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DR. A.G. ASGHAR,
M.S. ZAIDI
M.A. QAYYUM

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The paper has been divided in three parts: (i) Influence of the pellicular zone on the proportion of surface application reaching the sub-soil by Dr. A.G. Asghar; (ii) Construction of lysimeter and building up of soil profile by Dr. A.G,. Asghar and M.S. Zaidi; (iii) Influence of the surface application on the sub-soil water table under different crops by Dr. A.G. Asghar, M.S. Zaidi and M.A. Qayyum.

The surface application such as irrigation water and rainfall percolates the subsoil and grnerates vertical moisture gradient resulting in redistribution of moisture content from surface to the water-table. similar is the effect of high water table as the moisture travels upwards due to evaporation and transpiration at the surface. The Author divides the moisture distribution in two zones as against three suggested by Mr. Taylor. Experimental evidence shows that field capacity zone, recognised by Taylor as a constant moisture content region, is merely a point on the distribution curve. The zones above and below the point representing the field capacity may be termed as pellicular and capillary zones respectively. The surface application will cause accretion of water table provided the pellicular zone moisture content is raised to field capacity moisture and in case the surface application is insufficient the pellicular zone will be re-established before draining water from the water table, with the redistribution of moisture content depending upon the texture, compaction and nature of the soil crust.

For the pellicular zone to be raised to field capacity at the beginning of any period, the total capacity of the zone to retain moisture during the period must be equal to the total moisture removed by evaporation and transpiration. To make use of this capacity, the surface application must coincide with the period when the pellicular zone has been established. Since the exhaustiön of this zone is slower, its total capacity with less moisture is greater for more frequent and small surface applications as compared with those having shorter frquency and longer duration.

The experiments conducted on soil columns to study the effect of suraface application on moisture movement through the soil were not applicable to actual field conductions due to small pipes and lack of provision for measurement of water reaching the water table. It was concluded that for irrigation applied to the soil suraface a part of water is retained by the soil profile, another part is lost due to evaporation and the remaining water adds to the subsoil water table.

For the first time a study was undertaken in November 1942 to observe the moisture distribution in soil profile under natural condition by allocating a 40 ft x 40 ft unirrigated plot at Kot Lakhpat Lahore. The observations included measurement of irrigation water, rain fall and moisture contents at various depths ranging from 1 ft to 16 ft, with the estimation of field capacity and pellicular deficiency. It was concluded from the analysis of the results that the pellicular deficiency attains a maximum level during the dry period and reduces in Monsoon period due to rainfall. In areas under irrigated crops, pellicular deficiency is maximum before a watering. Irrigation water causes accretion of water table in the soil crust having low pellicular deficiency and even a high delta of irrigation water may not contribute to the water table in case of high order of pellicular deficiency. It requires further study of moisture movement on unirrigated and irrigated lands under principal crops to fix the delta of a crop and to avoid deposition of sodium salts.

PART-II

The study of moisture movement through construction of a Lysimeter started at the end of 18th century in regard to addition to subsoil water table and effect of prolonged leaching to the soil nutrients for plants. Lysimeter studies progressed in Cornell Agricultural Experimental

Station, New York State Agricultural Station and New Jersey Experimental Station. The experiments lacked in true representation of natural soil profile in respect of density, moisture content and the free water table. The Land Reclamation Laboratory, Lahore took a further step to continue the studies by constructing the Tank Lysimeters and the Iron Lysimeters.

Tank Lysimeters consisted of a set of four tanks 20'x20'x20', the walls being constructed with specially designed interlocking blocks, filled with cement concrete and finished plaster surface. At the junction point of the four tanks, arrangements were made for water table observation. The beds and sides of the tanks were coated with a thick coat of cotton to make them water tight. A three feet layer of coarse sand under 9" deep water was kept in each tank. The observations of moisture content and bulk density were made on the excavated soil compacted by sheep foot rollers in 6" layers, in the tanks. A tubewell was installed to irrigates the tank lysimeters.

A set of twenty Iron Lysimeters were constructed, each with 34 inches diameter and 15 ft height having holes at 120 degrees at every foot from top. A double wall room with brick platforms in 5 rows was constructed to house the lysimeters. In order to protect the soil from rainfall runoff, galvanized iron collars were provided. The soil profiles were transported from Lahore and Sheikhupura on UCC, Lyallpur on LCC, Montgomery on the LBDC and Sargodha on LJC and compacted to natural field conditions of moisture and density. The bottom of lysimeter was filled with 3" bajri and water table gauge was fixed in the sand column. The water level was maintained at 13.5 ft from the exposed top surface of the soil column.

The experiments were conducted on Tank and Iron Lysimeters to study the effect of surface application on the water table under various crops. After initial changes of moisture content the water table was maintained at 11 ft. depth from natural surface. The tank lysimeters were designated from D to G to keep track of observations and subsequent analysis.

In tank D, reclamation through crop rotation was applied by leaching through rice crop followed by gram, berseem and sugar cane. The analysis of results show an addition of 29.4% of surface aplication to the

water table during first reclamation rice, 48% during second reclamation rice and 28.2% during berseem. The sugar cane added 12.4% of the surface application to the water table.

In tank E, ordinary rice, wheat, maize and cotton were grown in rotation and it was observed that ordinary rice makes an addition of 24.5% of surface application to the water table, maize and wheat cause a depletion in the water able. In tank F, cotton, sugar-cane and maize were grown. The results of tank F were affected by heavy rainfall. Out of 22.02 inches in surface application 19.02 inches were of rain fall and 8.83 inches were added to the water-table.

The tank G was kept as control tank and a total evaporation of 55.8" was observed for a period of 3 years, covering three Kharif and three Rabi seasons. Considering the control tank as representative of fallow condition 55.8 inches of moisture was lost through evapiration and transpiration. The results indicate that for a given soil temperature of 27°C and presence of both sodium sulphate and sodium chloride in equal proportion, the average evaporation of 18.6" is capable of depositing 650 tons of salts annually. The salts are likely to remain at the surface if not washed down by heavy irirgation or rainfall.

The cultivation of rice year after year increases the yearly accretion rate. There is depletion of water table during growth of cotton, wheat, gram and maize. The extent of accretion to the water-table depends upon the previous type of crop grown. Heavy rain during short period greatly contributes to the accretion of watertable. Sugar-cane can be recommended as a crop for partially reclaimed fields.

The experiments on iron lysimeter, designated as 1,2,3 were carried out in the same pattern as for tank lysimeter. The results support the observations made in tank lysimeter in regard to accretion or depletion of water table with a slight difference in actual values. This fact points to the role that the size of lysimeter plays in moisture movement. The mechanical composition of the soil has direct bearing on the moisture movement and a given amount of surface application would not effect the water table for different soils to the same degree. The irrigation practice, therefore, should depend upon the knowledge of soils of a particular area.