

The Value of Cover Crops for Erosion Control

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Midwest Cover Crops Council
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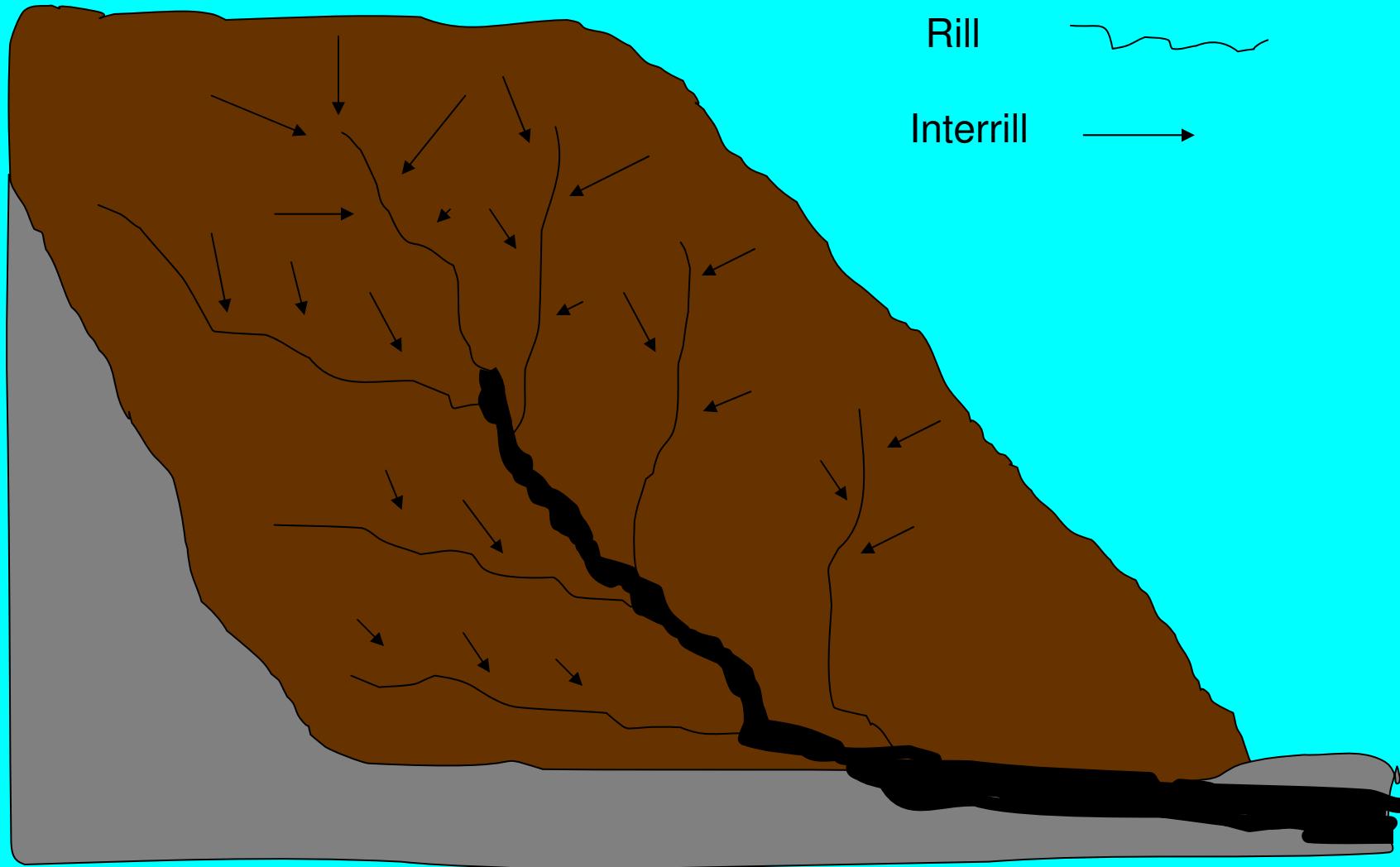
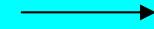
Gully



Rill



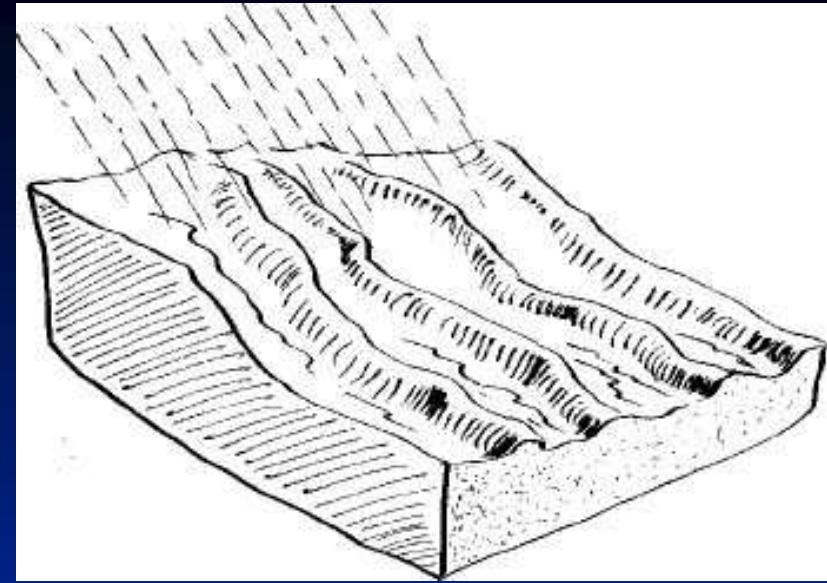
Interrill



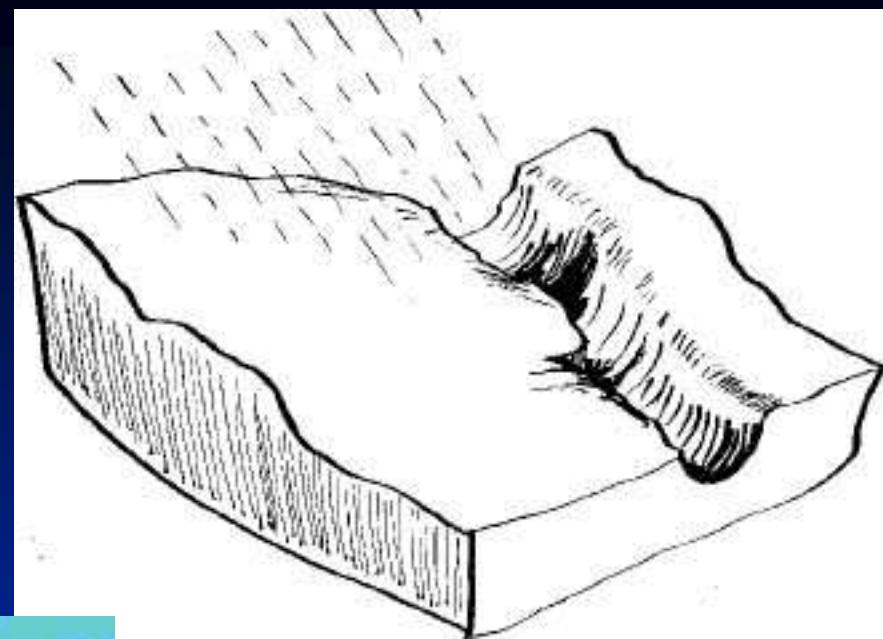
Interrill erosion also known as sheet erosion is the soil detachment and movement that is caused by raindrop impact and the diffuse flow of water across the soil surface. Eventually, the detached soil or sediment is transported to rills.



Rill erosion is the soil detachment and movement that is caused by flowing water in concentrated channels or rills. Rills are usually small enough to be leveled or smoothed out with tillage.



Gully erosion is often defined for agricultural land in terms of channels too deep to easily remedied with ordinary farm tillage equipment. In other words, gullies are rills that have gotten out of hand and do not have continually flowing water.



Source: NRCS

Why worry about erosion?

Because soil productivity depends on topsoil depth for water and nutrient storage.

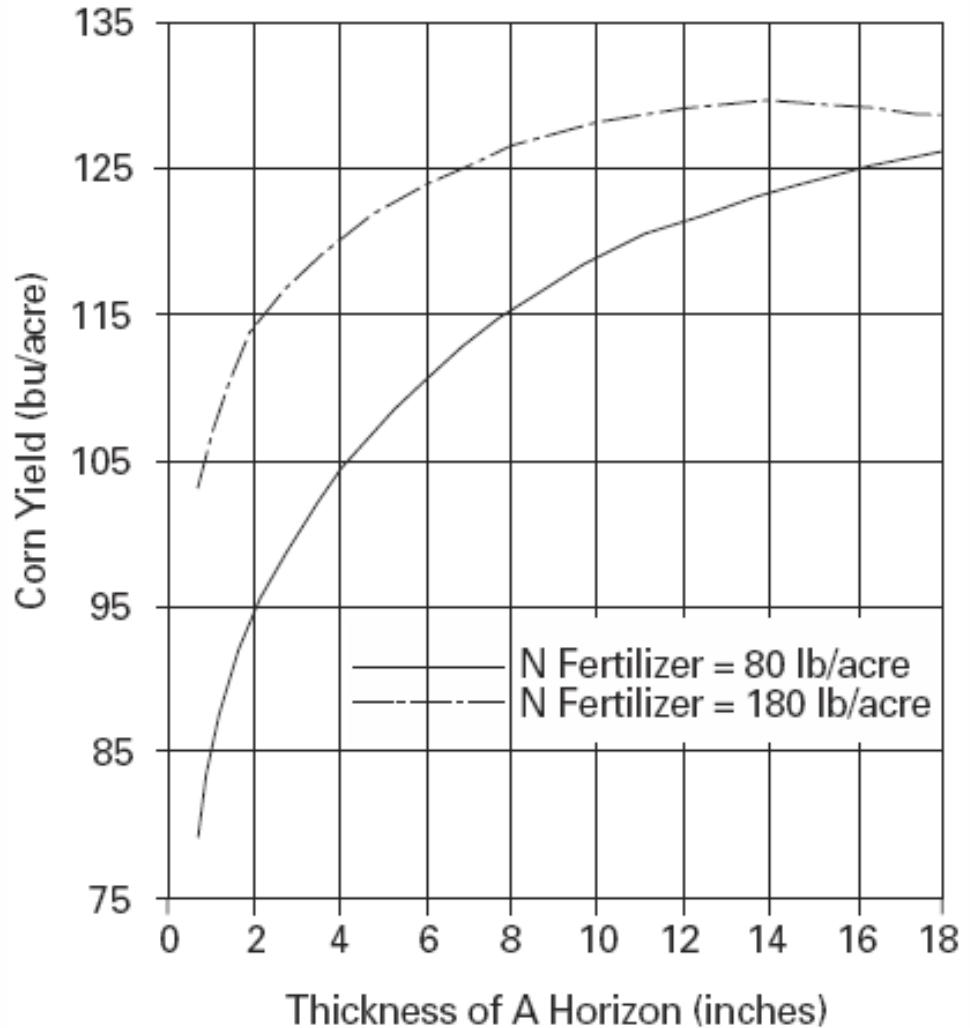


Figure 4. Effect of A horizon thickness on corn yields with two different N rates for till-derived soils (Kazemi et al., 1990).

Average erosion rate for U.S. cropland in 2003 is 4.7 tons soil/acre/yr, which results in:

- loss of estimated \$40/acre/yr of nutrients
- loss of 0.55 tons/acre/yr of soil organic matter
- loss of 0.033 inches of topsoil/acre/yr and this is about 10 times the rate of soil replacement from parent material (0.0035 inches/acre/yr)

In 150 years of farming, Iowa has lost an estimated 6-8 inches of topsoil at a rate of 0.04 to 0.53 inches/yr

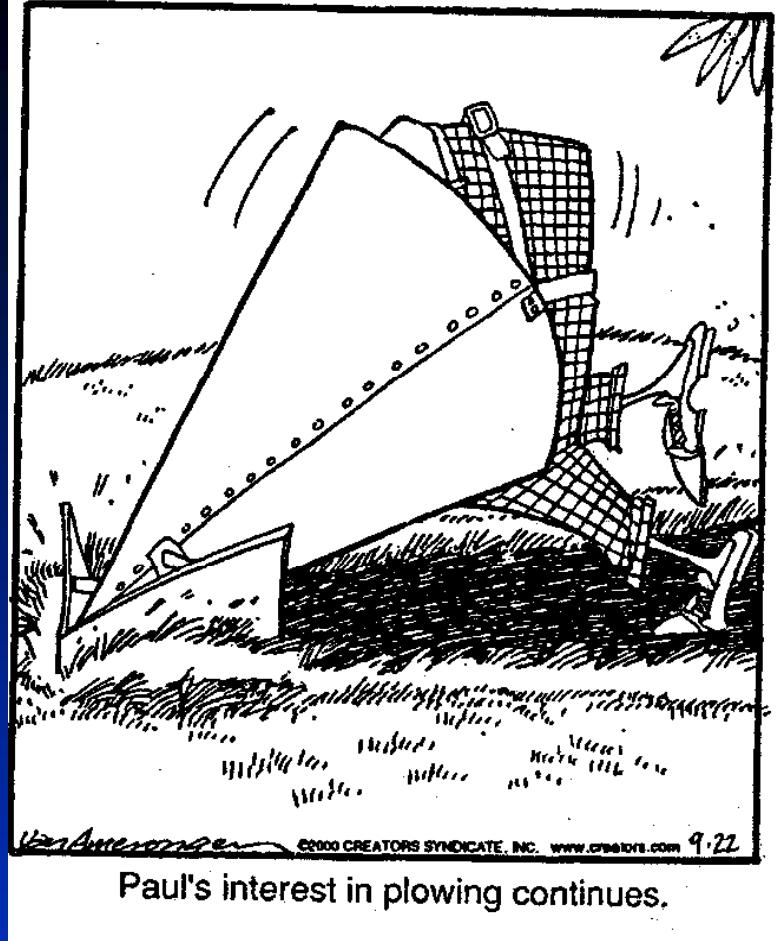
WE'VE LOST 10% OF THE
FERTILE SOIL ON EARTH SINCE 1945,
WE'LL DOUBLE OUR
POPULATION IN 50 YEARS,
AND REPLACEMENT OF TOPSOIL
TAKES 500 YEARS.



G.S.
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— NEW PLATES ON THE SURFACE BY
THE YEAR 2000

So if erosion is so bad, why haven't we done anything about it.

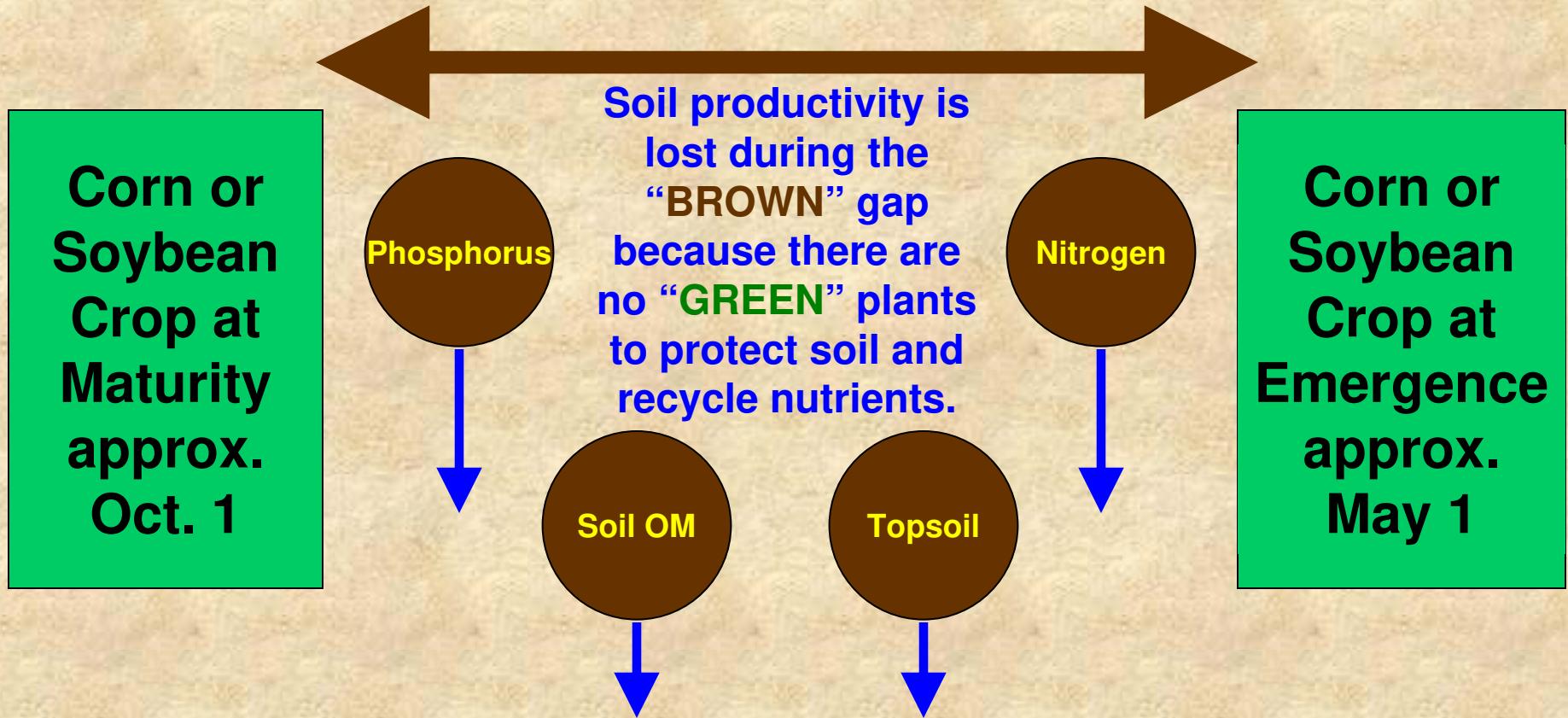


Paul's interest in plowing continues.

We like to till and there
are a lot of good
reasons for tilling.



Corn and Soybeans have a 7 Month “BROWN” Gap



Unlike natural systems that have some plants growing when the ground is not frozen, agricultural systems have extended periods without plants, which leads to losses.

So what do we do about erosion?

The first step is to leave more residue on the soil surface throughout the year.

A second step might be to grow winter cover crops between harvest and planting.

One of the main reasons for planting cover crops is to reduce erosion

Cover crops reduce erosion in several ways:

- Increase infiltration
- Protect the soil from raindrop impact
- Slow surface water flow rates
- Hold other crop residues in place
- Cover crop roots hold soil in place
- Supplement existing surface residues

Rainfall Simulator used for Erosion Measurements of No-Till Soybeans with and without Cover Crops in mid-April



After Simulated Rainfall



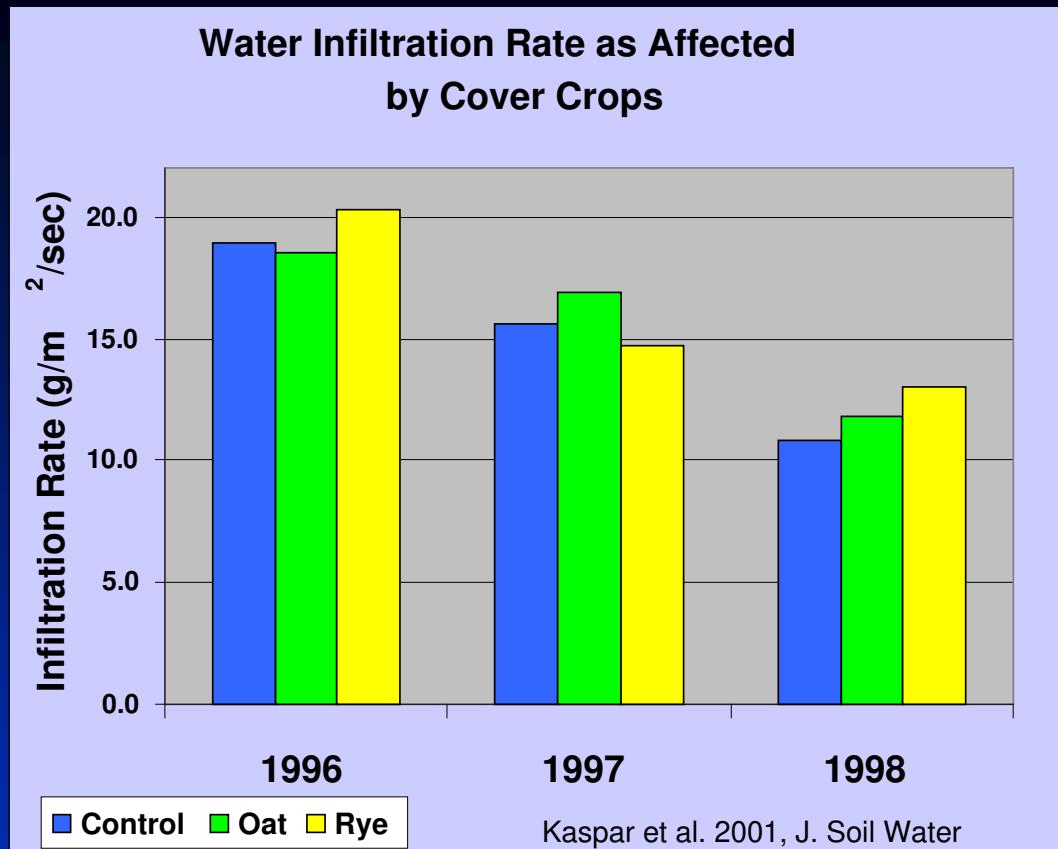
NO COVER CROP



OAT COVER



RYE COVER

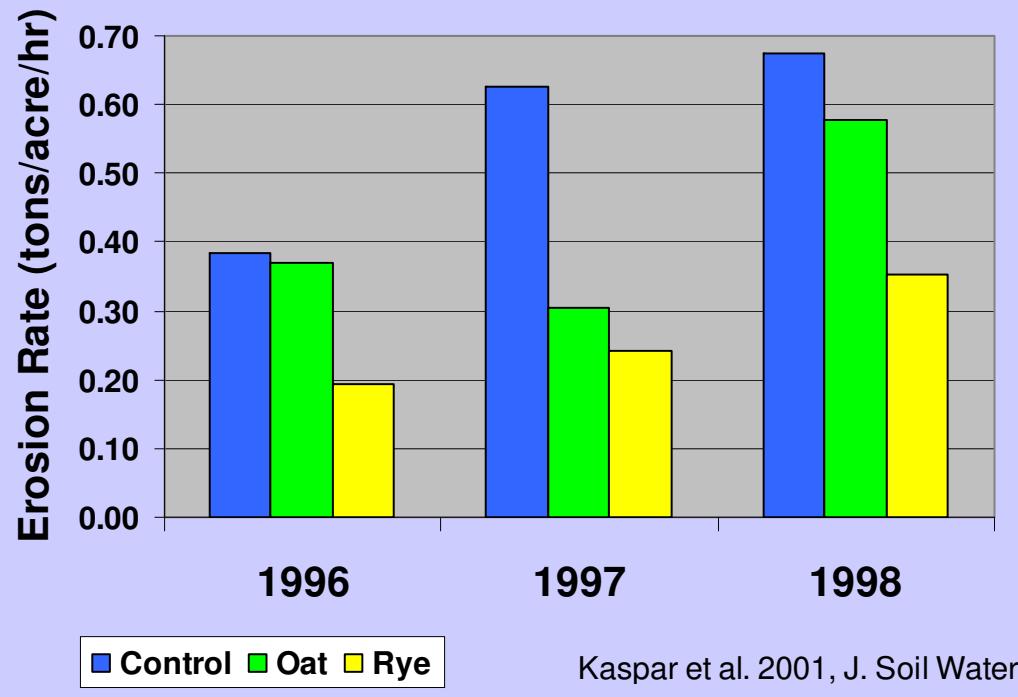


- Rye and oat cover crops increased infiltration only in 1998.
- Infiltration would be expected to vary from year-to-year depending on the growth of the cover crop, residue cover, compaction and the amount of rainfall received before the measurement.
- Cover crops were not planted after corn in this study

Cover Crops and No-Till Soil Structure



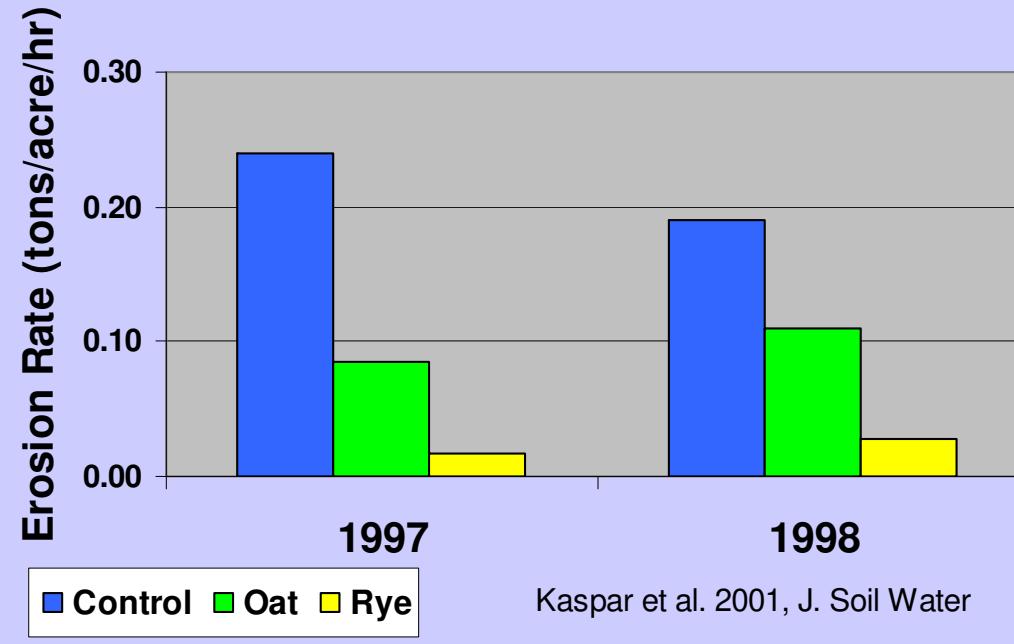
Interrill Erosion Rate after 5 inch Rain in 1 hr as Affected by Cover Crops



- The rye cover crop reduced interrill erosion in all three years, whereas the oat cover crop significantly reduced it only in 1997.
- Cover crops reduce interrill erosion by protecting the soil surface from raindrop impact, intercepting raindrop splash, and slowing the flow of water across the soil surface.
- Because no-till was used for all treatments, the soil had good residue cover to begin with and the erosion rate was low even for the control, which did not have cover crops.



**Rill Erosion Rate after 5 inch Rain in 1 hr as
Affected by Cover Crops Assuming Rills
Occupy 0.5% of Surface Area**



- Both the oat and rye cover crop significantly reduced rill erosion
- Rill erosion partly depends on slope length and the surface area occupied by rills.
- Cover crop shoots protected the soil surface from direct contact with flowing water and held other residues in place.
- Cover crop roots held the soil in place and prevented the flowing water from cutting into the soil to form larger rills or channels.

After Simulated Rainfall



NO COVER CROP



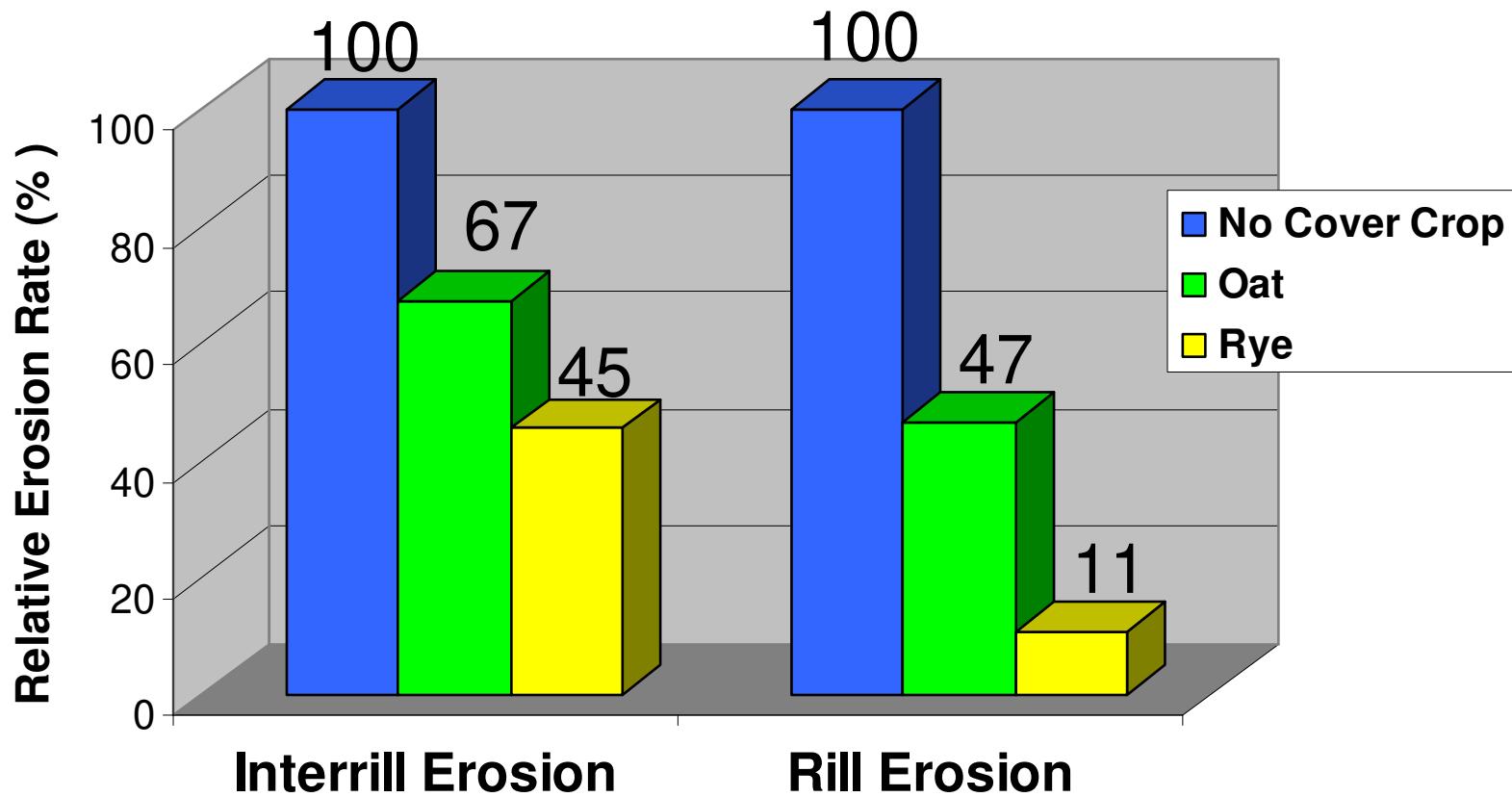
OAT COVER



RYE COVER

Relative Erosion

**Relative Rill and Interrill Erosion Rate in No-till
Soybean as Affected by Cover Crops**



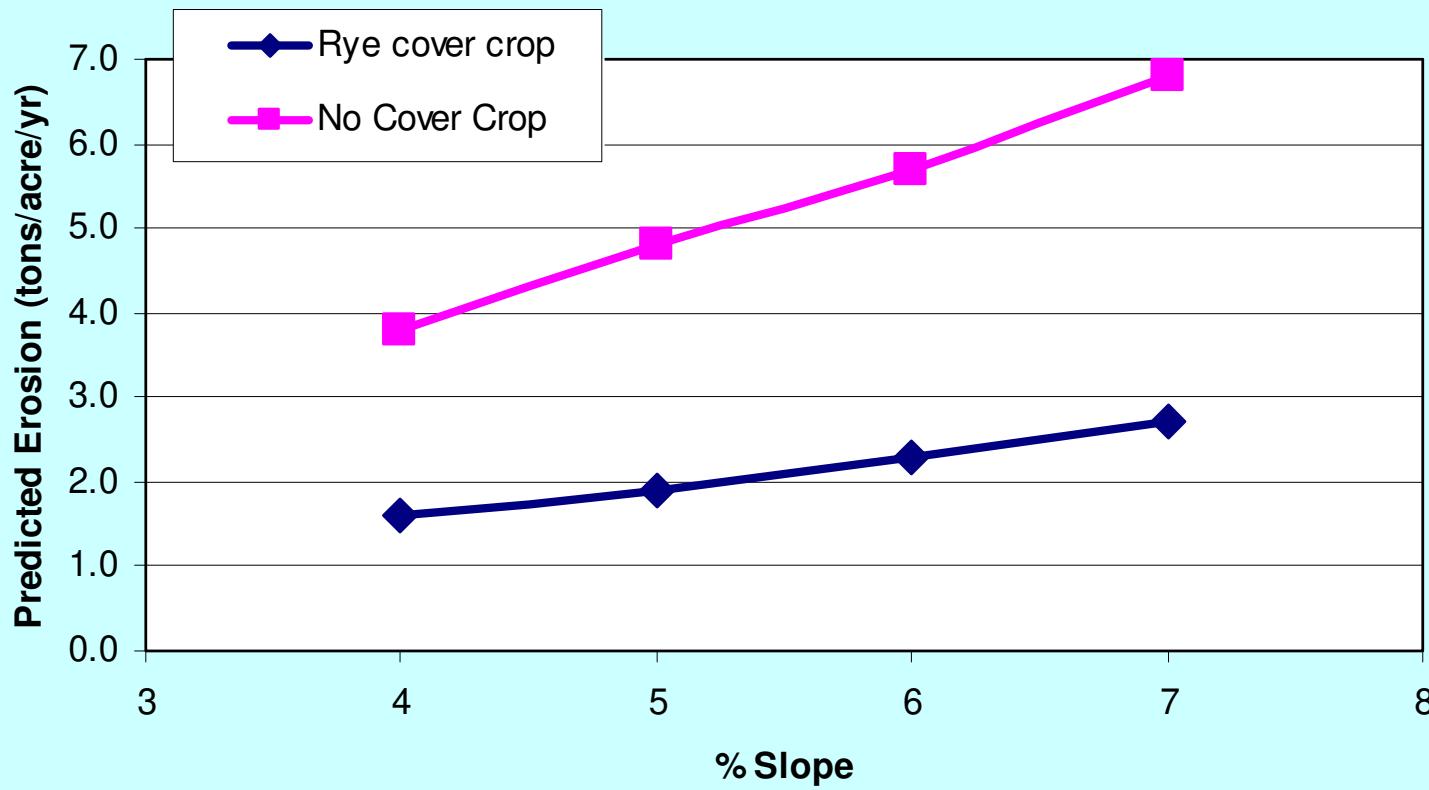
Literature summary of percent reduction (57 to 96%) in erosion due to winter cover crops.

Reference	Location	Cropping System	Cover crop	Reduction in Erosion
Beale et al., 1955	South Carolina	Conv. Till corn	hairy vetch and rye	57%
Wendt and Burwell, 1985	Missouri	No-till corn silage	winter rye or wheat	96%
Zhu et al. (1989)	Missouri	No-till soybean	chickweed	87%
Zhu et al. (1989)	Missouri	No-till soybean	downy brome	96%
Mutchler and McDowell 1990	Mississippi	Conv. Till cotton	wheat or hairy vetch	73%
Mutchler and McDowell 1990	Mississippi	No-till cotton	wheat or hairy vetch	88%

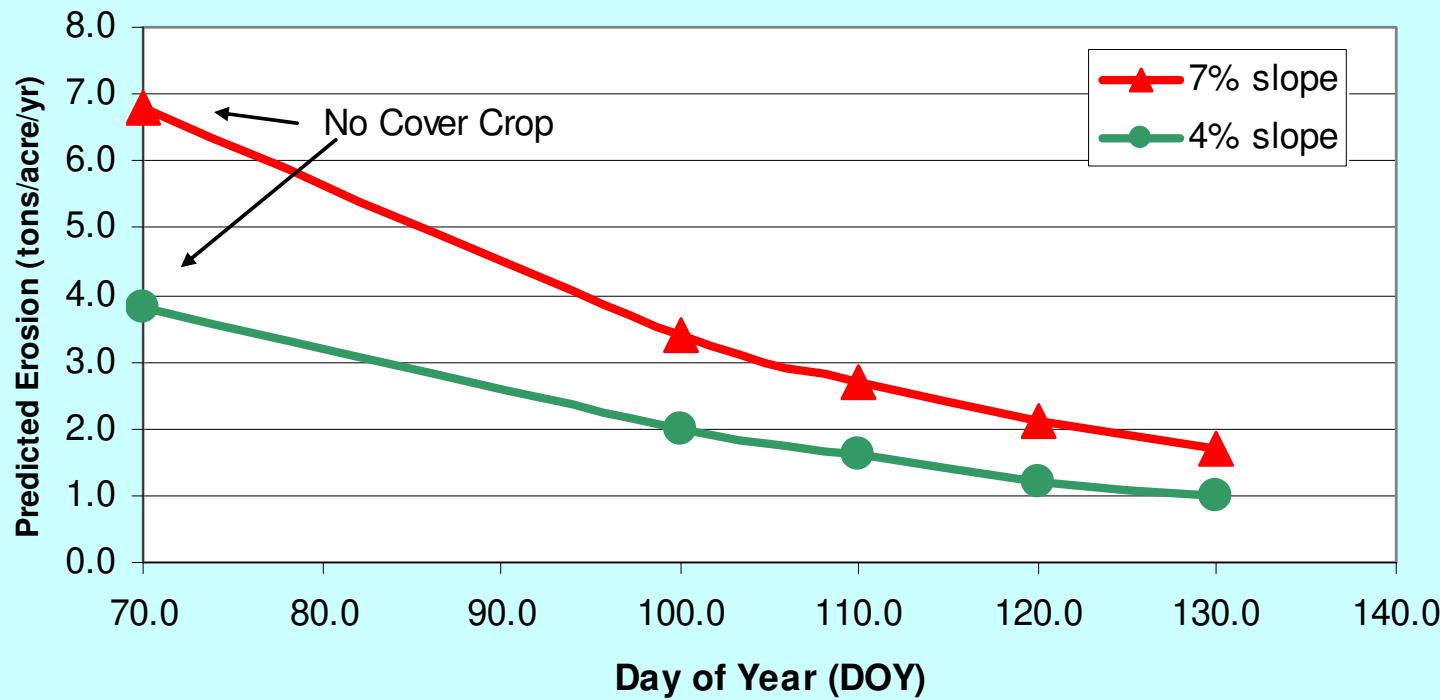
RUSLE2 Erosion Estimates Using Beta Version of Cover Crop Vegetation Files

- Corn–Soybean rotation, NT, spring anhydrous, 5% slope, 150 ft slope length, Ames, IA
 - without rye cover crop = 2.1 t/ac/yr
 - with rye cover crop = 1.2 t/ac/yr
- Continuous Corn Silage, NT, spring anhydrous, 5% slope, 150 ft slope length, Ames, IA
 - without rye cover crop = 4.8 t/ac/yr
 - with rye cover crop = 1.9 t/ac/yr

Predicted Erosion as Affected by Slope and Winter Cover Crops



Predicted Erosion as Affected by Slope and Kill Date of Cover Crops

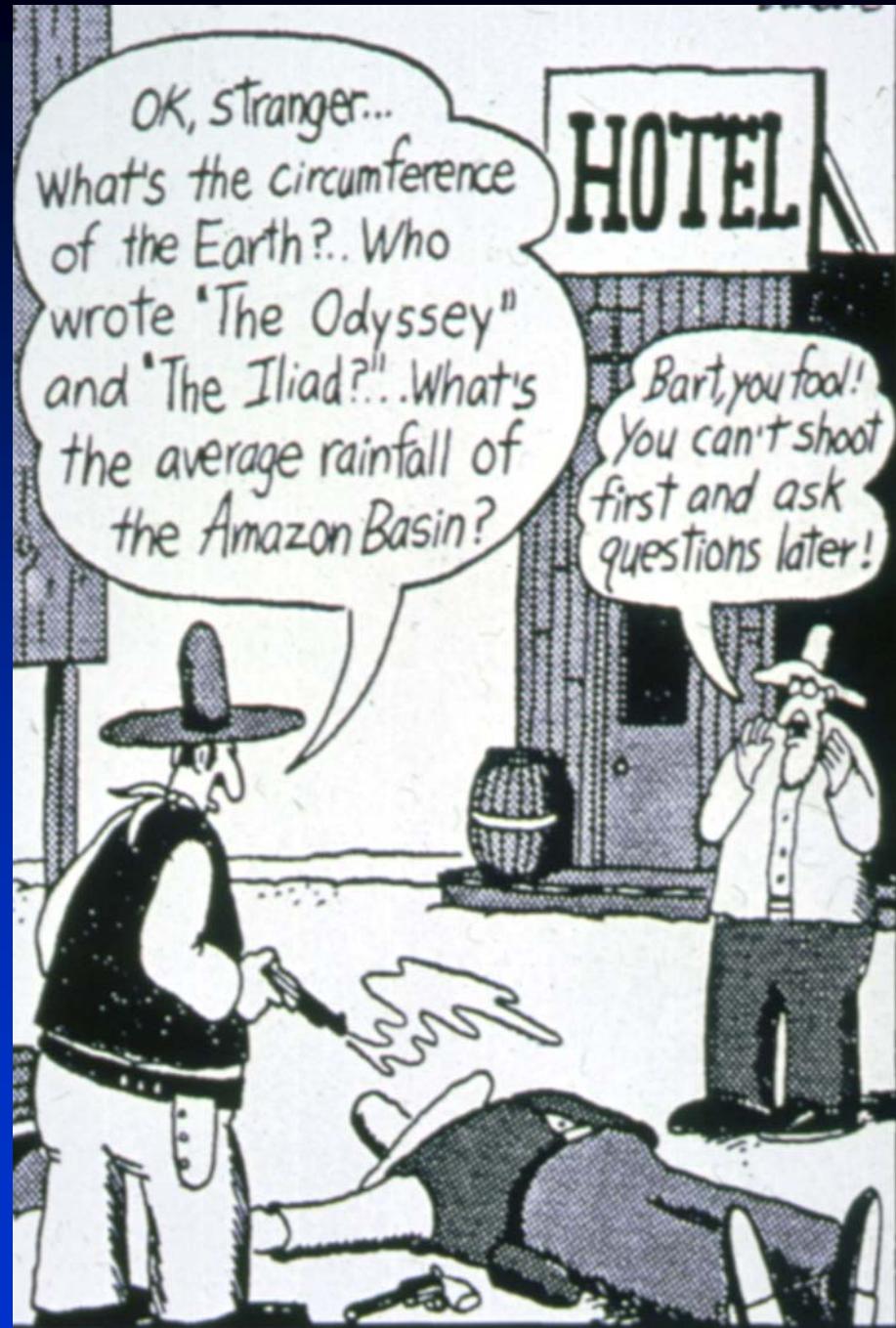


Conclusions

- Winter cover crops reduce erosion especially rill erosion.
- Winter cover crops reduce erosion by increasing residue cover and impacting erosion processes, which may not be completely reflected by current erosion models or databases.
- Unlike some conservation practices, erosion control is not the only benefit of winter cover crops.

Questions?

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Rye in Spring on Berger Farm



Rye in Fall on Berger Farm



Rye after Corn Silage



Oats after Soybean



Landscape

Overland flow



Intermittent

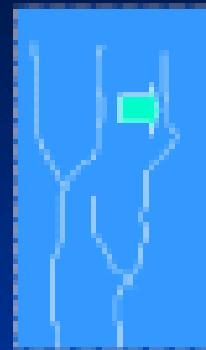
Rill

Ephemeral

Gully
(Concentrated
flow)



RUSLE2 Area



Erosion Types

Water erosion can be separated into two processes. Interill erosion and rill erosion. Interill erosion also known as sheet erosion is the soil detachment and movement that is caused by raindrop impact and the diffuse flow of water across the soil surface. Rill erosion is the detachment and transport of soil caused by flowing water in concentrated channels or rills.

