Cropping System Effects on Wind Erosion Potential

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Soil Wind Erosion: A Timeless Scourge

Since the first breeze picked up the first lonely, unattached soil particle, wind erosion has reshaped the topography and the fertility of the soil.

On-farm costs of wind erosion include the need to replace soil nutrients removed along with the erodible soil fraction, lower water infiltration, loss of water retention capacity, and reduced soil depth. These factors all decrease crop yields. While fertilizers and greater quantities of water can be applied to the crop to mitigate the effects of soil loss in the short term, soil degradation has long-term impacts on agricultural productivity and on ecosystem services provided by the soil.

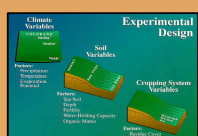
Dust storms in southeastern Colorado: 1937 and 2014.
Photos courtesy USDA and Amanda Wicks

The Research Sites: 30 Years of Knowledge

Colorado State University's Dryland Agroecosystem Project was founded in 1985 to study the long-term effects of crop rotation intensity in the western Great Plains.

Traditionally, producers in the region have used Wheat-Fallow rotations. In the last few decades many have moved to more intensive systems such as Wheat-Corn-Fallow or Continuous Cropping.

The greater crop diversity moderates income fluctuations and diversifies risk making farmers less exposed to the weather or pest impacts on a single crop or single year. The protection of the soil surface for longer periods of time also reduces water and wind erosion.



Map and diagram courtesy Dr Gary Peterson

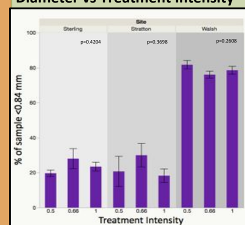
- All sites are no-till
- 400-450 mm precipitation annually at each site
- 3 soils: Loam, Clay Loam, Sandy Loam
- Each phase of each rotation represented every year
  - Wheat-Fallow
  - Wheat-Corn/Sorghum-Fallow
  - Continuous Cropping

Soil Aggregate Size

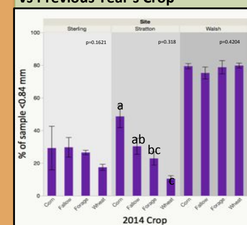
Soil aggregates larger than 0.84 mm are the most resistant to detachment from the surface. About 2 kg of soil was collected with a flat shovel to a 5cm depth. It was then put through a rotary sieve, the graduated sections divide the aggregates by size class.

Hypothesis: The legacy effect of 30 years of crop rotation history will influence the amount of erodible aggregates.

% Aggregates < 0.84 mm Diameter vs Treatment Intensity



% Aggregates <0.84 mm Diameter vs Previous Year's Crop



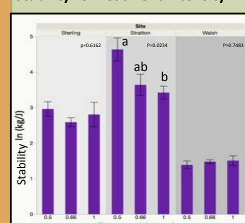
Results: Instead of the cropping system intensity being the influence, we found that recent crop was more significant at the Stratton site.

Soil Aggregate Strength

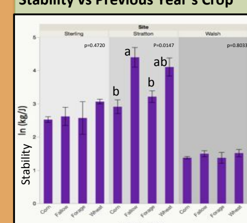
The extent to which aggregates hold together is another predictor of soil erodibility. Strong soils require the more forceful abrasion of higher wind velocities to detach particles. Soils were gently sieved in the field to collect aggregates larger then 2 in diameter. Strength was measured using a Soil Energy Crushing Meter. Individual aggregates were placed between two plates and the energy required to 'break' the aggregate structure quantified.

Hypothesis: The legacy effect of 30 years of crop rotation history will exert an influence on the aggregate stability (strength).

Stability vs Treatment Intensity



Stability vs Previous Year's Crop



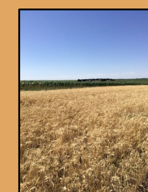
Results: Rotation history at the Stratton site had a significant effect on aggregate stability. As with aggregate size, we found recent crop to be significant as well.

Conclusions

Agricultural systems are the result of a complex interplay of soil, climate, plants, and management choices. Our results indicate the choice of crop could be a greater key factor than cropping system intensity when considering the erodibility of a soil.

In the spring when winds are most fierce and new crops provide little or no physical protection, soil is at its most vulnerable and protected only by its inherent properties. Management decisions that favor improved aggregation as a component of soil conservation may yield long-term benefits.

Corn residue, Walsh



Wheat ready for harvest, Sterling

Future Directions: Mechanisms and Systemic Investigations

The next step for this project is to investigate the mechanisms underlying the aggregation differences we found. We will look into whether crop rotation intensity is influencing soil moisture content. Also we will be exploring the microbial community composition and carbon content of the soil.

In agricultural research a great deal of focus has been on the differences seen between tillage systems. Less is known about cropping intensity affects on soil. Opportunities abound for researchers to further investigate all aspects of crop rotation intensity.

Climate change impacts on precipitation and temperature combined with a growing global population makes imperative the need to maximize yields within the constraints of the land and moisture available. Understanding cropping intensity is one way to expand the possibilities of agriculture.

Thank you! The CSU Agroecosystems Lab Team: Steve Rosenzweig, Rachel Seedorf, Zac Czarnecki, Bailey Kraich, Marcos Barancelli, Sergi Domenech, and Ivey Schnarr **USDA-ARS:** Lucretia Sherrod, Chris Lentz, and Jessica Baker