

EFFECTS OF TILLAGE AND CROPPING SYSTEM ON SOIL PROPERTIES

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INTRODUCTION

Tillage affects the physical and chemical properties of the soil and this directly affects the yield and productivity of crops. Tillage turns crop residues under, stimulating microbial mineralization that favors bacteria over fungi (Frey et al., 1999). This leads to loss of nutrients, but generally provides an excess at the outset of the cropping year. Excess moisture and nutrients provide a buffer that can provide stable yields with variable precipitation. However, repeated tillage breaks down soil structure to expose previously protected soil organic matter (SOM) to mineralization (Bossuyt et al., 2002). The result is relatively high moisture and nutrient availability from the fallow effect early in the growing season and low availability later, when crops need resources for grain fill and building protein (Biederbeck et al., 1994). These effects become amplified through time as SOM stores are reduced and moisture and nutrient storage capacity is lost. (Aguilar et al., 1988; Bowman et al., 1990). The objective of this study is to assess the effects of tillage, cover crop and rotation on soil properties.

MATERIAL/METHODS

Study Area/Soil: Freeman farm in central Missouri; Waldron silty-clay loamy substratum and Booker silty clay

Laboratory Analysis: Soil samples were taken from the field; fresh and dry weights were taken and from these data the physical properties of the soil were calculated. Soil samples are also still being analyzed for soil chemical properties (not discussed here).

RESULT/DISCUSSION

For the first year of study,

❖ Histograms of soil bulk density, air-filled pore space, water -filled pore space, volumetric water content, gravimetric water content and total pore space are showed in Fig. 1. Table 1 shows the summary of simple statistics.

	AFP	BDY	VOL	GRV	TPS	WFPS
N	516.00	516.00	516.00	516.00	516.00	516.00
Mean	0.23	1.24	0.30	0.25	0.53	57.30
SD	0.09	0.16	0.05	0.05	0.06	12.87
C.V.	37.97	12.85	17.69	19.64	11.30	22.46
Minimum	0.05	0.69	0.11	0.09	0.34	18.74
Median	0.23	1.22	0.30	0.24	0.54	57.31
Maximum	0.59	1.75	0.53	0.50	0.74	88.71
Skew	0.48	0.22	-0.14	0.66	-0.21	-0.11
Kurtosis	0.60	0.37	1.66	2.94	0.38	-0.01

Table 1. Summary of simple Statistics

Source	DF	SS	MS	F	P
Block	2	0.0178	0.0089		
Tillage	1	0.00356	0.00356	0.18	0.6713
CROP	3	0.02508	0.00836	0.42	0.7361
Depth	3	2.71412	0.90471	45.84	0.000
Tillage*CROP	3	0.00641	0.00214	0.11	0.9553
Tillage*DEPTH	3	0.25286	0.08429	4.27	0.0054
CROP*DEPTH	9	0.17647	0.01961	0.99	0.4442
Error	491	9.68952	0.01973		
Total	515				

Table 2. Analysis of variance for soil bulk density

Source	DF	SS	MS	F	P
Block	2	0.02252	0.01126		
Tillage	1	0.02241	0.02241	9.22	0.0025
CROP	3	0.00623	0.00208	0.86	0.4644
DEPTH	3	0.1808	0.06027	24.81	0.0000
Tillage*CROP	3	0.00538	0.00179	0.74	0.5296
Tillage*DEPTH	3	0.00923	0.00308	1.27	0.2850
CROP*DEPTH	9	0.01257	0.0014	0.57	0.8182
Error	491	1.19281	0.00243		
Total	515				

Table 3. Analysis of variance table for volumetric water content

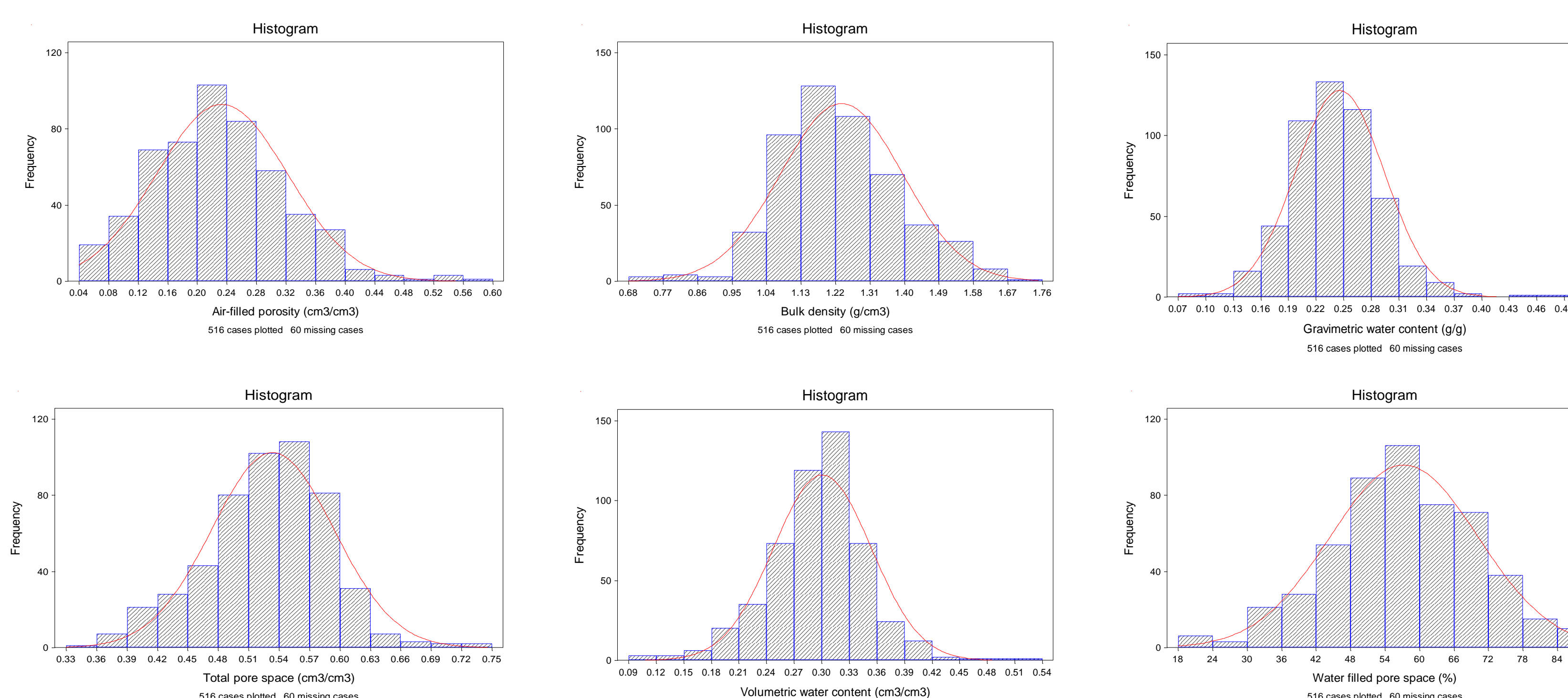


Fig.1 Histograms of soil physical properties

❖ The summary of statistics for soil bulk density, air-filled pore space, volumetric water content, gravimetric water content, total pore spaces and water -filled pore space are showed in Table 1. All soil physical properties were normally distributed with very little skewness .

❖ The Analysis of Variance in Table 2 shows that there was a significant interaction between tillage and depth for soil bulk density . The Analysis of variance also showed that tillage and depth had a significant effect on the volumetric water content of the soil (Table 3).

❖ Crop rotation (crop) alone did not significantly affect the bulk density, volumetric water content, gravimetric water content, air -filled pore space, water -filled pore space and total pore space of the soil.

❖ Gravimetric water content of the soil was only affected by tillage

SUMMARY

❖ Overall, soil physical properties were in the range of reported data with low variability (CV below 20%), except for soil air-filled porosity

❖ Crop rotation (Crop) had no significant effect on the physical properties of the soil.

❖ Tillage and depth had significant effect on the bulk density of the soil.

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