Spatial Variability of Soil Erodibility at the Field Scale

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Introduction

Soil erodibility is a key factor affecting soil erosion process. Different topographic positions on the landscape may have different surface and subsurface hydrology resulting in different localized soil condition and properties. In order to better assess soil erosion at the landscape, knowledge on the variability of soil erodibility within the same field (topographic effect) is necessary to provide scientific basis for soil erosion prediction.

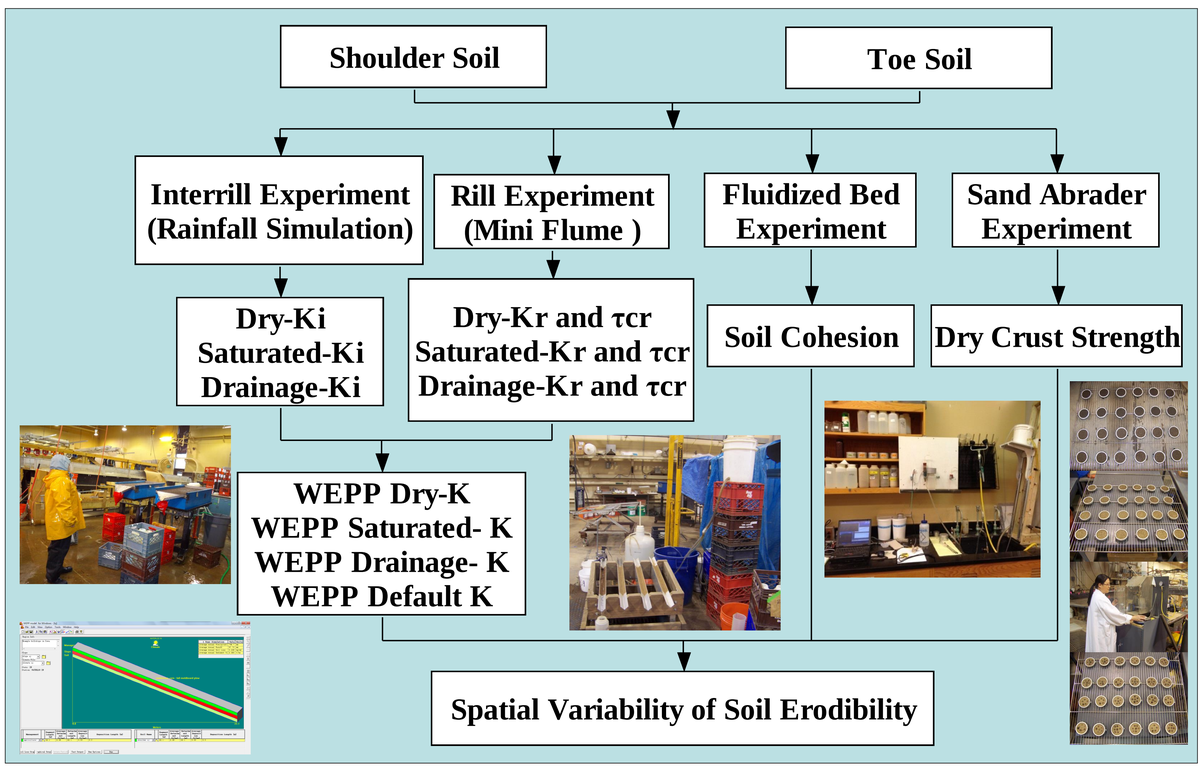
Materials

Two soils were collected from the shoulder and toe slope positions in the same field in the Upper Cedar Creek watershed of NE Indiana.

Table 1. Soil properties

Soil	Sand (%)	Silt (%)	Clay (%)	Organic matter (%)	Soil textural classification
Shoulder	44	36	20	3.1	Loam
Toe	34	42	24	4.4	Loam

Methods



Conclusion

Within the same field, different topographic locations may have impacts on the physical and chemical properties of the soil, causing the variability in soil strength, hence soil erodibility.

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Results and Discussion

Table 2. Interrill erodibility, K_i

Soil	K_i-dry x10^6 (Kg s m^{-4})	K_i-saturated x10^6 (Kg s m^{-4})	K_i-drainage x10^6 (Kg s m^{-4})
Shoulder	2.29	1.24	1.16
Toe	3.57	1.53	1.18

The K_i values of the shoulder soil were smaller than that of the toe soil because shoulder soil had higher sand content resulting in higher infiltration and lower runoff.

Table 3. Rill erodibility, K_r and critical shear (τ_{cr})

Soil	K_r-dry (s m^{-1})	K_r-saturated (s m^{-1})	K_r-drainage (s m^{-1})	τ_{cr}-dry (Pa)	τ_{cr} - saturated (Pa)	τ_{cr} - drainage (Pa)
Shoulder	0.0006	0.0019	0.00001	0.50	0.47	0.50
Toe	0.0006	0.0019	0.0001	0.33	0.53	0.50

The K_r values of two soils were similar under dry condition, however, the shoulder soil had greater τ_{cr} value due to higher sand content. The K_r values of two soils were also similar under saturated condition, but the toe soil had greater τ_{cr} value because of higher clay content and organic matter. Under drainage condition, the shoulder soil had smaller K_r value than that of the toe soil while their τ_{cr} values were similar.

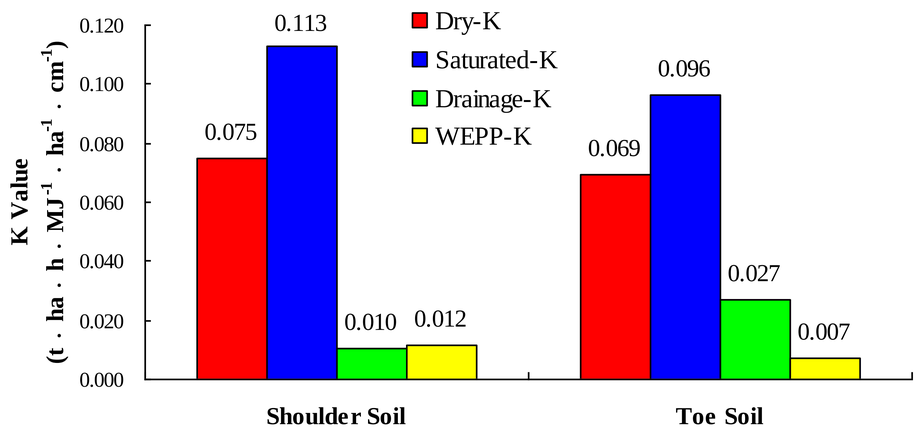

Fig 1. Back calculated USLE K values

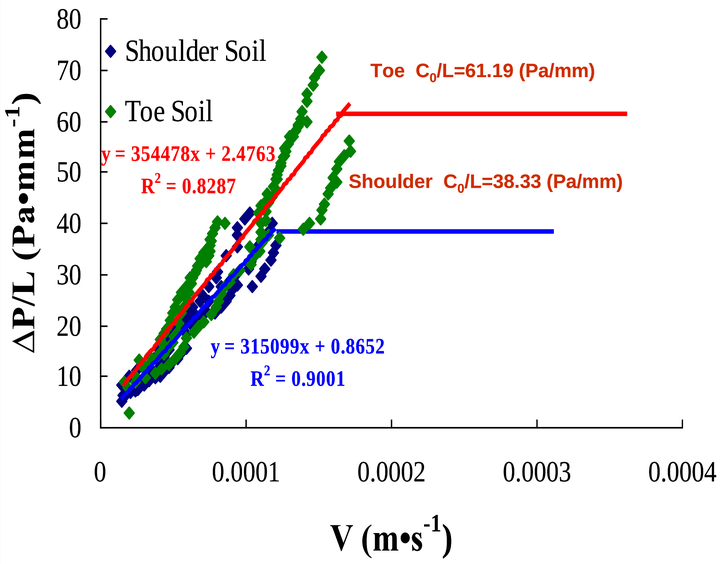

Fig 2. Soil cohesion values

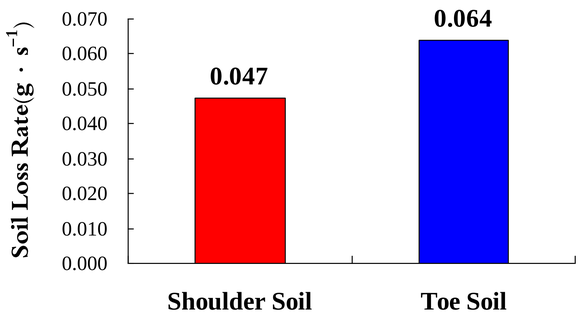

Fig 3. Dry crust strength values

The toe soil had stronger soil cohesion yet weaker dry crust strength than the shoulder soil due to its higher silt, clay, and organic matter content as well as lower sand content.