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The Risk of Not Liming

Hailin Zhang, Kendra Wise, Gene Krenzer, Gordon Johnson, and Bill Raun
Department of Plant and Soil Sciences
Oklahoma State University

Soils from many fields in the central Great Plains have become severely acidic due to intensive crop production. As high as 39% of the wheat fields have a soil pH less than 5.5. Some fields have a soil pH below 4.0. Remediation of soil acidity is needed for those fields to sustain normal crop yields. A long-term study on the effects of nitrogen source and rate on continuous winter wheat (Experiment 505, Lahoma, OK) is used to illustrate the risk of not liming while fertilizer is routinely applied.

Experiment 505 was established in the fall of 1970 under conventional tillage on a Grant silt loam. The source of nitrogen (N) includes anhydrous ammonia (AA), ammonium nitrate (AN), urea (UR), and sulfur coated urea (SCU) applied at 0, 30, 60, 120 and 240 lbs. N per acre annually. Split application of AN and UR has also been implemented but not included in the discussion here. Sixty pounds of P_2O_5 and K_2O are also applied annually to supply phosphorus and potassium needs.

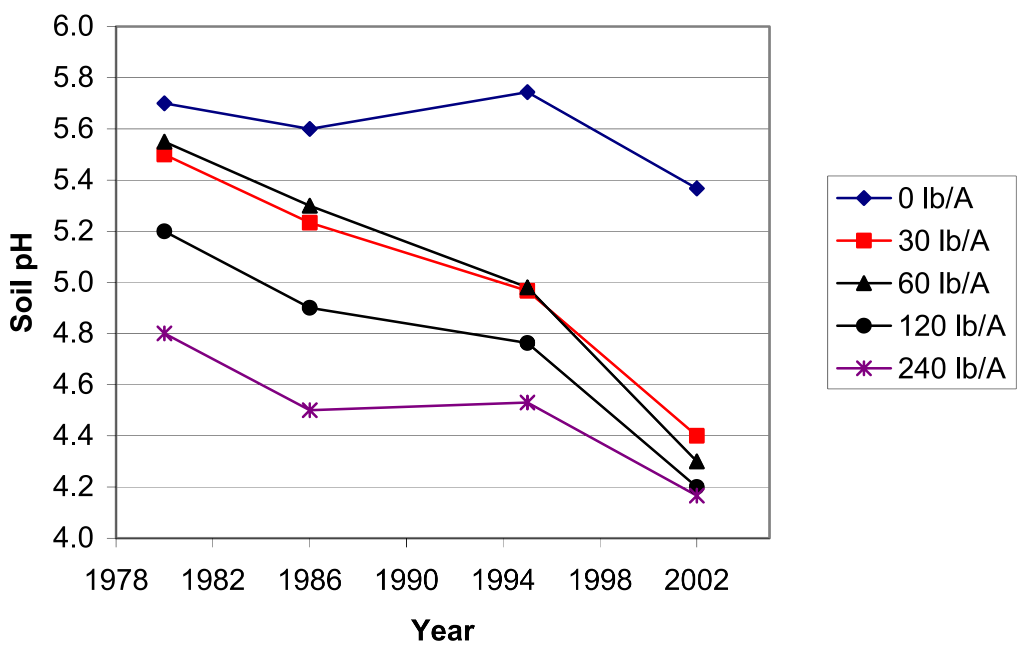

Figure 1. Soil pH change over time (1980 – 2002) with ammonium nitrate application (lb N/A). The experiment started in 1970, but soil pH was not available before 1980.

Soil pH gradually decreased over time for all the fertilizer treated plots (Figure 1 shows pH change of AN treated plots). The higher the N rates, the lower the soil pH. This is because higher N rates produced higher wheat yields in the early years and removed more base cations from the system. Some acidity is also a result of the acid forming nature of the fertilizer. Figure 2 shows the acidifying effect of the 4 different N sources. At 120 lbs N per acre, the acidifying effect of N fertilizer follows the order: AA > SCU >AN = UR; but at 240 lbs N per acre, the order is somewhat different: AN > AA > SCU > UR.

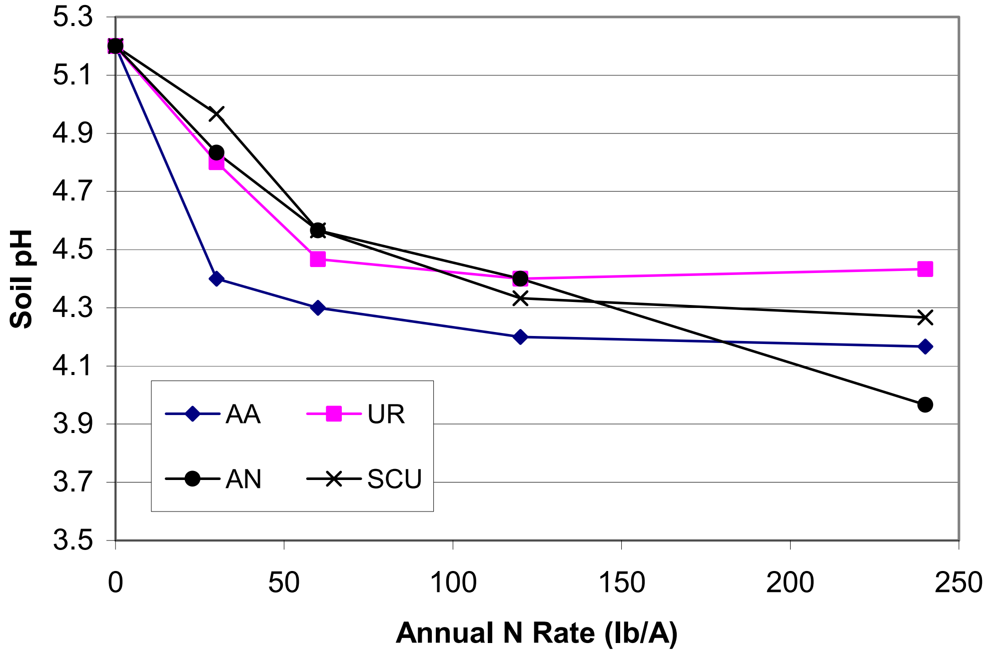

Figure 2. Soil pH recorded in 2002 with 5 nitrogen annual application rates (0, 30, 60, 120 and 240 lbs./acre) and 4 types of nitrogen sources (anhydrous ammonia, urea, ammonium nitrate, and sulfur coated urea).

When soil is getting more acidic, the aluminum (Al) is more soluble. High soluble and exchangeable Al in the soil is harmful to plant growth. Al saturation (the relative abundance of Al on the exchange sites to cation exchange capacity) has been shown to be a better indicator for Al toxicity. Al saturation is well correlated with soil pH (Figure 3). In general, the lower the pH is, the higher the Al saturation. This relationship varies slight among different soil types. Wheat grain yields have been gradually decreasing in the last decade for high N rate treatments due to soil acidity rather than nutrient supply (Figure 4). This is the risk we face if we continue to apply fertilizer without liming to correct soil acidity problem. A recent study in Perkins, OK showed soil pH had a dramatic impact on winter wheat fall forage production (Figure 5).

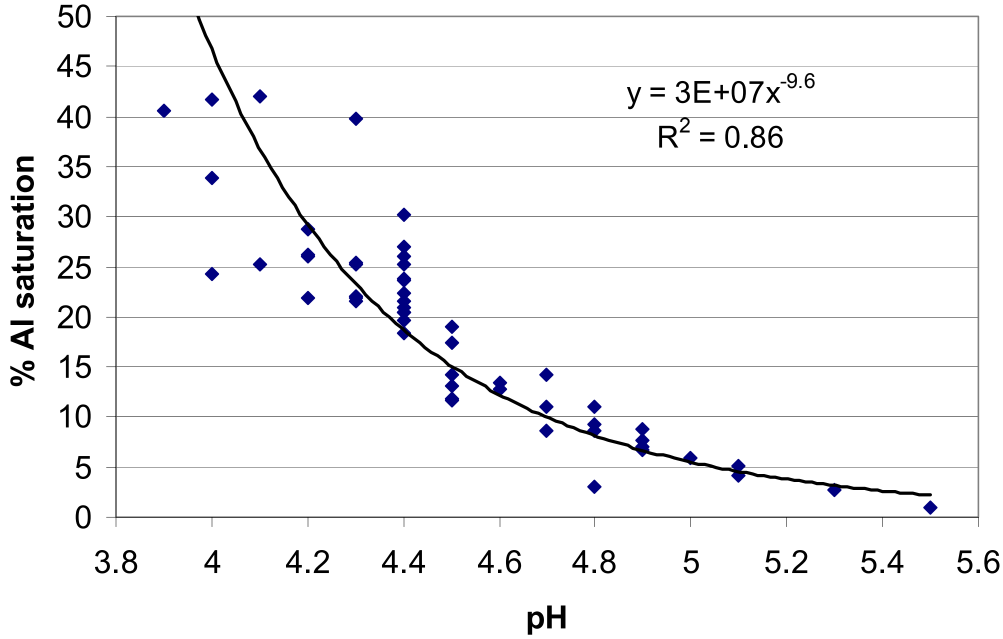

Figure 3. Aluminum saturation (Al relative to all the major exchangeable cations in the soil) is very high when soil pH drops to below 4.5.

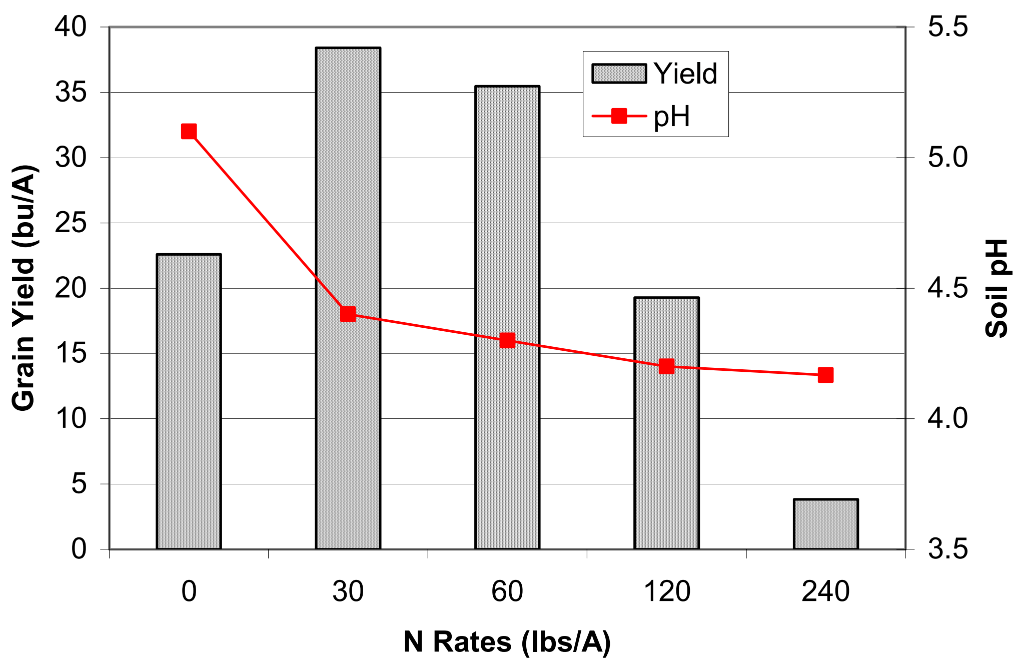

Figure 4. Average grain yields for the last 6 years are plotted against annual anhydrous ammonia application rates. Soil pH recorded in Spring 2002 is shown also. The reduced yield at high N rates is probably due to low soil pH or high Al saturation in the soil.

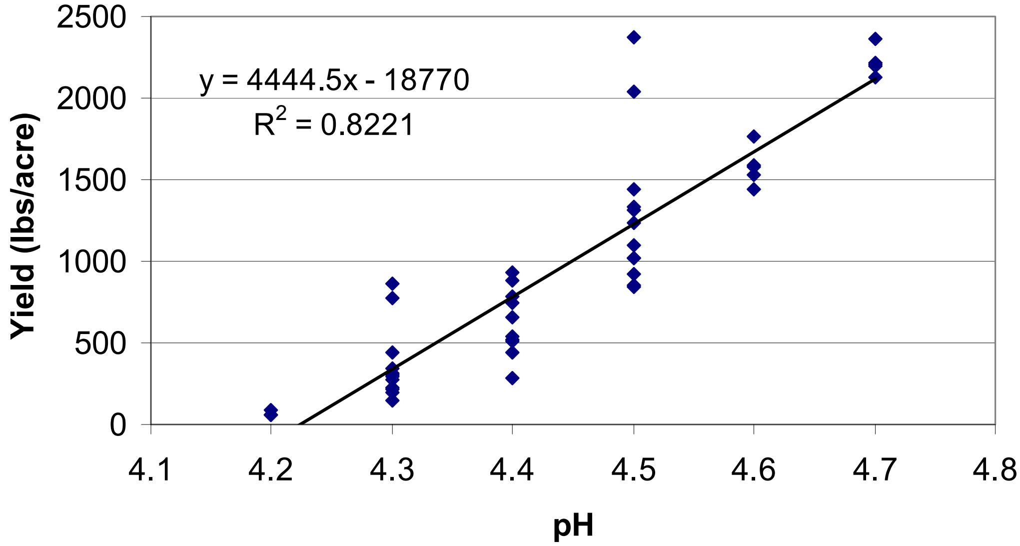

Figure 5. Winter wheat fall forage yields increased linearly with soil pH (data collected from Perkins, Oklahoma).

Liming is the most economical measure to increase soil pH, decrease soluble Al in soils, and improve wheat forage and grain yields. Now is the time to find out the soil pH in your field and plan liming to sustain crop yields and improve fertilizer efficiency.

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