Soil Fertility Dynamic in a Long-Term Cropping System in the Northern Great Plains

Ezra Aberle, J. Paulo Flores. NDSU Carrington Research Extension Center

Introduction

- Agriculture in North Dakota is diverse, and a large number of crops are grown across the state.
- Weather patterns and soils determine the distribution of crop production across the state.
- Soil tillage and crop rotation practices are widely used.
- What are the long term impacts of crop rotation, tillage, and fertilizers on soil fertility in the Northern Great Plains?

Material and Methods

- It was started in 1987 at the CREC (around 40 acres).
- Three tillage systems (North-South): no-till, conventional, and minimum tillage.
- Four nitrogen (N) treatments (East-West): 0, 50, and 100 lbs of N/ac (Urea, spring), and 200 lbs of N/ac every four years (composted feedlot manure, spring).
- Three, four-year crop rotations.

Figure 1. Long-term cropping system study plot map.

Results and Discussion

Table 1. The effect of tillage systems on soil attributes across years, crops, and fertility treatments (2007-2010).

Tillage	pH	P, ppm	OM, %	Nitrogen, lbs/ac			
		0-6 in		0-6 in	6-12 in	12-24 in	24-48 in
Minimum	6.6	15.9	3.3	15.5	7.5	13.4	24.0
No-Till	6.5	17.1	3.6	15.6	7.2	9.5	21.9
Tillage	6.6	15.5	3.2	14.8	7.5	14.8	23.2
C.V. (%)	8.1	15.4	64.1	64.1	124.9	125.1	93.4
LSD 0.05	0.1	1.2	0.1	NS	NS	1.8	2.6

Table 2. The effect of tillage systems on soil attributes across years, crops, and fertility treatments (2011-2014).

Tillage	pH	P, ppm	OM, %	Nitrogen, lbs/ac			
		0-6 in		0-6 in	6-12 in	12-24 in	24-48 in
Minimum	6.5	12.8	3.5	15.5	6.1	6.7	6.6
No-Till	6.4	13.8	3.7	16.0	5.9	6.6	5.5
Tillage	6.6	12.4	3.4	16.3	6.1	8.7	8.3
C.V. (%)	7.7	57.0	14.4	58.2	74.9	82.7	93.4
LSD 0.05	0.1	0.9	0.1	NS	NS	0.7	1.5

The no-till resulted in lower soil N in subsurface layers and total N in the profile, higher soil OM and P, and lower soil pH.

Table 3. The effect of fertility treatments on soil attributes across years, crops, and tillage systems (2007-2010).

Treatment	pH	P, ppm	OM, %	Nitrogen, lbs/ac			
		0-6 in		0-6 in	6-12 in	12-24 in	24-48 in
0	6.6	10.3	3.2	12.9	5.8	7.6	17.6
100	6.2	9.4	3.4	15.5	9.3	23.2	29.6
50	6.5	10.1	3.4	14.9	7.1	9.9	21.4
M	7.0	34.6	3.6	17.9	7.2	9.8	23.3
C.V. (%)	8.1	15.4	64.1	64.1	124.9	125.1	93.4
LSD 0.05	0.1	1.4	0.1	1.3	1.2	2.1	3.0

Table 4. The effect of fertility treatments on soil attributes across years, crops, and tillage systems (2011-2014).

Treatment	pH	P, ppm	OM, %	Nitrogen, lbs/ac			
		0-6 in		0-6 in	6-12 in	12-24 in	24-48 in
0	6.5	6.6	3.3	11.6	4.2	4.2	2.7
100	6.0	5.4	3.5	21.2	9.2	12.4	15.3
50	6.4	6.4	3.6	14.5	5.5	6.6	4.8
M	7.1	33.6	3.8	16.5	5.3	6.2	4.4
C.V. (%)	7.7	57.0	14.4	58.2	74.9	82.7	93.4
LSD 0.05	0.1	1.0	0.1	1.2	0.6	0.8	1.7

The manure treatment significantly increased soil OM, P, and pH, compared to other N treatments.

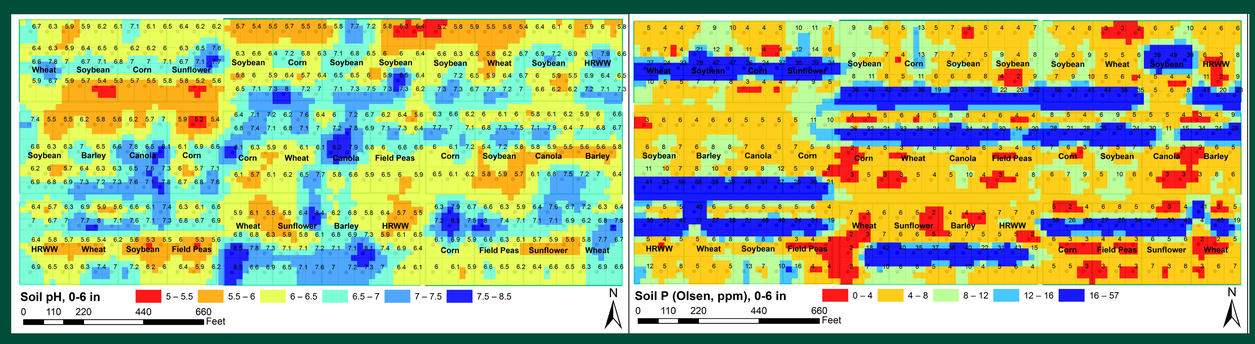

Figure 2. Soil pH and P maps (0-6 in, fall 2014) in a long term cropping system study at the Carrington REC.

Conclusions

- The no-till system increased OM and lowered pH.
- The manure treatment showed higher soil OM, P, and pH levels than the other nitrogen treatments.
- Rotation did not significantly impact soil attributes.

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