Soil Water Parameters and Soil Quality

Birl Lowery and William J. Hickey
University of Wisconsin
Madison, Wisconsin

M. A. (Charlie) Arshad
Agric and Agri-Food Canada
Beaverlodge, Alberta, Canada

Rattan Lal
Ohio State University
Columbus, Ohio

Water, comprising two-thirds of the Earth’s surface, is fundamental to life on this planet, and soil water is essential to soil organisms and plant life. Soil organisms such as ants, beetles, and earthworms reside in the soil matrix but much of the microfauna, which includes protozoa, rotifers, and nematodes, reside in soil water. Soil is a porous media in which soil water and air are found in the pores. Consequently, the nonlimiting water range for plant and microbial activity is greatly influenced by soil aeration and mechanical resistance, particularly so in dense, poorly structured soils (Letey, 1985). When soil is water-saturated and air is excluded for long periods of time, many soil organisms suffer from a lack of O₂. Plant and soil organisms require optimum levels of both water and O₂, so the ratio of water- to air-filled pores is critical. Linn and Doran (1984) noted that soil microbial activity under different tillage systems appears to be closely related to water-filled pores (percentage of saturation) of soil but aeration drives the system.

Relationships or interactions between soil and water are complex. Not only does soil water contain various chemicals that influence its behavior, but flow and retention of water in soils are keys to our understanding of soil processes. In addition to its considerable impact on soil physical, chemical, and biological properties, water plays a major role in soil formation and its changes over time. As water moves through soil, it leaches chemicals and small soil particles from the upper soil and displaces them within the lower soil profile. Water flows through soil under the force of gravity and the influence of soil matrix and other potentials. On the other hand, water is retained in the soil by soil adhesive forces. The