REACIDIFICATION OF THREE LIMED SOILS IN CENTRAL AND WESTERN OREGON[1]

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INTRODUCTION

Liming of acidic soils in western Oregon to obtain optimum crop yields is a well established practice. Also, formerly neutral to alkaline soils in central Oregon have become increasingly acidified by intensive management resulting in the need for liming of some crops in this area. The effect of lime in raising soil pH extends beyond the first year after application, but prediction of the rate at which limed soils reacidify is not usually known. Prediction of soil acidification rates could provide important information for predicting lime needs.

The objective of this study was to quantify the long-term acidification rates of three very different lime-amended soils in central and western Oregon.

MATERIALS AND METHODS

Soils and Experimental Design

In the 1970s liming experiments were initiated on three acid soils, two in the Willamette Valley of western Oregon (Nekia and Woodburn) and one in central Oregon (Madras) (Table 1).

Table 1. Lime treatments.

Soil Series	Year established	Initial pH	Lime rates	Material(s) used
			-----T/A-----	
Nekia	1972	5.0	0, 1, 3.75, 6.5	calcite/dolomite
Woodburn	1971	5.3	0, 1, 3, 5	calcite
Madras	1976	5.5	0, 1, 2	calcite

One ton of dolomitic limestone per acre was included in the lime applications made to the Nekia soil due to a low initial soil test level for magnesium (Mg). Crops grown on the plots include alfalfa, wheat, clover and potatoes. The plots on the Madras soil were irrigated.

Composite soils samples from the surface 6 inches were taken periodically to monitor changes in the levels of basic cations applied in the liming materials.

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[1]Proceedings, 1985 Western Oregon Fertilizer Dealers' Conference. Albany, Oregon. Feb. 7, 1985.

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RESULTS

Determination of soil pH and extractable basic cations were made for 12 years following application of lime to estimate the rates at which these soils reacidified. Acidification rates, expressed in terms of decrease in pH units per year, were calculated based on the measured decline in extractable basic cations and the relationship between soil pH and basic cation saturation. In each soil, the rate of reacidification increased as the amount of lime applied increased (Fig. 1).

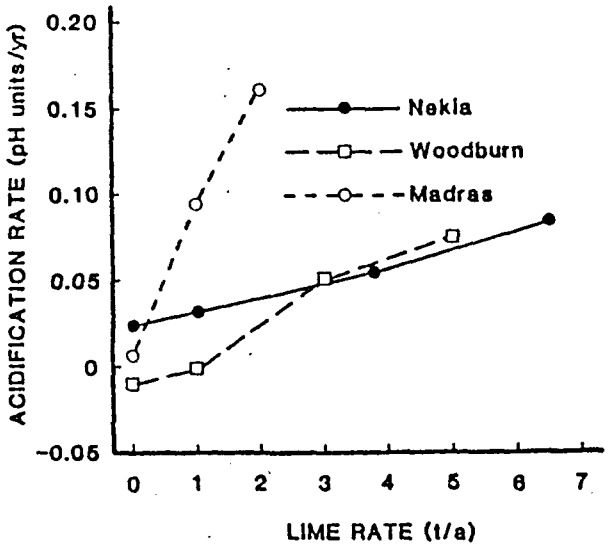

Fig. 1. Relationship between calculated soil acidification rates and amount of lime applied to Nekia, Woodburn, and Madras soils (0-6 in).

On the two nonirrigated Willamette Valley sites, unlimed soil acidified between nil and 0.02 pH units/year. At the highest lime rates, the pH of these two soils declined at the rate of 0.076 to 0.085 units per year. The highest acidification rate was measured on the central Oregon (Madras) soil receiving the highest rate of lime, 0.16 pH units/year. The positive relationship between soil acidification rate and quantity of lime applied is explained by the pH dependence of acidifying soil processes such as nitrification and carbonic acid formation from CO_2 in the soil atmosphere. Changes in the levels of extractable basic cations applied in the liming material were used to estimate the rates at which these soils reacidified.

In each experiment the amount of the basic cation(s) decreased linearly with time (Fig. 2).

SUMMARY

Long term lime experiments were conducted on two acidic Willamette Valley soils and one acid soil in central Oregon. Determination of soil properties related to liming were made for up to 12 years following application of lime to measure the rates at which these three very different soils increased as the amount of lime applied increased. This is attributed to the pH dependence of acidifying soil processes such as nitrification and carbonic acid formation from CO_2 in the soil atmosphere. Large differences in the acidification rates were observed between different soil types, with the highest rates occurring on irrigated coarse textured soils to which relatively high levels of NH_4 fertilizers had been applied.