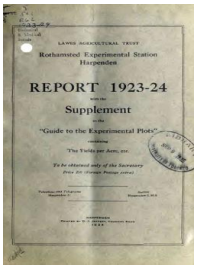
Report for 1923-1924 With the Supplement to the Guide to the Experimental Plots Containing the Yields per Acre Etc.



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Liming

Rothamsted Research

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yet tried. In pot experiments unrotted straw greatly increased the numbers of nodules formed on each plant; there was, however, no increase of yield till phosphates were added. A dressing of straw and phosphate has been found in field tests to be an effective fertiliser for beans and affords a method of increasing the organic matter of the soil which might find useful application in practice.

The second investigation brings out the fact that the plant is just as important as the organism in the partnership. It arose as a result of Miss Warington's important discovery that many leguminous plants fail to grow unless supplied with traces of boron. Dr. Brenchley and Mr. Thornton, taking the broad bean as their example, showed boron to be essential to the proper functioning of nodules on its roots. In the normal course, conducting vessels grow out from the vascular system of the plant root and enter the nodule. Along these vessels food materials are brought from the plant to the bacteria, and the products of their activity are carried back to the plant. The vessels thus act as conduit pipes, connecting the organisms with the plant and making the partnership effective. In the absence of boron these vessels do not form or are very weakly developed. The organisms, losing their normal source of food, become parasitic and destroy the plant protoplasm, being then harmful instead of useful to the plant. The work thus shows that the organism is a potential parasite; only by the nice adjustment occurring in the healthy plant can the beneficial partnership be maintained.

In most soils there is apparently sufficient boron to allow of full development. But instances are on record in Japan, and possibly elsewhere, where peas, which do not need boron, will grow while other leguminous plants which need it will not. In these soils there might be a boron deficiency. The more important result emerges that the successful growth of a leguminous crop depends on three conditions: presence of the proper organisms and soil conditions necessary for their growth; the proper nutrition of the plant; and development of the conducting system linking the organisms in the nodule with the circulating system of the plant.

Liming.

The effect of lime on sour arable land and on certain kinds of grass land is well known and farmers are frequently advised to use more of this substance. But directly they begin to follow the advice they are faced with the difficulty that analysts cannot as a rule inform them just how much lime per acre they should apply, and a round figure of one or two tons per acre is often suggested. The recommendation suffers from the defect that no farmer can afford to supply two tons per acre if one ton is sufficient, apart from the consideration that too large a dressing may injure the crop or the soil.

Various empirical methods have been devised from time to time to give some idea of the quantities needed, but the different tests give different results, and in absence of definite knowledge

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as to how they act or what they really indicate, it is impossible to arrive at any satisfactory conclusion.

The method hitherto used in this country was devised in 1913 by Drs. Hutchinson and MacLennan in these laboratories. It has served a useful purpose, but it suffers from the drawback that it is considerably affected by three soil factors, none of which it accurately measures: the hydrogen ion concentration: the "buffer action": and the neutral salt action in the soil. These are separated in the modern electrometric method used by Mr. E. M. Crowther in the Physics Department. The older method, however, has the merit of convenience, and it has now been improved by the introduction of certain empirical corrections.

Measurements at Rothamsted and at Woburn have shown that the effects of soil acidity induced by long-continued and excessive use of sulphate of ammonia are manifested as far down as 3 or 4 feet in the soil, and are not confined to the surface 9 inches.

Soil Chemistry, Physics and Microbiology.

In the Chemical Department work has been done under Mr. Page on the organic matter of the soil, which plays so important a part in soil fertility. Mr. du Toit has adduced evidence that humus is formed from lignin and not from the carbohydrate materials, cellulose, etc., to which its origin was formerly assigned. It is true that these substances can be made in the laboratory to yield black products looking like humus, but chemical examination shows that only the lignin product closely resembles the substance actually present in the soil. The problem is difficult and necessitates much further study, but the information is needed in order to discover what are the useful organic constituents of the soil. It is expected that this work will find application to green manuring.

Another important line of enquiry is in connection with the bases in the soil. It is shown that many of the important soil properties depend on the presence of a complex calcium combination: indeed, of all elements in the soil, calcium is probably the chief in agricultural significance. This calcium can be replaced by hydrogen under conditions of high rainfall: the soil then readily becomes acid. Alternatively it can be replaced by sodium in dry regions where irrigation water containing sodium salts is used (as not infrequently happens). The sodium combination differs chemically and physically from the normal calcium combination, and it is infertile when treated by the normal agricultural methods: it might conceivably be fertile if treated by methods specially suited to its properties. But its gravest defect is that it is easily hydrolysed, forming sodium carbonate, a very serious plant poison. Or, again, the calcium may be wholly or partially replaced by magnesium or potassium. Each of these products behaves unlike the calcium product when subjected to ordinary treatments and therefore is regarded as infertile. This new knowledge will undoubtedly prove useful in devising means of dealing with difficult soils: the Weald and Lower Lias clays deserve study from this point of view.

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