Profile Morphology in Response to Liming in the Kenyon Soil

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Liming benefits soil pH, soil organic matter (SOM), nutrient availability, root activity, and aggregate stability. Liming also influences a range of pedological processes throughout the profile, yet most liming research documents only properties in the top few inches of the soil profile.

The objective of this study was to document whole soil profile morphology and classification resulting from a one-time addition of contrasting lime rates in 1984 on a Kenyon (fine-loamy, mixed, superactive, mesic Typic Hapludoll) soil map unit.

Materials and Methods

Sixteen 40-in. deep soil cores were collected from a Kenyon soil map unit with eight collected in unlimed (UL) plots and eight collected in high lime (HL) plots. Cores were collected as pairs from a single plot (sampling of four plots UL and four plots HL). UL and HL plots had 0 lb. per acre and 16,000 lbs. per acre of effective calcium carbonate equivalent (ECCE), respectively, added in 1984. No additional pH-amendments have been added since then. Each plot is in a corn-soybean rotation. The plots are fall chisel plowed and annually fertilized at uniform rates of N (170 N lbs. per acre), P (50 to 60 lbs. per acre P_2O_5) and K (50 to 60 lbs. per acre). The pair of cores from each plot were split, with one being morphologically described and the other used for laboratory analysis. Laboratory cores were sampled at 0-6, 6-12, 12-24 and 24-40 in. Each laboratory sample was analyzed for bulk density (not reported here), pH in water (pHw), pH in dilute $CaCl_2$ (pHc), and organic carbon content (SOC). Statistical comparisons between HL and UL were analyzed using paired t-tests.

Key Takeaways

All 16 profiles are well-drained and have mollic epipedons deeper than 20 in. that occur immediately above argillic horizons that have active CEC. HL profiles have higher pH (Table 1) and are leached significantly deeper, yet have shallower redox features than UL profiles. SOC does not differ between UL and HL profiles (Table 1).

Each of the 16 profiles classify as a fine-loamy, mixed, active, mesic Pachic Argiudoll (Soil Survey Staff, 2021). This classification represents three differences from the expected "typical" Kenyon profile. First, the A horizon is thicker than normal. Second, there is a greater clay increase in the B horizon than normal. Third, the CEC is lower than normal.

The CSR2 S-factor and overall CSR2 value are unchanged. All 16 profiles have a CSR2 S-factor equal to 100, which is identical to the typical Kenyon soil. All plots have an overall CSR2 value equal to 83, which is unchanged from what is normal for a Kenyon soil on a B slope.

Table 1. Soil pH and SOC of high lime (HL) and unlimed (UL) profiles of the Kenyon soil.

Depth (cm)	pH_w						pH_C					
	HL	UL	Diff.	Std. error	P-value	N	HL	UL	Diff.	Std. error	P-value	N
0-15	6.5	5.2	1.33*	0.24	0.01	4	6.1	4.7	1.39*	0.27	0.01	4
15-30	6.1	5.2	0.93*	0.37	0.08	4	5.6	4.6	1.02*	0.38	0.07	4
30-60	6.8	5.9	0.92*	0.13	0.005	4	6.2	5.3	0.96*	0.16	0.009	4
60-100	6.8	6.0	0.81*	0.14	0.01	4	6.2	5.4	0.76*	0.13	0.008	4
	SOC (%)						SOC stock (g C/ m^2)					
0-15	2.39	2.36	0.03	0.13	0.67	4	3.89	3.87	0.02	0.11	0.85	4
15-30	2.09	2.42	-3.25	0.51	0.29	4	3.74	4.07	-0.33	0.67	0.65	4
30-60	2.04	1.99	0.55	0.28	0.72	4	7.57	7.30	0.27	0.52	0.63	4
60-100	1.56	1.58	-0.17	0.31	0.92	4	8.14	8.29	-0.15	0.9	0.89	4

*Indicates significant difference at alpha value of 0.1