

Iowa Senate

Natural Resources Committee

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Dr. Matthew Helmers

Dean's Professor, College of Agriculture &
Life Sciences

Professor, Department of Agricultural &
Biosystems Engineering

mhelmers@iastate.edu, (515) 294-6717

Dr. Michael Castellano

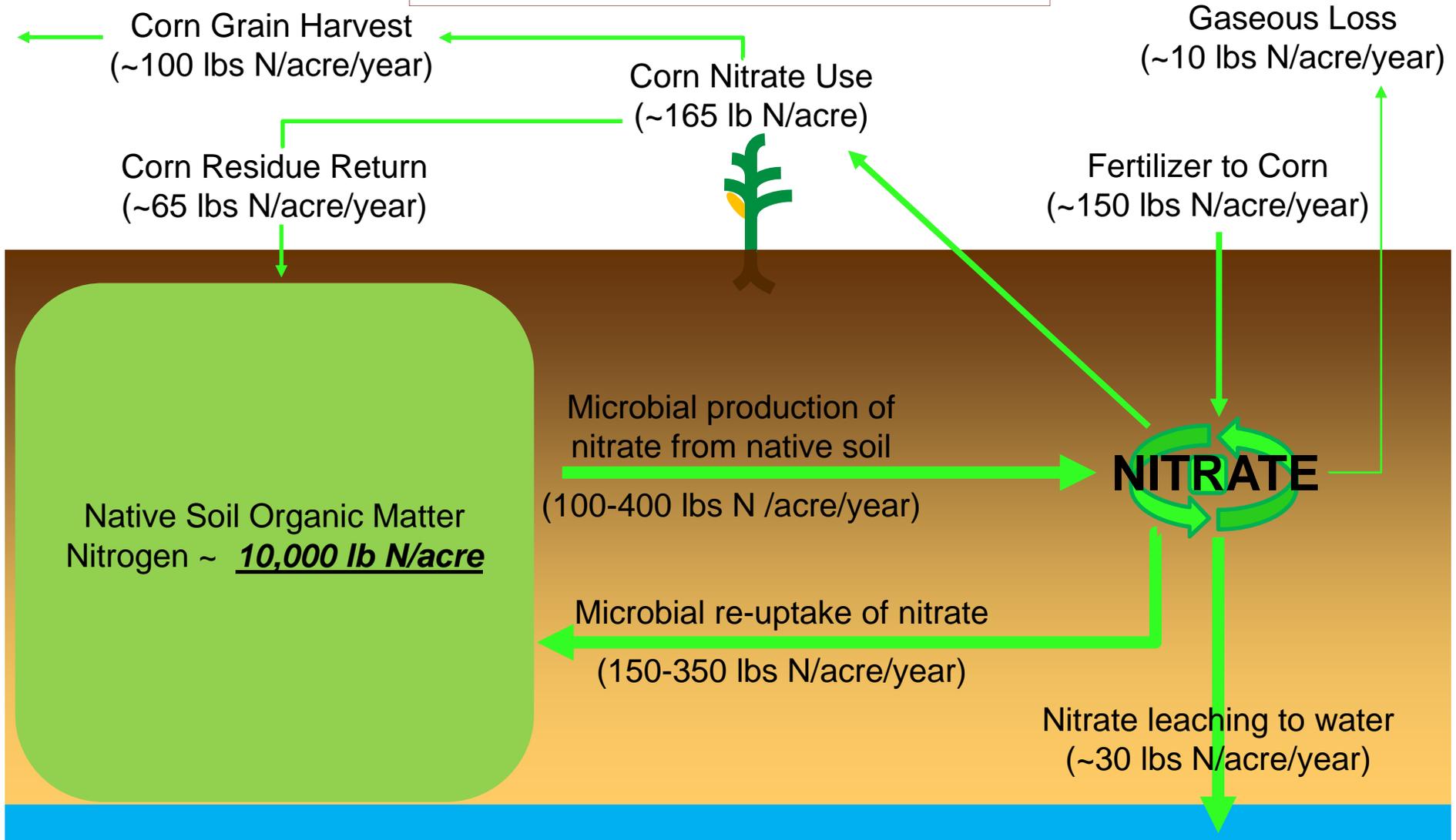
Assistant Professor,
Department of Agronomy

castelmj@iastate.edu, (515) 294-3963

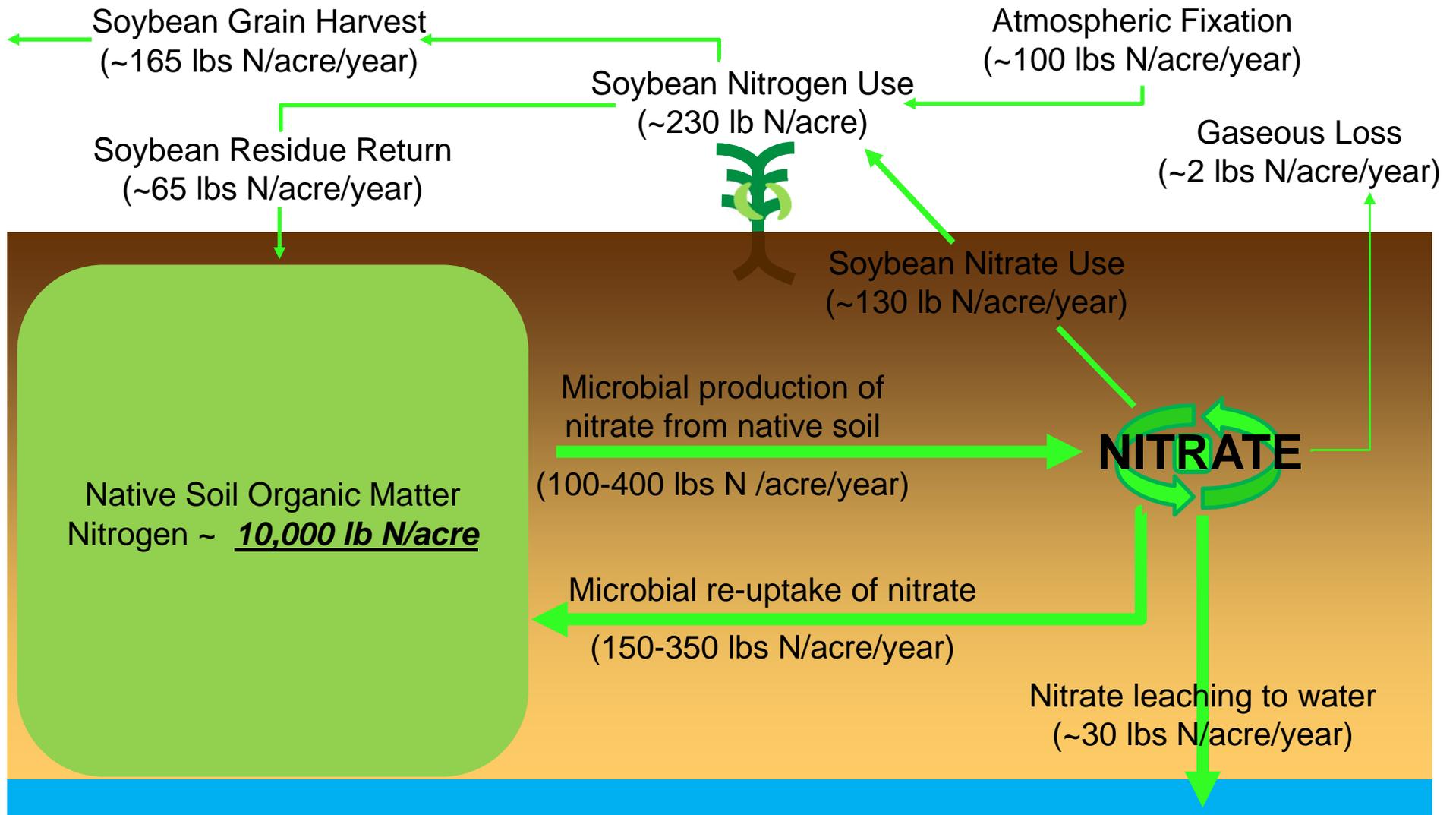
Soil Nitrogen Cycling & Budgeting

Dr. Michael Castellano
Department of Agronomy

Corn Nitrogen Cycling & Budget



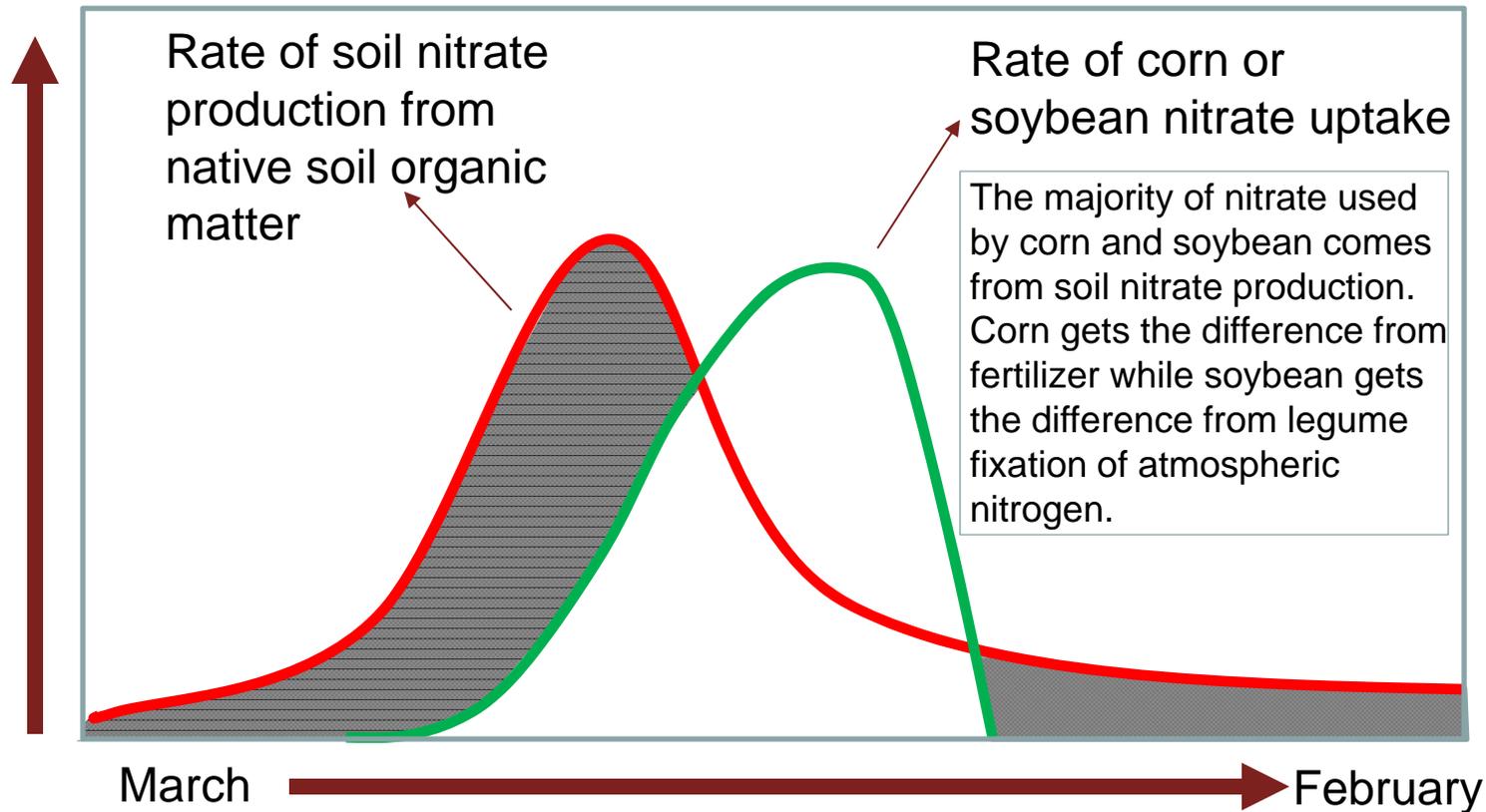
Soybean Nitrogen Cycling & Budget



Soil Nitrate Production Rate Is High



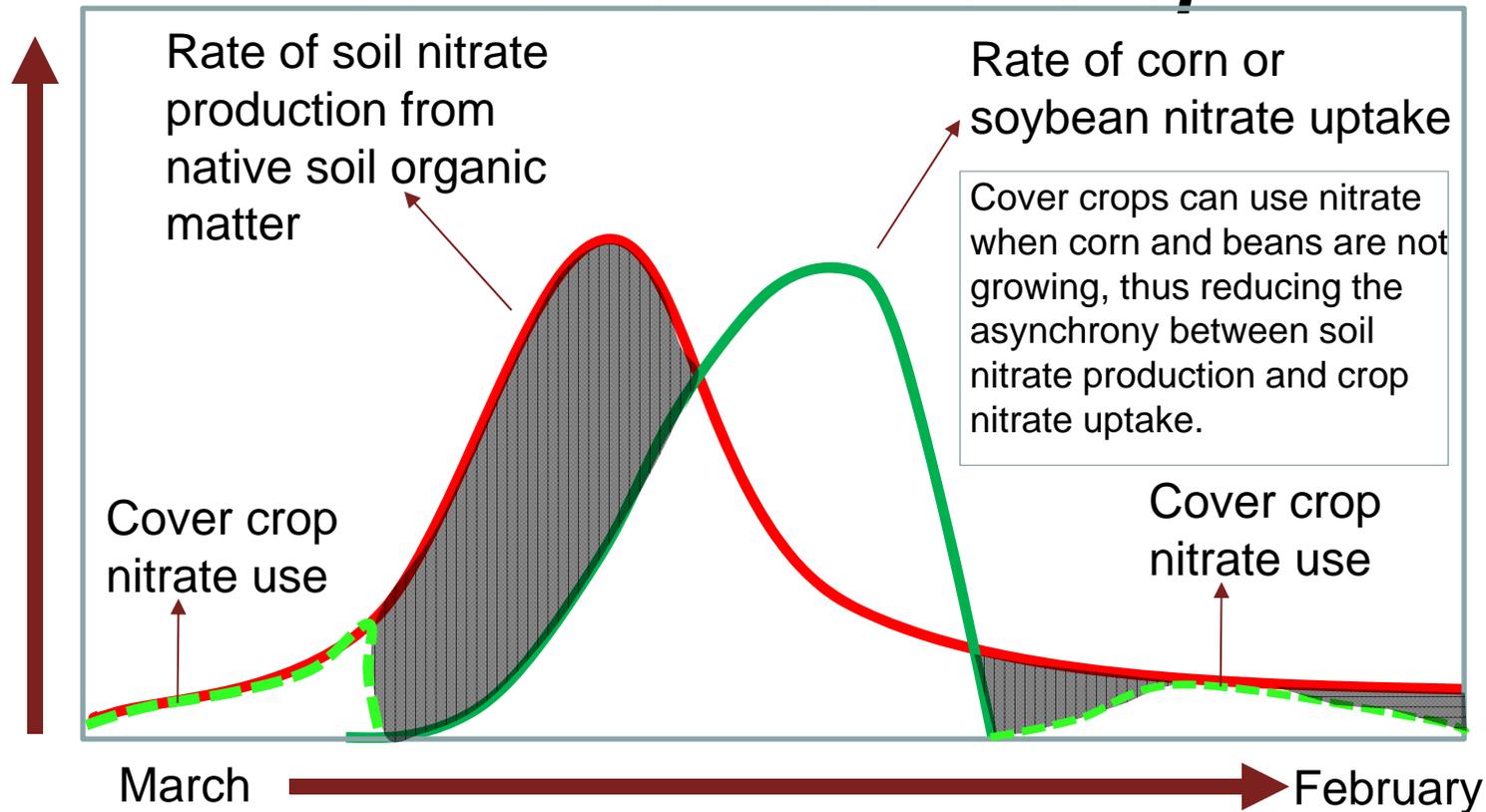
Soil Nitrate Production vs. Crop Nitrate Uptake



In the shaded areas, the soil produces nitrate, but there is no crop to use it. As a result, some nitrate is lost to waterways.

Soil Nitrate Production vs. Crop Nitrate Uptake

Addition of a Cover Crop



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Summary: Why Is Nitrate Lost?

- An average Iowa soil contains 10,000 lbs of nitrogen/acre in organic matter. This organic nitrogen is not susceptible to rapid loss.
- When the soil is warm and moist (not saturated), microbes transform the organic nitrogen into nitrate. Nitrate is susceptible to rapid loss.
- If there is no crop to use soil nitrate, it can be lost to waterways (especially during heavy precipitation).
- Almost all nitrate loss to Iowa waterways occurs when soils are warm and moist and crops are not rapidly using soil nitrate. While both spring and fall periods lack crops, more nitrate loss usually occurs in the spring because soils are **also** warm and wet.

Summary: Why Is Nitrate Lost?

- Nitrogen fertilizer mismanagement is not the primary reason for nitrate loss.
- Most nitrate loss to Iowa waterways is caused by a mismatch in timing between nitrate production from native soil organic matter nitrogen and the demand for soil nitrate by crops.

Examples:

- Nitrate loss from fertilized corn and unfertilized soybean is similar.
- In some situations, cover crops can reduce nitrate loss because they use nitrate in the spring and fall when corn and soybeans are not growing.
- There is little nitrate loss from perennial plants because they use nitrate when soil microbes are producing nitrate.

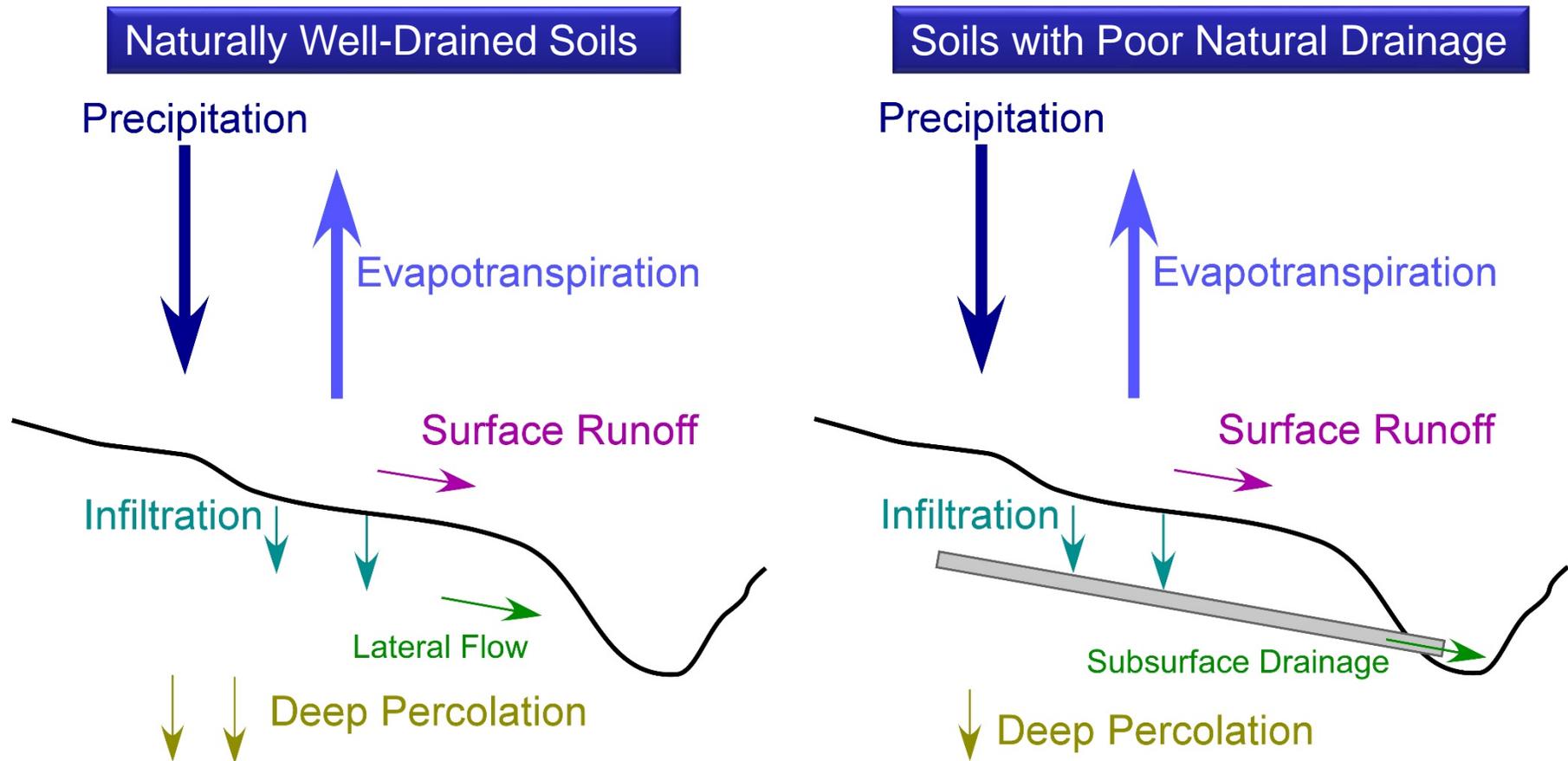
Drainage and Nitrate Loss

Dr. Matthew Helmers
Department of Agricultural and
Biosystems Engineering

Nitrate Loss Pathways

- Nitrate is leached from the plant/crop root zone
- Nitrate is primarily transported in subsurface flow pathways
 - In tile-drained lands: Nitrate moves to tile lines and is exported to streams
 - In non-tile drained lands: Nitrate moves to shallow groundwater

Water Flow Pathways



Land management and land use impact evapotranspiration and infiltration, which in turn impact surface runoff, subsurface drainage, deep percolation

Why Drainage?

- Remove excess water from naturally poorly drained soils to protect crops
- Reduce yield variation in-field
- More timely field operations
- Improve crop yields

Crop Yield Benefits of Subsurface Drainage (bushel/acre)

Crop	Iowa, 1984-1986	Ohio, 1962-1980
Corn	10 to 45	20 to 30
Soybeans	4 to 15	7 to 14

What Can We Do to Reduce Nitrate-N Export

Systems with Subsurface Drainage	Systems without Subsurface Drainage
Land Use Practices	Land Use Practices
Nitrogen Management	Nitrogen Management
Edge-of-Field Practices	

What Might It Take to Reach Goals?

Example: Combination Scenarios that Achieves N Goal From Non-Point Sources for Nutrient Reduction Strategy

Practice/Scenario	Nitrate-N Reduction
	% (from baseline)
N management - Maximum Return to Nitrogen Application Rate and 60% of all Corn-Bean and Continuous Corn Acres with Cover Crop Edge-of-Field - 27% of all ag land treated with wetland and 60% of all subsurface drained land with bioreactor	42

What Might It Take to Reach Goals?

Example: Combination Scenarios that Achieves N Goal From Non-Point Sources for Nutrient Reduction Strategy

Practice/Scenario	Nitrate-N Reduction
	% (from baseline)
<p>N management - Maximum Return to Nitrogen Application Rate and 25% of all Corn-Bean and Continuous Corn Acres with Cover Crop</p> <p>Land Use - 25% of acreage with Extended Rotations</p> <p>Edge-of-Field - 27% of all ag land treated with wetland and 60% of all subsurface drained land with bioreactor</p>	42

Summary: Drainage and Nitrates

- Nitrate is leached from the plant/crop root zone and is primarily transported through subsurface flow pathways to downstream waters
- Reaching water quality goals will require broad implementation of many practices