

Relationship of Soil Profile Hardness to Soil Productivity

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Objective

To identify relationship of soil profile hardness to soil productivity

Materials and Methods

- Research site: USDA-ARS research field in Centralia, Missouri, USA
- Soil: Mexico silt loam (Aeric Vertic Epiaqualfs)
- Field was managed in a minimum-tillage corn-soybean rotation since 1991
- Soil hardness measurement: hydraulically-powered corn penetrometer
- ECa measurement: electromagnetic induction type apparent soil EC meter
 - ECa was obtained in both shallow and deep mode at the soil surface in June 2002
- Combine yield monitoring system was used to obtain crop yield ('93-'02)
 - Yield data were cleaned and corresponded to sampling positions
- Sampling design: 30-m spacing grid sample within a 4-ha sub-field

Results and Discussions

- Measured soil hardness was correlated to both shallow and deep apparent soil electrical conductivity
- Soil hardness and crop yield were positively correlated in dry years and negatively correlated in wet years. Fifteen centimeter of precipitation in July and August could be a critical boundary to identify drought condition.
- Relationship of soil hardness to crop yield showed exactly opposite correlation trend when compared to soil electrical conductivity.
- We found that crop productivity was somewhat related to soil hardness but draught condition could be more critical to determine productivity.

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Table 1. Correlation of crop yield to soil profile hardness by soil depth.

Soil depth, cm	Corn				Soybean				
	'93	'97	'99	'01	'94	'96	'98	'00	'02
0 to 7	-0.19	-0.12	-0.19	-0.17	-0.16	0.06	0.08	0.02	-0.09
7 to 15	-0.18	-0.09	-0.13	-0.23	-0.16	0.07	-0.08	0.07	-0.07
15 to 30	-0.22	0.49	0.57	0.42	0.43	-0.34	-0.43	-0.42	0.15
30 to 45	-0.25	0.34	0.58	0.34	0.49	-0.46	-0.58	-0.45	0.01
45 to 60	-0.01	0.11	0.14	-0.01	0.00	-0.01	-0.25	-0.31	0.05
60 to 75	0.23	-0.39	-0.43	-0.44	-0.49	0.27	0.26	0.25	-0.09
75 to 90	0.20	-0.60	-0.60	-0.61	-0.56	0.24	0.34	0.43	-0.24

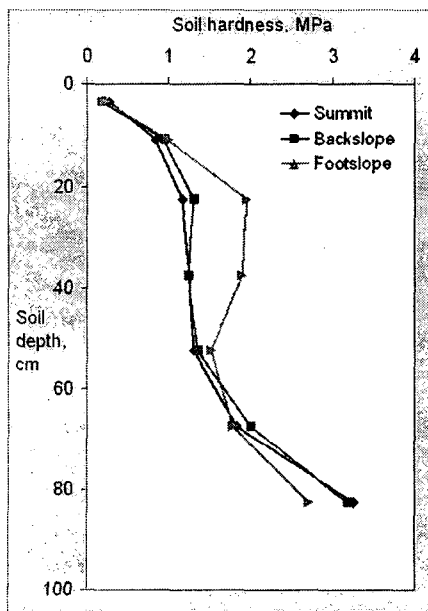


Fig. 1. Soil profile hardness by landscape position

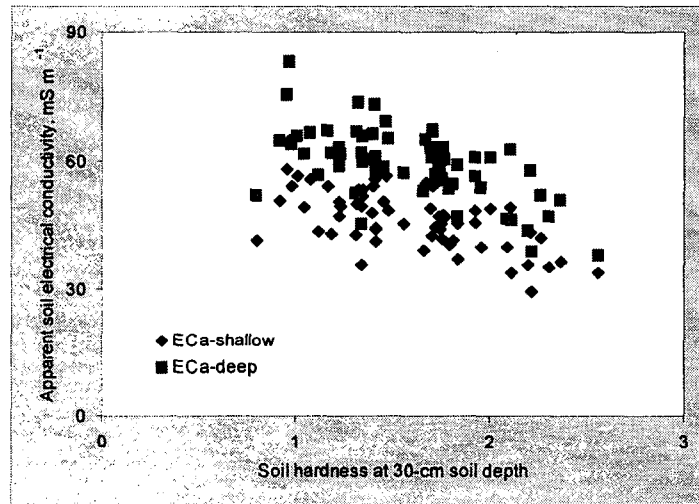


Fig. 2. Relationship of apparent soil electrical conductivity to soil hardness

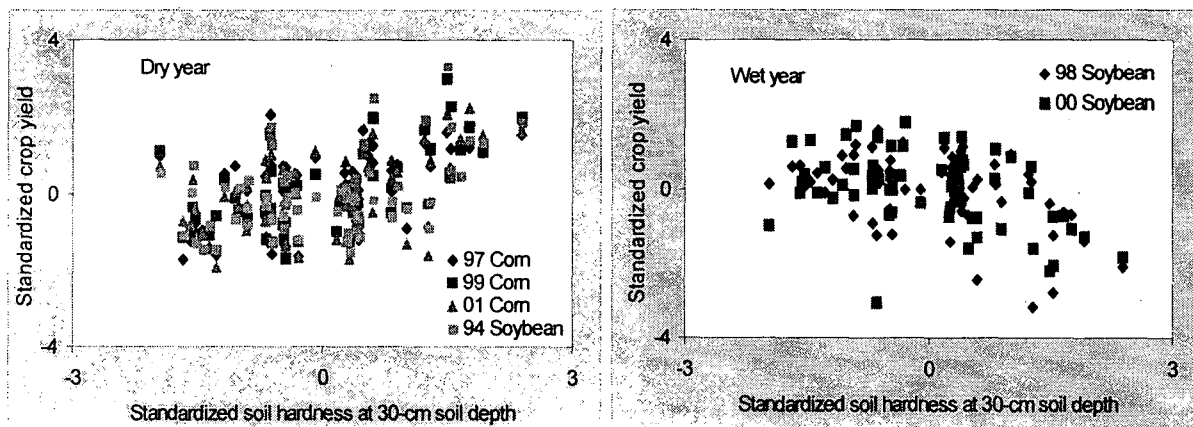


Figure 3. Standardized Crop yield and soil hardness at 30-cm depth were positively correlated in dry year (left) and negatively correlated in wet year (right).