Environmental Fate of Pesticides and How to Answer the Public's and Consumer's Questions

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The Question We've All Heard:

"Dude…man…..What's that &#!% you're sprayin?"

Some Not So Good Answers:

"I Don't know……."

Some Not So Good Answers:

"A poison for the weeds"

Some Not So Good Answers:

A Better Answer:

"An herbicide that is registered to selectively remove the dandelions and clover from the golf course"

You should also mention that you can give them access to the label and MSDS


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Environmental Issues

- Dramatic impact on construction and management of golf courses as well as lawn and landscape operations and sports facilities
  - Pesticide and fertilizer use
  - Water use
  - Land use policies, including loss of natural habitat and open land

Pesticide Usage

- Pesticide use in turf became controversial in the mid-1980's
  - Over the years, much concerns has been raised by groups such as Public Citizens Watch, etc.
  - The PLCAA, USGA, and other organizations dispute claims made by these groups

The Question We've All Heard:

"Hey man, that stuff you're spraying……is it safe for my kid to be around it?"

Pesticide Safety

- “Safe” means something different to everybody
- All pesticides have some level of toxicity
- Risk depends on 2 things:
  - Product toxicity
  - Exposure

Pesticide Toxicity

"All things are poison, and nothing is without poison; only the dose permits something not to be poisonous.“

- Paracelsus (1493 to 1541)

Pesticide Toxicity

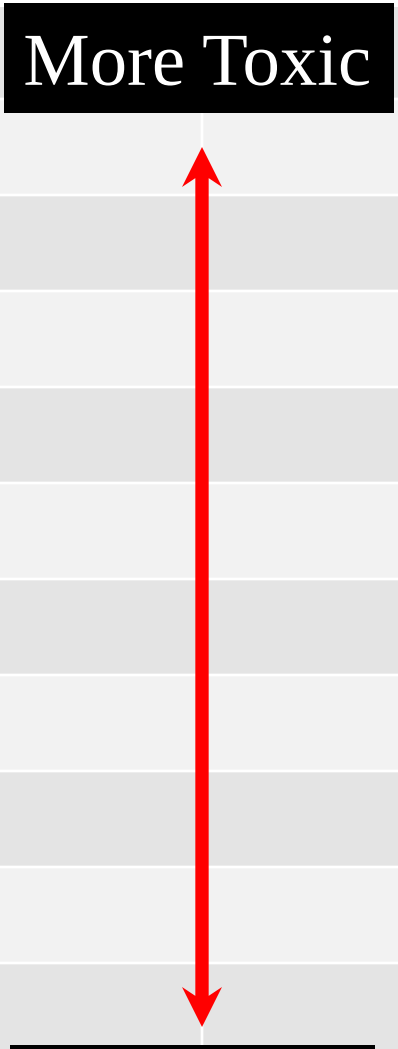
- LD_{50} – The lethal dose that is required to kill 50% of the test subjects
  - Rats are typically used to approximate human response
  - Measured in mg of substance per kg of tissue
  - **The lower the LD_{50}, the more toxic the compound is, because less is required**

Pesticide Toxicity

- One measure of product toxicity is the signal word on the label
  - Caution – Ld_{50} is >500 mg/kg
  - Warning – Ld_{50} is 50-500 mg/kg
  - Danger – Ld_{50} is 0-50 mg/kg

Pesticide Toxicity

Substance	Acute Oral LD50 (rat) in mg/kg
Honey Bee Venom	2.8
Nicotine	10
Gasoline	50
Diazinon	100
Caffeine	200
2,4-D	666
Pendimethalin	1050
Aspirin	1200
Bleach	2000
Trimec Classic	2240
Table Salt	3320
Roundup Pro	5180



Pesticide Toxicity

Pure oxygen and drinking too much water can also be toxic.

“Toxicity assessment is not about determining what is toxic, but rather about how much of a chemical causes what kind of harm.”

Pesticide Toxicity

- Lots of things around the house are just as toxic as common turf pesticides
  - Antifreeze, Motor oil, Battery acid, Bleach, Detergents, Household cleaning products
  - Any of these products applied to turf will also kill weeds. But, they also kill the turf.
- Why is selectivity such a scary thing?

The Comment We've All Heard:

"Yeah but my kid gets exposed to a lot more of the pesticide because that whole tank just got sprayed all over the golf course"

Exposure to Pesticides

- Another important factor is exposure
- On the product label, the section “Hazards to humans and domestic animals” gives an overview of the risks

Acute Exposure

- A spray tank usually contains relatively little active ingredient
  - 4.5 lb of Trimec needed for an acre - that's about 2084 grams
  - A person who weighs 100 lbs (45 Kg) would need to ingest orally (45 Kg x 2240 mg/Kg) = 100.8 g (or all of the formulated spray applied to 2106 ft^2 – just over 4 gallons) to have a 50% chance of dying from acute exposure

Acute Exposure

- Dizziness, nausea, headaches due to exposure to vapors are more common

- Most product labels require a specific amount of time to elapse between application and reentry. During this time the pesticide residues dry and become bound to soil or plant tissue.

Pestic. Sci. 1984, **15**, 353–360

Persistence, Distribution and Dislodgeable Residues of 2,4-D Following its Application to Turfgrass

Dean G. Thompson, Gerald R. Stephenson and Mark K. Sears

Department of Environmental Biology, University of Guelph, Guelph, Ontario, Canada N1G 2W1

(Revised manuscript received 28 October 1983)

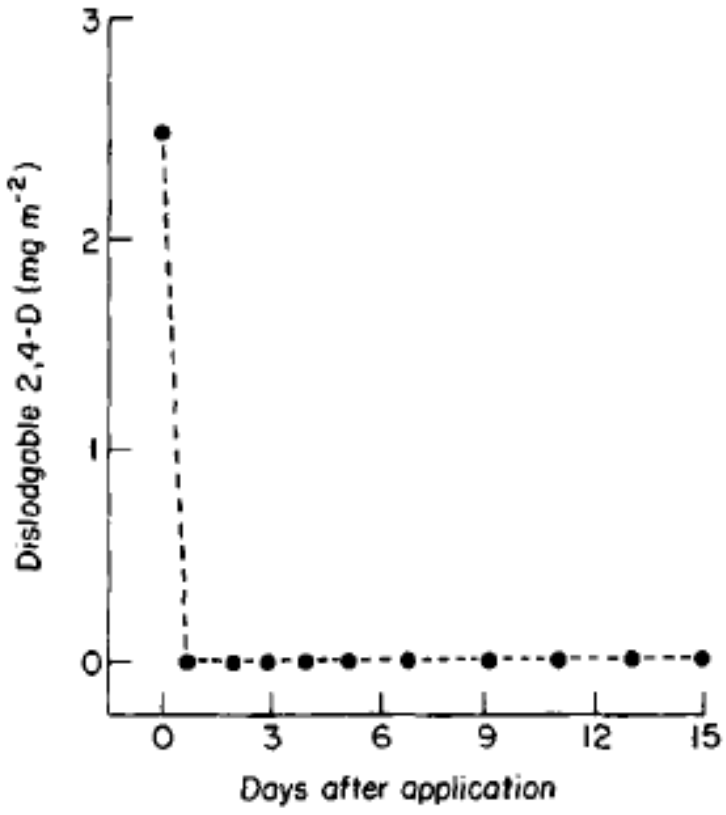


Figure 4. Influence of rainfall on dislodgeable residues of 2,4-D in turfgrass. The application of 2,4-D (as the dimethylamine salt 500 g litre^{-1}) at a rate of 1.0 kg a.e. ha^{-1} was made on 27 May 1982 (day 0). A rainfall of 18 mm was recorded only hours after sampling.

Chronic Exposure

- After the reentry period, research shows that very little of the pesticide residues will dislodge from the turf or soil onto socks or clothing
- This greatly reduces exposure, but does not eliminate it
- Which leads us to……

The Question We've All Heard:

"Hey man, that stuff you're spraying……ain't that gonna get all up in my kid and cause like cancer and stuff?"

The effects of chronic exposure are more difficult to study and in some cases a bit less clear.

The EPA

The U.S. Environmental Protection Agency (EPA) is the primary federal agency regulating pesticides

They require that pesticides undergo some 120 health, safety and environmental tests to assure that they do not cause undue harm.

The EPA

- EPA's tests evaluate the pesticide's potential to adversely affect humans, animals and the environment.
- Special attention is given to the pesticide's possible effects on humans with extra requirements for protecting children's health.
- It is a scientific process that takes an average of nine years.

Food Quality Protection Act

- FQPA was passed in 1996
  - Primary driver of change in pesticide choices since the 1990's
  - Widely supported at time of passage

Food Quality Protection Act

- Pesticide tolerances were reviewed by 2006
  - A tolerance is the limit set by the EPA on the amount of residue that can remain on a treated food
  - Application frequency, amount of pesticide applied and toxicity are considered

Food Quality Protection Act

- Wide margin of safety was required
  - 100 X safety factor ensures that residues are many times lower than what could cause adverse effects
  - Additional 10 X safety factor to address toxicity concerns in children

Food Quality Protection Act

- Contained a “Reasonable certainty of no harm” standard
  - Also considered exposures sources other than food crops
    - Home and garden use
    - Turfgrass
    - Pet care
    - Residues in drinking water

Food Quality Protection Act

- All pesticides with the same mode of action are grouped when assessing risk
  - Chlorpyrifos – Dursban, Lorsban
  - e.g. not just chlorpyrifos exposure, but exposure to all organophosphate and also carbamate insecticides was considered

Food Quality Protection Act

- When exposure was deemed too high
  - Primary registrant had several options
    - Voluntary removal of product
    - Eliminate some uses

Food Quality Protection Act

- For example
  - Exposure to chlorpyrifos was deemed too high
    - Was used in food production, nursery production, lawn and landscape, termite control
  - Primary registrant canceled most uses
    - Was at the time still registered for golf courses, ornamental nurseries, and all crops except tomatoes

Food Quality Protection Act

- Overall goal of FQPA was sound
- Had important consequences in turfgrass management
  - Initial reduction in labeled products
  - New products have since been introduced

H - 65676

DuPont™ Acelepryn™

INSECTICIDE

Professional Products

GROUP	28	INSECTICIDE

INTENDED FOR USE BY COMMERCIAL APPLICATORS ONLY.

For foliar and systemic control of white grubs and other pests infesting landscape and recreational turfgrass (including golf courses) as well as landscape ornamentals, interior plantscapes and sod farms.

Active Ingredient	*By Weight*
Chlorantraniliprole* 3-Bromo-N-[4-chloro-2-methyl-6-[(methylamino)carbonyl]phenyl]-1-(3-chloro-2-pyridinyl)-1H-pyrazole-5-carboxamide	18.4%
Inert Ingredients	81.6%
TOTAL	100.0%

ACELEPRYN™ insecticide is a suspension concentrate. This product contains 1.67 pounds of active ingredient per gallon.

*Chlorantraniliprole belongs to the anthranilic diamide chemical class.

EPA Reg. No. 352-731 EPA Establishment No. _____

Nonrefillable Container

Net: _____

E.I. du Pont de Nemours and Company
1007 Market Street
Wilmington, Delaware 19898

KEEP OUT OF REACH OF CHILDREN

Si usted no entiende la etiquete, busque a alguien para que se la explique a usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)

FIRST AID

For questions regarding emergency medical treatment, you may contact **1-800-441-3637** for information.

PRECAUTIONARY STATEMENTS HAZARDS TO HUMANS AND DOMESTIC ANIMALS

When used as directed this product does not present a hazard to humans or domestic animals

PERSONAL PROTECTIVE EQUIPMENT

Applicators and other handlers must wear:
Long-sleeved shirt and long pants.
Shoes plus socks.

After the product has been diluted in accordance with label directions for use, shirt, pants, socks, and shoes are sufficient Personal Protective Equipment (PPE). Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables are available, use detergent and hot water. Keep and wash PPE separately from other laundry.

USER SAFETY RECOMMENDATIONS

USERS SHOULD: Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet. Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

ENVIRONMENTAL HAZARDS

This pesticide is toxic to aquatic invertebrates, oysters and shrimp. Do not apply directly to water. Drift and runoff may be hazardous to aquatic organisms in water adjacent to use sites.

[NOTE: NO SIGNAL WORD is required for this product]

DUPONT

The miracles of science™

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2,4-D and Cancer

- On August 8, 2007, the United States Environmental Protection Agency issued a ruling that stated that existing data does not support a conclusion that links human cancer to 2,4-D exposure.

Cancer Risk Due to Exposure

- 2,4-D residues on the field –
  - Not according to EPA
- Chlorinated Tap Water –
  - The Morris study found disinfection by-products in chlorinated water to be responsible for 9% of all bladder cancers and 15% of rectal cancers in the U.S.
- Sunlight

The Bottom Line

- If used according to the label, registered pesticides are considered reasonably safe

- Follow label exactly
- Follow laws that govern pesticide application
  - ODA Rules
  - New Rule on Pesticide Use in Schools

The Statement We've All Heard:

"See man, they test that &#!% on animals because they know it kills them….which means you're killing them when you spray the turf"

Pesticides and Wildlife

- All registered herbicides must be assessed for potential hazards to wildlife
  - Mammalian
  - Avian
  - Aquatic
- Pesticides with high risk are either classified as restricted use, or denied registration

The Question We've All Heard:

"Hey man, that stuff you're spraying……ain't you like poisoning the groundwater and stuff?"

Pesticide Fate

- Several factors affect pesticide fate
- Several processes can occur to degrade a pesticide in the environment
- Fate in the environment is sometimes unique to a particular pesticide

Factors Affecting Pesticide Fate

- Chemical & physical properties of pesticides
  - Solubility, sorptivity, vapor pressure
- Soil properties
  - Porosity, organic matter content
- Site
  - Shallow water table, near surface water
- Management

Fate Processes of Pesticides

- Leaching and runoff
- Sorption by soil mineral and organic matter
- Degradation by soil microbial populations
- Volatilization
- Chemical decomposition
- Photochemical decomposition
- Plant uptake

Leaching and Runoff

- Depends on site and interaction of the pesticide with soil solids
  - Runoff is more likely on slopes
  - Leaching is higher in sand, lower in silt or clay
  - Some pesticides bind to soil more strongly

Sorption and Degradation

- Sorption - pesticide binds to soil particles

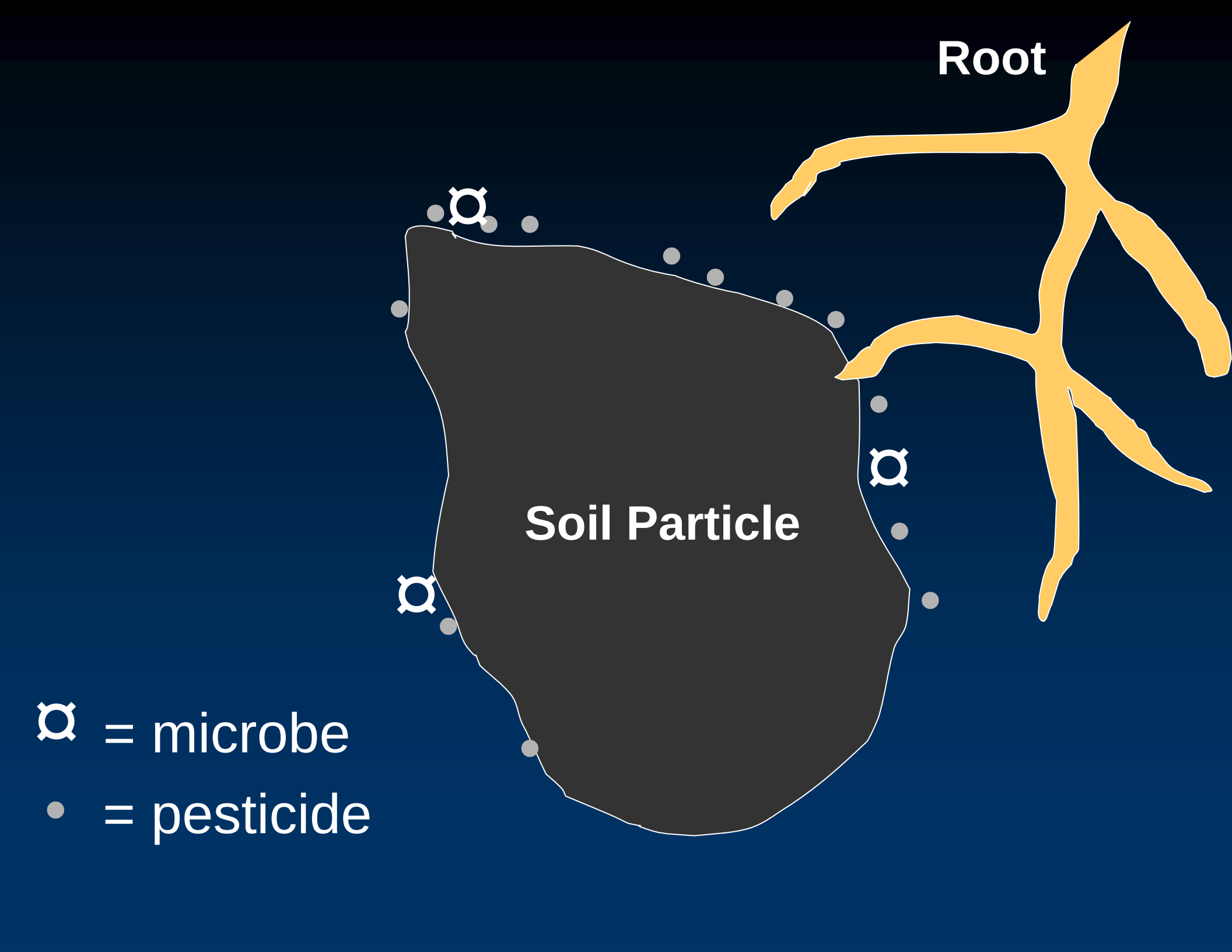
- Pesticides are broken down by soil microorganisms and chemical means
  - Rate (½ life) affected by pesticide concentration, temperature, soil water content, and prior pesticide usage
  - Degradation rates are quite variable

Pesticide Fate in Turf

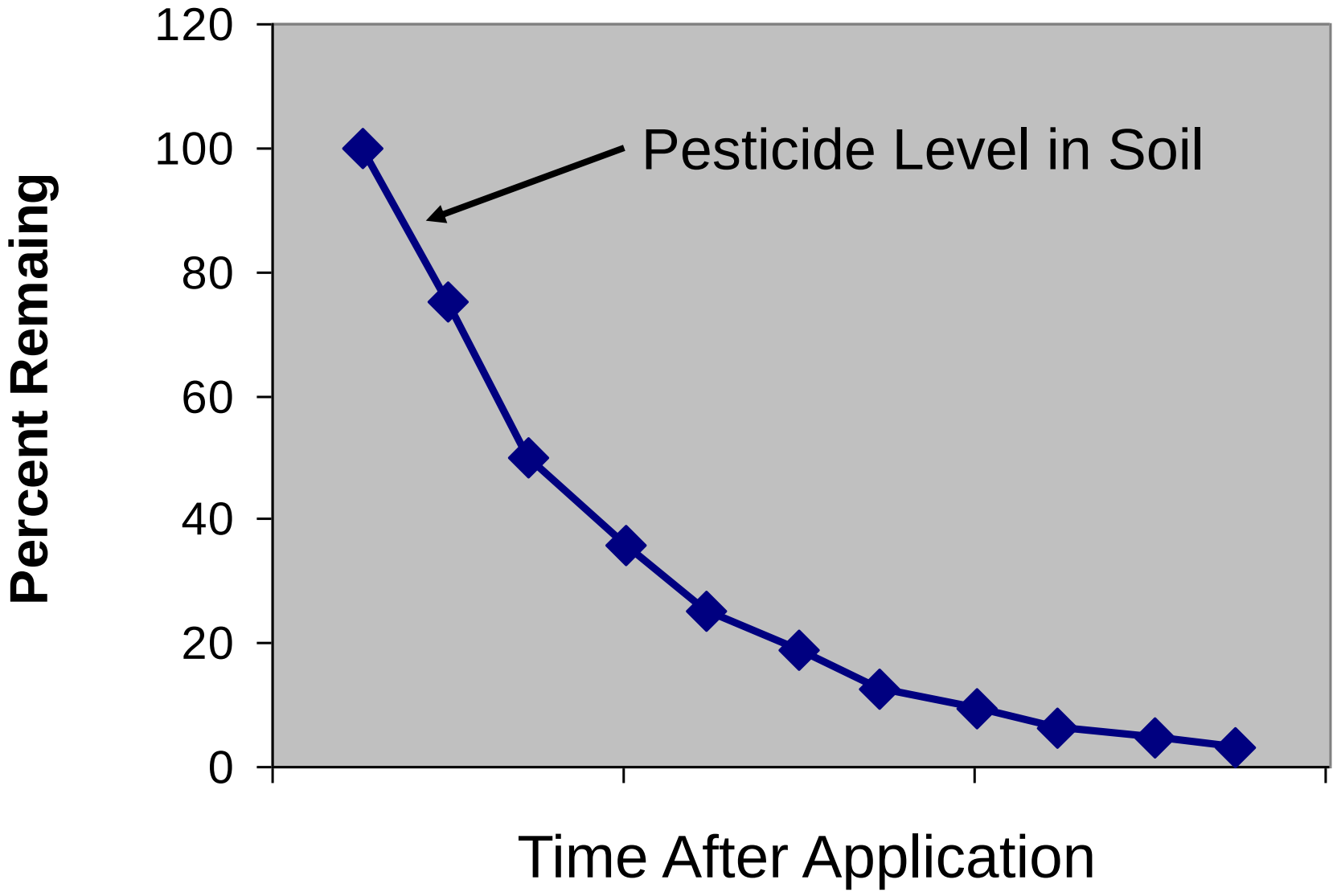
- Organic carbon content of the soil
  - Most important factor governing fate
  - High organic carbon content can attenuate movement of pesticide into soil
    - Increased sorption of pesticide
    - Increased microbial degradation

Pesticide Fate in Turf

- Thatch is rich in organic carbon


Root
Soil Particle
¤ = microbe
• = pesticide

Pesticide Dissipation



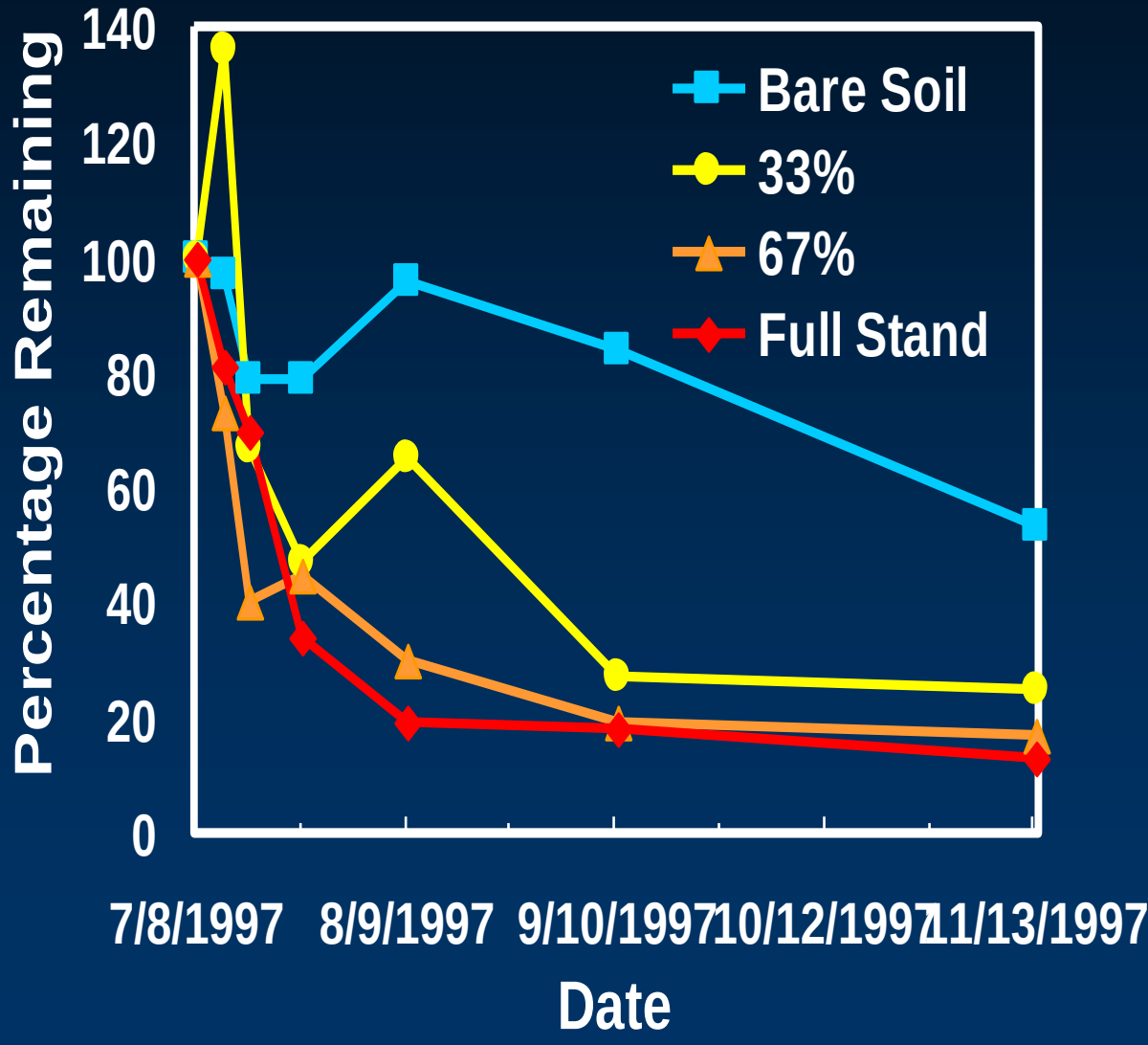
Lysimeter Installation

- Lysimeters installed in turfgrass and bare soil
- Installation prior to pesticide application prevented downward contamination when sampling

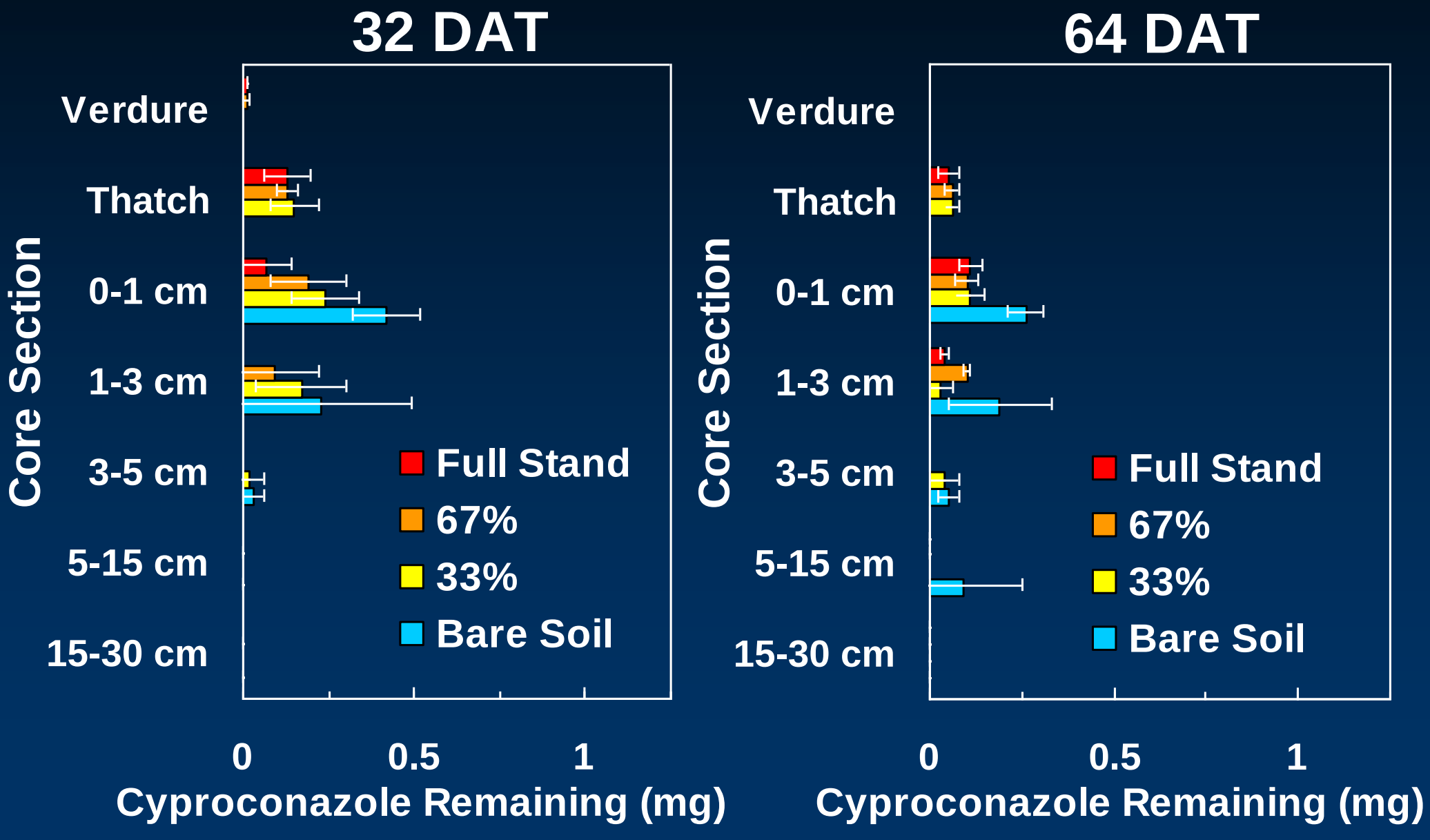
Lysimeter Core Section

Cyproconazole Dissipation

- Half-life
  - Bare Soil: 129 d
  - 33%: 15 d
  - 67%: 8 d
  - Full Stand: 11 d

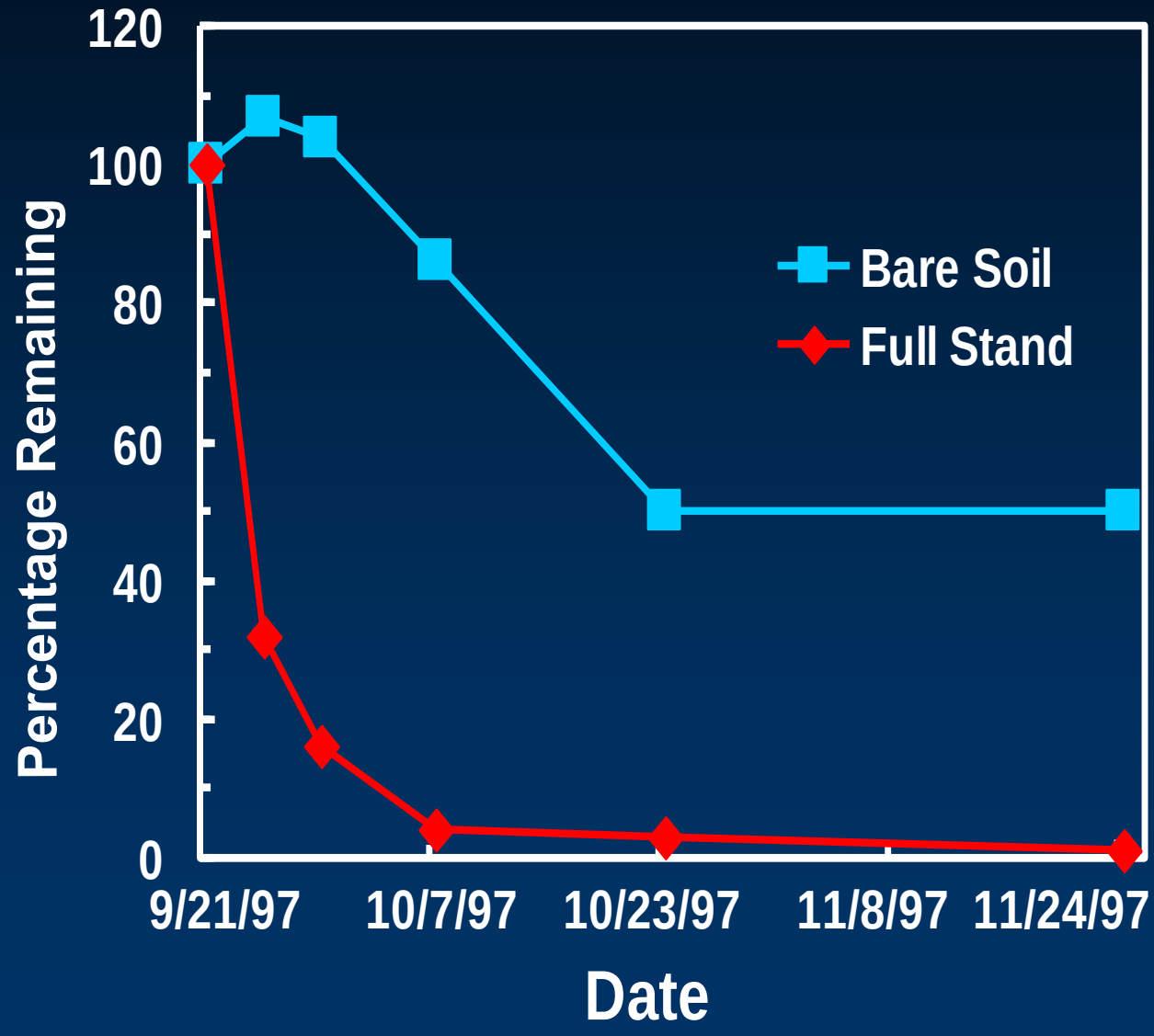


Cyproconazole Distribution

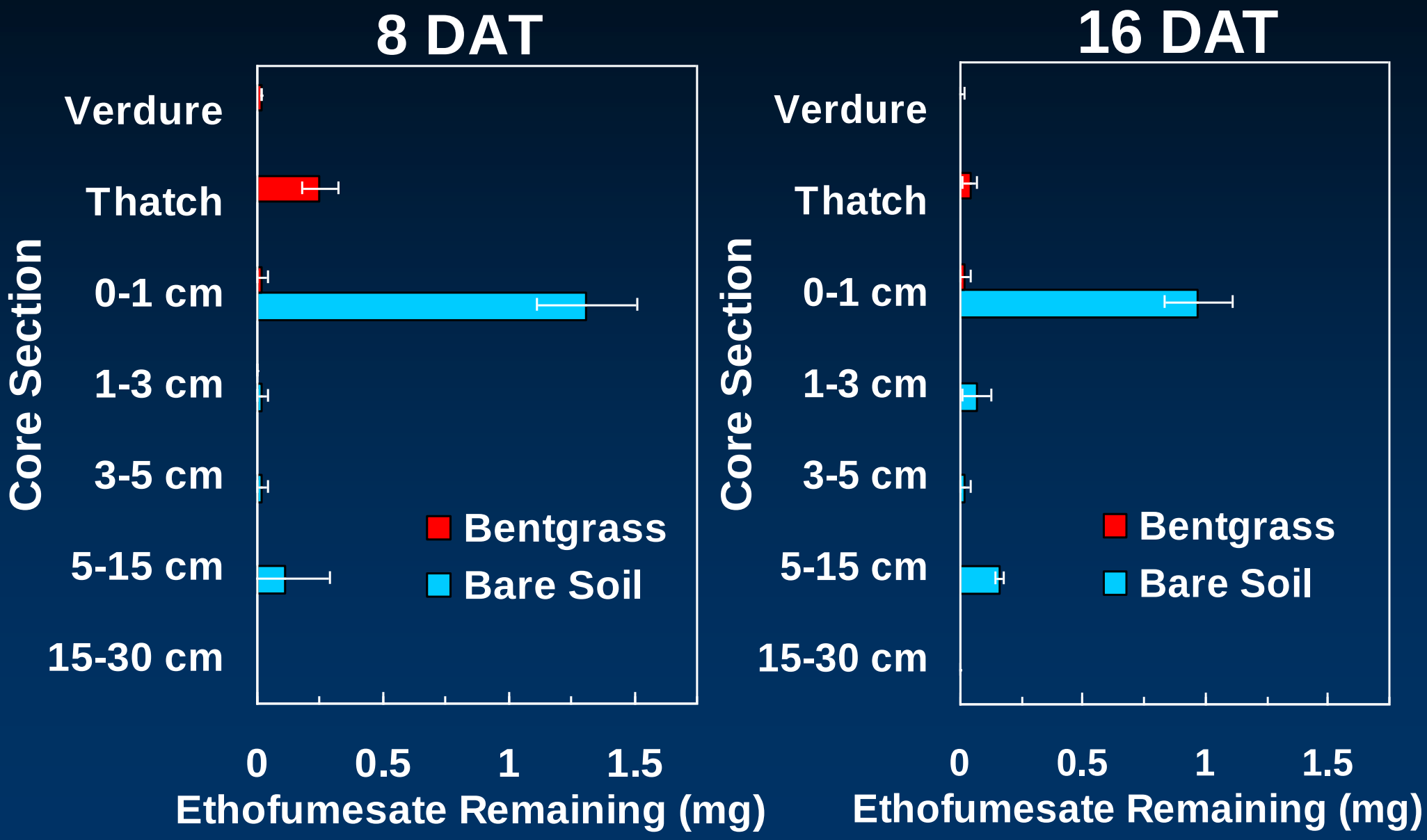


Ethofumesate Dissipation

- Half-life
  - Bare Soil
    32-64 days
  - Full Stand
    3 days

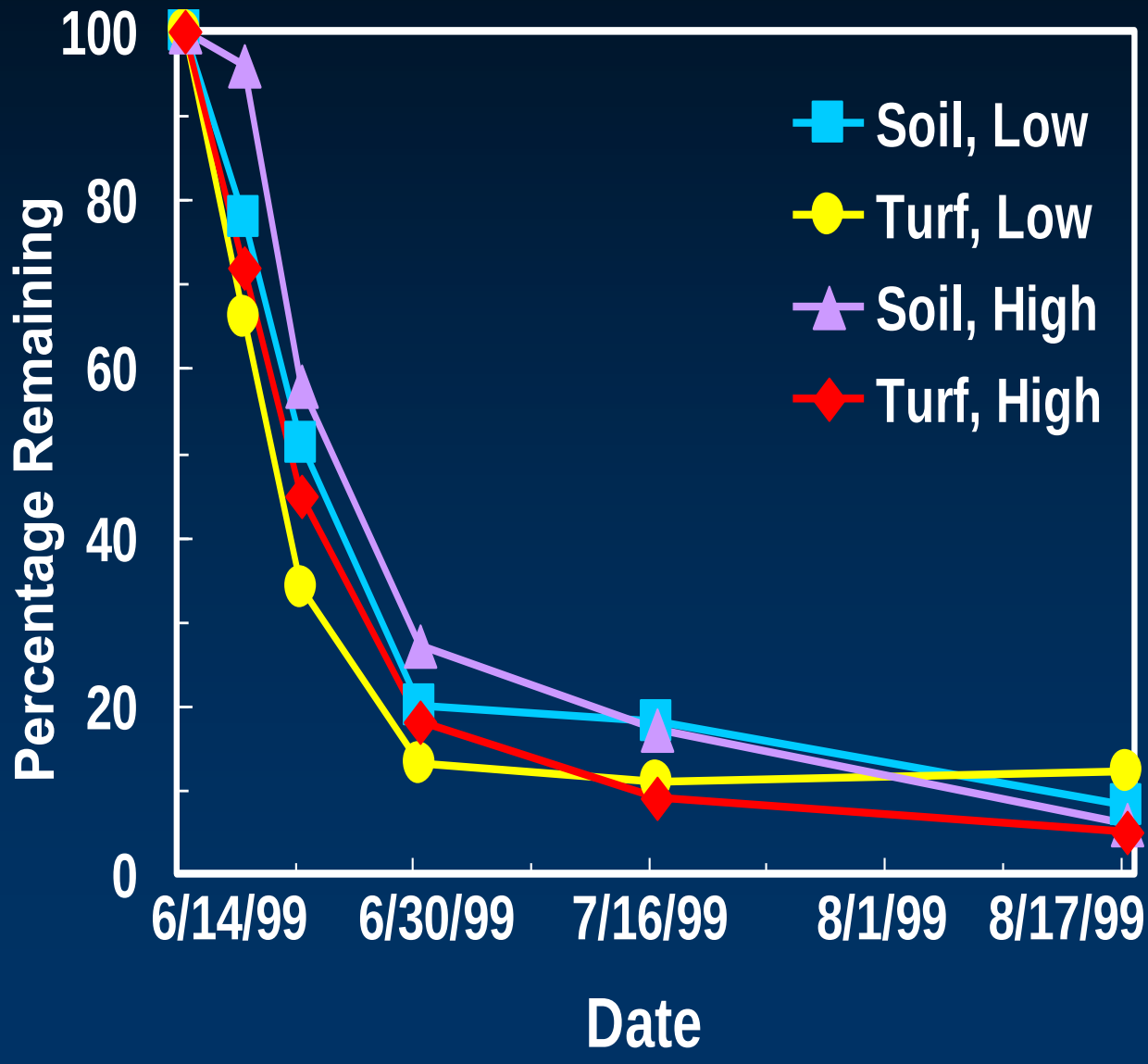


Ethofumesate Distribution

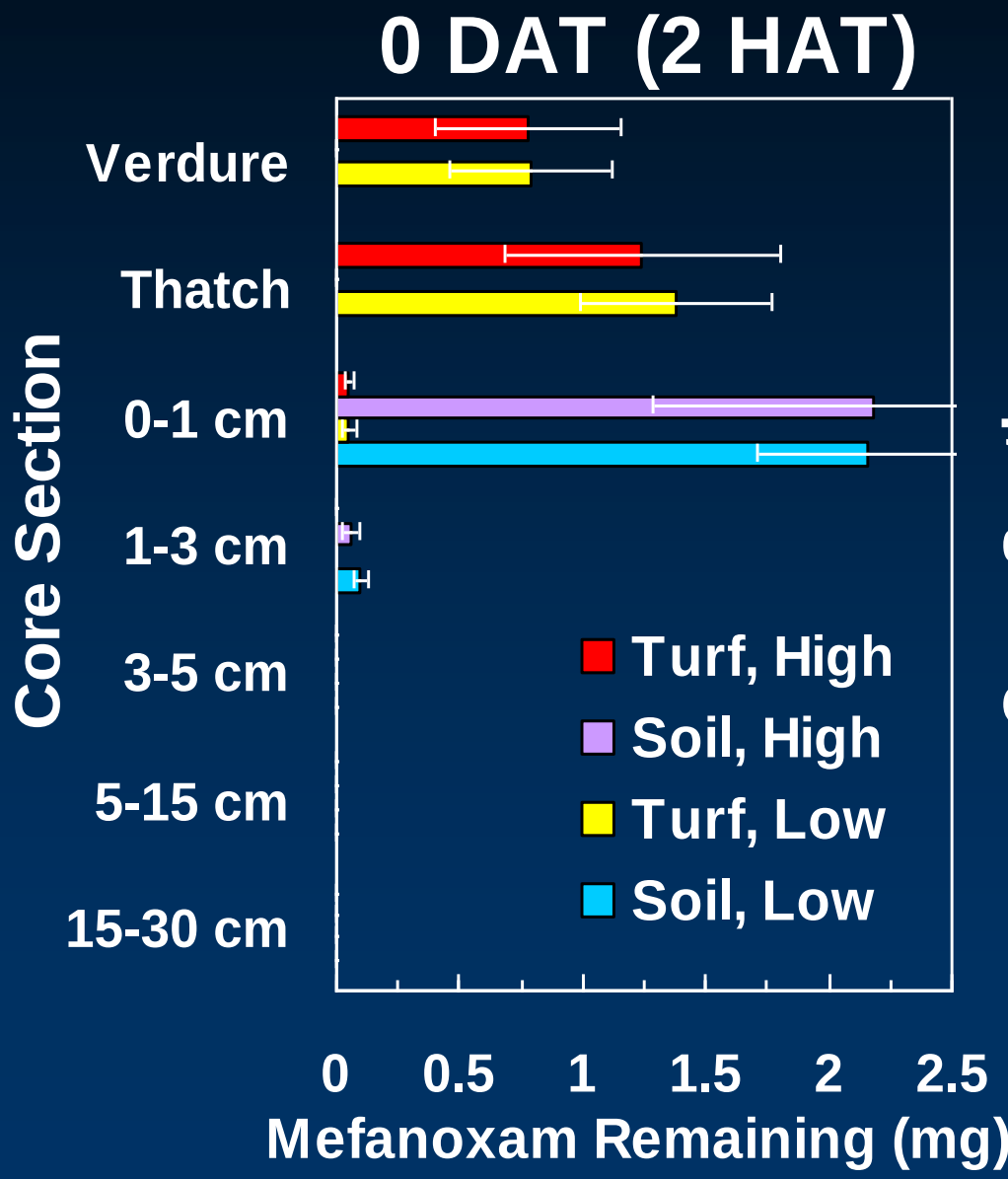


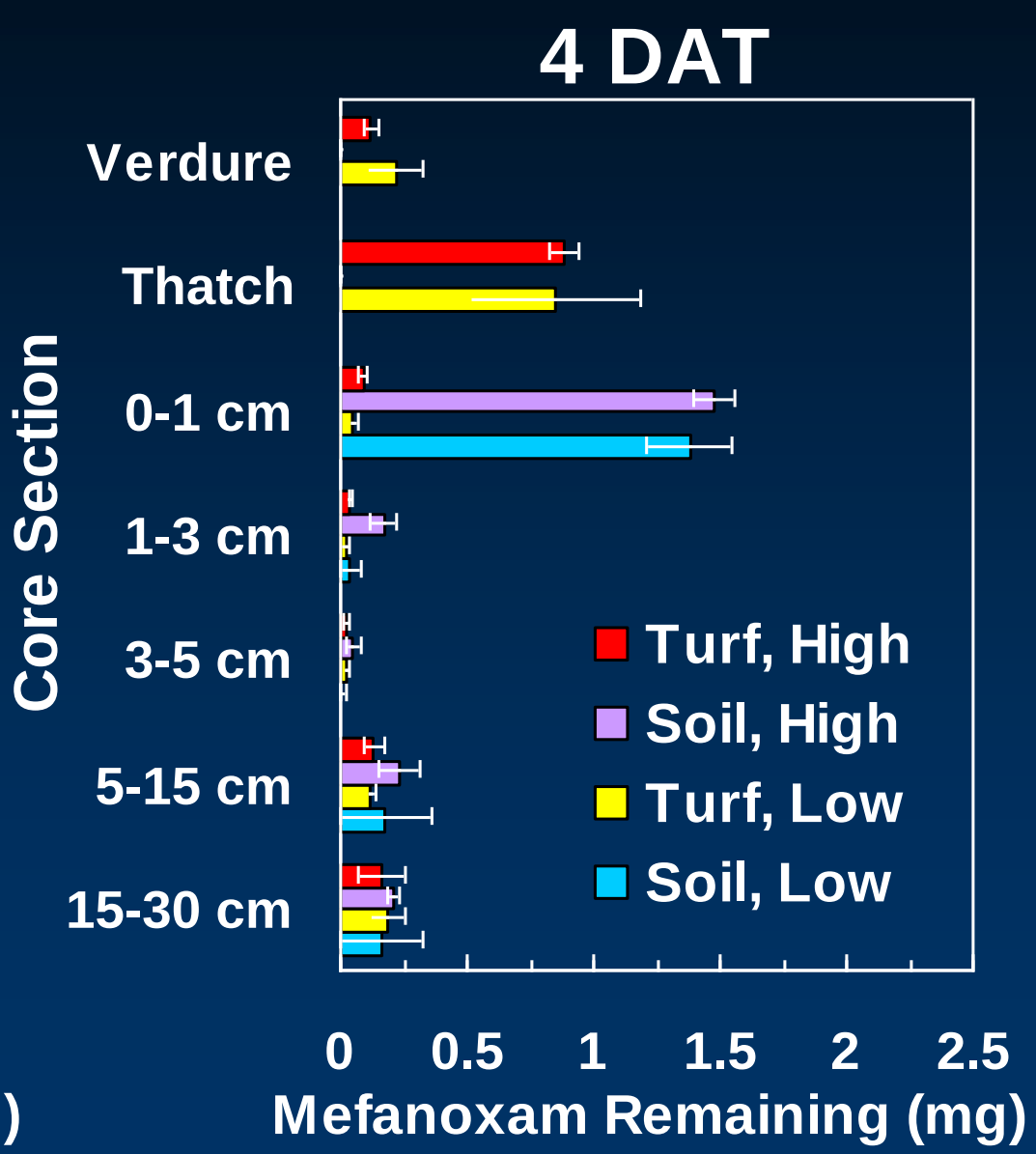
Mefanoxam Dissipation

- Half life
  - ●◆Turf
    6-8 Days
  - ■▲Soil
    10-12 Days
- Irrigation had minimal effect



Mefanoxam Distribution





Summary

- Chemical properties and fate data from soil studies alone may not predict fate in turf
- Thatch will increase the degradation rate and reduce movement of immobile and moderately mobile pesticides
- Thatch may not have as much impact on more mobile pesticides

Pesticide Fate

- Most data supports responsible use of pesticides and fertilizers on turf
- Some data calls for change in management practices or product choice
- Challenge is for turf industry to make its case for responsible usage

The Question We've All Heard:

"Are you using that product that was in the newspaper last year that killed everyone's trees?"

Imprelis™ Herbicide

David Gardner
The Ohio State University

http://buckeyeturf.osu.edu
gardner.254@osu.edu

Ground Ivy Control 56 DAT with Imprelis™

Imprelis Damage

- Several reports of plant damage
  - Reports in late May and early June
  - Imprelis applied in April
- Most affected species
  - Norway Spruce
  - White Pine

Imprelis Damage

- Other affected plants
  - Blue Spruce
  - Douglas Fir
  - Maples
  - Honeylocust
  - Taxus
  - Arborvitae
  - Turfgrass

- *Picea abies*
  - Norway Spruce

ENVIRONMENTAL HAZARDS

Do not apply directly to water, or to areas where surface water is present, or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters or rinsate.

Surface water advisory:

This product may impact surface water quality due to runoff of rain water. This is especially true for poorly draining soils and soils with shallow ground water. This product is classified as having high potential for reaching surface water via runoff for several months after application. A level, well-maintained vegetative buffer strip between areas to which this product is applied and surface water features such as ponds, streams, and springs will reduce the potential loading of aminocyclopyrachlor from runoff water and sediment. Runoff of this product will be reduced by avoiding applications when rainfall is forecasted to occur within 48 hours.

Groundwater advisory:

Aminocyclopyrachlor has properties and characteristics associated with chemicals detected in ground water. This chemical may leach into ground water if used in areas where soils are permeable, particularly where the water table is shallow.

DuPont™ Imprelis™

HERBICIDE

- Do not apply this product to exposed roots of trees and shrubs.
- Do not apply to any ornamental bed.
- Do not apply this product directly to, or allow spray drift to come in contact with, ornamental groundcovers, foliage plants, flowers, trees, shrubs, nearby crop plants or other desirable plants; or to the soil where potentially sensitive plants will be planted during the same season.
- Do not exceed specified application rates for any area and particular care must be taken within the dripline of trees and shrubs or other ornamental plants.
- Do not apply where runoff or irrigation water may flow onto susceptible turfgrass, ornamental plants or crops as injury may result.

Imprelis

- Voluntary suspension of sale by DuPont in August, 2011
- Stop sale ordered by EPA soon after
- Return and refund program now underway

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