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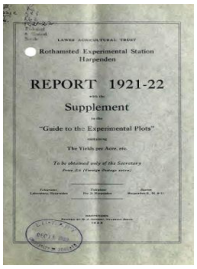
Report 1921-22 With the Supplement to the Guide to the Experimental Plots Containing the Yields per Acre Etc.



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Environmental Factors

Rothamsted Research

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FACTORS DETERMINING ENVIRONMENTAL CONDITIONS.

XXVI. E. J. Russell. *"The Physico-Chemical Problems relating to the Soil."* Trans. Faraday Society, 1922. Vol. XVII. pp. 219-223.

A general survey of the physico-chemical factors operating in the soil and their influence on fertility. The soil is regarded as a system formed of four components : (i.) mineral particles; being disintegrated and decomposed rock fragments which, through the action of weather, water, ice and other factors, have in course of time been reduced to dimensions varying from about 1 mm. in diameter to molecular orders of magnitude. (ii.) Colloidal material; either very fine particles or a jelly coating the larger particles and consisting of materials such as precipitated oxides of iron and aluminium, silicia, etc., or both. (iii.) Intermingled in most intimate fashion with this is the organic matter, residues of past generations of plants and animals, which represents the source of energy for the large population of soil organisms. (iv.) The soil solution, being the soil water and everything dissolved therein. The whole mass is permeated with air. It is shown that the agricultural and physical properties of the soil can to a considerable extent be explained by such a system, but there are facts which do not as yet readily fit it.

A more detailed discussion of certain aspects of the subject is given in the following three papers.

XXVII. H. J. Page. *"The Part Played by Organic Matter in the Soil System."* Trans. Faraday Society, 1922. Vol. XVII. pp. 272-287.

The influence of the humic material of the soil, on the physical and physico-chemical properties of the soil is discussed. Owing to the colloidal nature of this humic material, its chemical nature and mode of formation are still little understood. The established agricultural practice of using dung, green manures, etc., to maintain the fertility of the soil, however, depends in a large degree on the colloidal nature of the humic material derived from such organic manures; even without more knowledge of the chemical nature of humus, its effect on tilth, moisture relationships, supply of plant nutrients, and soil reaction can be explained, at any rate on broad lines, in terms of its physical, *i.e.*, colloidal, properties.

XXVIII. B. A. Keen. *"The System Soil—Soil Moisture."* Trans. Faraday Society, 1922. Vol. XVII. pp. 228-243.

A general discussion of the relations existing between the soil and its moisture content, with especial reference to the physical significance of the various divisions of soil moisture that have been proposed from time to time.

XXIX. E. M. Crowther. *"Soil Acidity in its Physico-Chemical Aspects."* Trans. Faraday Society, 1922. Vol. XVII. pp. 317-320.

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A general discussion of the methods used for the determination of the acidity and lime requirements of soils, with especial reference to the hydrogen-ion concentration of soil suspensions and the action of neutral salts on acid soils.

XXX. W. B. Haines. *"The Volume-Changes Associated with Variations of Water Content in Soil."* Journal of Agricultural Science, 1923. Vol. XIII. pp. 296-310.

A new and simple method of measuring the shrinkage of moist soil on drying is described, which at the same time gives values for the pore space and specific gravity of the soil. Diagrams are given showing the characteristics of the shrinkage for diverse samples, including pure clay, heavy loam, sandy and peaty soils. The shrinkage is shown to take place in two stages, in both of which there is a linear relationship to the moisture content. The first stage is largely governed by the clay-content of the soil and its limit is fixed by the point at which air begins to replace water in the pores of the soil. The second stage, called the residual shrinkage, is smaller than the first, and seems to depend upon the more highly colloidal material which has been supposed to surround the clay and other particles. Explanation of the shrinkage is developed on these lines with confirmatory experiments.

The effect of alternate wetting and drying of soil in producing a good tilth is illustrated.

XXXI. B. A. Keen and H. Raczkowski. *"The Relation between the Clay Content and Certain Physical Properties of a Soil."* Journal of Agricultural Science, 1921. Vol. XI. pp. 441-449.

A simple experimental method has been described for measuring certain physical constants of soil, using small brass boxes into which soil passing a sieve of 100 meshes to the inch has been packed by hand. The quantities determined are :—

1. The weight of unit volume (1100 ccs.) of air-dry soil, or the apparent specific gravity.
2. Amount of water taken up by unit weight of soil.
3. Pore space.
4. Specific gravity of the soil.
5. The volume expansion of unit volume (100 cc.) of soil when saturated.

The results for one soil only are given, and discussed, to illustrate the method. With the co-operation of the Science Masters' Association it is being applied to a number of soils by various schools.

The particular soil used was obtained in six depths, as follows : 0-6″, 6-12″, 12-18″, 2-3′, 3-4′, and the constants were determined in each depth. It was shown that 1 and 4 varied inversely with the percentage of clay in the soil, while 2, 3, and 5 varied directly with the clay percentages. The effect on the constants of the larger quantities of organic matter present in the top two layers of soil was, weight for weight, approximately equal to that of the clay, except in the volume expansion results where the effect, if any, was within experimental error.

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It is possible that the fraction fine silt II., whose upper limit of diameter is .005 mm., has similar effects to the clay fraction.

XXXII. B. A. Keen. *"Evaporation of Water from Soil II. Influence of Soil Type and Manurial Treatment."* Journal of Agricultural Science, 1921. Vol. XI. pp. 432-440.

Further experiments have been done on the evaporation of water from soil, using the same apparatus and technique as described in an earlier paper. The present series of experiments was designed to investigate the effect of clay content and manurial treatment on the evaporation. Two soils have been used, one containing only 6% clay and the other 15%, and from each soil samples were taken from plots which had received (*a*) no manure, (*b*) artificial manure, (*c*) farmyard manure. The rate at which the soils lost water over concentrated sulphuric acid and at a constant temperature was found to depend firstly on the amount of clay present, and secondly on the amount of organic material in the soil. The differences due to content of organic material were more obvious in the soil containing the larger amount of clay; the farmyard manure plot lost water at the slowest rate, and the unmanured plot occupied an intermediate position. In the sandy soil the differences in evaporation due to manuring were small.

There is evidence that the moisture equivalent of these soils measures the percentage of water at which the evaporation is first directly affected by the soil particles, and that at percentages of water in excess of the moisture equivalent evaporation is taking place substantially from a free water surface.

XXXIII. E. J. Russell and B. A. Keen. *"The Effect of Chalk on the Cultivation of Heavy Land."* Journal of Ministry of Agriculture, 1922. Vol. XXVIII. pp. 419-422.

Measurements taken with a dynamometer showed that dressings of chalk applied 8 years ago were still effective in facilitating cultivation, the saving of drawbar pull being in these trials no less than 180 lb. on a three furrow plough (see p. 12).

THE PLANT IN DISEASE.

INSECT PESTS AND THEIR CONTROL.

XXXIV. A. D. Imms. *"Recent Research on the Head and Mouth-parts of Diptera."* Entomologist's Monthly Magazine. 3rd Series, 1920. Vol. VI. pp. 106-109.

A short discussion of the subject from the morphological standpoint.

XXXV. J. Davidson. *"Biological Studies of* Aphis Rumicis *Linn. IV. Reproduction on varieties of* Vicia Faba*—with a Statistical Appendix by* R. A. Fisher." (See No. XV.) Annals of Applied Biology, 1922. Vol. IX. pp. 135-145.

The reproduction of the bean aphis on 18 varieties of field beans was tested and compared with reproduction on Prolific Longpod broad beans.