Crop and Soil Responses to Rates of Lime

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Introduction

Grain producers in Iowa are interested in the effects of liming rates on crops and soils in corn/soybean rotations. Without forage legumes in a rotation, a soil must be properly fertilized to grow profitable, top yields. This is important for corn because a large amount of nitrogen (N) fertilizer is needed. Soil acidification from N fertilizer occurs at a rate that consumes 185 lbs of pure calcium carbonate/100 lbs N.

Materials and Methods

Each crop is grown in alternate years on a Kenyon soil that had an initial soil pH of 5.5. Agricultural limestone from a local quarry was broadcast in May 1984 at rates of 0, 1, 2, 4, 8, 12, and 16 thousand lbs effective calcium carbonate equivalent (ECCE)/acre and incorporated with a field cultivator. Soybeans are grown in even-numbered years and corn in odd-numbered years. In October 2001, soil samples were collected with a probe to a depth of 6 inches. Those samples were analyzed in Ames to determine acidity and lime requirement, available phosphorus (P), and exchangeable cations (calcium–Ca, magnesium–Mg, potassium–K, and sodium–Na.). Cation exchange capacity (CEC) was determined by summation of the calculated milliequivalent (meq) contents of Ca, Mg, K, Na, and hydrogen (H). The meqs of H were determined from lime requirement pHs using Equation [1].

$$H_{meq} = 12 \text{ X } (7\text{-}pH_{\text{lime requirement}}) \qquad [1]$$

Results and Discussion

Crops. Crop grain moisture contents and yields from 1994 to present are shown in Table 1. These data show that both crops respond positively to lime. The four-year averages show that corn moisture decreased 0.3% and yield increased eight bushels/acre as liming rates increased from zero to the maximum. Soybean grain moisture content and yields were generally greatest at 6,000 lbs ECCE/acre, although the decline to the -zero rate was greater than that to the 16,000-lb rate.

Soils. Soil tests were conducted to determine chemical properties affected through the past 17 years. Results shown in Table 2 are averages of four replications of each lime rate. Soil acidity declined to 5.1 from the initial 5.5 pH measured in 1984. Acidity decreased (higher pH) as liming rates increased, with the greatest increases occurring at the greatest rates. This observation is expected because the amount of soil acidity measured by pH increases 10-fold with every unit change in pH value. Available P– and K–values were erratic but tended to be greatest at soil pH near 7.0. Two P-test methods were used, Bray-1 and Olsen bicarbonate. The former is best for soil with pHs less than 6.5, and the latter at pH greater than 6.5. Exchangeable Ca and Mg contents increased with lime rate. This is reflective of the dolomite lime used in 1984. Soil cation exchange capacity (CEC) of the soil increased with greater acidity (lower pH). This is consistent with pH-dependent CEC observed in many soils.

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