ROTHAMSTED RESEARCH

Report for 1952

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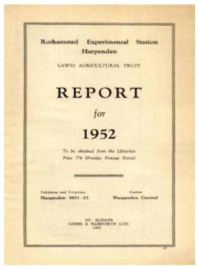
Rothamsted Experimental Station
Harpenden
LAWES AGRICULTURAL TRUST
REPORT
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Field Experiments Section

Anon

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FIELD EXPERIMENTS SECTION

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

The number of plots handled by the Field Staff at Rothamsted and Woburn were:—

	Grain	Roots	Hay	Grazing	Total
Classical					
Rothamsted	124	72	47	—	243
Woburn	36	—	—	—	36
Long-period experiments					
Rothamsted	335	312	248	96	991
Woburn	133	314	55	12	514
Annual experiments					
Rothamsted	449	569	177	—	1,195
Woburn	8	73	64	—	145
Total	1,085	1,340	591	108	3,124

Considerably more plots were put down in 1952 than in the previous year. This was partly accounted for by some 300 microplots devoted to a preliminary test of a synthetic soil conditioner, and about 250 to small-scale tests of fertilizer placement on beans and other vegetable crops. Some plots were for observation only; the total number of plots actually harvested on the two farms was 2,748.

The weather conditions affecting agricultural operations are described in detail in the farm report; the following brief notes put on record the main features of 1952 to provide a general background for the year's experimental work.

The first two months of the year were much drier than usual, the land was in ideal condition for early spring sowings and most of the spring cereal crops, including Hoosfield barley, were drilled on the last few days of February or the first days of March. The weather then became showery and tilths deteriorated, but there was worse to come, for on 29th March a severe snow-storm occurred with drifts which persisted for nearly a week. This was followed by further showery weather and experimental field work was stopped till mid-April. Roots and potatoes were put in rather late, sometimes on poor seedbeds. Sowings were completed by the first week in May except for barley on Great Field II which followed a failed crop of linseed and was not drilled till 13th May. The weather then became warmer and drier, conditions for growth were very good, and a warm dry spell in June and July, pushed the corn to an unusually early harvest. Spring oats were cut on 23rd July and barley and rye plots were harvested three days later. The plots were got up in very good condition, but before the commercial harvest was complete the weather broke and August had 2·54 inches above the average rainfall, mostly in heavy thunderstorms. Owing to a very wet September and unsettled conditions in October lifting of experimental potatoes continued till the early days of November. A succession of snowfalls and frosts in the last fortnight of the

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month further delayed root lifting, leaving a small area of Barnfield mangolds and sugar beet still to complete at the end of the year.

The Classical Experiments

The autumn of 1951 was so wet that Broadbalk was not fit to drill till 5th December in a very poor seedbed, the land being so sticky on the southern side of the field that the seed could scarcely be covered. In spite of this a good plant was found in spring on all plots except plot 10 (nitrogen only) which is usually thin in the section immediately after bare fallow. The first-year effect of bare fallow was less noticeable than usual, but as in the previous year this may have been due to very wet weather. Wild oats, which have now been energetically tackled on this field for several seasons, were abundant by mid-summer but were perhaps not quite so bad as usual. Hand-pulling was once again carried out very thoroughly before the oats had shed and this greatly improved the appearance of the field and increased its value for demonstration purposes. There was little lodging and owing to the catchy weather the crop was harvested rather late and over-ripe.

Hoosfield had an excellent early start, and made an even crop except on certain plots, notably 5A, where acidity is now becoming serious, and also on plot 30 where a slight depression held snow for a long period and seriously damaged the plant. Wild oats were as usual very conspicuous before harvest, so much so that complete hand-pulling was out of the question. The procedure followed in 1946 and 1947 was again adopted whereby the bulk of each plot was cut and carted green before the oats shed, leaving a small area to be hand-pulled and harvested for an estimate yield.

Barnfield carried a good plant and looked somewhat better than usual. There was an exceptional growth of groundsel late in the season on strip AC receiving high nitrogen and in certain areas this topped the plant and probably affected yields. Owing to the wet autumn and snow in late November, lifting was much delayed.

Agdell field which should have carried swedes in 1952 was not drilled, for in recent years this crop has failed entirely owing to severe attacks of clubroot. The future of the Agdell experiment is now under consideration by the Plots Committee.

At Woburn an interesting feature of the Classical experiments was the growth of a winter-sown barley, Pioneer, for the first time on the permanent barley plots. The winter-sown and the usual spring-sown varieties were compared in strips running side by side through the experiment. The winter barley yielded from twice to three times as much as the spring barley alongside. This comparison will be repeated in 1953. The yields are given in the section of the report relating to the Woburn Experimental Station.

Long-Period Rotation Experiments

Ley-arable experiments

In 1952 the experiments on Highfield and Fosters gave the first measurements of fertility differences arising out of cropping with various grasses and legumes over the previous three years. The test crop wheat was excellent on both fields. The crops were clean, stood well and showed differences due to the various pre-treatments. In Highfield the wheat after three years' arable cropping looked the best, but on Fosters lucerne gave the finest wheat crop.

The effect of the higher level of "Nitrochalk" top-dressing was slightly harmful on Highfield, but beneficial on the average on Fosters especially on the straw. The crops following lucerne showed no benefit from nitrogen. The grain yields and the extra effect of the double top-dressing above the single one are given for both fields below.

Ley-arable experiments, Highfield and Fosters, 1952
Wheat, mean yield of grain: cwt. per acre

	After 3 years' cropping with:—				
	Lucerne	Grazed Ley	Cut Grass	Arable Crops	Mean
Highfield					
Mean yield	40·7	36·1	34·1	43·1	38·5
Increase for N	— 3·7	— 1·8	— 5·9	— 1·7	— 3·2
Fosters					
Mean yield	40·5	34·7	36·2	35·3	36·7
Increase for N	0·9	2·3	0·7	3·5	1·8

Potatoes and barley, the second and third test crops were not yet in cycle so merely served to measure the effects of dung and nitrogen. Both crops were more successful on Highfield than in 1952, the potatoes being less damaged by birds and the barley less severely lodged. The potatoes gave a good response to dung on both fields and to nitrogen on Highfield; the residual effect of dung measured in barley amounted to 2·8 cwt. grain in both fields but the direct response to the higher nitrogen dressing was small.

Lucerne in its second and third years became very grassy on Highfield, so much so that the third year yield was affected. Violet root rot noted on certain plots on Highfield in 1951 still persisted.

The grazing plots of permanent grass and leys came on well after the snow of early April and were ready to stock in the third week of this month. At this time all supervisors were fully engaged in completing the arable programme so the grass plots could not then be stocked and the plots had to be mown on 12th May in order to measure the early output and prepare for grazing later. The produce of all hay plots and of the preliminary cuts on the grazing plots were weighed green and sampled for dry matter. The output of the grazed plots was determined from random samples taken with a rotoscythe before every grazing. The mean yields under the various systems of management are given below in terms of hundredweights of dry matter per acre.

Yield of herbage crops, Highfield and Fosters, 1952
Dry matter: cwt. per acre

	Old grass		Reseeded grass		3 year ley		Cut	Cut	1 Year Ley
	Hay.	Grazed	Hay.	Grazed	Hay.	Grazed	Grass	Lucerne	Hay
Highfield									
Blocks:									
1st year	29·0*	17·9	32·2*	21·8	—	35·7	46·0	44·5	66·0
2nd year	11·9*	26·7	24·2*	27·3	27·3*	26·1	59·8	81·5	—
3rd year	52·4	13·9*	67·1	17·0†	27·5*	20·7	53·3	68·7	—
Fosters									
Blocks:									
1st year	—	—	18·9*	23·6	—	18·4	11·4	29·8	63·2
2nd year	—	—	15·8*	25·0	19·7*	21·3	63·7	93·0	—
3rd year	—	—	49·8	13·3†	17·3*	23·0	49·5	102·9	—

* Pre-grazing cut. † Aftermath grazing.

The yield of grass, although good, was somewhat below that obtained in the very favourable season 1951. Thus the average production of dried cut grass of all ages was 47 cwt. in 1952 as against 56 cwt, in the previous year. On the other hand lucerne did very well on both fields, and on Fosters it produced the remarkable yield of 103 cwt. dry matter in the third year, considerably more than grass under any system of management.

Nitrogen responses were substantial on second and third year cut grass, averaging 6·8 cwt. dry matter per acre as a total of 4 cuts for the extra 4 cwt. of " Nitrochalk ". The permanent and reseeded grass laid up for hay in the third year also averaged 4·3 cwt. dry matter for an extra 1 cwt. of " Nitrochalk ". The nitrogen dressings on grazing land gave only small increases in dry matter per acre.

Grazing commenced on 29th May and most of the plots had 4 circuits with teams of 4–5 sheep although wider variations in stocking were necessary in special circumstances. There was a gap in the grazing for much of July and August owing to the dry weather.

The new 3-course rotation

A 3-course rotation experiment which was started in 1933 to test the long period effect of dressings of raw straw and straw compost was terminated in 1951. A full discussion of the results of three 6-year cycles of this experiment is contained in the Report for 1951, pp. 135–140. In brief, straw depressed the yield of barley and sugar beet, but increased the yield of potatoes; and its action could be explained on the assumption that straw had two main effects (1) immobilization of available nitrogen and (2) provision of readily available potash. Measurements made of residual and cumulative effects suggested that nitrogen locked up by straw or compost was very slow to return to circulation; there was no general build-up in soil fertility, due to organic manures applied over a long period.

To analyse these findings in more detail the 3-course rotation was recast for a further period commencing with the crops of 1952. The new scheme is in outline as follows:—the 3-course rotation, potatoes, barley, sugar beet, continues as before. The compost treatment is stopped, the new experiment being confined to testing straw. The plots formerly receiving only inorganic fertilizers are now maintained without any organic additions and test inorganic nitrogen applied as sulphate of ammonia in alternate years. One third of the original plots testing straw or compost continue to receive straw in alternate years, while the remainder test in the presence and absence of sulphate of ammonia, an amount of muriate of potash equivalent to the K_2O contained in the straw application. In the original experiment the straw received a quantity of nitrogen at the conventional rate, 0·7 per cent of the dry weight of straw, but in the modified scheme the straw receives nitrogen at two rates, 0·4 per cent and 1·2 per cent respectively, the straw plots having the lower rate of nitrogen being supplemented by a direct addition of sulphate of ammonia in the second year. No further nitrogen is added in the second year to straw plots receiving high nitrogen.

Every plot in the above schedule of main treatments is divided to test an addition of muriate of potash. At present the intention is to harvest the half plots only when the crop is potatoes, as this crop is most likely to reveal differences in potash responses in the presence or absence of straw either applied directly or in the form of residues.

Irrigation experiment, Woburn

The rotation experiment testing three systems of applying water to sugar beet, barley, early potatoes and a grass mixture was continued for a second season, and the results are summarized in the report of the Physics Department. The growing period was moist enough in spring and late summer, but June and July were very dry. Irrigation at the highest level tested, approximately 5 inches, gave an increase of 4·2 tons of early potatoes, lifted on 10th July, 36 cwt. dry grass as a total of 7 cuts, 2·2 tons sugar beet roots, and 2·6 cwt. barley grain.

Short-Period and Annual Experiments

Many of the short-period and annual experiments were carried out on behalf of the scientific departments who made the necessary observations and in some cases did some of the field work. The account of these experiments will be found in the departmental reports. They were:—

Fertilizer placement experiments. (G. W. Cooke, Chemistry Department).

(1) Spring beans—Great Harpenden II, superphosphate and sulphate of potash, broadcast and placed.
(2) Broad beans—Great Harpenden II, granular PK fertilizer, broadcast and placed.
(3) Lucerne—Highfield V, superphosphate and muriate of potash, broadcast and ploughed in; with and without placed superphosphate.
(4) Red beet—Long Hoos IV, complete fertilizer, broadcast and placed.

Experiments with "nitrophosphate". (G. W. Cooke, Chemistry Department)

(1) Barley—Highfield III, "nitrophosphate" and equivalent nutrients, broadcast and combine-drilled.
(2) Old grass—Highfield IX, residues of two "nitrophosphates" applied in 1951.
(3) Potatoes—Highfield V, three "nitrophosphates" and levels of superphosphate.

Experiments on eyespot of wheat. (M. D. Glynne, G. A. Salt, Plant Pathology Department)

(1) Rotation experiment—Little Knott, 3rd year: testing 32 different crop sequences on the incidence of eyespot. These rotations are being built up for a test in wheat in 1953.
(2) Great Field I: testing two varieties; two seed rates; two levels of nitrogenous manuring applied on four occasions; and effect of spraying with sulphuric acid in early spring.

Wireworm experiment on wheat. (F. Raw, Entomology Department, C. Potter, Insecticides Department)

Geescroft; test of five soil fumigants.

Experiments on the control of bean aphis. (M. J. Way and P. Smith, Insecticides Department)

Spring beans—Great Harpenden II; six insecticides.

Control of late blight on potatoes. (J. M. Hirst, Plant Pathology Department)

Effect of copper and sulphuric acid sprays.

Virus yellows experiment on sugar beet. (J. W. Blencowe, Plant Pathology Department)

Great Harpenden II; effect of three sowing and three singling dates.

Virus spread experiments. (L. Broadbent, Plant Pathology Department)

(1) Potatoes—Long Hoos V, examination of crop grown from seed produced in an experiment carried out in 1951 testing five insecticides against aphids.

(2) Potatoes—Long Hoos V, spread of two viruses from infector plants.

(3) Cauliflower—Long Hoos VII, spread of two viruses from infector plants.

Other Annual Experiments

(1) Wheat—Little Hoos, the residual effects of various amounts of dung applied to the previous potato crop.

(2) Potatoes—West Barnfield II, 4th season, dung at 3 levels, ploughed in in winter, ploughed in in spring, and spread down the ridges. Test of sulphate of ammonia, superphosphate and muriate of potash.

(3) Potatoes—West Barnfield II, method of planting. This was a continuation and development of previous experiments started in 1949. The main comparison was between broadcast fertilizer and fertilizer placed 2 inches to the side of the seed by a planter provided with a special fertilizer placement unit. This comparison was made when planting in ridges, and also when working from the flat. Plots manured in the ridges and planted by hand in the usual way were included as controls. In two of the previous experiments this standard method had given somewhat lower plant populations and lower yields than machine-planting, and it was thought that the difference might be due in part to excessive drying out of the ridges before planting. Consequently in the present experiment one set of plots were planted by the ordinary method in ridges that had previously been exposed to the weather for a week, while another set of plots were planted in ridges that had been set up the same day. All ridges were then split back immediately. A preliminary examination of the figures shows them to be closely in line with earlier experiments carried out by G. W. Cooke for the Agricultural Research Council at outside centres. There were big responses to fertilizer. Granular compound fertilizer either placed by machine or broadcast over the ridges before splitting back was much more efficient than an equal quantity broadcast on the flat. Of the above two methods of concentrating the fertilizer close to the seed, the banded

fertilizer gave slightly better results than those obtained by the standard method. Owing to the continued showery weather during the week in early May when the ridges were exposed this treatment showed no harmful effect as compared with immediate planting and splitting back.

(4) Late nitrogen on cereals. Experiments testing top-dressings of 1½ and 3 cwt. "Nitrochalk" per acre applied when the cereals were in ear were continued for the third season in 1952. They were carried out on fields which had already received the nitrogenous top-dressings used for ordinary commercial crops, so that late nitrogen was being tested on crops adequately manured. Wheat had 2½ cwt. sulphate of ammonia on 25th April, and the late nitrogen was applied on 28th June, 44 days before cutting. Barley received 2½ cwt. sulphate of ammonia (applied 19th March for linseed which failed) and a further ¾ cwt. sulphate of ammonia combine-drilled on 13th May, and the late nitrogen was given on 16th July. This late sown barley which was not harvested till 16th September could not be regarded as a normal crop and the yields have little value. They do at least show that generous manuring cannot compensate for late sowing. Oats were an excellent crop; they had received 2½ cwt. sulphate of ammonia on 3rd March, and the late top-dressings were applied on 30th June, only 23 days before cutting.

The summer was not favourable for late nitrogenous dressings for June and July were very dry. The oats only had 0·5 inches of rain in the three weeks in which the dressings were on the land, the wheat only 0·9 inches in the six weeks' period; the barley had practically no rain for a fortnight after application, so for this crop the nitrogenous dressing could be regarded as having remained inactive till the beginnings of August. Subsequently there was plenty of moisture.

The yields of grain and straw, the increase in crude protein and the uptake of added nitrogen are set out for the three crops in the table below.

Late nitrogenous top dressings on cereals, Rothamsted, 1952

"Nitrochalk" cwt. per acre	Wheat Grain	Wheat Straw	Barley Grain	Barley Straw	Oats * Grain	Oats * Straw
		Yield, cwt. per acre				
0	19·0	33·7	13·1	19·6	35·5	45·5
1·5	20·9	34·1	13·5	18·3	36·4	45·5
3	20·8	35·9	13·1	19·2	35·2	45·6
		Increase in crude protein, cwt. per acre				
1·5	0·33	0·00	0·08	–0·06	0·30	0·05
3	0·32	0·06	0·02	–0·05	0·24	0·10
		Percentage uptake of added nitrogen				
1·5	23	1	6	–4	21	3
3	11	2	1	–2	8	3

* corrected to 85 per cent. dry matter.

Wheat was only a fair crop owing to a rather severe attack of eyespot; there was a small increase in yield for the smaller dressing of "Nitrochalk", and the gain of 0·33 cwt. crude protein per acre in the total produce was intermediate between the good result obtained in 1950 and the poor one in 1951. Barley, which so far has been the most responsive crop gave practically no response to late nitrogen in 1952, but for reasons already stated the crop was very poor. The yield of oats was excellent and was not improved by late nitrogen which in this case only had three weeks to act. There was a gain of 0·3 cwt. protein, chiefly in the grain, for the light dressing of " Nitrochalk ".

The experiments on wheat and barley were enlarged to test a small pusher combine specially designed by the National Institute of Agricultural Engineering for harvesting small plots, the standard for comparison being the normal binder procedure used at Rothamsted. These and other similar harvesting tests are discussed in the farm report. In the present report figures derived from harvesting by the standard procedure have been used.

Soil conditioners

A number of small-scale experiments were laid out in April 1952 at Rothamsted and Woburn to test the effect on soil structure and crop yields of a synthetic soil conditioner—the sodium salt of a hydrolized polyacrylonitrile, supplied as " Krilium CRD-189 ". In one set of experiments, two on each farm, the conditioner was incorporated at two rates (3 and 6 cwt. per acre) by rotary cultivation and also tested at the lower rate by broadcasting and raking in. The experiments were in 4 × 4 Latin squares with plots of 5 × 2 square yards. Four rows of each of four crops—carrots, red beet, clover and ryegrass—were taken in strips across every plot of the experiment. Several small-scale experiments were made on other crops—sugar beet, potatoes, wheat, barley. Where the conditioner was raked into the soil surface, the Rothamsted experiments sometimes showed a honeycomb of small pits which were empty in dry weather and full of wet jelly after rains. The soil adjoining the pits had a hard and somewhat darker crust. Similar observations were occasionally made where the conditioner had been incorporated by two rotary cultivations, but in most of the experiments it was difficult to detect any consistent visual differences in the structure of surface soils with contrasted treatments. There was no evidence of any appreciable increase in crop yield from using the conditioner. In these experiments the active ingredient was applied directly without a filler. Its hygroscopic properties may have prevented the conditioner from being intimately incorporated with the soil. Although the results of these preliminary experiments are not very promising, it is possible that improved methods of preparation and incorporation may be found in the future.

Staff

Mr. G. V. Dyke transferred from the Statistical Department to fill a vacancy in the Field Experiments Section caused by the death of Mr. J. W. Weil.

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