

SOIL CHEMISTRY AND CLAY MINERALOGY 1/B. R. Bertramson 2/

The early work of Fulmer characterized some of the representative soils of the State through total inorganic chemical analysis (Fulmer and Fletcher 1894). Sievers and Holtz (1912, 1923) did early pioneering studies on the carbon-nitrogen ratios and their relationships with the soil organic matter in soils of the Palouse. Vandercaveye joined Holtz to continue this pioneering work.

Vandecaveye (Personal correspondence with BRB 1983) observed more than 60 years later that control of codling moth with lead arsenate in apple orchards of the irrigated areas had been a costly mistake (Vandecaveye, 1938). The control of the insect has long since been effected by other insecticides; but the toxicity of the lead arsenate to crops subsequently grown on those soils largely remains, even today on over 40,000 acres of good irrigable land in central Washington (Benson and Reisenauer, 1951). They were able to describe the problem as to the concentrations and the very slow movement of this chemical through the soil; but simple corrective measures were not forthcoming. The arsenic toxicity still prevails, and is expected to remain a problem for decades.

Attention was also given to correcting soil acidity on Western Washington soils. To correct the soil acidity by liming --as had been done so successfully in the Midwest--was complicated here by:

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1. the huge amounts of lime required to raise the pH of very acid soils to the desired level, and
2. the unavailability of commercial agricultural lime from local sources resulted in a prohibitive cost of liming on the very acid soils.

The liming problems often seemed different from those of the Midwest. Several criteria were relied upon to diagnose the need and to indicate the best treatments to cope with this problem. These criteria were based upon field research and the development of correlated chemical tests. Even today, questions remain as to the most effective and economical methods of dealing with the soil acidity problems of these acid soils of Western Washington.

Heavy nitrogen fertilization of the irrigated soils of central Washington and of the Palouse wheatlands has markedly increased soil acidity of these soils which were near neutrality prior to cultivation. The time may come when liming will be a consideration on these soils. Indeed, some orchard soils of the Wenatchee area were found so acidic from early fertilizations with ammonium sulfate that severe manganese toxicity resulted (Benson, 1984).

Alkali soil problems were recognized very early in the work of the Experiment Station (Heileman, 1901). In the late 1940's Heald, Moodie, and Leamer (1950) tackled the problem of alkali soil reclamation in the irrigated areas of central Washington with elemental sulfur, gypsum, and flooding under irrigation. Positive results were obtained, but the applications were not economically feasible at that time. The accumulation of salts in irrigated soils--like the accumulation of lead arsenate in orchard soils--was a man-made problem, better to be avoided than to be corrected.

Added impetus to research on alkali soils of Washington was given by the employment of Dr. Brian McNeal in 1969. His prior experience at the U.S.D.A. Salinity Laboratory at Riverside, California, was a great asset in furthering research on the nature of the alkali soils and diagnosis of the severity of the alkali problems.

Basic studies of the mineralogical nature of Washington soils--though initiated earlier by Robert McCreery, a graduate student under Dr. H. W. Smith--were given impetus by the arrival of Dr. J. A. Kittrick in 1955. He conducted extensive studies on the identification of the clay minerals of Washington soils by X-ray diffraction. He also made extensive use of the electron microscope in his clay mineralogy studies and aided colleagues in their application of electron microscopy to studies of soils and biological materials.

Dr. Kittrick conducted pioneering work on the chemistry of soils through determining the stability of many of the important clay minerals in soils (1977). This made it possible for him to show how the formation of clay minerals in soils is controlled by the composition of the soil solution. Kittrick greatly strengthened graduate study in soils by offering an outstanding course in the clay mineralogy of the soil. His colleagues and admirers often said, "Kittrick has the knack of explaining involved principles and phenomena so they are quickly grasped by the students." This course was included in the graduate study program of nearly all the graduate students seeking a Ph.D. in any of the areas of soil science offered at WSU.

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