# Soil Erosion & RUSLE2

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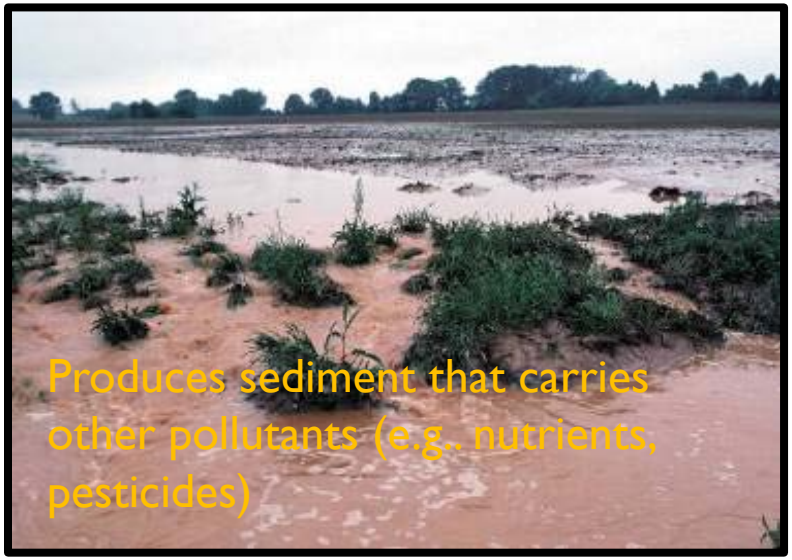
# Objectives

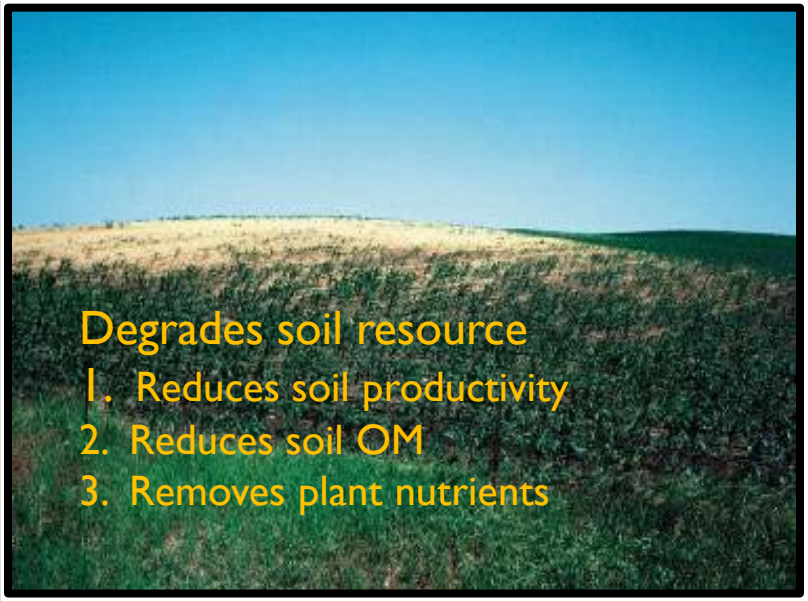
- Understand soil erosion processes
- Understand the factors affecting sheet and rill erosion
- Learn how RUSLE2 "thinks"
- Know what information is required to run the program
- Gain a basic understanding of RUSLE2 products
- Learn what resources are available and where to go for HELP!!

# Soil Erosion 101

# Why Erosion Is a Concern

(What are the impacts of erosion?)

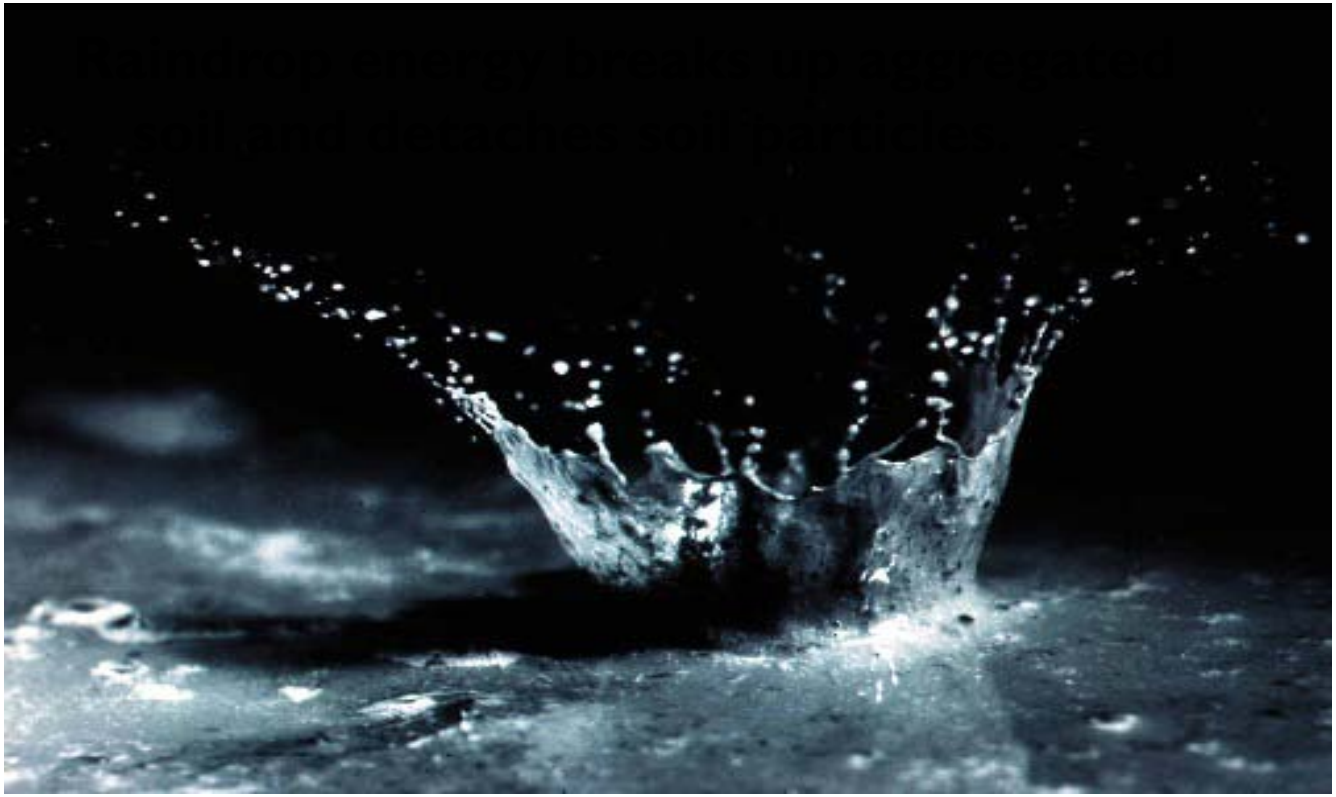




# WATER EROSION PROCESSES

1. Detachment
2. Transport
3. Deposition

# Detachment

The energy of a rainstorm is a function of the amount of rain and its intensity.



As storm intensity increases, so does the velocity and size of each raindrop

# Transport

Detached soil is carried downhill by running water.

The flowing water detaches additional soil.

# Deposition

Eventually, if the slope levels out, the water slows down.

This reduces the energy to carry soil, and the soil settles out and is deposited on the land.

# Types of Erosion Within Fields

- Sheet
- Rill
- Concentrated Flow
  - Classic Gully
  - Ephemeral Gully

# Types of Water Erosion


Ephemeral

Rill/Inter-rill (Sheet & Rill)

RUSLE2

# Sheet Erosion

- Thin, uniform wearing away of the uppermost surface layers in the soil profile

- Have you seen it?
  - 1/32" topsoil ≈ 5-7 tons/acre

# Rill Erosion

- Follows sheet erosion
- Water begins to concentrate and wear away rivulets in the soil surface
- Velocity and turbulence are increasing… detachment and transport
- Rills tend to be parallel

# Concentrated Flow

- Hillslopes intersect & collect overland flow
- Gullies may occur, depending on volume of runoff and erosivity of soil
- Gullies occur at the same point on the landscape, year after year

# Rills vs. Gullies

| | Rills | Ephemeral Gullies | Classic Gullies |
|---|---|---|---|
| Erased by tillage? | Yes | Yes? | No |
| Pattern | Parallel? disconnected | Dendritic; natural channels | Dendritic; natural channels |
| Influenced by… | Micro-topography | Macro-topography | Macro-topography |


Concentrated flow is not calculated into RUSLE2


Stream bank erosion is not part of the calculation

# RUSLE2 “Science”

# RUSLE2 Concepts

- Computer-based program
- Determines soil loss for one soil map unit on one slope grade and one slope length
- Replaced USLE and RUSLE
  - USLE – first published in 1958
    - Agricultural Handbook AH-537 (1978)
  - RUSLE – developed around 1985 due to new Farm Bill requirements
    - Agricultural Handbook AH-703 (1997)
- What does it do for me?
  - Calculates average annual soil loss
  - Soil Condition Index (SCI)
  - Soil Tillage Intensity Rating (STIR)
  - Energy Calculator
  - Estimate of surface residue
  - Other . . .

# Why Do I Care about RUSLE2?

- USDA Farm Bill Compliance
  - Must be following an approved conservation system or plan
  - Land sodbusted after December 23, 1985 must be to "T"
- State Regulations
  - NR243 WPDES Permits
  - ATCP50/NR151 Ag Performance Standards and Prohibitions
- State Programs
  - Working Lands Initiative/Farmland Preservation
- Objectives of Farm Operation
  - Guide management decisions
  - Evaluate impact of erosion
  - Inventory soil erosion

# RUSLE2 Factors

$$a = r\ k\ l\ s\ c\ p$$

r – rainfall

k – soil erodibility

l – slope length

s – slope steepness

c – cover management

p – supporting practices

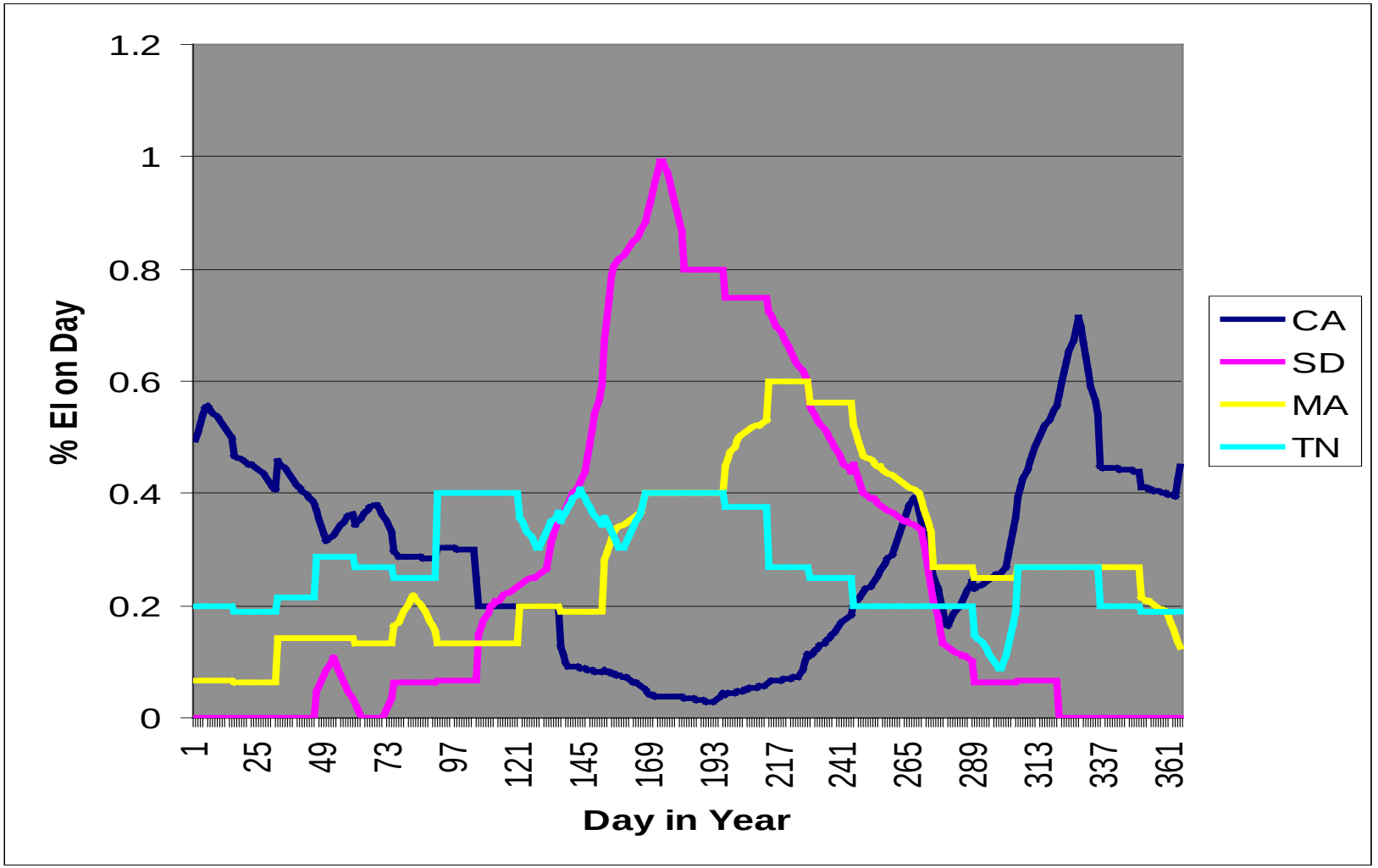
# Rainfall/Runoff - r

- Each climate has a unique pattern of rainfall and storm intensity.
- A measure of erosivity of climate at specific locations

| | | | |
|---|---|---|---|
| **Las Vegas, NV** | **8** | **Richmond, VA** | **200** |
| **Phoenix, AZ** | **22** | **St. Louis, MO** | **210** |
| **Denver, CO** | **40** | **Dallas, TX** | **275** |
| **Syracuse, NY** | **80** | **Birmingham, AL** | **350** |
| **Minneapolis, MN** | **110** | **Charleston, SC** | **400** |
| **Chicago, IL** | **140** | **New Orleans, LA** | **700** |
| **Dane County, WI** | **150** | | |

# Rainfall/Runoff Distribution

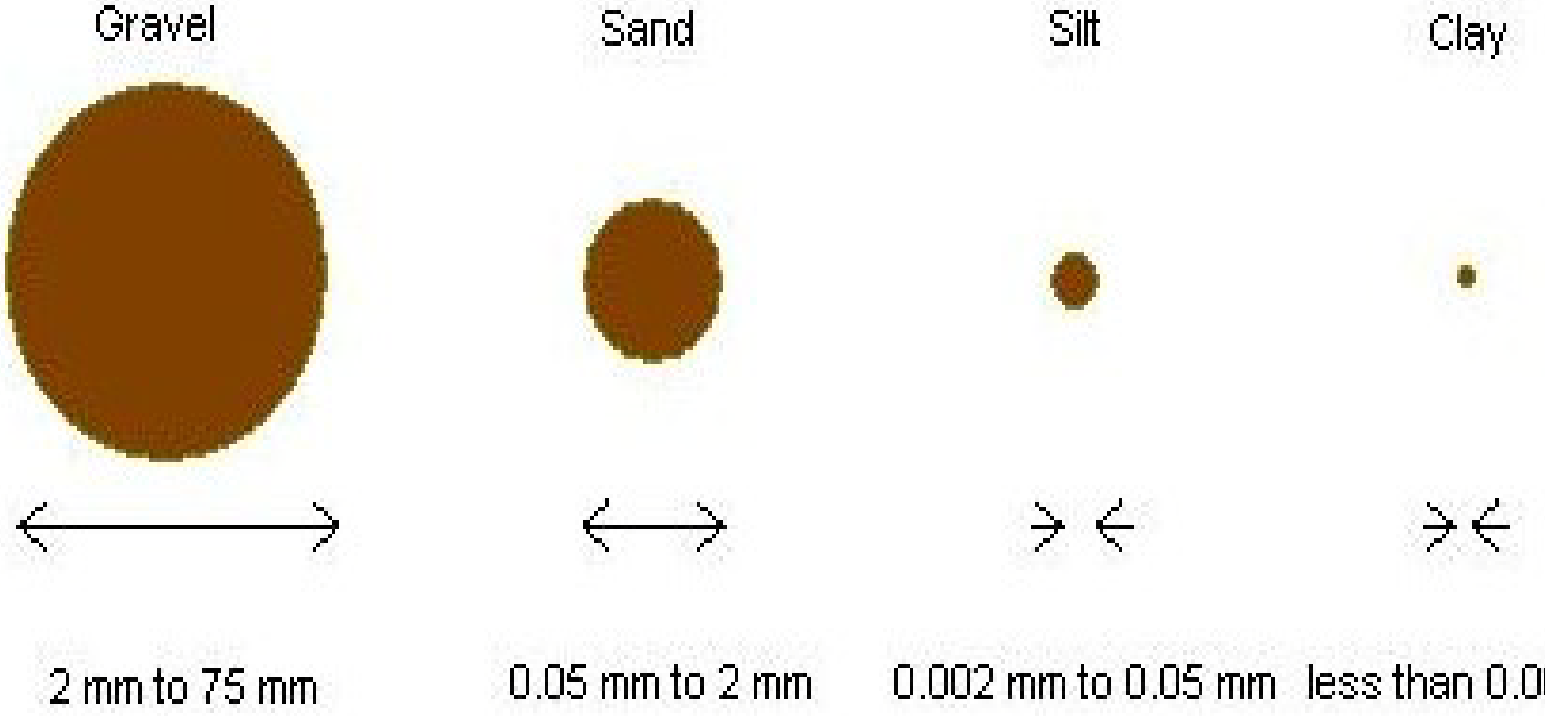
(Varies During Year)



# Soil Erodibility - k

- During mapping, soils are assigned an erodibility factor based on their inherent potential to erode.
- Soil erodibility factors assigned to soils usually range from values of 0.17 to 0.60. Organics can be as low as .02.
- The higher the erodibility factor, the greater the inherent potential to erode.
- Major factors: texture, organic matter, permeability, and structure

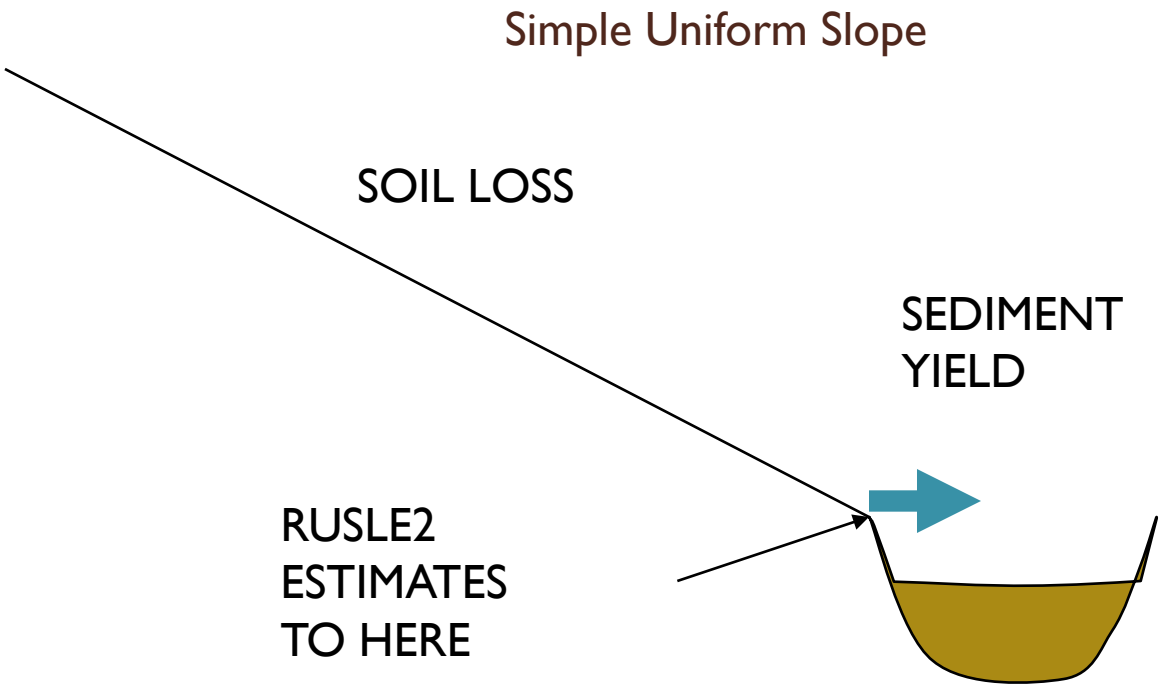
# Particle Size



# Soil Erodibility - k

- Effect of texture
  - clay (0.1 - 0.2) resistant to detachment
  - sand (0.05 - 0.15) easily detached, low runoff, large, dense particles not easily transported
  - silt loam (0.25 - 0.35) moderately detachable, moderate to high runoff
  - silt (0.4 -0.6) easily detached, high runoff, small, easily transported sediment

# Slope Length & Steepness - ls



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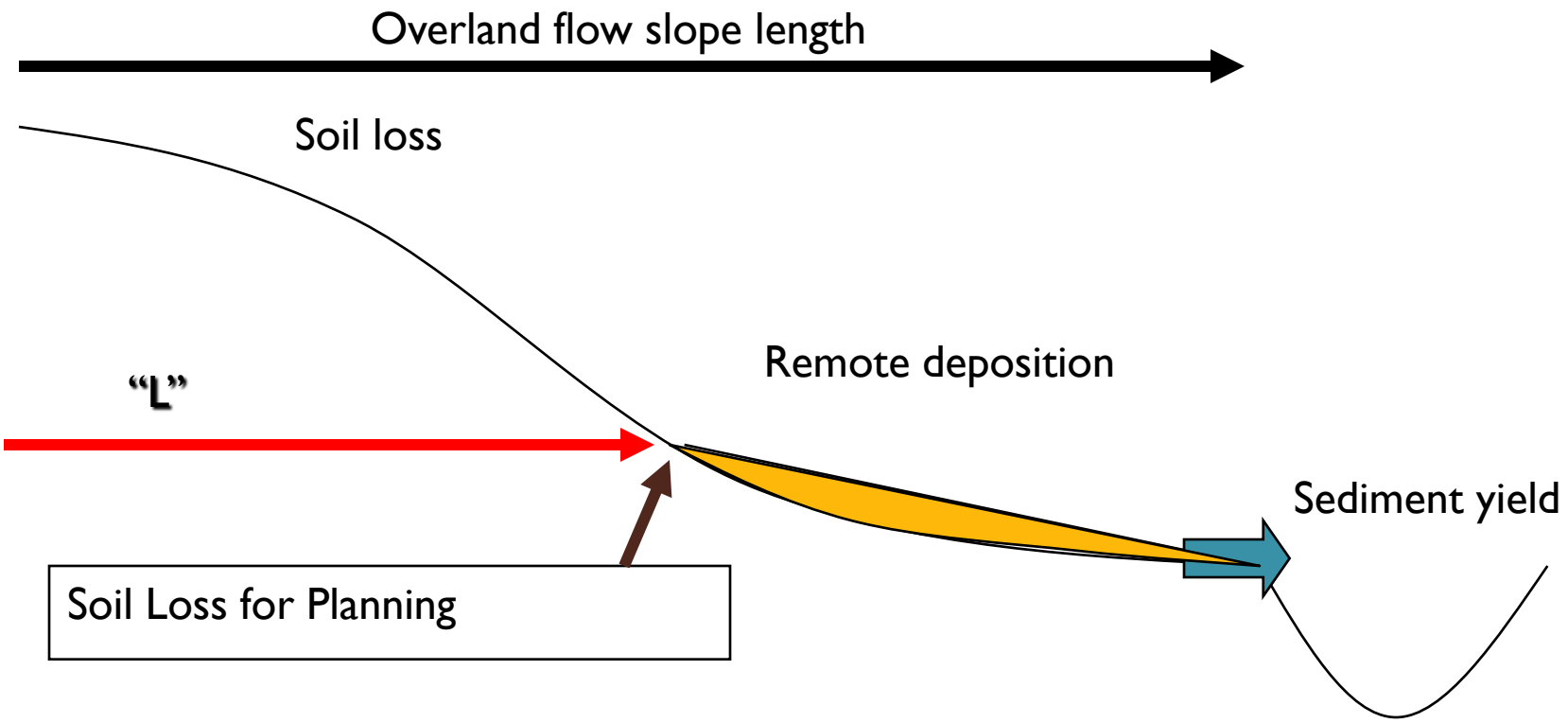
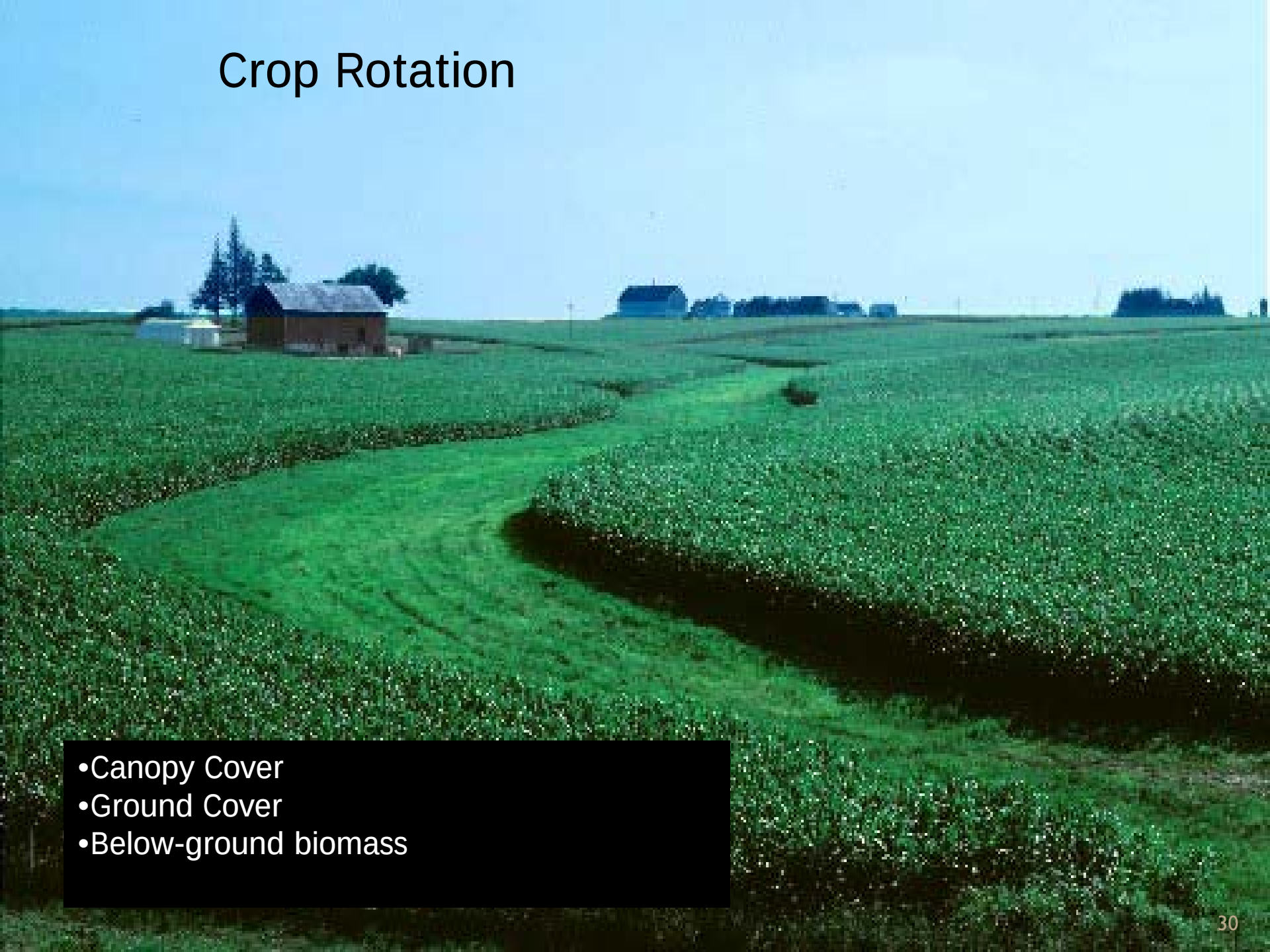



Complex Slope – Convex/Concave

# Cover/Management - c

- Crop rotation
- Type of tillage practices
- Application of materials (mulch, manure)
- Removal of materials (straw, corn stalks, etc.)
- Random roughness in the field

# Crop Rotation



- Canopy Cover
- Ground Cover
- Below-ground biomass

# Canopy

- Cover above soil surface that intercepts rainfall but does not touch soil surface to affect surface flow
- Main variables
  - Percent of surface covered by canopy
  - Effective fall height

# Ground Cover

- Cover directly in contact with soil surface that intercepts raindrops, slows runoff, increases infiltration
- Examples
  - Live plant material
  - Plant residue and litter
  - Applied mulch
  - Stones

# Below Ground Biomass

- Live roots
  - Distributed non-uniformly within soil
- Dead roots
- Buried residue
  - Half of material decomposed on surface is added to upper 2 inches
  - Incorporated biomass

# Tillage

- Surface roughness
- Ridges
- Soil Consolidation

# Soil Roughness

- Creates depressions
- Usually creates erosion resistant clods
- Increases infiltration
- Increases hydraulic roughness that slows runoff, reducing detachment and transport capacity

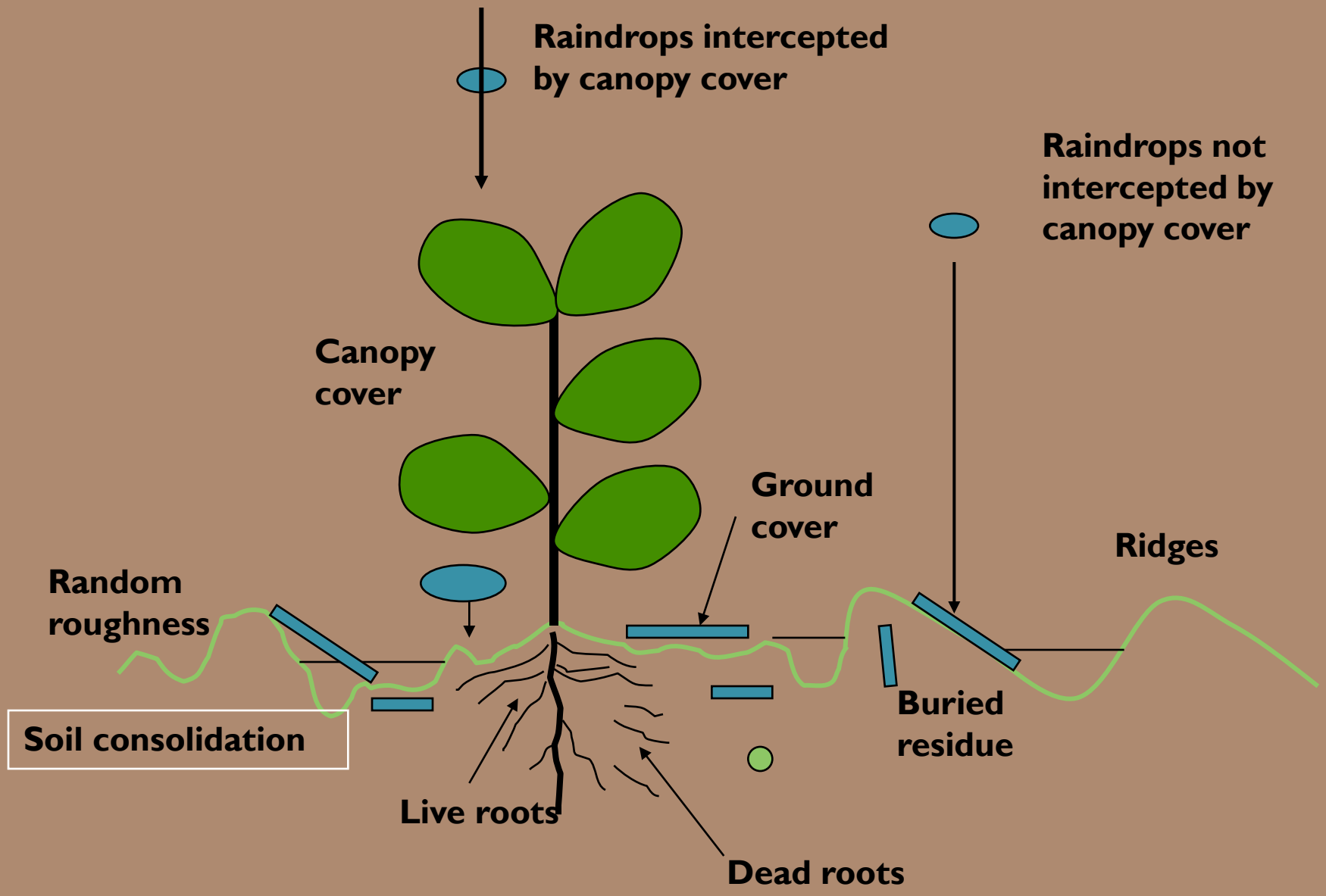
# Ridge Height

- Ridges up and downhill increase soil loss by increasing inter-rill erosion
- Function of:
  - Effect increases with ridge height
  - Effect decreases with slope steepness above 6%
- Ridge height decays with rainfall amount and interrill erosion
- Effect shifts from increasing soil loss when up and downhill to decreasing soil loss when on the contour

# Soil Consolidation


- Overall, freshly tilled soil is about twice as erodible as a fully consolidated soil
- Soil consolidation occurs after six years in Wisconsin which means infiltration, soil aggregation, microbial activity are at their peak
- This can be lost in two weeks through aggressive tillage + climate factors
- Consolidated soil is much less likely to erode

# Cover-Management (C)



Addition of materials


Removal of materials

# Supporting Practices - p

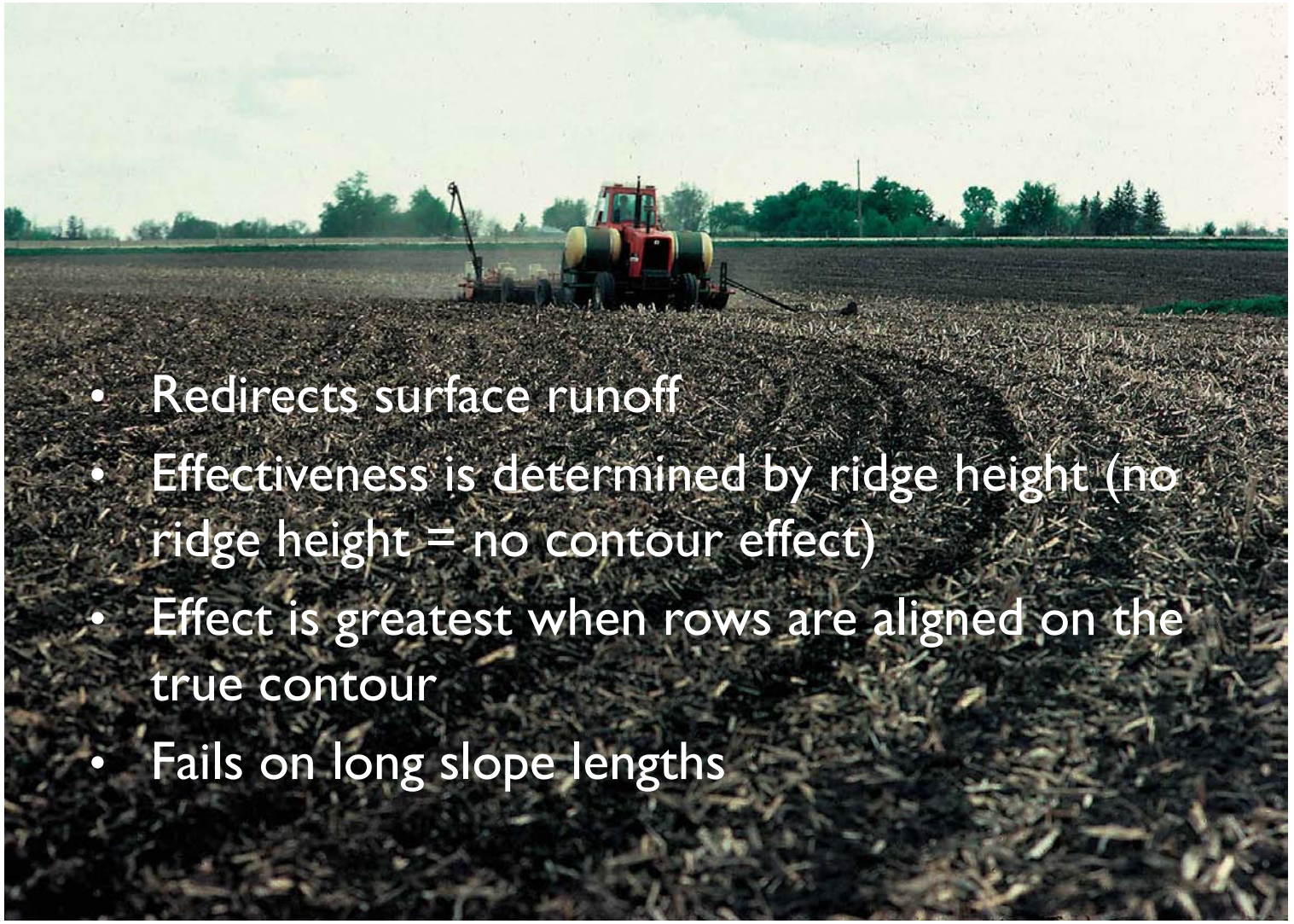
Contour Stripcropping

Contouring

Terraces

Contour Buffer Strips

# Supporting Practices - p
## (Contouring/Cross Slope Farming)



- Redirects surface runoff
- Effectiveness is determined by ridge height (no ridge height = no contour effect)
- Effect is greatest when rows are aligned on the true contour
- Fails on long slope lengths

# Supporting Practices - p
## ( Contour Buffer Strips)

# Supporting Practices – p
## (Contour Stripcropping)

- Usually equal width strips.
- Crops in the strips are rotated through a rotation cycle.
- Crops are offset among the strips so that strips of close growing crops (e.g. small grain, perennial crop) separate strips with more erodible crops (e.g. corn, soybeans)

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