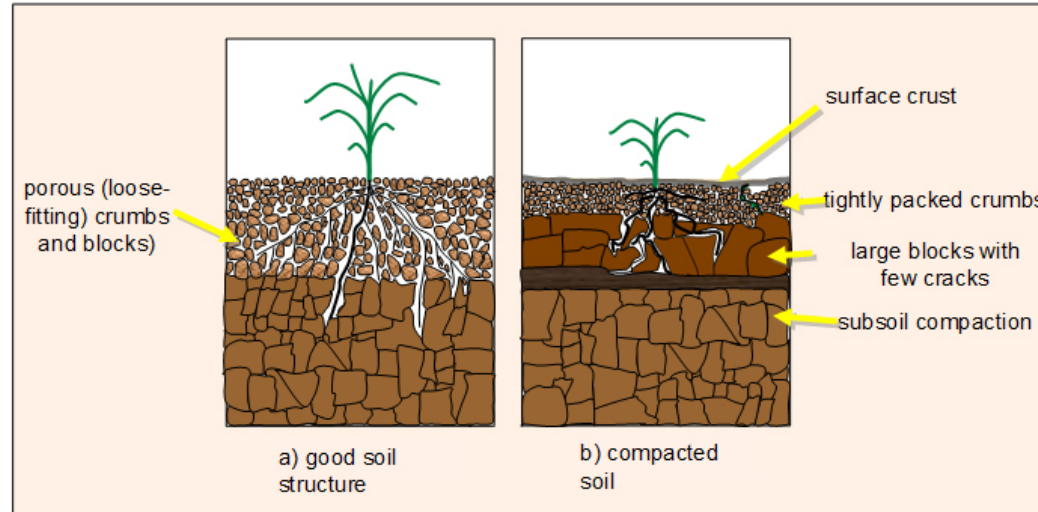
### Compaction Avoidance

- **Compaction reduces the soil's water holding capacity.**
- **Soil compaction is not fully revisable but deep tilling and incorporating topsoil will improve soil pore space.**



# Preventing and Minimizing Environmental and Non-Target Effects

## Soil Compaction



# Preventing and Minimizing Environmental and Non-Target Impacts

## Organic Matter Management for Soil Health

- **Organic matter** contains carbon formed from living plants and organisms.
- **Contributes to: soil health, soil structure, amount of nitrogen and other nutrients available water-holding capacity and diversity of soil organisms**
- **Organic matter can be incorporated into existing soils.**

# Preventing and Minimizing Environmental and Non-Target Impacts

## Ornamentals

Selecting the right plant for the site will minimize the need for pesticides.



# Preventing and Minimizing Environmental and Non-Target Impacts

**Identify plant stressors and select plants that can tolerate the stress or**

**Change the stress e.g. selecting salt tolerant plants on roadsides to prevent salt damage**



# Short Summary

**Fish and aquatic invertebrates are sensitive to pesticides at specific concentrations. Some pesticides may be toxic to fish at higher concentrations.**

**Organic matter in the soil contributes to soil health, soil structure, amount of nitrogen and other nutrients available water-holding capacity and diversity of soil organisms.**

# Quick Questions

**What is the likely cause of fish kills?**

*Fish kills are more likely to occur from pesticide spills than from normal applications.*

**What is the role of turfgrass in reducing runoff?**

*Well managed turfgrass can have 15x less runoff than a lower quality lawn.*

**How does compaction affect the soil's water holding capacity.**

*Compaction reduces water holding capacity*

# Preventing and Minimizing Environmental and Non-Target Impacts

**Nursery and Greenhouse Production**

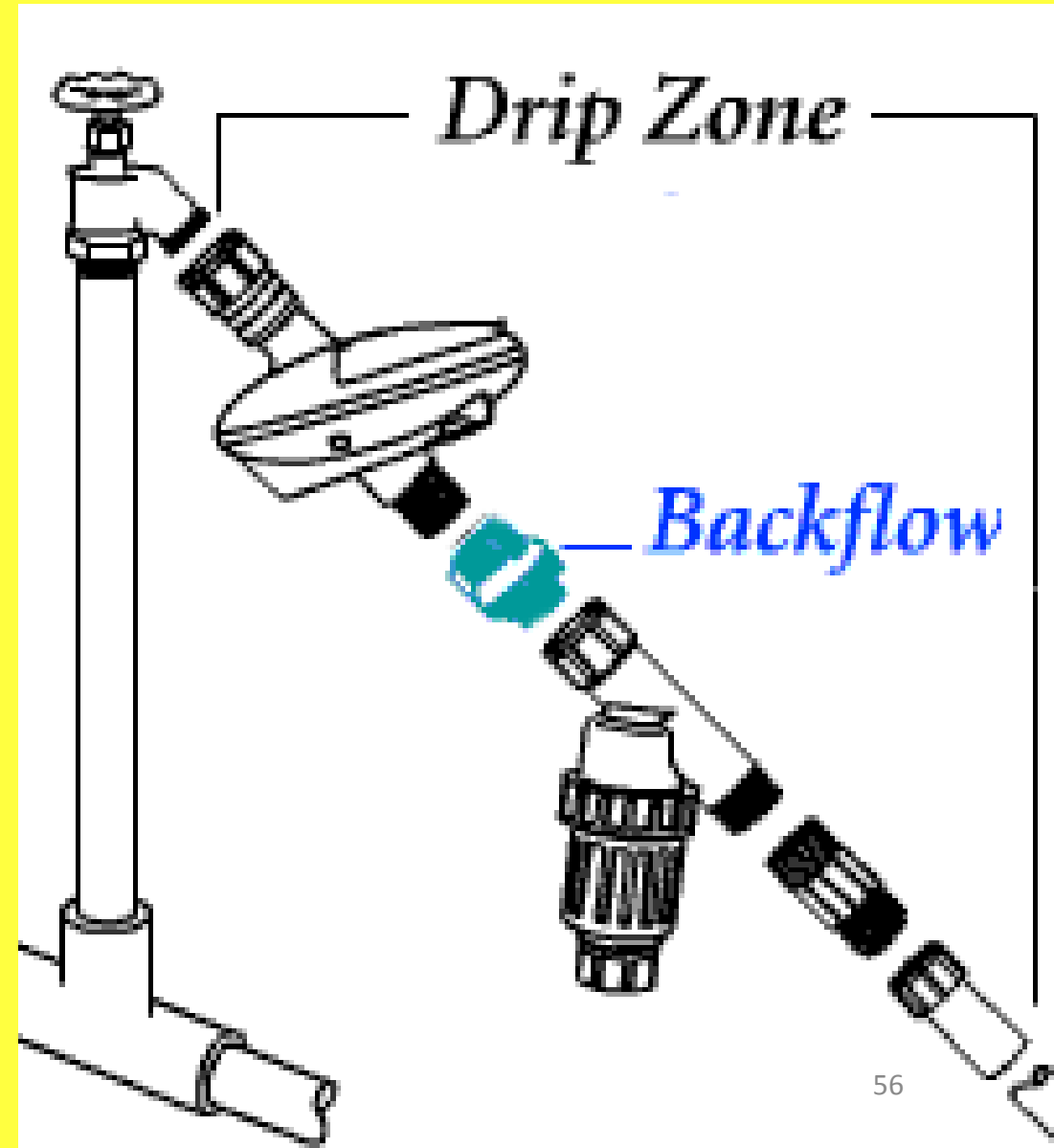
**Chemigation** the injection of fertilizers and or pesticides through an irrigation system



# Preventing and Minimizing Environmental and Non-Target Impacts

## Nursery and Greenhouse Production

**Anti-backflow** devices must be built into chemigation systems to prevent water contamination.





# Preventing and Minimizing Environmental and Non-Target Impacts

## Interiorscapes

Interiorscapes have unique stressors

- Limited light
- Limited vents
- Garbage
- Place plants away from the reach of children and others where possible



# Choose the Pesticide with the Least Environmental and Non-Target Impact

## Know the pest identification

- If you don't properly identify the pest your pesticide application may be unnecessary and **'off-label'**.
- Pesticides are registered for specific crops/sites.



**Choose the Pesticide with the Least Environmental and Non-Target Impact**

**Know the pest identification**

**Research control options including non-chemical options.**

# Choose the Pesticide with the Least Environmental and Non-Target Impact

**IPM**

**Using IPM is a great way to reduce environmental impacts!**

# Choose the Pesticide with the Least Environmental and Non-Target Impact

## Study and understand the label!

- In some cases Minnesota state law is more restrictive than the label. In such cases state law must be followed.
- Review Safety Data Sheets **SDS** formerly known as Material Safety Data Sheets **MSDS**.

# Choose the Pesticide with the Least Environmental and Non-Target Impact

## Use adjuvants where appropriate

- **Adjuvant** an additive to a pesticide that enhances pesticide effectiveness.
- Adjuvants may reduce environmental impacts and increase the effectiveness of pesticides.
- 'Surfactants' surface active ingredients, lower the surface tension of water and may reduce the volume pesticide applied.

# Choose the Pesticide with the Least Environmental and Non-Target Impact

## Use adjuvants where appropriate

- Thickeners increase the viscosity and weight of pesticide spray droplets and therefore reduce drift.
- Check the pesticide label before adding an adjuvant for potentially altered toxicity or environmental impact.

# Choose the Pesticide with the Least Environmental and Non-Target Impact

## Effectiveness vs. toxicity

- **Toxicity is** the extent to which a chemical or substance is poisonous.
- If multiple applications of a less toxic are needed it may be more harmful to the environment than a single, or lesser number, of applications of a more toxic pesticide.



# Choose the Pesticide with the Least Environmental and Non-Target Impact

## Effectiveness vs. toxicity

- **'Plant-derived'** pesticides, sometimes called natural or botanical, should be considered but in some cases a synthetic pesticide is less toxic.
- Some plant-derived pesticides break down more rapidly in the environment and require more applications to maintain effectiveness.

# Choose the Pesticide with the Least Environmental and Non-Target Impact

**Effectiveness vs. toxicity**

**To protect the environment weigh both the toxicity and other environmental impacts against the pesticide's effectiveness.**

# Short Summary

**Pesticide use is thought to be a factor in the decline of bee populations.**

**Bees can carry pesticides with pollen back to the hive.**

**Some fungicides can alter bee foraging behavior, reduce bee pollination potential, or affect the conversion of pollen to feed for bees in the hive.**

# Quick Questions

**What is an SDS?**

*A safety Data Sheet*

**Are plant derived pesticides less toxic than synthetic pesticides?**

*No necessarily, some are more toxic*

**What is a great way to reduce environmental impacts**

*Adopt IPM practices!*

# Choose the Pesticide with the Least Environmental and Non-Target Impact

**Apply pesticides carefully!**

- **Soil structure will affect how pesticides move.**
- **Pesticides will bind better to soil with high organic content.**
- **Sandy soils are more likely to leach thereby contaminating ground water.**
- **Do not apply pesticide to frozen soil.**

# Choose the Pesticide with the Least Environmental and Non-Target Impact

## Drainage

Avoid applying pesticides in drainage areas where they may be transported by groundwaters.

Water resources include

- Wetlands
- Ponds
- Streams
- Lakes

# Choose the Pesticide with the Least Environmental and Non-Target Impact

**Vernal pools**, i.e. temporary wetlands, may form from snowmelt and runoff.

Vernal pools are important for

- Waterfowl feeding on aquatic insects
- Breeding areas for salamanders and frogs



# Choose the Pesticide with the Least Environmental and Non-Target Impact

## Application near surface waters

- Never directly or indirectly apply pesticides and fertilizers on to surface waters or hard surfaces which drain into surface waters
- Direct pesticide application. A precise application to a specific area or site, such as a basal application to woody plants, crack-and-crevice or specially positioned nozzles so that only weeds are sprayed during a band application to crops.



# Choose the Pesticide with the Least Environmental and Non-Target Impact

## Shoreland buffer zones

### Minnesota DNR

- Provide habitat for a wide variety of wildlife
- Filter out pollutants and runoff that degrade water quality
- Prevent shoreline erosion by absorbing wave action



# Choose the Pesticide with the Least Environmental and Non-Target Impact

**Minimize injury to non-target plants** in a mixed landscape with shared root zones

- Consider *spot treatment* instead of a blanket application
- Select herbicides with short half-lives. "**Half-life.** The amount of time it takes for  $\frac{1}{2}$  of the original material to be broken down or removed. For each additional half-life period, 50% of the remainder will be lost. Dan Mahr Extension Entomologist, University of Wisconsin-Madison."

# Choose the Pesticide with the Least Environmental and Non-Target Impact

**Minimize injury to non-target plants in a mixed landscape with shared root zones**

**Plan applications so that the pesticide can dry on the foliage.**



# Choose the Pesticide with the Least Environmental and Non-Target Impact

**Minimize injury to non-target plants in a mixed landscape with shared root zones**

**Always read the pesticide label!**



# Choose the Pesticide with the Least Environmental and Non-Target Impact

**Minimize injury to non-target plants in a mixed landscape with shared root zones**

- **Make a trial application when possible prior to a large scale application.**
- **Always know the weeds that need to be treated and their biology.**
- **Consider using contact products and spot treatments when treating weeds in mulched mixed beds.**

# Choose the Pesticide with the Least Environmental and Non-Target Impact

Use site appropriate equipment and techniques

Use appropriate application equipment

- Rotary spreaders use edge guards along sidewalks, driveways and other hard surfaces
- Hydraulic sprayers spot sprays can be used instead of blanket applications



# Choose the Pesticide with the Least Environmental and Non-Target Impact

**Use site appropriate equipment and techniques**

- Always follow all label instructions including instructions for mixing and post application watering.
- Post application irrigation **Preemergent herbicides** must be applied to the soil surface. Depending on soil type  $\frac{1}{4}$  to  $\frac{1}{2}$  inch of water will need to be applied after application

# Choose the Pesticide with the Least Environmental and Non-Target Impact

## Clean up misapplications and spills

- Fill spreaders on hard surface where pesticides can be easily cleaned up.
- **Misapplication is illegal** and can cause contamination of surface water.
- Use a backpack sprayer or broom to move granular pesticides from hard surfaces back to application sites.



# Short Summary

Consider a *spot treatment* instead of a blanket application.

Plan applications so that the pesticide can dry on the foliage.

Never directly or indirectly apply pesticides and fertilizers on to surface waters or hard surfaces which drain into surface waters

# Quick Questions

What type of spray application should you consider instead of a blanket application?

*A spot spray.*

What should you consider when treating weeds in mulched mixed beds?

*Consider using contact products and spot treatments*

What is the half life of a pesticide?

*The amount of time it takes for ½ of the original material to be broken down or removed*

# Choose the Pesticide with the Least Environmental and Non-Target Impact

## Grass clippings

- Except for golf greens, grass clippings should be retained in the turf to decompose and recycle nutrients.
- Clippings sprayed with herbicides may be harmful to other plants when used for mulch.

# Choose the Pesticide with the Least Environmental and Non-Target Impact

## Grass clippings

- Grass clippings should never be blown into gutters or on to the street
- Clippings are a nutrient source, especially nitrogen, and can contaminate surface waters



# Choose the Pesticide with the Least Environmental and Non-Target Impact

## Use fertilizers responsibly

- Avoid over-application by testing the soil and following UofM guidelines.
- Do not apply fertilizer to hard surfaces.
- If spilled, fertilizer should be cleaned up immediately.



# Choose the Pesticide with the Least Environmental and Non-Target Impact

**Use fertilizers responsibly**

**Minnesota State law restricts fertilizer use.**

- **The intent of the law is to reduce the amount of phosphorus entering surface water.**
- **If released into surface waters the nutrients in fertilizers will result in algal and vegetative growth.**



# Choose the Pesticide with the Least Environmental and Non-Target Impact

## Use fertilizers responsibly

### Permissible uses of fertilizers containing phosphorus under Minnesota law

- Soil test verifying the need for phosphorus
- New lawn by seed or sod
- Golf course application by trained individual
- Application on commercial sod farm

# Choose the Pesticide with the Least Environmental and Non-Target Impact

## Contacts for further information

- Chemical spills must be reported to the at **651-649-5451** or **1-800-422-0798**
- University of Minnesota Lawn Care at [www.extension.umn.edu/garden/yard/lawns](http://www.extension.umn.edu/garden/yard/lawns)
- University of Minnesota Soil Testing Lab 612-625-3101 or <http://soiltest.cfans.umn.edu/how-to-submit-samples/lawn-garden>



# Choose the Pesticide with the Least Environmental and Non-Target Impact

## Contacts for further information

- Minnesota Phosphorus Lawn Fertilizer Law  
[www.mda.state.mn.us/phoslaw](http://www.mda.state.mn.us/phoslaw)

- University of Minnesota Pesticide Safety and Environmental Education, UMN PSEE  
[www.extension.umn.edu/pesticides/commercial.html](http://www.extension.umn.edu/pesticides/commercial.html)

# Protect Pollinators

## Importance of insect pollinators

- **One third of world crop species are dependent on bee pollination.**
- **Bees provide pollination worth \$20 billion in North America.**
- **Most of our crops are pollinated by commercial hives.**

# Protect Pollinators

## Importance of insect pollinators

- **Pollinators are essential to seed-producing plants.**
- **Bees ensure garden plants, ornamentals and wildflowers get adequate pollination.**

# Protect Pollinators



# Protect Pollinators

## Common Insect Pollinators of Minnesota

- Of approximately 400 bee species in Minnesota <2% are bumblebees and honey bees the remaining 98% are solitary bees that do not actively help one another.
- Solitary bees use open cavities in wood or open soil to nest.

# Protect Pollinators

## Common Insect Pollinators of Minnesota

- Honey bees and bumble bees are social bees work together in colonies.
- Urban landscapes provide habitat for insect pollinators.
- Pesticide applicators need to be aware of insect pollinator presence in urban landscapes and of the increasing popularity of bee keeping.

# Short Summary

**Except for golf greens, grass clippings should be retained in the turf to decompose and recycle nutrients.**

**Honey bees and bumble bees are social bees work together in colonies.**

**One third of the World food crops are dependent on bee pollination.**

# Quick Questions

Where do solitary bees nest?

*Solitary bees use open cavities in wood or open soil to nest.*

What is unique among bee families about honey bees and bumble bees?

*Honey bees and bumble bees are social bees work together in colonies.*

How are most crops pollinated?

*By Commercial hives*



# Protect Pollinators

## Challenges to pollinator health from pesticide application

**“Colony Collapse Disorder CCD is the phenomenon that occurs when the majority of worker bees in a colony disappear and leave behind a queen, plenty of food and a few nurse bees to care for the remaining immature bees and the queen.” US EPA**

# Protect Pollinators

## Challenges to pollinator health from pesticide application

### Reasons for bee CCD:

- Losses of **habitat**
- Pathogens diseases like **Nosema**
- Parasites Varroa and tracheal mites
- Pesticides, especially the insecticide class neonicotinoids

# Protect Pollinators

**Bees can be harmed by**

- **Direct spray or indirect contact with pesticide residues on plant surfaces.**
- **Pollen with pesticide residues can be carried to the hive where it can injure the colony**



Bee  
collecting  
pumpkin  
pollen

# Protect Pollinators

## Pesticide Residues

- Residues can be present in nectar and pollen ingested by bees.
- Herbicides kill weedy flowers, e.g. dandelion and clover, that provide pollen and nectar for bees.

# Protect Pollinators

## Pesticides harmful to bees

The class e.g., major pesticide group neonicotinoids is more harmful to bees than other pesticide classes. Neonicotinoids may be a contributing factor in Colony Collapse Disorder. Neonicotinoids include

## Highly toxic to bees

- Imidacloprid
- Clothianidin
- Dinotefuran
- Thiamethoxam

# Protect Pollinators

**Pesticides harmful to bees**

**Neonicotinoids include**

*Less toxic* to bees than imidacloprid:

- Acetamiprid
- Thiacloprid

**Imidacloprid is the most commonly neonicotinoid insecticide used for sucking insects in home landscapes**

# Pollinator Protection Best Management Practices

**Protect and encourage pollinator habitat!**

**Two basic habitat requirements of native bees**

- **Diverse flowering plants**
- **Egg-laying or nesting areas**

**Help protect pollinators by protecting their nesting areas and food sources**

# Pollinator Protection Best Management Practices

**Protect and encourage pollinator habitat!**

**Flowering plants that are attractive to bees**

- **Bee balm, *Monarda fistulosa***
- **Blazing stars, *Liatris* species**
- **Culvers root, *Veronicastrum virginicum***
- **Sunflowers, *Helianthus* species**

**When you plan a pesticide application on a site, inquire about the existence of bee–friendly plants on the property and nearby.**



# Pollinator Protection Best Management Practices

**Protect and encourage pollinator habitat!**

**Pollinators are insects and other organisms that carry pollen from one flower to another. Consider because clover is very attractive to bees**



# **Pollinator Protection Best Management Practices**

**Protect and encourage pollinator habitat!**

## **Pollinators**

**Insects and other organisms that carry pollen from one flower to another. Clover is very attractive to bees.**

# Pollinator Protection Best Management Practices

**Protect and encourage pollinator habitat!**

## **Pollinators**

**Insects and other organisms that carry pollen from one flower to another. Clover is very attractive to bees**

### **Native bee habitat:**

- **60-70% of native bees dig burrows in the ground. They prefer dry sandy soil devoid of vegetation.**
- **30-40% of native bees nest in cavities, such as hollow plant stems, instead of tunneling.**
- **Pollinators need water from bird baths or puddles on hot days.**

# Pollinator Protection Best Management Practices

## Protect and encourage pollinator habitat!

- **Avoid spraying in bee habitat if bees are observed.**
- **Attract ground nesting bees by leaving some areas of expose, undisturbed soil in the yard.**
- **Dead branches in less visible areas will also attract bees.**

# Choose Pesticides Carefully

**Follow bee mandatory and advisory statements**

**“Pollinator protection statements. EPA required statements on pesticide labels which provide information on use of the product in a manner that reduces impacts on pollinators.”**

# Choose Pesticides Carefully

## Follow bee mandatory and advisory statements

- The pesticide labels for neonicotinoid pesticides used outdoors for foliar applications contain a bee hazard statement in the and restrictions in the 'directions for use' box.
- Pesticide labels, affected by the new standards, will also contain the US EPA bee hazard icon




The new bee icon helps signal the pesticide's potential hazard to bees.


# THE NEW EPA BEE ADVISORY BOX

On EPA's new and strengthened pesticide label to protect pollinators

**PROTECTION OF POLLINATORS**



**APPLICATION RESTRICTIONS** EXIST FOR THIS PRODUCT BECAUSE OF RISK TO BEES AND OTHER INSECT POLLINATORS. FOLLOW APPLICATION RESTRICTIONS FOUND IN THE DIRECTIONS FOR USE TO PROTECT POLLINATORS.

Look for the bee hazard icon  in the Directions for Use for each application site for specific use restrictions and instructions to protect bees and other insect pollinators.

**This product can kill bees and other insect pollinators.** Bees and other insect pollinators will forage on plants when they flower, shed pollen, or produce nectar.

Bees and other insect pollinators can be exposed to this pesticide from:

- Direct contact during foliar applications, or contact with residues on plant surfaces after foliar applications
- Ingestion of residues in nectar and pollen when the pesticide is applied as a seed treatment, soil, tree injection, as well as foliar applications.

When Using This Product Take Steps To:

- Minimize exposure of this product to bees and other insect pollinators when they are foraging on pollinator attractive plants around the application site.
- Minimize drift of this product on to beehives or to off-site pollinator attractive habitat. Drift of this product onto beehives can result in bee kills.

Information on protecting bees and other insect pollinators may be found at the Pesticide Environmental Stewardship website at:  
<http://pesticidestewardship.org/pollinatorprotection/Pages/default.aspx>

Pesticide incidents (for example, bee kills) should immediately be reported to the state/tribal lead agency. For contact information for your state/tribe, go to: [www.aapco.org](http://www.aapco.org). Pesticide incidents can also be reported to the National Pesticide Information Center at: [www.npic.orst.edu](http://www.npic.orst.edu) or directly to EPA at: [beekill@epa.gov](mailto:beekill@epa.gov)

Alerts users to separate restrictions on the label. These prohibit certain pesticide use when bees are present.



The new bee icon helps signal the pesticide's potential hazard to bees.

Makes clear that pesticide products can kill bees and pollinators.

Bees are often present and foraging when plants and trees flower. EPA's new label makes it clear that pesticides cannot be applied until all petals have fallen.

Warns users that direct contact and ingestion could harm pollinators. EPA is working with beekeepers, growers, pesticide companies, and others to advance pesticide management practices.

Highlights the importance of avoiding drift. Sometimes, wind can cause pesticides to drift to new areas and can cause bee kills.

The science says that there are many causes for a decline in pollinator health, including pesticide exposure. EPA's new label will help protect pollinators.



# Choose Pesticides Carefully

Select the least harmful pesticide!

- **Toxicity** where alternatives exist select the pesticide least toxic to bees
- **Exposure** Consider how pollinators will come into contact with the pesticide higher toxicity can be offset by lower exposure.



# Choose Pesticides Carefully

**Select the least harmful pesticide!**

- **Persistence chose lower persistence and short-residual**
- **Formulations Use granules, solutions, emulsifiable concentrates and soluble powders instead of dusts**

# Choose Pesticides Carefully

**Select the least harmful pesticide!**

**Effectiveness:**

- **Select an option that can be accomplished without multiple applications**
- **Use *lowest effective* label rate**



# Choose Pesticides Carefully

## Application Selection

- **Spot spray vs. broadcast or blanket spray to minimize potential off target impacts**
- **Avoid spraying near plants in bloom.**
- **Avoid spraying near bees when bees are present or foraging.**

# Choose Pesticides Carefully

## Application Timing

- Bees are active slightly after dawn until dusk. Peak activity is morning and afternoon.
- Best time to spray is at night after sunset
- Bees are active at temperatures 50 degrees and above
- Clear calm days that are not too hot or humid are ideal for bee activity.

# How to Reduce Environmental Impacts from Pesticide Applications

## Application Planning

Use IPM to select the least toxic but effective product

- Apply carefully
- Follow label directions
- Clean up spills
- Pay attention to site and weather conditions.

# Short Summary

**Use IPM to select the least toxic but effective product.**

**Herbicides kill weedy flowers, e.g. dandelion and clover, that provide pollen and nectar for bees.**

**Use granules, solutions, emulsifiable concentrates and soluble powders instead of dusts**

# Quick Questions

**When does bee activity peak?**

*Morning and afternoon*

**When is the best time to spray to conserve bees?**

*At night after sunset*

**When a pesticide application rate is stated as a range what rate should you use?**

*The lowest effective rate*