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

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INTRODUCTION

The most frequently cropped soils in the western part of the Pampean Region of Argentina are Mollisols. They are deep sandy to sandy-loamed, well-drained, with low to medium organic matter contents and low water storage capacity. The organic matter content in the top layer has been described as the soil property that is most related to the yields of the principal crops of the region. This soil property plays a key role in these soils through its regulation of water and nutrient supply and in maintenance of stable soil structure. The use of no tillage systems is increasing in this area because of the advantages of this system, which are mainly related with organic matter conservation, improvements in water infiltration and storage, and reduced soil erosion.

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 little is known about the contribution of different crops and cropping sequences to soil properties under continuos no-tillage management. The total amount of residue deposited, its composition, and its resistance to complete mineralization varies among plant species and can interact in a complex way with crop sequence and tillage practice. Plant materials with a high C: N ratio (corn, wheat) and high yields may be preferable in order to accumulate organic matter in these soils.

The objective of this study was to identify the effects of several corn-based crop sequences on the properties of an Entic Hapludoll under continuos no tillage management.

MATERIALS & METHODS

Field plots were established near Daireaux, Buenos Aires (Argentina), in 1994, on an Entic Hapludoll (clay = 13.1 %, silt = 11.0 %). We used a completely randomized design of 16 plots (6.2 acre each) containing the following 4 crop sequences:

A= Wheat/Soybean - Corn - Sunflower - Corn
B= Corn - Sunflower - Corn- Sunflower
C= Sunflower - Corn - Soybean - Wheat/Corn
D= Soybean- Wheat-Grazing Oats/Sunflower-Corn

The no-tillage management of the plots consisted only of chemical weed control immediately after the harvest of the crops, during fallow, and then in the growing season of the crops. Wheat crops were sown in early July, oat in March, corn and sunflower crops in October, soybean in November and corn or soybean as double crops after wheat harvest in December. Fertilizers were applied only for corn crops (45 lb. acre-1 of DAP and 90 lb. acre-1 of urea). The oat crop was grazed directly with stacker cattle during winter.

After the harvest of crops in the fall of 1998 composite soil samples were taken at the 0 to 2 and 2 to 6-in depths. The following analyses were performed on the air-dried soil samples: organic matter (Walkley and Black), available phosphorus (Bray Kurtz 1) and pH in water (1:2.5 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 factor (crop sequence and depth) and means were separated by the LSD (T) significance test.

RESULTS & DISCUSSION

Although significant interactions due to the sampled depth and the crop sequence were observed, the soil organic matter (SOM), phosphorous (P) and pH levels were generally higher in the 0 to 2-in layer than in the 2 to 6-in layer. The opposite behavior was found for the bulk density values, likely related to the lesser amount of organic matter at the deeper depth. Most of the differences in soil properties due to the crop sequence were observed in the 0 to 2 in layer. The high P requirement of the sunflower crop and the lack of P fertilization of this crop, explain the low available P in treatment B (Table 1).

We observed that increasing the frequency of corn and wheat in the crop sequence (treatments A and C) caused

the level of stored SOM in the 0 to 6 in layer of the soil to be higher than that observed in the other sequences (Fig.1). This behavior can be ascribed in part to higher residue yield from corn and faster decomposition of soybean or sunflower residues. The grazing effect may also have had negative consequences on organic matter accumulation.

The SOM levels did not correlate with the BD values and we assume that the lack of relationship between both properties can be attributed to the random effect of traffic and the texture of the soil (sandy-loam).

From these results we conclude that crop sequences including corn and wheat components are beneficial for rapid SOM accumulation in Entic Hapludolls from subhumid temperate regions.

Table 1: Effects of 4 crop sequences on soil organic matter (SOM), available P (Bray Kurtz 1) and bulk density (BD) levels.

Crop sequence	0 to 2 in. Depth				2 to 6 in. Depth			
	SOM	P	pH	BD	SOM	P	pH	BD
	%	ppm		Mg m-3	%	ppm		Mg m-3
(A) W/S-C-Su-C	3.55 ab	20.9 a	6.47 a	1.32 a	2.81 a	7.7 c	6.32 a	1.32 a
(B) C-Su-C-Su	2.97 b	17.5 b	6.58 a	1.29 b	2.67 a	9.2 bc	6.35 a	1.34 a
(C) Su-C-S-W/C	4.12 a	20.7 a	6.46 a	1.29 b	2.60 a	12.8 a	6.08 b	1.32 a
(D) S-W-o/Su-C	3.10 b	22.8 a	6.47 a	1.29 b	2.11 b	10.8 b	6.07 b	1.32 a

Columns followed by the same letter are not significantly different (Tukey, $p<0.05$).

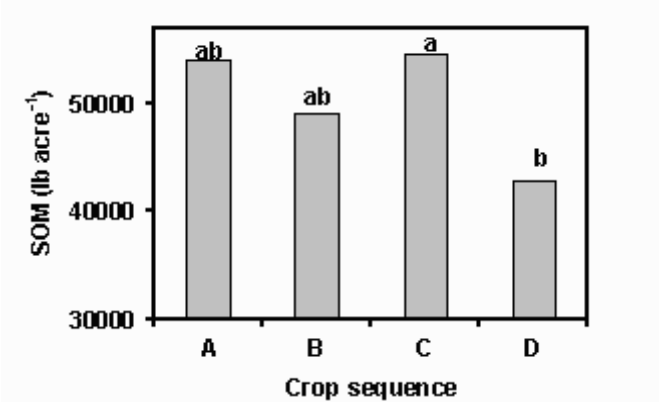

Fig.1: Soil organic matter content (0- 6 in depth) under 4 crop sequences grown on a Entic Hapludoll under continuos no tillage management. Bars topped by the same letter are not significant different.