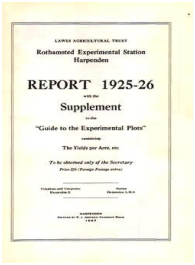
Report 1925-26 With the Supplement to the Guide to the Experimental Plots



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General Soil Physics

Rothamsted Research

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the soil and its plasticity. These are all much affected by water content, but in different ways; the cohesion decreases but the friction increases as the water increases; the effects just about balance, so that the drawbar pull, the sum of all of them, alters but little.

This analysis is being continued in order to insure a better understanding of the field experiments.

The work on soil cultivation is beginning to afford a physical explanation of the "condition" of the land—a term much used by farmers. It has also aroused much interest among the implement manufacturers, who are endeavouring, through their Association, to find part of the necessary funds to ensure the continuation and adequate development of this subject at Rothamsted.

GENERAL SOIL PHYSICS.

Much of the work in the Soil Physics Department is necessarily concerned with the general development of Soil Physics, the science that underlies soil management and explains the air, temperature and water relationships of soils.

Many attempts have been made to find means of expressing the highly complex water relationships. They appear to be best expressed by such properties as cohesion, plasticity and shrinkage, which show variations at moisture contents where plant growth is satisfactory; the vapour pressure method that at first sight seems more promising, is not so satisfactory since the values are still at their maximum when the moisture content is well below the minimum for plant life.

The vapour pressure curves, however, promise to be important in soil physics; they show typical hysteresis effects associated with colloids, and they are markedly affected by treating the soil with agents known to disintegrate the aggregates characteristic of good tilth. They are also of use in the search for a " single value " measurement for classifying soils—a long sought end—to which much attention has been given in the Physics Department.

Hitherto it has been difficult to decide what property, or combination of properties, the " single values " proposed really measure. Many of them have been tested on some forty different types of soil. The air-dry moisture content, or, more accurately, the moisture content at 50 per cent. relative humidity, as given by the vapour pressure curve, was found to be controlled mainly by the percentage of clay in the soil; while the " sticky point " (the water content of a plastic mass of soil when it first ceases to adhere to the fingers) is controlled by the material lost on ignition of the soil, i.e., the organic matter and water of constitution in the clay. These discoveries have greatly simplified the problem of " single value " classification.

The cohesion of soil presents an interesting problem. The work of Atterberg, in Sweden, appeared to show that, although the cohesion decreased with increasing moisture content, the curve connecting the values was broken into two distinct portions.

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Atterberg considered that soils could be classified by measuring the moisture content at which the break occurred. We have not been able to reproduce these results at Rothamsted, our curves being always smooth and unbroken within the limits of experimental error. Dr. Haines has now shown both theoretically and experimentally, that the capillary effects of water in the pores of a soil block give rise to cohesion values that increase to a maximum at the highest moisture content the soil block can hold before it becomes disintegrated. This suggests that the two sections of Atterberg's curve may be attributed to two types of cohesion, one predominating at high moisture content and due to capillary forces, and the other predominating at low moisture contents and due to the colloidal nature of the soil. The features of these two factors are such that, when combined, a broken curve might be expected with certain types of soil. Quantities of the colloidal material have been obtained by means of the Super-centrifuge in order that its properties and its effects on the soil may be studied.

Dr. Keen has acted as convener of a committee, including Professors Comber of Leeds, Hendrick of Aberdeen and Robinson of Bangor, appointed by the Agricultural Education Association to investigate methods of mechanical analysis of soil, it being now known that the old method used for over twenty years in this country is untrustworthy, since it fails to secure complete disintegration of the soil crumbs. After full tests at Rothamsted and elsewhere, Professor Robinson's method has been officially adopted, and the more important of the older analyses will now be revised.

A measure of soil tilth has been obtained by studying the degree of disintegration secured under standardised laboratory conditions on soil brought in from the field.

Work in the Empire.

The water relationships of the soil, important as they are in British farming, are of supreme importance for great parts of the Empire where low rainfall compels recourse to irrigation for crop production. An increasing number of problems is being referred to Rothamsted from various regions of the Empire, and agricultural experts have been sent from India and Africa to study methods and problems in our laboratories.

The Empire Cotton Growing Corporation has made provision for a soil physicist to carry out investigations at Rothamsted. Dr. E. M. Crowther, who holds this post, last year studied some of the soil problems of the Gezira, the great irrigated area between the White and Blue Niles, for which purpose he worked in the laboratories at Wad Medani for the six months, October, 1925, to March, 1926. (See Paper No. xxxiii, p. 67.) He succeeded in tracing relationships between early rainfall and crop yields and between permeability of the soil and its fertility, a rapid rate of movement of water being associated with a low salt content and high fertility. Some of the problems have been brought back to the Rothamsted Laboratories for further investigation.

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