The Collection and Study of Natural Soil Cores for Determining Irrigation Properties

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SOME soils of the Owyhee Irrigation Project in the Snake River Valley of eastern Oregon have shown an overall water use far in excess of the figure originally estimated and used in the design of the project. This high requirement has severely taxed the distribution facilities during the midsummer months. Preliminary investigations conducted by the Extension Service revealed that high runoff waste accounted for a considerable part of the excess use, and attempts were made by demonstrations to show how this runoff could be reduced by better irrigation methods.

The demonstrations showed that runoff was still very high with careful irrigation and that slow infiltration seemed to be the causative factor. The land is somewhat rolling and is irrigated by the furrow method. To secure satisfactory wetting the irrigation has to be prolonged to such an extent that high runoff is almost unavoidable.

Field plot trials were then undertaken cooperatively by the Soil Conservation Service Research and Oregon Agricultural Experiment Station using treatments which might be expected to improve the infiltration rates and so reduce the runoff. These trials gave quantitative proof of the problem, with infiltration rates from 0.04 to 0.08 inches per hour and runoff from 20% to 50%, but did not succeed in discovering a satisfactory solution to the problem.

Intake and transmission of water in the surface soil seemed to be a critical phase of the problem for the soil would not wet between furrows except under prolonged irrigations. Soil profile investigations revealed that some of these soils had a highly nodulated horizon, very compact in many cases, from 3 to 12 inches thick and commencing anywhere from 18 to 34 inches below the surface. The nodules were irregularly shaped rounded lumps of very compact silty material imbedded sometimes in silty material and sometimes in fine sandy material. Root matting was observed at these layers and it appeared likely that downward water transmission was being impeded severely. If water were being held up, a temporary perched water table would be expected to form and the soil above soon become saturated.

METHODS

Description of Soils

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Observations never have indicated that this occurred, trials did not succeed in identifying precise position or exact cause of the difficulty.

It was desired to locate the position of greatest impedance and if possible to ascertain the desirable was a measure of the relative permeability of the various problem soils. The cutting of natural soil cores and their subsequent study under controlled conditions in the laboratory seemed a promising way to obtain this information. This paper describes the methods used and some of the results obtained.

Soil groups identified six soil groups as problem soils. Soil group 110 is characterized by a hard, brittle, compact or soft silty substratum varying from 8 to 16 inches in thickness occurring at depths of 12 to 30 inches, more generally 24 inches. This compact layer contains numerous nodules imbedded in the water-deposited, silty material and has almost no permeability. Soil group 110 has a surface soil with clay understratum. This dark, slowly permeable and generally occurs at a depth of 10 to 12 inches. The thickness generally varies from 10 to 16 inches. This profile is often underlain by a lighter textured soil. Soil group 130 is characterized by a substratum of massive, porous material, generally a few soft nodules. This profile is only slightly compacted generally, the infiltration problem is not considered serious. Soil group 10 contains compact nodular substratum imbedded in a massive, very compact material of low porosity. The compactness and permeability of this soil is very similar to that of the 20 group. The difference between these soils is the material in which the nodules are imbedded. Soil group 30 is characterized by a highly nodular or hard, lime-coated, cemented, silty substratum. This compact layer has a hard lime capping which prevents root penetration. The hard lime capping is generally 1 inch in thickness and the compact layer is similar to the 20 group. Soil group 80 has a substratum very slightly to almost no permeability. This substratum is composed of nearly impervious laminations of various thickness, which are generally found from 8 inches from the surface of the soil. From each of the four typical sites were located.