CROP SEQUENCE EFFECTS ON THE PROPERTIES OF A PALEUDALF UNDER CONTINUOUS NO-TILLAGE MANAGEMENT

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REFERENCE: J.E. Hook (ed.) *Proceedings of the 22nd Annual Southern Conservation Tillage Conference for Sustainable Agriculture,* Tifton, GA. 6-8 July 1999. Georgia Agriculture Experiment Station Special Publication 95, Athens, GA.

INTRODUCTION

Weathered well-developed soils are common in the Southeastern region of the US. These soils usually have low organic matter contents and often are highly susceptible to erosion. The maintenance of soil residue cover is key to improved soil productivity in this region and many of the region's cropping systems utilize reduced and no-tillage practices.

The literature is extensive regarding the effect of tillage and residue management on soil organic matter and resulting changes in soil physical and chemical properties. Tillage can mask crop rotation responses and rotation can alleviate potential adverse effects of reduced tillage on certain soils. However, the effects of cropping sequence on properties of soils under no tillage management have not been extensively studied. The amount of residues deposited, their composition, and their resistance to mineralization varies between plant species and often interacts with crop sequence and tillage practice. Plant materials with a high C: N ratio (corn, wheat) and great residue yield may be preferable to fasted the accumulation of organic matter in these soils because the hot humid climate provides an environment where residues decompose rapidly. Under these conditions, plant materials with high C: N ratios and/or lignin contents, which in turn produce a longer lasting mulch, may be preferable. Corn and wheat residues are examples of such plant materials.

The objective of this study was to identify the effects of several corn-based crops sequences on the properties of a Paleudalf under continuos no tillage management.

MATERIALS AND METHODS

The experimental site was located near Lexington (Kentucky, USA) on a Paluedalf (clay = 26 %, silt = 67 %). In 1990, the following 4 crop sequences were established in a randomized block design and with 4 replicates:

A= Continuous corn(C-C-C)
B= Corn - Wheat/Soybean - Corn(C-W/S-C)
C= Corn - Soybean - Corn(C-S-C)
D= Forage - Forage - Corn(F-F-C)

The no-tillage management of the plots used only chemical weed control just prior to and shortly after crop establishment (pre-emergence//post-emergence). Wheat crops were sown late October, corn and soybean crops in May and soybean as a double crop immediately after the wheat harvest in July. The clover in the forage treatment was sown in March and the grass in the prior October. Nitrogen fertilizers were applied to corn and wheat crops. Potassium fertilizers were applied in all the treatment with a higher rate used in the forage plots. Liming was done whenever called for by soil analysis.

During establishment of the summer crops in 1998 composite soil samples were taken at 0 to 3 and 3 to 6 in depths. The following analyses were performed on the air-dried soil samples: organic matter (dry combustion), total nitrogen (Kjeldahl), phosphorus, potassium, calcium and magnesium (Mehlich-3 extraction) and pH in water (1:10 ratio). The total amount of organic matter in each layer was calculated from the product of the sampled depth and the bulk density (Uhland sampler). All the soil properties were subjected to correlation analysis and ANOVA in two factors (crop sequence and depth) and means were separated by the LSD (T) significance test.

RESULTS AND DISCUSSION

The crop sequence and sampling depth did not interact significantly where pH, P, Ca, Mg and bulk density (BD) values are concerned. The first of these four properties were higher in the 0 to 3 in layer than in the deeper layer. No differences between depths were observed in the BD values (table 1).

The crop sequence that included 2 years of forage before planting the corn crop (Treatment D) induced a greater accumulation of soil organic matter (SOM) in the 2 sampled layers (table 2). When the row crop sequences were considered (Treatments A, B and C) differences in SOM were found only in the top layer, with the highest values observed in the continuos corn treatment (table 2). From the strong relationship between SOM and total N values ($r = 0.989$, $p<0.01$) it was deduced that although the different crop residues have different initial quality, the C:N in the soil remains practically constant. The differences in the extractable K levels between the crop sequences observed in the 0 to 3 in layer can be explained on the basis of the high fertilization rate in treatment D. No significant effects of SOM on the BD (compaction) status of the soil were observed.

The dry matter production of the forage plus the corn residue after harvest in treatment D was significantly higher than the crop residue left in the other treatments. In Fig. 1 it can be observed that the stored SOM in the cup 0 to 6 in layer of this soil was higher only under the F-F-C rotation. The insignificant differences between the row crop sequences reflect the minor variations in the accumulation pattern of the residues in these sequences.

Table 1: Effects of four crop sequences on soil ph, extractable P, Ca, and Mg and bulk density (BD) levels of a paleudalf under continuos no tillage management. Averages by depth or by crop sequence. Columns means followed by the same letter are not significantly different (tukey, $p<0.05$).

Crop Sequence	pH	P	Ca	Mg	BD
		------------------------lb acre^{-1}		-----------------------	g cm^{-3}
(A) C-C-C	6.15 b	93.0 a	3450 a	219.9 b	1.30 ab
(B) C-W/S-C	6.07 b	104.1 a	3337 a	217.6 b	1.28 b
(C) C-S-C	6.37 a	101.4 a	3662 a	243.5 a	1.34 a
(D) F-F-C	6.19 b	107.4 a	3517 a	213.5 b	1.33 a
Depth	pH	P	Ca	Mg	BD
		-----------------------lb acre^{-1}		---------------------	g cm^{-3}
0-3 in	6.27 a	112.2 a	3668 a	242.9 a	1.32 a
3-6 in	6.12 b	90.7 b	3315 b	204.4 b	1.31 a

Table 2: Effects of four crop sequences on soil organic matter (som), total Nitrogen (Nt) and extractable K in two sampling depths of a Paleudalf under continuos no-tillage management. Columns means followed by the same letter are not significant different (tukey, $p<0.05$).

	Depth					
	0-3 in			3-6 in		
	SOM	Nt	K	SOM	Nt	K
Corn Sequence	------------ %	-----------	lb acre^{-1}	------------%	----------	lb acre^{-1}
(A) C-C-C	3.39 b	0.202 ab	355 b	2.22 b	0.149 b	188 a
(B) C-W/S-C	3.11 c	0.190 bc	345 b	2.35 ab	0.152 ab	176 a
(C) C-S-C	2.96 c	0.181 c	346 b	2.23 b	0.146 b	180 a
(D) F-F-C	3.62 a	0.216 a	566 a	2.52 a	0.162 a	197 a

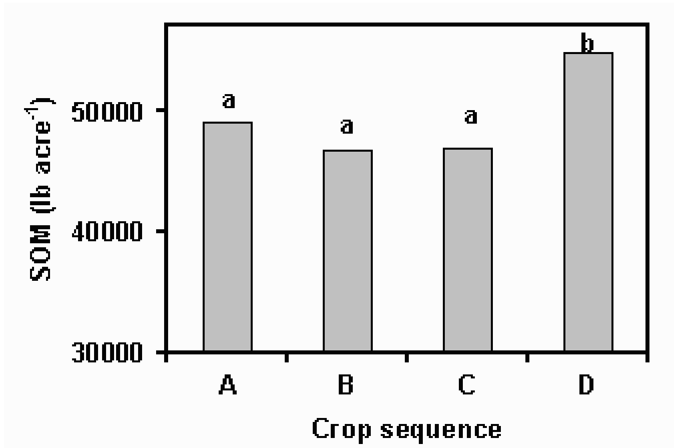

Fig. 1. Soil organic matter level in the 0 to 6 in layer of a Paleudalf under 4 crop sequences. Bars topped by the same letter are not significant different (Tukey, p<0.05).