Free discussion on soil moisture.

Dr. SCHOFIELD gave an introduction to a free discussion on soil moisture. He referred to work in India carried out in 1907 which was resumed in 1930.

LEATHER made a first attempt to obtain a value for evaporation from bare soil over an extended period using measurements of moisture of the soil in place. The investigations were made at Pusa (N.India) on an alluvial soil; sampling was done to 12 ft depth with a boring tool and moisture data were obtained on a volume basis as well as on a weight basis. Within 12 ft. from the surface three kinds of soil occurred: a loam type soil, a sandsoil and a clay soil. The climate is wet from July until September and dry from October until the end of June. Soil samples were taken at 24 depths.

At the end of the wet season scarcely any air was left in the samples from which the moisture profile was determined. LEATHER calculated a loss of 25 cm of water in the dry season under a bare soil which was carefully kept free of vegetation and he concluded that this had been lost by evaporation. This conclusion was accepted for a long time. Much later however, in 1930, A. T. SEN at Pusa was able to follow the up and down movement of water by determining the small salt concentrations which existed in the soil and he found that 20 cm of the water loss previously calculated was due to a downward movement of water leaving only 5 cm loss by evaporation.

LEATHER's assumption that no water passed down appeared to be incorrect and one must conclude that with almost complete filling of the pore space with water an appreciable quantity of water can flow even through a heavy clay soil. VERHOEVEN recently applied a similar method as SEN to a soil under a crop cover. The experiments at Pusa constitute a very important example to show how dangerous it is to determine evaporation from the change in soil moisture content. In this striking case the neglect of the downward motion of water introduced an error of 400 percent in the estimation of evaporation. Dr. SCHOFIELD then invited other participants to communicate on soil moisture.

Prof. RENTSCHLER gab eine Auseinandersetzung der Sickerwassermessanlage in Hohenheim, wobei das Sickerwasser auf 50 cm Tiefe unter bewachsenem Boden aufgefangen und gesammelt wird. Dr. BAYER hat hierüber in 1954 veröffentlicht.

Die Bodenfeuchtigkeit wird mittels der Borenmethode bestimmt und auf Prozente der maximal möglichen Feuchtigkeit umgerechnet. Wenn dieselbe über 90 % betrug wurde festgestellt dass nach 7 Tage das aufgefangene Sickerwasser 100 % des gefallenen in den Boden eingedrungen Niederschlags betrug.

Dagegen wurde bei 85 % der maximal möglichen Feuchtigkeit nur 7.1 % aufgefangen. Der Rest war noch im Boden hintergeblieben. Also wurden, allerdings für eine kleinere Tiefe, die Erfahrungen von A. T. SEN bestätigt.

Mr. PRUNSTER referred to Dr. PENMAN's statement at the beginning of this meeting that a suitable physical method of determining soil moisture is still needed, particularly for the field biologist. With halomorphic soils, swelling clays or even soils of the redbrown earth type, where the A horizon is shallow the gypsum block is not suitable and the time and labour consuming gravimetric determination is still relied on. Tensiometers are useful only over a limited tension range and in most of the Australian environment we are concerned with much more arid conditions than apply in Europe.

In Australia, high potential evaporation, and generally low summer rainfall over the greater part of the continent, can leave soils dried out well below the permanent wilting point. In this conference, SLATYER has mentioned tensions as high as 200 atmospheres. He also referred to evidence that plants of rigid structure are able to satisfy some of their moisture requirements at tensions far in excess of 15 atmospheres. Under these conditions are limitations on production and transpiration imposed by too low transmissability of water through the soil mass to root surfaces, or through the plant, or both. These points are referred to indicate the more severe moisture deficits encountered in Australia and similar climatic environments.

Dr. SCHOFIELD referred to work of LEATHER and SEN at Pusa in 1910 and 1930: LEATHER's work indicated a loss of 25 cm from a 3 m depth of soil by evaporation during a nine months period of dry summer. SEN's later work indicated that only 5 cm of this was lost by evaporation and 20 cm by slow movement down a tension gradient. Experiments at Deniliquin under irrigated (by inundation) rice plots and inundated bare plots show a leaching depth to 8 and 10 feet respectively. Leaching continued slowly during the following winter rainfall period. In the next six summer months the electrolyte concentration increased at all levels in the profile from 10 ft. to the surface. This does indicate a considerable transfer of moisture as a result of the high evaporation potential. This flow takes place as unsaturated flow.

There is a need to increase our physical studies in unsaturated flow and vapour transfer of moisture in relation to plant growth.

Dr. MÄDE weisst auf einige Ergebnisse von Durchflussmessungen mit Klein-Lysimetern hin. In den Klein-Lysimetern war ein zweites Lysimeter eingebaut; der Durchfluss aus beiden wurde gemessen. Aus dem zweiten Lysimeter floss erst dann Wasser ab, wenn er mit einem genügend hohen Rand versehen war.

Dr. STAPLE pointed out that many factors control the movement and loss of moisture from the soil profile. Referring to Dr. SCHOFIELD's introduction with the work of LEATHER and SEN, extremely high rates of evaporation might occur if the soil is maintained at or near field capacity for an extended period of time. On the other hand, experience in Western Canada has shown that considerable moisture may move downward below the root zone during the summer fallow period. The moisture conditions there are more like those described by Mr. PRUNSTER than those found in Europe. The soil moisture is reduced frequently to the wilting point or below it. At seeding time the effective field capacity is about 75 per cent of that determined in the laboratory or used in irrigation work.

In most cases moisture losses from the soil profile can be explained in terms of moisture tension gradients and capillary conductivity coefficients.

Although we do not use BOYOUCOS- or other types of blocks extensively at Swift Current because of various reasons mentioned at the meeting, they are used with success in irrigation work by W. L. JACOBSON at Vauxhall, Alberta and by J. C. WILCOX at Summerland, British Columbia. JACOBSON has found the COLEMAN fiber glass blocks most useful both to indicate when irrigation is required and also in conjunction with moisture samples to determine the consumptive use of water.

Dr. SLATYER discussed the points that may be of value in understanding why success or failure has attended various attempts to use gypsum blocks for moisture measurements.

It seems that the following soil characteristics are desirable :

1 That the soils should be non-saline.

2 That they should be relatively non-swelling. This factor results in interferences with block-soil contact, in uneven wetting and drying and in extreme cases in actual damage to blocks and leads.

3 The soils should be free draining and root distribution should not be restricted by soil compaction.

4 They should not be too wet for too long a period.

In use, recognition must be made of :

5 The sensitivity limits of the blocks (0.5–15 atm tension).

6 The fact that the calibration curve may drift with time.

7 Hysteresis effects.

8 Adequate replication is needed in field experiments.

9 That conditions favouring rapid moisture extraction are desirable.

10 Careful installation.

Although these limitations appear very severe, there are still many areas in the world, particularly in sub-humid and semi-arid areas, where the blocks should succeed. This in turn is largely dependent on the type of information desired.