CHARACTERIZATION OF SOIL HYDRAULIC PROPERTIES IN THE THREE DRAINAGE ASSOCIATIONS OF REDDISH BROWN EARTH SOILS

By

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ABSTRACT

The main objective of this study was to characterize the soil hydraulic properties of the three drainage associations in Reddish Brown Earth (RBE) soils, namely RBE well drained soils, RBE imperfectly drained soils and Low Humic Gley soils. The main properties characterized were infiltration, sorptivity, saturated and unsaturated hydraulic conductivity, and water retention characteristics.

Results from this study showed average steady infiltration rates for WD, ID and LHG as 1.9, 0.6, and 0.3 cm/hr respectively. Based on infiltration characteristics the well drained RBE soils showed optimum suitability for surface irrigation methods while imperfectly drained RBE soils and LHG soils showed suitability and marginal suitability for surface irrigation methods respectively.

The mean saturated hydraulic conductivities of WD, ID, and LHG soil profiles were 2.1, 0.6, and 0.4 cm/hr (i.e. 0.51, 0.15, and 0.09 m/day) respectively. Therefore, LHG soils may need very closely spaced drains to drain the soil for the cultivation of other field crops which may not be economical. Though the reduction in saturated hydraulic conductivity along the profile was not significant, it is probable that the underlying layers will limit the vertical drainage.

The unsaturated hydraulic conductivities reached an order of magnitude of 10^{-3} to 10^{-5} m/day at a moisture content little below the observed field capacities and it reached even below 10^{-9} m/day when the moisture content reached nearly 75% depletion of the available water.

Soil water retention relationships were nearly horizontal beyond a suction of 300 kPa (nearly 3000 cm water) which also corresponded to

relatively higher moisture contents ranging from 16.4 to 24.7 cm/m.

Average field capacities of WD, ID, and LHG up to the depth of 0.6 m were 25.4, 27.2, and 27.4 cm/m respectively. The average permanent wilting points of WD, ID, and LHG were 17.3, 19.2, and 18.5 cm/m respectively. Fifty percent depletion of available water occurred between 100 and 300 kPa while 75% depletion occurred between 300 and 500 kPa matric suction.

Total porosities (or the saturation moisture contents) were nearly the same for WD and ID and showed considerably higher values than LHG. Macro porosity of RBE soils were observed to be low. In particular, LHG showed less amount of macro pores than WD and ID. On the other hand micro porosities were nearly the same for ID and LHG and varied considerably from WD.

Field air capacities of RBE and LHG soils were even less than the critical vales of 10% in most cases. Poor field air capacity together with low saturated hydraulic conductivity of underlying layers may cause the risk of reduction in aeration due to temporary water logging even in RBE well drained soils. Therefore, quick disposal of surface water is essential during prolonged rainfall.

A simple mathematical model was used to demonstrate how soil hydraulic properties could be used as a tool for planning and management of irrigation systems efficiently.