Development of Lime Recommendations for California Soils

FREP Contract # 01-0511

Project Leaders
Robert O. Miller
Soil and Crop Sciences Department
Colorado State University
Fort Collins, CO

Dr. Janice Kotuby-Amacher
USU Analytical Laboratory
Utah State University
Logan, UT

Nat Dellavalle
Dellavalle Laboratories
Fresno, CA

Objectives

(1) Evaluate soil acidity on 100 soils from across the Central and Northern California, with emphasis on tree and vine crops
(2) Evaluate six buffer pH methods cited in the literature on California soils
(3) Evaluate lime equilibration models based on soil buffer pH
(4) Validate model buffer pH using twenty additional California soils
(5) Provide buffer pH method and model calibration to California soil testing laboratories.

Introduction

Acid agricultural soils although small in acreage across California, dominate vineyards in the North coast region, coarse textured field soils of San Joaquin Valley (SJV) and Sacramento valley. Increasingly strongly acid soils have been noted in Sonoma, Marin, Mendocino and Lake Counties, volcanic soils of Modoc and Lassen counties and moderately acid soils in Glenn, Butte, Stanislaus, Merced, Fresno and Tulare counties. In specific instances pH values are sufficiently low to produce aluminum toxicity. This occurs on soils with pH (1:1) less than 5.50.

Soils of the North coast are dominated by serpentine parent materials low in base saturation and moderately weathered. Particularly noteworthy are low pH values which impact vineyard production in Mendocino, Lake and Sonoma counties. Soils of the east SJV tend to be coarse textured, poorly buffered and receive moderately high amounts of ammoniacal nitrogen which acidify the soil. Low soil pH results in decreasing availability of calcium, magnesium, phosphorus, potassium, molybdenum, decreased nitrogen fixation and a decrease the activity of soil bacteria. Grapevine root growth can be seriously impeded by soil acidity. Management of soil acidity by liming and rootstock selection are

important factors in viticultural management.

Lime recommendations made by testing labs and consultants in California are made using the SMP Buffer pH method. This method was originally developed in 1961 for soils in Ohio and Mid Atlantic states and utilized in California over the last 30 years. Little or no lime requirement calibration data for this method is available for California soils and crops. Nor is it known whether the SMP method is the best analytical method to assess lime requirements on California soils. It is likely to over predict lime requirements on soils acidified through fertilization. No calibration data is available as to its effectiveness on serpentine soils of the North Coast area. With increasing occurrences of acid soils and intensities there of in California, soil buffer pH methods (and lime recommendations) need to be evaluated for California and their performance assessed with respect to soils, climate and cultural practices. This project will assess the performance of soil analysis methods as to their ability to predict neutralization of soil acidity across the North coast region, SJV of California and Sacramento Valley. Specific attention will made to reducing soil exchangeable aluminum.

One-Hundred soils are to be collected across California representing soils where soil pH (saturated paste methods and pH 1:1) has been reported to be less than 6.0 in the past five years. Special emphasis will be given to soil pH values less than 5.50, soils which have high KCl extractable aluminum (> 20 mg/kg) and soils where large amounts of ammoniacal nitrogen fertilizer has been applied in North coast region of California, soils of the north Sacramento Valley and coarse textured soils of the SJV.

Soils will be characterized with respect to soil pH (1:1), saturated paste characteristics, organic matter, KCl extractable aluminum, base saturation, CEC, total exchangeable acidity, extractable cations and sand silt and clay content. All soils will be analyzed using 10% standard reference standards secured from the North American Proficiency Testing Program.
Soil buffer pH will be evaluated using six reference methods: SMP Buffer pH; Modified SMP Buffer; Adams-Evans Buffer; Mehlich Buffer; Woodruff Buffer; and Modified Woodruff Buffer. Lime Equilibration will be based on the application of 100% Calcium Carbonate equivalent at five rates to 1.0 kg of each soil and equilibrated for 60 days.

Regression models will be developed which predict lime application and the buffer pH test method which prescribes soil acidity and best prescribes lime requirement will be selected. Models will also be developed predicting TEA. Twenty new soils will then be selected and the model retested using a second lime equilibration study. The models will be re-evaluated to assess their accuracy and validity.

Results

The project began in May 2002, and has collect 70 of the 100 soils (pH less than 6.0) from the Central coast, San Joaquin Valley, Sacramento Valley and the North Coast. Soil materials have been provided by commercial labs, field agronomists, consultants, UC extension personnel and fertilizer industry representatives. Soil analysis commenced in October 2002 and lime equilibration studies will initiate in March 2003.