Local Soil Attributes & Classification

To my knowledge, the BCSR theory has never been used to classify soils into groups based on their major element content. Earlier I cited several of the researchers from the literature who suggested the importance of using BCSR methodology, and reviewed the controversy over interpretation strategies. Hendricks, Nettleton and Grossman (1985, p. 49) discussed the importance of clay in arid soil classification:

> We propose that the clay mineralogy be made part of the family mineralogical criteria irrespective of the clay content. In most instances, the clay mineralogy is more important for predicting behavior than is the mineralogy of the nonclay. The U.S. system of soil taxonomy was developed largely at a time when interpretations for nonagricultural uses were more important relative to plant growth than is the case today. ... But for plant growth, specification of the clay mineralogy would seem the most important single mineralogical criterion, whether the zone contains 40 or 5% clay.

The Sonoma County Soil Survey (USDA 1990) shows the exchangeable cations and total CEC for six of the most extensive soil series in the county, although ratios must be calculated by the reader. Several agronomists use BCSR in their practices, notably Ralph Jurgens in the San Joaquin Valley, Amigo Cantisano in the Sacramento Valley, and Kate Burroughs in Sonoma County.

I have used and advocated the system for over 20 years,and more references to Ca: Mg ratios are now showing up in fertilizer recommendations of others. I noticed trends in topography and basic soil groups several years ago, and began to publish these generalizations in my newsletters to growers about 1986. I have wanted to correlate my soil test results with Soil Conservation Service Soil Surveys since 1989.

Several generalizations can be made from the interaction of our climate with the soils of Northern California. The moderate to high rainfall leaches out sodium. Except for ocean or bay front locations, no high sodium soils are found in the area. Leaching of calcium, with the resultant acidity, increases as the climate changes from the Central Valley westward and northward. This leaves the soils of northern coastal California with a limited number of possible combinations of major cation ratios. Several illustrations of these soil types are shown in Appendices J-L. Soils with high calcium and sodium are common in desert areas, and the BCSR theory also works well in such low rainfall areas. From over 20 years of soil testing in northern coastal California, I have found only variations of the following broad categories, based on the BCSR system:

Low Ca: high Mg: low to adequate K: low Na - These are found along the river valleys in sandy, silt and clay loam soils. They are commonly planted to tree fruits or vines with some pasture, hay, dairies or specialty crops.

Low Ca: medium to very high Mg: medium K: low Na - These are found on the dark gray soils of lowlands and basins, and are very heavy clays which are derived from serpentine. They are commonly planted with tree fruits, vines or pastures.

Low Ca: low to adequate Mg: high K: low Na - These are found on the red-brown loam and clay rich mountains, hills and terraces of the coast range. They are commonly planted to tree fruits and vines or used for grazing.

Low Ca: low Mg: high K: low Na - These are the highly leached sandy and silt foams of Sebastopol, Anderson Valley, and coastal regions. They are commonly planted to apples and grapes, or often used for timber or grazing.

Appendices M - Q are detailed descriptions of the general soil associations matched with Soil Conservation Service (SCS) Soil Surveys, along with instructions for interpretation. These add important nutritional information to the wealth of information contained in the county Soil Surveys.

This classification system has very practical uses: Limestone requirement can be determined by the Ca needed to raise the level to within the optimum range. It is easy to determine whether to add calcite or dolomite. Soil structural problems can be predicted and diagnosed. Potash and magnesium shortages or excesses can be predicted for given locales. Factors affecting the availability of other nutrients can be addressed, and costs of supplying major amendments estimated. Areas of similar cation ratios when overlaid on the US Soil Conservation Survey maps give a more complete picture of mineral characteristics and productivity potential. Managers can match nutrient needs of tree fruits, vines, vegetables, forages and pastures with soil nutritional characteristics. Likely limiting factors and estimates of appropriate amendments are easily made using charts of crop requirements with BCSR and other nutritional data.

Soil engineers rely on soil textural classifications to design site plans and specifications for wastewater and septic systems. Although drainage is one of of the most important characteristics in such systems, engineers seldom consider

the chemistry of the clay in their designs. Having base cation saturation ratios to correlate with general soil associations will help them predict where problem soils are found. By using this information, performing actual soil analyses on the sites, and recommending the proper amounts of amendments, many soils with marginal drainage and aeration could be usable. Since insuring good percolation is so important, consideration of BCSR should be mandatory for siting of wastewater systems.

This classification system, based on measured base cation saturation ratios, is a universal model for understanding important aspects of soil productivity, the chemistry of clays and fertilization needs in all soils from high rainfall forests to alkaline deserts. It is especially useful for fine tuning fertility programs, improving problem soils, and achieving the best quality or pest and disease resistance.