ORGANIC MATTER AND NITROGEN IN AN ULTISOL AS AFFECTED BY CROPPING AND TILLAGE SYSTEM AFTER SEVEN YEARS.

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Organic matter (O. M.) contents in the soil surface is usually higher under no-tillage or minimum tillage than under conventional tillage (Gallaher, 1983, Dick, 1983). Blevins, et al., (1977) showed that organic soil N was significantly higher under no-tillage and increased with increasing rates of N fertilizer applied.

The objective of this study was to determine the O. M. and N content in an Ultisol as affected by cropping and tillage systems.

Materials and Methods

The experiments were conducted at Green Acres Agronomy farm near Gainesville, Florida, on an Arredondo loamy sand, a member of the loamy, silicious, hyperthermic family of grossarenic Paleudults. The field study started in 1976 included cropping systems of oat (Avena sativa)/soybean (Glycine max L. Merr.) versus oat/grain sorghum (Sorghum bicolor L.) that were split plots of four tillage treatments: No-tillage subsoil, no-tillage, conventional tillage subsoil, and conventional tillage. Tillage treatments were whole plots in a randomized complete block with four replications.

In November 1983 soil samples were taken in 12 increments of depths (0-5, 5-10, 10-15, 15-20, 20-25, 25-30, 30-35, 35-40, 40-50, 50-60, 60-70, 70-80 cm) for laboratory analysis of N and O M The soil was air dried and sieved to pass a 2 mm stainless steel screen. Organic matter (organic carbon) was determined by the Walkley-Black method and soil N was by Kjeldahl digestion followed by colorimetric determination. Statistical analysis of each soil depth was for a split plot and was conducted with a TRS 80 Model III microcomputer.

Results and Discussion

Nitrogen

Cropping systems did not differ in soil N at any depth (table 1). There were differences in percent N among tillage plots only at the 0-5 cm depth (table 1). No interaction occurred and N was highest in no-tillage plots compared to conventional tillage. No-tillage had more soil N than other treatments and was 12, 15, and 2% more than no-tillage subsoil, conventional tillage subsoil, and conventional tillage, respectively (table 1).

Organic Matter

No differences in O M were found between tillage systems at the 0-5 cm depth. Similar results in O C levels were reported by Hargrove, et al., (1982). There were differences in percent O M among tillage treatments at the 5-10 and 10-15 cm depths at the 99% probability level and at 25-30 and 60-70 cm depths at the 90% probability level (table 2). No interactions occurred at the 5-10 and 10-15 cm depths and O M was generally highest in conventional tillage and lowest in no-tillage.

Conventional tillage was 16, 22.6, and 5% higher in O M than no-tillage subsoil, no-tillage, and conventional tillage subsoil at the 5-10 cm depth (table 2). Soil O M at the 5-10 cm depth was not affected by subsoiling but was higher in the "conventional tillage without subsoil" treatment that either of the no-tillage treatments (table 2). No differences were found between cropping systems at this depth. Conventional tillage had 23.6, 13, and 26% higher O M than no-tillage subsoil, no-tillage, and conventional tillage subsoil at the 10-15 cm depth (table 2). Soil O M at the 5-10 cm depth was not affected by subsoiling but was higher in conventional tillage, than the no-tillage treatment (table 2). No differences were found between cropping systems at this depth.

Differences in O M were found at the 25-30 and 60-70 cm depths at the 90% probability level (table 2). Conventional tillage subsoil showed 2, 16.6, and 3% more O M than no-tillage and conventional tillage, respectively at the 20-25 cm depth (table 2). Conventional tillage subsoil had 23.6, 13, and 26% more O M than no-tillage subsoil, no-tillage, and conventional tillage at the 60-70 cm depth (table 2). No differences between cropping systems were found at this depth.

Variations in percent O M (percent O C) and percent N in the first 0-30 cm soil depth has been reported by several investigators in minimum and conventional tillage experiments (Gallaher (1983), Dick (1982), and Hargrove et al., (1982). Some important points affecting no-tillage O C and N in the 0-30 cm soil depth, were outlined by Hargrove et al., (1982). In this Florida experiment, several factors are suggested that can affect the distribution of O M through the soil profile (especially in the 0-15 cm depth).

1. High temperature and moisture in Florida would limit the accumulation of O M from plant residues deposited on the soil surface (O M oxidation and C loss).
2. Incorporation of residues by plowing may explain the higher contents of O M at the 5 to 15 cm depth. Incorporation would place residue in a more moist and cooler environment than leaving on the soil surface in the hot humid climate of Florida.
3. The sandy texture of this Florida soil would not retain O M as well as a soil having a clayey texture.

O C-N relationships (C/N)

The O C/N ratio in the 0-5 cm soil depth was lower for no-tillage compared to conventional tillage (table 3). Cropping systems did not differ in O C/N at any depth of the soil profile.

No-tillage had the lowest O C/N ratio followed by no-tillage subsoil, conventional tillage and conventional tillage subsoil. This lower O C/N ratio in the no-tillage systems at the 0-5 cm depth could be explained by:
1. There would be more residues on the soil surface of no-tillage plots to accumulate as compared to incorporation in conventional tillage. 2. The higher temperature on the soil surface causes plant residues to break down rapidly through oxidation and CO_2 evolution. 3. The conditions that cause rapid breakdown of O M under no-tillage also would favor a more rapid N mineralization.

Conclusions

Tillage affected N and O M in the top 15 cm. Nitrogen was higher in no-tillage than in conventional tillage systems at the 0-5 cm soil depth. Organic matter was higher in conventional tillage than in no-tillage at the 5-15 cm depth. Cropping systems of oat/grain sorghum versus oat/soybean had little effect on these variables.

Soil N and O M were highly positively correlated throughout the soil profile. Both N and O M decreased almost linearly from the surface (N = 0.06% and O M = 1.57%) to a depth of 35 cm, (N=0.015% and O M = 0.45%), then increased to a depth of 70 cm (N = 0.011% and O M = 0.32%) and decreased again at 80 cm.

The analysis of variance of the O C/N ratio only detected differences (95% probability) between treatments at the 0-5 cm depth. Otherwise, the O C/N ratio followed the same trend as that observed in O M and N except at the 30 cm depth.

Various factors such as climate, residue accumulation and incorporation, soil temperature, moisture, tillage, cropping systems, and soil particle size influence O M and N. More soil chemical and physical variables need to be studied to better understand N and O M in this tillage and cropping systems experiment.

Literature Cited

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Table 1. Percent nitrogen in the 0 to 5 cm depth of an Arredondo fine sand as affected by tillage and cropping system after seven years.

Tillage	System: Oat/Soybean	Oat/Sorghum	Average
	%N		
No-tillage subsoil	.063	.056	.60 ab
No-tillage	.068	.069	.068 a
Co-tillage subsoil	.044	.058	.051 b
Co-tillage	.053	.058	.056 b
Average	.057	.060 NS	

Values in average column not followed by the same letter are significantly different at the 0.05 level of probability according to Duncans new multiple range test.
NS= No significant differences at the 0.05 level of probability according to F test.
No-Sub= No-Tillage Subsoil
No= No-Tillage
Conv-Sub= Conventional-Tillage Subsoil
Conv= Conventional-Tillage

Table 3. Organic Carbon/Nitrogen relationships in an Arredondo fine sand at the 0-5 cm depth as affected by tillage and cropping system after seven years.

Tillage	System: Oat/Soybean	Oat/Sorghum	Average
	OC/N		
No-tillage subsoil	15.01	14.17	14.59 ab
No-tillage	12.10	14.11	13.41 b
Co-tillage subsoil	17.73	16.86	11.10 ab
Co-tillage	17.27	16.65	16.96 a
Average	15.53	15.60 NS	

Values in columns not followed by the same letter are significantly different at the 0.05 level of probability according to Duncans new multiple range test. The NS between average values for comparing croppinu systems means no significant differences at the 0.05 according Lo F test.
OC/N = Organic Carbon/Nitrogen.
Co = Conventional-Tillage.
No = No-Tillage.

Table 2. Percent organic matter in the 5 to 10, 10 to 15, 25 to 30 and 60 to 70 cm depth of an Arredondo fine sand as affected by tillage and cropping system after seven years.

Tillage	System: Oat/Soybean	Oat/Sorghum	Average
	%OM (5-10 en)		
No-Tillage Subsoil	1.45	1.21	1.33 be
No-Tillage	1.17	1.29	1.23 c
Co-Tillage Subsoil	1.42	1.61	1.51 ab
Co-Tillage	1.41	1.12	1.59 a
Average	1.31	1.46 NS	
	%OM (10-15 cm)		
No-Tillage Subsoil	1.24	1.20	1.22 b
No-Tillags	1.10	1.11	1.13 b
Co-Tillage Subsoil	1.29	1.54	1.42 a
Co-Tillage	1.40	1.58	1.49 a
Average	1.26	1.37 NS	
	%OM (25-30 cm)		
No-Tillage Subsoil	0.98	0.90	0.94 at
No-Tillage	0.12	0.88	0.80 b+
Co-Tillage Subsoil	0.81	1.10	0.96 a+
Co-Tillage	0.84	1.02	0.91 a+
Average	0.84	0.98 NS	
	%OM (60-70 cm)		
No-Tillage Subsoil	0.36	0.21	0.29 a+
No-Tillage	0.21	0.40	0.33 b+
Co-Tillage Subsoil	0.29	0.41	0.18 ab+
Co-Tillage	0.23	0.32	0.28 b+
Average	0.28	0.35 NS	

Valuer in average column not followed by the same letter are significantly different at the 0.05 level of probability according to Duncans new multiple range test. The NS between average values for comparing cropping systems means no significant differences at the 0.05 level of probability according to F test.
+ = Means that the level of provability is at the 0.10 level according to Duncans new multiple range test.
Co = Conventional-Tillage
No = No-Tillage