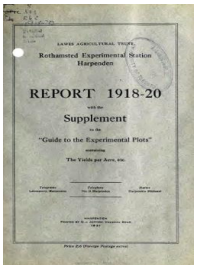
Report 1918-20 With the Supplement to the Guide to the Experimental Plots Containing the Yields per Acre Etc.



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Fertiliser Investigations

Rothamsted Research

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200lbs. of ammonium salts per acre, and the dressings were increased up to 800lbs. per acre. It was then found that the effect of the last 200lbs. of fertiliser, *i.e.*, of the increase from 600 to 800lbs. was very small and unprofitable, while the first 200lbs. had proved distinctly useful. This is in accordance with the Law of Diminishing Returns. It was assumed, therefore, that the law held for light as well as for heavy dressings of manure and a deduction was made for which the evidence was rather slender, that a small dressing of manure gave the largest rate of profit, while further dressings gave a relatively smaller return.

Recent work, however, has disturbed this view. 200lbs. per acre of ammonium salts is too large a unit for modern practice, hence more interest attaches to the effect of the smaller than to the larger dressings. Examination of the Broadbalk results shows that the largest return is given, not by the first dressing, but by the second.

The conditions of an experimental field are not quite those of practice, and accordingly a new experiment has been started to see if under ordinary conditions of farming the highest rate of profit is given by good rather than by small dressings of fertilisers. The results of the first year (1920) suggest that this may be so.

INCREASE IN WHEAT CROP, 1920, FROM SPRING DRESSINGS OF SULPHATE OF AMMONIA AND SUPERPHOSPHATE (p. 79).

	Grain: Bushels Per Acre.			Straw: Cwts. Per Acre.		
Date of Application of Manure . . .	Feb. 10	March 6	May 10	Feb. 10	March 6	May 10
Single Dressing . .	Nil.	0.9	2.7	2.7	6.9	9.4
Double Dressing . .	7.0	—	3.7	11.7	—	12.7

While the single dressing (100lbs. sulphate of ammonia per acre) gave no appreciable increase in grain, and only a few cwts. of additional straw, the double dressing gave increases of no less than 7 bushels of grain and 12 cwts. of straw. Late application of the double dressing, however, was risky, giving an unhealthy straw liable to lodge and prone to disease.

If funds allow, the experiment will be developed on a much fuller scale: it certainly is of great importance in fertiliser practice.

INVESTIGATIONS ON ARTIFICIAL FERTILISERS.

The artificial fertiliser position has been profoundly modified by the War, and extensive factories now manufacture nitrogenous fertilisers from the air. Of these nitrate of lime, nitrate and muriate of ammonia, and nitrolim have been or are under investigation at Rothamsted.

A further important source of organic nitrogenous manure is sewage. The total amount of nitrogen contained in the sewage of the United Kingdom is estimated at 230,000 tons per annum, which is equivalent to 1,150,000 tons of sulphate of ammonia—

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five times our present agricultural consumption. Under present conditions most of this is wasted, only a small portion finding its way on to the farms. A new method of dealing with sewage has, however, been devised by Dr. Fowler and his assistants at Manchester, and has been carefully tested at Rothamsted by Messrs. Richards and Sawyer. It yields an "activated" sludge, containing 6 or 7 per cent. of nitrogen and 4 per cent. of phosphoric acid, much richer than any of the older sewage sludge, and of very distinct promise as a fertiliser (p. 56). Moreover, no less than 15% of the nitrogen present in the sewage was recovered. Assuming, as seems permissible, the same percentage recovery elsewhere, the general adoption of this method would add considerably to the supplies of organic manures.

An entirely new method of treating sewage has been evolved, suitable for country houses, villages, etc., in which straw is used and a manure akin to farmyard manure is produced.

The phosphatic manures are of almost equal importance with the nitrogenous fertilisers. Considerable attention has been devoted to Basic Slag, which during the War changed considerably in character, and is not likely to go back to the old pre-war standard. A grazing experiment with sheep, and a set of hay experiments on permanent and on temporary grass land, have been started to ascertain the value of modern slags and of mineral phosphates. In addition an elaborate series of pot experiments is in hand to find out whether any constituent besides the phosphate is of value and whether the ordinary solubility test is sufficiently reliable to justify its retention. This work involves co-operation with the steel makers, and in order to develop it fully a Committee has been set up by the Ministry, composed of steel makers and agriculturists, under the Chairmanship of the Director.

Manures not only increase the crops; they bring about other changes. Phosphates improve root development, not only of swedes and turnips, but of cereals also. The Botanical Staff under Dr. W. E. Brenchley have shown that phosphates, nitrogenous and potassic manures, all cause marked increases of root development of barley, sodium nitrate whether alone or in conjunction with superphosphate being particularly effective. The root system of wheat, however, is less affected by nitrates or phosphates. Nitrogenous compounds in reasonable amount encourage early growth and help the plant in case of insect attack, while the combination of a small dressing of nitrogenous manure with a large amount of phosphates has been shown to help cereal crops, particularly oats, to mature more early in cold, wet districts. Potash increases the resistance of the mangold crop to disease and improves the sugar content of the root. Further, manures very considerably affect the composition of the herbage in grass land. Potash and phosphates encourage leguminous herbage and greatly improve the feeding quality of the herbage; nitrogen compounds encourage the grasses and largely increase the bulk of hay (p. 70 *et seq.*).

The effects of manures and cultivations on crop yields are by no means simple and straightforward. Every farmer knows the variations due to season and weather conditions. And although weather may never be controllable forcknowledge of its probable

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effects on the crops would be highly valuable. In order to study these effects a Statistical Department has been set up, in which Mr. R. A. Fisher and his assistant, Miss W. A. Mackenzie, have undertaken an analysis of the meteorological conditions at Rothamsted in conjunction with the crop records since 1852.

THE NEED OF ORGANIC MATTER IN THE SOIL.

However skilfully artificial manures are used it is essential on all ordinary farms to add organic matter to the soil. Four ways have been investigated for doing this.

1—*Farmyard Manure.*—Some 40,000,000 tons of farmyard manure are made by the farmers of the United Kingdom, but it is estimated by Hall and Voelcker that some 50% of the value is lost through avoidable causes. Thanks to the generous assistance of Viscount Elveden, it has been possible to retain an expert chemist, Mr. E. H. Richards, expressly for the purpose of studying this important question. Broadly speaking, the conditions to be secured in the making of the manure are sufficient supplies of nitrogen compounds and of air to allow the cellulose-decomposing organisms to break down the straw. For the storing of manure, however, it is necessary to have shelter from the rain and from access of air. The best methods of securing these conditions require working out for particular cases, which can be done after consideration of all the local circumstances.

Field experiments have shown that farmyard manure made and stored under these conditions is of higher fertilising value than the ordinary material—the crop being 10% or more beyond that given by manure kept in the usual way. An experiment has been begun in which one lot of bullocks is kept in a covered yard and an equal lot in an open yard, and the manure from both will be compared. During the War, when all sources of loss had to be studied, and as far as possible stopped, the necessary conditions were vigorously brought to the notice of farmers and Executive Committees by the Food Production Department and the Journal of the Ministry of Agriculture. Savings of several per cent. on old-established practice are possible, and every per cent. saved would mean in the aggregate some £200,000 at present prices.

A beginning has been made with a much more difficult problem—the handling of manure on a dairy farm. The conditions here are very different from those on an ordinary mixed farm where bullocks are fattened: it is desirable that the dung should be as little in evidence as possible and that the urine should be quickly and completely removed from the cow-sheds. So important is this that it must be done even if loss be thereby incurred. Two methods have been studied:—

(a) The solid excreta are removed and stored under cover and out of access of air; the liquid manure is collected in a tank and applied to temporary or permanent grass land and on the stubbles prior to the root crop.

This method is already in use on certain dairy farms, but when a careful examination was made a considerable deficit on the nitrogen account was revealed: the liquid contained only about one-

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