ROTHAMSTED RESEARCH

Report for 1931

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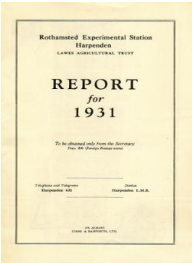

Elements Needed by Plants in Small Quantities

Rothamsted Research

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agrestis) and lady's mantle (*Alchemilla arvensis*) is very rapid, but others appear to be more easily controlled by cultivation methods.

One point of great practical importance is that fallowing operations may be worse than useless if they are not thorough. After the autumn ploughing the practice is to have the ground untouched till early spring, but during this period a few weeds, as shepherd's purse (*Capsella bursa-pastoria*), thyme-leaved sandwort and large flowered speedwell are able, in favourable seasons, to flower and seed so that there may be more seed present in the soil after fallowing than before. To make fallowing effective, cultivation needs to be frequent, and to be carried out during the winter months as well as during the normal growing season.

TABLE IX.

Ineffectiveness of fallowing, as a means of destroying certain weeds.

Arenaria serpyllifolia.	Millions per acre.
Before fallowing	0.9
After 1 year's fallow	1.0
,, 2 ,, ,, ...	0.7
,, 3 ,, ,, ...	1.0
,, 4 ,, ,, ...	0.7 *

ELEMENTS NEEDED BY PLANTS ONLY IN SMALL QUANTITIES

Plants are made up of some nine or ten elements in rather large amounts; of these carbon, hydrogen and oxygen come from the air and water, and are not usually under control in this country; nitrogen, potassium, calcium and phosphorus come from the soil and are regularly controlled by the use of artificial fertilisers; magnesium, sulphur and iron occur in some of the fertilisers, and are therefore supplied incidentally; in any case they are usually present in sufficient amount in the soil.

Besides these, however, there are other elements needed only in very small amounts. How many of these there may be is not yet known. The most detailed studies have been with boron, the necessity for which has been demonstrated by K. Warington in these laboratories.

Plants without boron neither grow nor flower normally—special symptoms are produced, including death of the apices and breakdown of conducting tissues. These effects appear much more rapidly in summer than in spring or autumn. The difference is not in the temperature but in the hours of daylight, since plants grown without boron in summer but allowed only 9 hours of daylight are also slow to develop the symptoms, and behave, indeed, like plants grown in spring.

There is some superficial resemblance between the effects of light and of boron. Plants supplied with boron but allowed only a short period of light every day fail to develop flowers just as if they were deprived of boron; but they will produce flowers when they are given more light, while those without boron will not.

The amount of boron needed by plants is exceedingly small.

* Figures incomplete. Will be higher.

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Of all plants yet tested, broad beans seem to require most, but even for them access to 0.2 mgms. and probably less, of boric acid (H_3BO_3) per week per plant during the growing season suffices, while peas and barley require much less. Apparently all plants require some.

These very small amounts are usually, if not invariably present in the soil. No clear case is known where addition of boron has improved plant growth in the field. There are a few possible exceptions which deserve further investigation: *e.g.* a certain tobacco disease in Java may be attributable to boron deficiency.

When the need of the plant is satisfied, further quantities of boron may easily do much harm; citrus growers in California have suffered loss through the presence of boron in the irrigation water. Manuring with boric acid is certainly not recommended; indeed, it is strongly to be deprecated.

SOIL PHYSICS

During R. K. Schofield's charge, the work on soil cultivation was continued.

In the laboratory further search was made for easy and rapid methods of soil testing. A new machine, called the Pachimeter, was devised by R. K. Schofield and G. W. Scott Blair to study the process of rolling a plastic cylindrical mass of moist soil or clay between two plates under a gradually increasing load. It was found that the load at which permanent lengthening of the cylinder first occurs is, within limits, a definite and reproducible value which varies considerably with the nature of the soil or clay examined, and this measurement promises to be of value in soil classification and surveying. The method has attracted a good deal of attention outside the sphere of soil investigations, and especially in the flour-milling industry.

R. K. Schofield has developed a new rapid method for determining the "base exchange capacity" of a soil: it consists in measuring the decrease in conductivity of a potassium phosphate solution when a weighed quantity of soil is introduced.

C. G. Hawes, Executive Engineer, Lloyd Barrage and Canals Construction, Sind, spent nine months in the department studying methods of distinguishing soils likely to give trouble under irrigation conditions.

METHODS FOR AGRICULTURAL SOIL SURVEY

In recent years there has been marked development in the number and extent of the soil surveys undertaken in this country and elsewhere, and it has become essential to work out satisfactory methods for field and laboratory examinations. Much progress has already been made in the United States and in Russia. The Russian methods have been studied in Russia during the past few years by several members of the Rothamsted staff. E. W. Russell worked for some months with a soil survey party in South Russia; G. V. Jacks and H. L. Richardson have worked there for shorter periods; while E. M. Crowther, H. L. Richardson, and the Director have traversed the country with the leading Russian soil experts to learn their methods from them at first hand.

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