SOIL NITROGEN AND ORGANIC MATTER CHANGES AS AFFECTED BY TILLAGE AFTER SIX YEARS OF CORN

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Abstract

Changes in soil chemical properties are expected from different tillage systems. Nitrogen and Organic Matter (OM) were measured to a depth of 60 cm in tillage treatments on an Alfisol (Hernando loamy fine sand, a member of the fine mixed thermic family typic Hapludalfs) in a six year old corn (Zea mays L.) experiment. The experiment was a split plot with conventional and no tillage treatments as whole plots, and position of sampling either over the row or between the row as split plots. No tillage treatments had 45% more N in the top 15 cm of the soil as compared to conventional plots (3.065% N in no-tillage versus 0.045% in conventional). This same relationship was similar for OM with no-tillage plots having 35% more OM than conventional. There was a close positive correlation between N and OM and they decreased linearly with depth. The decrease from the surface to 60 cm was from 2.00 to 0.50% for OM and 9.05 to 0.013% for N.

Introduction

The organic matter OM) content present in the soils is highly variable, and is considered to be a very important factor in plant growth and soil fertility. Stevenson (1982) by considering several important facts about OM, concluded: 1) Addition of fresh organic residues may result in a small priming action on the native OM of the soil; 2) Plant residues decay rapidly in soil and are more or less completely transformed, even the lignin fraction.

In multicropping farming, land productivity is maximized per unit area per season. This practice is very important in Florida where rainfall is high and the year round warm climate is conducive to multiple cropping. Several studies conducted with no-tillage and minimum tillage have shown that OM content on the soil surface is higher as compared to conventional tillage systems (Blevins et al., 1977 ; Dick, 1983 ; and Lal, 1974). Moschler et al (1972) suggested that the no-tillage increases the total OM in the soil.

The purpose of this study was to determine the relationship between N and OM after six years of conventional tillage and no-tillage practices used on corn (Zea mays L.).

Materials and Methods

The experimental field is located in Williston, Florida. The soil is a Hernando loamy fine sand (Member of the fine mixed thermic family of typic Hapludalfs) with a slope of 2 to 5%. Corn had been grown for Six years. Four tillage treatments (no–tillage plus subsoiling, no–tillage, conventional tillage plus subsoiling, and conventional tillage.) were replicated four times. The experiment was a split plot with conventional and no–tillage systems as whole plots and position of sampling either over the row or between the row as split plots. Analysis of variance for a split plot was conducted according to Steel and Torrie (1960) using a TRS 80 Model III microcomputer.

The soil samples were taken in early spring of 1983, between the row and over the row to a depth of 60 cm in 5 cm increments to a depth of 30 cm and 15 cm increments from the 30 crn to the 60 cm depth. The samples were air dried and ground to pass a 2 mm sieve. Organic matter was determined by Walkley-Black method (Allison, 1965). Soil N was by Kjeldahl digestion (Gallaher et al., 1975) followed by colorimetric determination on an autoanalyzer.

Results and Discussion

Soil N was different in the 0-5 crn soil layer among tillage treatments, however there were few differences at deeper layers (Table 1). Percent N was not affected by row sampfing position at any depth and there were no interactions between tillage treatments and the position of sampling. More soil N was associated with no–tillage by 45% (no-tillage 0.065% N and conventional 0.045% N) as compared to conventional tillage treatments (Table 1). Soil N content was higher over the row position at the soil surface in no-tillage treatments as compared to no-tillage plus subsoiling, however these differences were lower between the row. This fact may be accounted for by N leaching and denitrification losses as a result of subsoiling.

By combining sampled soil layers in 15 cms increments with depth (Table 1) differences in N were only found at the 0-15 cm depth where no-tillage treatments were higher than conventional tillage by a difference 0.01% N. No differences were found at greater depths in the soil profile.

Percent OM was significantly affected by tillage at at the 90% probability level in the 0–5 cm depth and at the 95% probability level in the 45–60 crn depth. Between the row, OM was higher than over the row, at the 0-5 cm depth. At the same depth, the interaction between sampling position and tillage treatment was significant. In the no–tillage plus subsoiling treatment, OM decreased by 20% over the row as compared to the other sampling position. Migration of OM, leaching of N, and increased OM decomposition as a result of increased aereation could be responsible for this decrease. In the 0-5 cm depth significant differences were found between the row, in no–tillage plus subsoiling and conventional tillage plus subsoiling. On the average, OM was 35% higher in no-tillage treatments than in conventional tillage treatments (Table 2).

When combining layers in 15 cm increments with depth, interactions were found between sampling position and subsoiling treatments (no–tillare and conventional). Between the row, the subsoiling treatments were different, and over the row no–tillage and conventional tillase plus subsoilins were different. At the 45 to 60 cm depth, no-tillage plus subsoiling had more 0.M. than conventional tillage treatments (Table 2).

Summary

1. No–tillage treatment increased the soil N in the 0-5 cm depth.
2. Increases up to 35% and 45% in OM and N respectively occurred in no–tillage treatments as compared to conventional tillage treatments.
3. Subsoiling over the row decreased OM by 20X as compared to other non subsoiling treatments. This was likely due to leaching of N and decomposition of OM and its migration to the lower profiles.
4. Soil OM and N decreased with depth but the change in OM was geater than in N.
5. A highly positive correlation was obvious between OM and N especially in the 0–5 cm depth. This may be because most of the N is likely associated with the OM in the soil surface and to mineral colloids in lower depth.
6. The use of crop residues in no–tillage and multicroppinq systems can alleviate the losses of N by leaching and denitrification in this type of soils. The values reported, support the fact that OM can be increased in soils with high rainfall and temperature regimes.

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Table 1. Percent nitrogen in the *0-5* and *0-15* cm depth of an Alfisol as affected by conventional versus no-tillage treatments and corn management after six years.

Tillage	Soil Surface Position: Between Row	Over Row	Average
	% N, *0-5* cm Depth		
No with Subsoil	*0.060*	*0.060*	*0.060* ab
No	*0.063*	*0.068*	*0.065* a
Conv with Subsoil	*0.046*	*0.043*	*0.045* b
Conv	*0.047*	*0.048*	*3.047* b
Average	*0.054*	*0.055* NS	
	% N, *0-15* cm Depth		
No with Subsoil	*0.051*	*0.053*	*0.052* a
No	*0.053*	*0.055*	*0.054* a
Conv with Subsoil	*0.044*	*3.042*	*0.043* b
Conv	*0.045*	*0.046*	*0.046* b
Average	*0.048*	*0.049* NS	

NS means no significant difference. Values in columns not followed by the same letter are significantly different at the *0.05* level of probability. No means no-tillage. Conv means conventional tillage.

Table *2.* Percent organic matter in the *0-5, 0-15* cm depth of an Alfisol as affected by conventional versus no-tillage treatments after six years of corn cropping.

Tillage	Sig	Soil Surface Position: Between Row	Over Row	Average
		% OM, *0-5* cm depth		
No with subsoil	*	*2.16* a	1.72 ab	*1.94*
No	NS	*2.01* ab	*2.14* a	*2.08*
Conv with subsoil	NS	*1.43* b	*1.35* b	*1.39*
Conv	NS	*1.56* ab	*1.51* ab	*1.54*
Average		*1.79*	*1.68*	
		% OM, 0-15 cm depth		
No with subsoil	*	*1.79* a	*1.59* ab	1.69
No	NS	*1.70* ab	*1.75* a	*1.73*
Conv with subsoil	*	*1.41* b	*1.34* b	1.38
Conv	NS	*1.52* ab	*1.53* ab	*1.52*
Average		1.61	*1.55*	
		% OM, *45-60* cm depth		
No with subsoil		0.68	*0.57*	0.63 a
No		*0.42*	*0.57*	*0.50* ab
Conv with subsoil		*0.41*	*0.32*	*0.37* b
Conv		*0.40*	*0.40*	*0.40* b
Average		*0.48*	*0.47* NS	

NS means no significat differences. The * means there are significant differences in OM between soil surface positions of sampling within the tillage treatment at the *0.05* level of probability. Values in columns not followed by the same letter are significantly different at the *0.05* level of probability. No means no-tillage. Conv means conventional tillage.