ROTHAMSTED RESEARCH

Report for 1927-28

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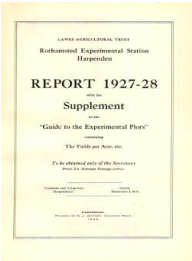

The Constituents of the Soil

Rothamsted Research

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re-opened at Rothamsted. The " sticky point " (*i.e.*, the moisture content at which a plastic mass of soil and water is just about to become sticky) is promising. It is closely correlated with the loss on ignition which may be taken as an approximate measure of the amount of the organic and the inorganic colloids : it is not, however, correlated with the percentage of clay. The amount of moisture in air dry soil is correlated with the percentage of clay, but not with the loss on ignition, *i.e.*, not with the total colloids : this moisture is therefore presumably held in the minute interstices between the small particles. On the other hand, the clay and the sticky point, and the ignition loss and the air dry moisture content, are significantly correlated. These results indicate two ways in which the water is held in the soil. The organic and the inorganic colloids control the sticky point, while the minute interstices between the small particles control the air dry moisture content. Confirmation has been obtained by repeating the measurements after treating the soil with hydrogen peroxide to remove the non-structural organic matter. The two values are therefore of help as a means of soil specification, and an extended co-operative comparison of them for many different soil types has been agreed to by the International Society of Soil Science. This work will be controlled from Rothamsted.

THE CONSTITUENTS OF THE SOIL.

The Organic Matter.

For some years past the chemical changes occurring during the decomposition of plant residues in the soil, and especially those concerned in the formation of humus, have been studied by Mr. H. J. Page and his staff, G. V. Jacks, C. E. Marshall, C. W. B. Arnold and others.

Lignin is the main, though not the only source of humus, but the plant residues apparently humify as a whole.

Humus is very complex in composition, and its effects in the soil are not yet fully known. There is an important difference between the humus of the soil and that of leaf mould and peat : while all three kinds of humus yield up ferric iron after hydrolysis with acid in boiling solution, soil humus gives ferrous iron also.

Now iron may play an important part in the oxidation processes in the soil : for example, the artificial production of humic acid from lignin by atmospheric oxidation in strongly alkaline solution takes place only in the presence of organically combined iron.

The clay and the reaction of the soil.

The reaction of the soil is closely associated with the amount of the bases, particularly calcium, that can be replaced by other bases when the soil is mixed with a salt solution. Much work is being done on the amounts of these replaceable bases in the Woburn soils.

The exchangeable calcium is greatly reduced by sulphate of ammonia, and slightly increased by nitrate of soda, superphosphate and farmyard manure. The exchangeable potassium is very low : it is hardly affected by nitrate of soda or sulphate of ammonia in spite of the fact that this reduces the calcium, but

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it is much increased by farmyard manure. A method is badly needed for estimating the extent to which the soil is saturated with bases, or, alternatively, the extent to which the bases have been replaced by acid hydrogen: attempts are being made to solve this problem by mixing the soil with excess of calcium carbonate and extracting with sodium chloride.

The most widely used and most convenient way of measuring the reaction of the soil is the quinhydrone electrometric method. Miss Heintze and Dr. Crowther used it for a series of Gold Coast soils and obtained clear and definite results at least one-third of which subsequently proved to be quite erroneous.

The trouble was traced to the manganese dioxide present in certain soils in a form which reacts with the quinhydrone producing a base and a corresponding reduction in acidity. Similar errors have been found in English soils and methods of detecting and avoiding them are being worked out.

SOIL MICROBIOLOGY.

The investigations in soil microbiology fall into two main divisions: (1) the study of the micro-organisms living in the soil, their kinds, numbers, mode of life, their various activities and their relation to one another.

(2) A detailed study of soil micro-organisms directly affecting plants: the nodule organisms of the leguminosæ, organisms parasitic on plants and producing diseases.

The chief groups of soil micro-organisms are: bacteria, fungi, including actinomycetes, algæ, protozoa and nematodes: all are studied at Rothamsted except the nematodes, which are left to the Institute of Helminthology, St. Albans, though it is hoped to effect some co-operation with this body as the work is now beginning to suffer through so artificial a restriction.

All the organisms, except some of the protozoa, feed on the organic matter in the soil, some of them also ferment part of it: in either case, they decompose it, producing humus, nitrates, phosphates and compounds of calcium, potassium and other elements of great importance in soil fertility. Soil micro-organisms are, to a large extent, the producers of soil fertility, though they also reduce it by assimilating to themselves nitrates and phosphates that would otherwise serve for plants. It is this close connection with soil fertility that justifies the extended study made of them at Rothamsted.

Broadly speaking, fungi predominate in acid soils and bacteria in neutral soils, and of the substances they decompose fungi assimilate more, build up more protoplasm and retain more nitrogen than do bacteria: they are less economical as plant food producers because bacteria convert more of the organic matter into carbon dioxide, water and ammonia. For this reason less of the nitrogen can be nitrified in an acid than in a neutral soil.

There is considerable difficulty about estimating the numbers of fungi and studying their activity: Dr. Brierley has shown how to obtain comparable data under strictly controlled conditions, but the results have no absolute value and the higher figures are not intrinsically more probable than the lower ones. More

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