ROTHAMSTED RESEARCH

Rothamsted Report for 1938

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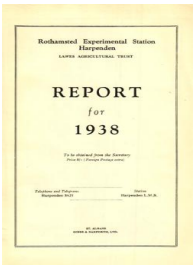

Crops and Micro-organisms

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with the surface of the clay particles when suspended in a solution of an electrolyte. One is associated with acidic " spots " where negative charges develop at high pH values of the medium through dissociation of the H+ ions which probably come from hydroxyl groups attached to silicon atoms at the corners and edges of the crystals. The other of these two kinds of charges is associated with basic " spots " which become positively charged at low pH values of the medium through combination with H+ ions : the chemistry of this process is not known, but it may involve an interaction with an aluminium-oxygen group. These basic " spots " occur on many of the common subsoil clays and indeed in some instances, a striking example of which was a red clay from Natal, they are so numerous that they exceed the permanent negative charges. In such cases by regulating the degree of acidity the number of positive charges can be made equal to the number of negative charges and the clay then carries no nett charge : it becomes incapable of retaining exchangeable ions, e.g. it cannot, like a fertile clay, hold calcium, magnesium and potassium and supply them to the growing plants.

The recognition of clays that can thus become uncharged at only a moderate degree of acidity (pH 5) is obviously of considerable agricultural importance. The defect can to some extent be remedied by the addition of humic material which at this pH is negatively charged, and in such soils it is essential to maintain the supplies of organic matter.

These basic spots do not occur on all clays : montmorillonite and kaolinite seem to be free from them.

Soil surveyors use the colour of the soil as one of its properties for classification, but the estimation of soil colours is very vague. Dr. Schofield has devised an instrument for exactly measuring colour, and this has been taken over by Tintometer Ltd. for exploitation on a commercial scale. The instrument should prove of great value to a wide range of workers.

Water supply to plants.—The water supply to plants is at least as important as the food supply, and it is well known that different soils show remarkably wide variations in their power of holding water : some retain a large part so firmly that plants cannot get it, others hold the water with much less tenacity. A method of measuring the intensity with which soils hold water has been worked out in the Physics Department and is being developed for wider use. The underlying conception of water suction is being applied to a study of the pore size distribution in soils.

CROPS AND MICRO-ORGANISMS

For many years the Bacteriology Department has been engaged on a study of the organisms associated with leguminous plants and one of the best known results has been the working out of a method of inoculating lucerne seed before sowing : this is now generally adopted by farmers.

Investigation showed that clover nodule bacteria are very widely distributed throughout the country, but that some of their strains or varieties are much less efficient than others. One of the poorest, found on the Welsh hills, has been studied in some detail.

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It is so inefficient that it can barely sustain its host plant; the growth of the clover is miserably poor. The reason for the inefficiency of such strains has now been traced to some incompatibility between them and their hosts: they get into the root and start forming the nodule, and then commence to fix nitrogen just as the more efficient forms do. But in a very short time the nodules begin to disintegrate. Similar results have been obtained with peas and soya beans. Evidence was obtained that plants bearing inefficient nodules produce some substance toxic to the organisms and so put an end to their activities. There is acute competition between good and poor strains of nodule bacteria in the soil, and apparently those that multiply most rapidly are able to dominate the others and to enter the plant.

Soil contains quantities of unspecialised bacteria which have hitherto been little studied but are important by reason of their large numbers and variety. A survey to study their distribution under different systems of cropping and manuring is being made in the Microbiological Department. There is some suggestion of a relation between cropping and bacterial flora: comparison of the unmanured plots on Broadbalk wheat field and on Park Grass showed only two species of bacteria common to both, but on the other hand four of the eleven species isolated from the unmanured Park Grass plot were found on unmanured grassland in other parts of the country.

The process of denitrification whereby nitrates are reduced in the soil to gaseous nitrogen has hitherto been regarded as entirely anaerobic. It is now shown that this is not so, and that complete reduction of nitrate to gaseous nitrogen can take place under aerobic conditions with the difference that, for a C/N ratio of 10, the whole of the carbon supplied is used up under aerobic conditions, but part of it is left untouched under anaerobic conditions.

Light appears to have no effect on the process.

It is a commonplace that scientific investigations properly carried out are apt to develop in wholly unexpected directions. This work on soil organisms was soon found to provide the key to a particularly difficult practical problem, the purification of effluents from sugar beet factories and from milk factories. By arrangement with the Department of Scientific and Industrial Research this problem was actively followed up for several years, with such success that at the end of September 1938 it had reached the stage where it passed out of our hands and could be handed over to the factories as a matter of factory technique. The work was done jointly by the Microbiological and Fermentation Departments with the cordial co-operation of Anglo-Scottish Sugar Beet Corporation (Colwick) and United Dairies Ltd. (Ellesmere).

Soil fungi responsible for certain plant diseases are dealt with later, where it is shown that the persistence of one of the more serious diseases is related to the bacterial activity in the soil.

The protozoa of the soil have also been studied and it is shown that, in addition to their effect in reducing bacterial numbers, they have a further effect in raising the bacterial efficiency, as the members of a small bacterial population are more efficient than those of a large one.

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