Chapter 14

Salinity: Electrical Conductivity and Total Dissolved Solids

J. D. RHoades, U.S. Salinity Laboratory, Riverside, California

INTRODUCTION

The term salinity refers to the presence of the major dissolved inorganic solutes, essentially Na⁺, Mg²⁺, Ca²⁺, K⁺, Cl⁻, SO₄²⁻, HCO₃⁻ and CO₃⁻, in aqueous samples. As applied to soils, it refers to the soluble plus readily dissolvable salts in the soil or, more usually, in an aqueous extract of a soil sample. Salinity is quantified in terms of the total concentration (or, occasionally, the content) of such soluble salts. The diagnosis, assessment, management and need for reclamation of saline soils and the suitability of waters for various purposes, including irrigation, are evaluated using information of soil and water salinity.

For certain soil salinity considerations, it would be desirable to know the individual concentrations of the major solutes in the soil water over the range of water contents that occur in the field and to obtain this information in the field, without the taking of soil samples and the carrying out of laboratory analyses. No practical methods are available at present to permit such detailed determinations, but total salinity can be measured in situ using electrical signals from various types of sensors (Rhoades, 1978, 1990; Rhoades & Oster, 1986). The latter determinations are often sufficient for purposes of diagnosing, surveying, and monitoring soil salinity, and for assessing the adequacy of leaching and drainage, even though they only give information of total soluble salt concentration, and hence supplant the need for carrying out conventional laboratory analytical procedures; in other cases they greatly minimize the number of samples requiring compositional analyses because correlations frequently exist between salinity and the concentrations of individual solutes and their ratios within the same general area of the landscape (Skarie et al., 1987).

The total soluble salt concentration (or content) of a water can be determined from either measurement of its electrical conductivity (EC) or of its residue-weight upon evaporation to dryness after filtration. Likewise, soil salinity can be determined from either measurement made: (i) on an aqueous extract of the soil sample, (ii) or on a sample of displaced soil solution. Alternatively, soil