Long-Term Liming Effects on Coastal Plain Soils and Crops

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Summary: *Many soils in the southern Coast Plain provide a hostile subsoil environment for root development. High aluminum levels, resulting in acidic soils, can cause toxicity of this element and low availability of calcium and magnesium. Adding more calcium and magnesium cannot correct the pH, however. Traditionally, liming has been the tool to combat acidity, but there has been some question over its ability to change* subsoil *pH. And, incorporating limestone directly into the plow layer is cost prohibitive.*

Now, we have data that that demonstrates surface liming does change the pH of the subsoil. At the University of Georgia-Tifton, research spanning more than 2 decades on one test plot and 3 decades on another plot proved that limestone migrates to the lower layers over time, resulting in a more suitable soil environment for root growth (see abstract and tables below). The rate of its migration and the amounts of lime needed are dependent on the soil type.

In sum, farmers can rest assured that a long-term liming program will help alter the stubborn soils of the Southeast. With a proper program, producers can balance the subsoil pH, thereby reducing toxicity from aluminum and improving calcium and magnesium availability.

ABSTRACT

Most agricultural soils in the southern Coastal Plain need liming to decrease acidity; however, long-term liming data on the value of liming and changes in soil profile pH, Ca, or Mg are needed. Field studies with lime rates have been maintained on a Tifton soil (Plinthic Kandiudult) for 31 yr and on Pelham soil (Arenic Paleaquult) for 24 yr to determine soil chemical changes, rates needed for high yields, and if yield of cotton (*Gossypium hirsutum* L.) on low pH soils can be increased by Ca or Mg fertilization. Total amounts ($CaCO_3$ equivalent) of dolomitic lime were 0, 7.5, 15.0, and 30.0 Mg ha^{-1} for Tifton and 0, 11.7, and 34.0 Mg ha^{-1} for the Pelham soil. Liming increased soil pH, Ca, and Mg to a depth of 90 cm. Decreases in soil pH, Ca, and Mg were closely related to the amount of ammoniacal N applied. Application of 15 Mg dolomitic lime ha^{-1} on the Tifton in 31 yr and 34 Mg ha^{-1} on the Pelham soil in 24 yr maintained surface-soil (0-15 cm) pH near 6.0 and provided sufficient Ca and Mg for greatest crop yield. In no-lime plots, in yr 2000, exchangeable Al (0 to 45 cm depth) was >0.3 $cmol_c$ kg^{-1} and Al saturation was >15 % of the effective cation exchange capacity on Tifton and >20 % on Pelham soil. In those plots, low cotton yields were not increased by fertilization with Ca or Mg salts without liming. Providing lime at 5.25 kg per kg N for the Tifton and 14 kg per kg N on the Pelham soil decreased soil Al saturation to <7 %.

Influence of limestone rates on crop yield and relative yield on Pelham soil for 24 years.

Year	Crop	Limestone rate ($CaC0_3$ equiv)			Limestone rate		
		0	Low	High	0	Low	High
		-------------Yield (Ton/acre)[1]--------------			------------Relative yield (%)----------		
1977	Soybean	1.29	1.29	1.29	100	100	100
1978	Soybean	0.91	0.89	0.91	100	97	100
1979	Soybean	0.94	1.03	1.01	92	102	100
1980	Soybean	0.14	0.23	0.21	70	113	100
1981	Soybean	0.86	1.02	0.63	135	161	100
1982	Corn	4.12	4.45	3.92	106	114	100
1983	Corn	3.13	3.15	3.06	102	103	100
1984	Peanut	2.66	3.01	2.84	94	106	100
1985	Tobacco	1.26	1.23	1.28	98	96	100
1986	Tobacco	0.82	1.02	1.17	70	87	100
1987	Peanut	2.06	2.03	1.82	114	112	100
1988	Rye	0.88	0.92	0.94	94	98	100
1989	Peanut	1.07	1.20	1.24	86	96	100
1990	Peanut	0.53	0.47	0.43	124	110	100
1991	Canola	0.43	0.80	0.93	47	86	100
1991	Cotton (seed)	0.26	0.62	0.64	41	96	100
1992	Canola	0.32	0.95	1.22	26	78	100
1992	Cotton (seed)	0	0.41	0.56	0	73	100
1993	Cotton (seed)	0.22	0.78	1.03	22	76	100
1994	Cotton (seed)	0.14	0.71	0.90	15	80	100
1995	Millet forage	3.60	5.66	6.53	55	87	100
1996	Millet forage	4.10	5.45	6.40	64	85	100
1997	Millet forage	2.78	3.70	4.13	67	90	100
1998	Cotton (lint)	0.21	0.48	0.46	46	105	100
1999	Cotton (lint)	0.06	0.24	0.31	19	76	100
2000	Cotton (lint)	0.09	0.47	0.52	18	91	100
Mean	-	-	-	-	69	97	100

[1] Data represent grain yields for canola, corn, rye, and soybean; oven-dry forage for millet; peanut pods; lint cotton and with seeds; and tobacco leaves.

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