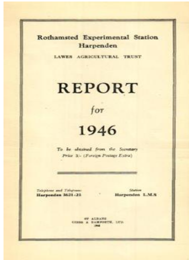
ROTHAMSTED RESEARCH

Rothamsted Report for 1946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Field Experiments of Rothamsted Farm

Anon

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FIELD EXPERIMENTS ON THE ROTHAMSTED FARM

The following members of the staff, who constitute the Field Plots Executive Committee, are responsible for planning and carrying out the programme of field experiments: E. M. Crowther, H. V. Garner, J. R. Moffatt, D. J. Watson and F. Yates.

The programme of experiments was slightly smaller than in previous years. The total number of experimental plots was 1,554, compared with 1,722 in 1945.

A.—Classical experiments

1. *Broadbalk and Hoosfield.*—Some of the Broadbalk plots and the whole of Hoosfield were heavily infested with wild-oats. An attempt was made to remove them by hand-pulling soon after the panicles emerged. All the Broadbalk wheat plots were cleared, except for Section IV of plot 2, where the infestation was particularly heavy, and had obviously depressed the growth of wheat. On this section a narrow strip was cleared of oats and left to give an estimate of yield at harvest; the rest of the crop was cut green and carted off to prevent reinfestation with shed seed.

The infestation on the Hoosfield barley experiment was more severe and widespread than on Broadbalk, and it was found impossible to clean more than a small fraction of each plot by hand. Accordingly the weeding operations were restricted to a small section of each plot. The crop on these parts was left to ripen, and the unweeded crop was cut green and removed.

2. *Barnfield.*—Sugar beet were grown on Barnfield for five years before the present continuous cropping with mangolds began in 1876, but at that time the crop was not commonly grown in this country and the results were of little practical interest. As it has now become one of the most important crops in the Eastern Counties it was decided to resume cropping with sugar beet on about a quarter of each plot, the remainder continuing in mangolds as previously. It is hoped that this will provide useful information on nutrient-deficiency symptoms in sugar-beet, and on the effect on yield of nutrient supply over a much wider range than can be obtained in short-period experiments on other fields of the farm.

Unfortunately, the 1946 crop was very irregular, and failed almost completely in some parts of the field. It was thought that this might be due to an increase in the severity of attack by beet eelworm, which is known to be present in the field, and arrangements were made for a further investigation of the eelworm cyst population after the removal of the crop.

No changes were made in the other classical experiments.

B.—Modern long-period experiments

All the existing long-period experiments were continued, and no new ones were begun. The deep-cultivation rotation experiment, started in 1944, has passed through its preliminary years, and all stages of the rotation were established for the first time in 1946.

C.—Short-period experiments

Short-period experiments were made on the following problems:

(1) *Bulky organic manures.*—The manurial value of the following materials was tested: farmyard manures, made with varying ratios of straw to feeding-stuffs, in covered boxes or in open yards; sewage sludge; composts made of straw and sewage sludge; bracken compost; peat. To distinguish between physical and nutrient effects of the organic manures, the responses to nitrogen, phosphate and potash in the presence and in the absence of the manures were measured.

The residual effects of similar materials applied to potatoes in 1945 were measured in a wheat crop.

(2) *Fertiliser placement.*—Work on fertiliser placement which has been going on for several seasons was continued. Two experiments were made. The first, on potatoes, compared the effect of a broadcast application of mixed fertiliser with applications in bands in contact with the seed, below the seed, or on either side of the seed. In the second, the effects on winter beans of phosphate and of potash broadcast or drilled with the seed were measured.

(3) *Beans.*—The experiment on beans tested, in addition to the placement of phosphate and potash, the responses to farmyard manure and nitrogen. A comparison of early and late autumn sowing was also included, but the late sowing failed because of severe damage by birds and had to be resown in spring.

In another experiment four strains of winter beans were compared. Two rates and times of sowing and two methods of sowing, by broadcasting the seed before ploughing or dropping it into the plough furrows, were also tested.

(4) *Eyespot disease of wheat.*—An experiment started in 1944, on varietal differences in susceptibility to infection with eyespot disease and to lodging, in crops sown in October or in November, was continued.

In another experiment the effects of varying the rate and depth of sowing, and the rate of application of a nitrogenous top-dressing on the amount of infection and lodging, were studied. This experiment also included a test of spraying with sulphuric acid in the spring as a method of controlling the disease.

(5) *Potatoes.*—The study of the effect of varying the time of planting between the end of March and early June on yield and on the responses to farmyard manure and fertilisers, begun in 1945, was continued in an experiment which was also used to provide information on the spread of leaf-roll and severe mosaic virus diseases from infected tubers planted on each plot.

Another experiment was designed to compare deep and shallow inter-row cultivation, and to measure the effects of earthing up and of a straw mulch applied between the rows, on yield and on the amount of greening and blight infection in the tubers.

Hoos field four course rotation

This experiment was started in 1930 on a four course rotation with one block for each crop each year. Each block had 25 plots and different experimental manurial treatments were given to five plots in any one year and repeated on the same plots every fifth year. The combination of a four course cropping rotation with a five course manuring rotation means that for each material the combination of a given crop and a given stage of exhaustion recurs only once in 20 years. By this time each one of the 20 plots for each manure will have been used to test each stage of exhaustion on every crop. The effects of soil irregularities will thus be reduced to a minimum.

The experiment falls into two sections. The first tests three bulky organic manures: farmyard manure, straw-compost, and raw straw. The farmyard manure and straw compost supply equal amounts of organic matter, and the raw straw is equal in amount to that used in making the compost. Each manure is analysed shortly before application, and extra fertilisers are added to provide equal amounts of nitrogen, phosphoric acid and potash in all three treatments. No further fertiliser is given in the next four seasons. The second section has two treatments—superphosphate and mineral phosphate—applied once in five years with the same total amount of phosphoric acid as in the adjusted organic manures, but with annual applications of nitrogen and potash equal to one-fifth of the total amounts used in the organic manure series. The superphosphate series thus tests five-yearly phosphate with annual nitrogen and potash against equal total amounts of plant foods in organic manures applied every five years. The experiment would show in time whether the omission of organic manures has any cumulative effect. Mineral phosphate is known to be unsuited for this neutral soil, but it was included to serve as a "control" in the early years and also to test whether or not it might exert any progressively beneficial effect over a long period.

Data for each stage of exhaustion are already available in fourteen seasons for potatoes, barley and wheat and in ten seasons only for rye grass. A summary of the main results is given below.

Residual effects in Hoos Field four-course rotation experiment, Rothamsted, 1932 to 1945

The dung and straw compost each supplied 50 cwt. organic matter per acre. The raw straw equalled the amount used to make the compost. Fertilisers were added to raise the total plant food to 1·8 cwt. N, 1·2 cwt. P_2O_5 and 3·0 cwt. K_2O per acre. These manures were applied every five years with nothing in the four intervening seasons.

The superphosphate and mineral phosphate supplied 1·2 cwt. P_2O_5 per acre every fifth year with 0·36 cwt. N and 0·6 cwt. K_2O as sulphate of ammonia and muriate of potash per acre every year.

The benefits from farmyard manure are very much less after one year than in the year of application, and there is a small but steady decline up to four years after application. In the year of application raw straw with fertilisers gave better results than farmyard manure or straw composts, the advantage being especially great with rye-grass, which responded very well to the large amount of sulphate of ammonia given with the straw. The average residual effects from raw straw with fertilisers were at least equal to those from farmyard manure. Farmyard manure gave better results than straw-compost on potatoes, both immediately and as residues; these two manures gave equal yields for the other crops. Raw straw with fertilisers gave better results than straw-compost,

	Years after application	Potatoes tons per acre	Barley cwt. grain per acre	Rye grass cwt. dry matter per acre	Wheat cwt. grain per acre	Average crop* cwt. per acre
Farmyard Manure						
	0	5·93	28·5	18·9	22·6	24·9
	1	4·71	23·2	12·5	18·9	19·5
	2	4·56	20·7	10·3	17·4	17·8
	3	4·29	19·2	9·6	17·2	16·9
	4	4·06	18·5	8·9	16·0	15·9
	Mean	4·71	22·0	12·0	18·4	19·0
Straw Compost						
	0	5·30	27·7	18·1	23·2	23·9
	1	4·16	22·2	12·9	18·3	18·6
	2	3·86	20·2	9·8	16·8	16·5
	3	3·72	19·2	8·9	17·5	16·0
	4	3·73	18·3	9·7	15·6	15·6
	Mean	4·15	21·5	11·9	18·3	18·1
Raw Straw						
	0	6·42	29·5	30·6	25·3	29·4
	1	4·70	22·5	12·4	18·0	19·1
	2	4·77	21·0	11·9	18·7	18·9
	3	4·32	20·6	10·8	17·6	17·6
	4	4·18	20·8	9·4	16·6	16·9
	Mean	4·88	22·9	15·0	19·2	20·4
Superphosphate						
	0	6·44	28·4	18·1	20·3	24·8
	1	5·16	27·2	19·4	20·3	23·2
	2	5·36	27·1	18·8	20·3	23·2
	3	5·38	27·1	16·8	20·5	22·8
	4	5·08	26·7	17·2	20·3	22·4
	Mean	5·48	27·3	18·1	20·3	23·3
Mineral Phosphate						
	0	4·17	24·1	16·4	19·6	20·2
	1	4·17	25·0	16·8	20·4	20·8
	2	4·24	25·6	15·8	20·3	20·7
	3	4·54	23·8	15·6	21·0	20·8
	4	4·12	26·2	16·2	19·8	20·7
	Mean	4·25	24·9	16·2	20·2	20·6

though the differences in residual effects were small for cereals and rye-grass.

The plots with superphosphate every five years and one-fifth of the total nitrogen and potash given each year gave yields similar to farmyard manure in the year of application. This suggests that only about one-fifth of the nitrogen in farmyard manure is immediately available. In residual effects these fertiliser plots were far superior to the residues of farmyard manure at all stages, because the annual application of nitrogen and potash supplied much more available plant food than the residues from the organic manures.

The superphosphate plots brought out a most important general point in connection with the residual value of fertilisers. The yield of potatoes immediately after application was over 1 ton per acre more than from residues at any stage, but the value of the residues fell off only very slowly, if at all, from the first to the fifth year. Since mineral phosphate gave the same immediate and residual effects it may be assumed that this form of phosphate has so far been practically ineffective. If mineral phosphate is treated as a "control", it follows that superphosphate has a considerable and

* Approximately in terms of dry matter on basis 1 ton potatoes = 5 cwt. grain.

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prolonged residual effect, since its residues give one ton more potatoes per acre than the residues of mineral phosphate for each of the five years.

A similar effect is also seen in barley. The figures are:—

Difference superphosphate—rock phosphate

	1st Year	2nd Year	3rd Year	4th Year	5th Year	Mean
Potatoes, tons ...	2·27	0·99	1·12	0·84	0·96	1·24
Barley, cwt. ...	4·3	2·2	1·5	3·3	0·5	2·4

The high immediate effect of superphosphate on potatoes clearly depends in part on the circumstance that it is applied in bouts at the time and in the place where it can act most quickly on the young crop. This is an excellent form of "fertiliser placement". All residues from previous crops are necessarily much less efficient, because the intervening ploughing dissipates them through a large mass of soil and leaves no local concentration near the sets. This result must be expected in all soils, but in many there is the additional rapid wastage through so-called "phosphate fixation" or the formation of inert and useless residues in the soil.