ROTHAMSTED RESEARCH

Report for 1935

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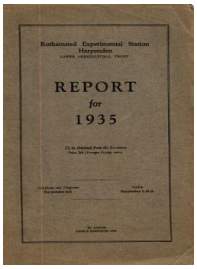

Mechanised Cultivation of Grain Crops

Rothamsted Research

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EFFECTIVENESS OF FERTILISERS

Our experiments show certain consistent differences between the three main groups of fertilisers. Nitrogenous fertilisers nearly always increase plant growth, though in many cases they produce their full effect only when potash and phosphates are also supplied. It is not usually possible to say beforehand whether these will be necessary or not ; soil analysis reveals the extreme cases of poverty but often fails to show the requirements on ordinary good farms. The effectiveness of potash and phosphate depends much more on soil and season than does that of nitrogen ; in 1935 some of the responses to potash were very marked, while others were not :

Comparison of Potash Response of Different Crops in 1935

				Mean Yield	Increase per 1.0 cwt. K_2O	% Increase
Six course rotation	Sugar beet.	Roots.	Tons	8.56	−0.24	−2.8
		Tops	,,	9.05	−1.55	−1.7
	Barley	Grain.	Cwt.	37.1	0.7	1.9
		Straw	,,	45.2	1.2	2.6
	Wheat	Grain	,,	25.3	3.2	12.6
		Straw	,,	42.0	6.2	14.8
	Potatoes		Tons	6.75	1.08	16.0
	Beans		Cwt.	21.0	2.7	12.9

Superphosphate was less effective than potash in 1935. Many experiments show that potash or phosphate can in certain seasons be omitted from the fertiliser without loss of crop, the necessary food being taken from the soil. But this process cannot be continued indefinitely ; if phosphate or potash starvation sets in it seriously reduces yields of important and expensive crops like potatoes. There may be times when the stored up fertility of the soil can be drawn upon and converted into cash, but as a regular procedure this may soon have undesirable effects. Now that rotations are not so strictly followed as before and farmyard manure is less readily obtainable it becomes important to watch the manuring closely and ensure that ample dressings are given for full crops and for maintaining the productiveness of the land.

MECHANISED CULTIVATION OF GRAIN CROPS

Problems arising out of the mechanised cultivation of arable land continue to receive attention. Both at Rothamsted and at Woburn deterioration of yield has followed from long continued growth of cereals on the same land where only artificial fertilisers are used, but the yields have been better maintained with farmyard manure. On modern mechanised farms and market gardens, little or no farmyard manure is made and therefore organic manure must either be brought in from outside or more or less dispensed with. For cereal growing it is not yet clear that this will matter very much for a few years, and good yields have been obtained without farmyard manure by suitable additions of artificial fertilisers, by occasional fallows and clover leys. For root crops, potatoes, sugar beet, for market garden crops and in some circumstances apparently

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for clover and lucerne, farmyard manure has special beneficial effects not easily obtained otherwise. Also on the lighter soils, such as those on which mechanisation is likely to be practised, the supply of organic manure is very important even for cereal growing. Two methods are being tried for increasing the supply of organic manure on the farm : green manuring and the return of straw to the land. The former is an old device, but very uncertain in its operation. The latter can be accomplished in various ways, several of which are being studied :

(*a*) Straw is being rotted in heaps by addition of the necessary nutrients for the micro-organisms ; this involves the difficulty of adequately moistening the heap.

(*b*) Straw is spread over the ground and ploughed in, the necessary artificial fertilisers being added either with the straw or later when they are likely to be most effectively used by the following crops. This method is being tried also at Sprowston on the farm of the Norfolk Agricultural Station.

In the Fermentation Department much work is done on the rotting of straw and other vegetable products to produce a good manure. This work continues to attract considerable attention, and workers come from overseas to study the possibilities of products available to them ; an Indian worker, Dr. Acharya, has in 1935 been investigating the rotting of rice straw. Organic manures, so far as they have been tested, have, however, less fertiliser value than the equivalent dressings of inorganic fertilisers.

Neither at Rothamsted, Woburn, nor on Mr. Prout's farm at Sawbridgeworth, were diseases or pests important, even after many years of continuous wheat growing. But in 1935 complaints reached us from mechanised farms of serious disease trouble even after 3 or 4 years only of wheat growing. Mr. Samuel found that the trouble was due to Take-all (*Ophiobolus*) or to *Fusarium*. By a curious coincidence, none of the three classical continuous wheat fields is liable to these diseases (though Take-all appeared at Woburn near the end of the experiment), but the light chalky soils on which mechanisation is developing are more susceptible to them. Mr. Samuel is taking up this question in detail.

Fallowing is, however, very effective in restoring productiveness to land deteriorated by continuous cultivation, though it is only temporarily beneficial. In general it makes a better preparation for wheat than clover or temporary leys. Unfortunately, fallowing favours the Wheat bulb fly (*Hylemyia coaretata*), and at the time of writing (May, 1936) the wheat crops sown after the fallows of 1935 are looking worse than any on the farm as the result of attacks by this insect, aggravated no doubt by heavy losses of soil nitrates during the very wet winter. Methods of control are being sought.

An important effect of fallowing is to keep down weeds and Dr. Brenchley has spent much time in discovering the conditions under which this is best done for the more important species. Chemi-

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cal spraying methods are also being tried, and a series of experiments has been started, with quite interesting results so far, on the possibility of removing weeds from grassland by spraying.

SOIL CULTIVATION

The cultivation experiments have continued, and an extensive series of observations on rotary cultivation is being worked up.

Soil tilth has been studied from the field side in Dr. Keen's cultivation experiments and from the laboratory side by him and his assistants, Mr. Scott Blair, Mr. Cashen and Dr. E. W. Russell. The essential point is to bring the soil into an aggregation of crumbs and to prevent it falling into a state of dust. The actual changes depend on the drying and re-wetting of the soil and are brought about largely by the weather, but the implements play a vital part in putting the soil into such form that the weather can act. The field experiments have shown some of the differences between rotary cultivation and the older methods. They are now being extended to show how the soil moisture is affected by the various cultivation processes : this work is difficult because the Rothamsted soil, by its stony nature, is not readily sampled, and no method of estimating the moisture content *in situ* is yet free from objection.

The laboratory work has now reached a stage where the numerous facts are falling into order. An important test of value of any new development is the extent to which it can be used. These physical investigations have already proved of value to experts concerned with such diverse industries as flour milling and oil boring apart from their use in agriculture.

MINOR ELEMENTS IN PLANT NUTRITION

In 1923 Miss Warington proved definitely for the first time that a minute quantity of boron is essential for plant growth, and this result has already found applications in practice. Various crop diseases previously incurable have now been traced to a lack of available boron ; notably a heart rot in sugar beet and " Internal cork " in apples in New Zealand, " Top rot " of tobacco, and diseases of potatoes, turnips, tomatoes and other crops. These diseases may occur even when compounds of boron occur in the soil, but presumably the boron is unavailable, because they are cured by addition of a small quantity of borax. The subject is being further developed and several field experiments on sugar beet have been started in affected areas in consultation with us.

It is known that oats suffer from shortage of manganese on certain soil types, and the factors controlling the availability of the manganese in soils are being studied.

Small amounts of molybdenum salts are also shown to affect plant growth considerably, causing, in some cases, simulation of

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