ROTHAMSTED RESEARCH

Report for 1958

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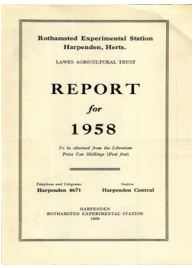

Field Experiments Section

Anon

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FIELD EXPERIMENTS SECTION

The field experiments at Rothamsted and Woburn are controlled by the Plot Committee consisting of the following members of the staff: F. Yates (Chairman), H. V. Garner (Secretary), F. C. Bawden, G. W. Cooke, P. H. Gregory, J. R. Moffatt, C. A. Thorold, R. G. Warren and D. J. Watson.

Table 1 shows the total number of large plots on the two farms and how they were distributed between different crops and experiments of different durations. In addition, there were many micro-

TABLE 1

	Grain	Roots	Hay	Grazing	Total
Classical experiments:					
Rothamsted	230	153	53	—	436
Woburn	—	—	—	—	—
Long-period experiments:					
Rothamsted	277	270	243	96	886
Woburn	157	250	55	12	474
Annual experiments:					
Rothamsted	724	166	160	—	1,050
Woburn	366	—	72	—	438
Total	1,754	839	583	108	3,284

plots. The increased number of cereal plots and grass plots was more than offset by a decreased number of root plots.

The characteristics of the season are detailed in the report on the Farms; only the main features are mentioned here as a background to the account of the field experiments. The year 1958 will long be remembered for its dull, wet summer. Every month from April to November was below the average in sunshine, and the period June to September had over 4 inches more rain than usual. Conditions for hay-making were particularly bad: fortunately most of the herbage experiments, except for Park Grass, are now weighed green and sampled for dry matter. June had 4·7 inches of rain and a deficiency of over 60 hours of sunshine; singling and hoeing were hindered, and barley on the heavily manured plots began to lodge by the end of the month. July had slightly less than the average rainfall, but 18 wet days, dull weather and lack of drying winds left the land generally wet. Weeds grew fast and conditions so favoured the spread of potato blight that spraying was begun in the middle of the month. The weather became much worse in August, which rivalled June in lack of sunshine. There was much lodging: in an experiment in which the factors concerned in lodging were being studied, all plots regardless of treatment went down. The corn harvest started in the last week of August, and everything had to be dried. When work was held up by bad weather an early start was made with potato lifting, which continued under fairly good conditions till the end of September. Despite blight, yields of Majestic were only slightly below average, and there was little

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tuber infection. Further rain in the first week of October made it necessary to leave the potato experiments and transfer to Barnfield mangolds, which had done particularly well in the wet summer. Autumn ploughing and cultivations for wheat and beans went on whenever possible; but with no night frosts, little drying wind and persistent showery weather the seedbeds for the early sown experiments were very poor. November had 0·34 inches less than the average rainfall, but frequent fogs, heavy dews and no drying winds made surface conditions worse and the few experimental plots of wheat and beans sown were drilled with great difficulty. Commercial potatoes came up very badly indeed, and lifting was not completed by the end of the month. A slight improvement in early December enabled most of Broadbalk (except the dunged plot) to be drilled on the 9th in the worst seedbed for many years. By mid-month water was standing in hollows all over the farm.

Notes on the Experiments

On the classical experiments the main point of note was the use of the combine-harvester on Hoosfield barley for the first time. The square plots on this field are less convenient for combining than the long, narrow strips on Broadbalk, and there is more variation within plots. Operations in 1958 were therefore preliminary, and on the more variable plots several combine cuts were taken and weighed individually. This year the effect of the long struggle against wild oats (*Avena fatua*) was unmistakable. The small amount of weed that appeared was easily hand-pulled during the summer. Unfortunately coltsfoot (*Tussilago farfara*) was now increasing on some of the plots to such a degree that a special programme of herbicides will be tried. The first step was to spray the stubble with MCPA after harvest.

Broadbalk was drilled on a rather rough seedbed on 20 November. The winter was wet but not particularly cold. On 13 December very heavy rain left water standing in furrows and on the lower parts of the field, and most of the drains ran strongly. The crop looked well until it became ragged and twisted in the August rains, but only the heavily manured plots were badly lodged. The continuous wheat section nearest the farm, carrying its seventh crop, was sprayed with CMPP. The kill of weeds was very good, heavy infestations of vetch and buttercup being controlled on several plots. On these plots, particularly those low in nitrogen, spraying improved the growth of the crop so markedly that they were taller and greener than the corresponding plots on the adjoining unsprayed section which had been fallowed only 2 years before. This striking effect is being studied in the Botany Department. The amount of chaff and small straw not picked up by the baler, and therefore left on the plots after combine-harvesting, was measured on certain plots; the figures are given in another section of this report.

The eighty-seventh crop on Barnfield was drilled in a very good seedbed on 7 May and gave a full plant with unusually high yields on the better-treated plots.

The original plots of Agdell field were cropped with Italian ryegrass generously treated with nitrogenous fertilizer to measure the

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uptake of phosphorus and potassium left in the soil from the former long-period treatments.

For the second year the East end of the Exhaustion Land was drilled with six different crops to measure residual effects of the former phosphorus and potassium treatments against direct additions of these nutrients. The fresh land required for these experiments was provided by the uncropped headlands of 1957. The usual strips of nitrogen-treated barley occupied the West end of the field, and were combine-harvested for the first time.

Long-period experiments

Two methods have been employed in the Rothamsted ley–arable experiments to estimate the output of grazing land: dry matter calculated from the live-weight increases and grazing days of sheep, and dry matter estimated by sampling cuts taken at the beginning of every grazing period. Figures obtained by these two methods over an 8-year period were inconsistent, and as the weighing of sheep was difficult and time-consuming, the weighings were discontinued and the yield estimate is now made from the pasture cuts only. The reseeded grass established 6–8 years ago showed signs of deterioration, particularly on Fosters but also to a lesser extent on Highfield. Mr. J. O. Green of the Grassland Research Institute examined all the grass plots in winter 1957 and reported that the reseeded plots need not be ploughed up and resown, but could be upgraded by taking an early silage cut in alternate years. The new management, which was extended to the old permanent grass plots on Highfield also, was therefore: first year early silage cut followed by sheep grazing for the rest of the season, second year sheep grazing only. Cutting for hay, formerly carried out once in 6 years, was stopped.

The three-course rotation experiment, modified in 1952 to study more closely the effect of straw on crop yield, has now been discontinued. The results for the period 1953–58 are summarized by H. D. Patterson in this report on pp. 167–171 below.

Annual Experiments

A series of fourteen experiments testing levels and times of application of " Nitro-Chalk " to spring wheat and barley was made on both farms from 1955 to 1958. The rates of application tested were 0, 0·3, 0·6 and 0·9 cwt. N/acre in all experiments except for barley at Rothamsted, where because of the risk of serious lodging with the higher dressings the levels were 0, 0·23, 0·46, 0·69 cwt. N. Times of application for each level were: (i) all in seedbed; (ii) all as early top dressing; (iii) all as late top dressing; (iv) half in seedbed, half early; (v) half in seedbed, half late; (vi) half early, half late; (vii) one-third of the dressing at each time of application. Table 2 shows that there were very good responses to nitrogen up to 0·6 cwt. N, but the extra increase for the third 0·3 cwt. N was profitable only at Woburn.

Table 3 shows the effects of time of application.

At Rothamsted the method of application made very little difference on either crop. At Woburn late top dressing for wheat was

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inefficient, and seedbed application for barley was less effective than early top dressing. These statements apply not only to the averages given above but to all the individual experiments. In

TABLE 2

Rothamsted and Woburn 1955–58

Spring Wheat and Barley

Responses to successive doses of " Nitro-Chalk " cwt./acre

(Averaging all times of application)

	No nitrogen	Successive increases N_1–N_0	N_2–N_1	N_3–N_2	Total increase
Spring wheat:					
Rothamsted	23·0	+ 6·0	+2·2	+0·8	+ 9·0
Woburn	13·2	+ 8·8	+4·8	+1·2	+14·8
Barley:					
Rothamsted	30·8	+ 4·7	+3·5	+0·8	+ 9·0
Woburn	17·5	+10·3	+6·0	+2·9	+19·2

three out of the four series, seedbed applications were as good as any other method, and the extra labour required for divided dressings was not justified; indeed, in three out of the four series the best single dressing outyielded all the divided dressings.

TABLE 3

Rothamsted and Woburn 1955–58

Spring Wheat and Barley

Effect of time of application of " Nitro-Chalk ", cwt./acre

(Mean of all rates of application)

	Seed bed (S)	Early (E) top dressing	Late (L) top dressing	½ (SE)	½ (SL)	½ (EL)	½ (SEL)	Mean of all divided dressings
Spring wheat:								
Rothamsted ...	31·6	30·8	29·8	30·0	31·4	30·0	31·0	30·6
Woburn ...	27·6	24·2	23·2	26·6	25·4	24·7	26·6	25·8
Barley:								
Rothamsted ...	37·9	37·9	38·0	38·1	38·2	38·2	38·2	38·2
Woburn ...	31·5	33·9	32·3	32·1	32·3	32·4	33·7	32·6

THE USE OF COMBINE-HARVESTERS FOR CEREAL EXPERIMENTS

Harvesting cereal plots by combine was a major advance in field technique, for it meant corn crops could now be studied not only at experimental stations but also on ordinary farms. One of the first to develop the new method was Mr. H. W. Gardner, then at the Hertfordshire Institute of Agriculture, who used tractor-drawn combines on commercial farms in 1940, and turned to the much more convenient forward-cut, self-propelled machines in 1941. Rothamsted had been well staffed and equipped for cutting, storing and threshing small plots since 1925, so there was no immediate need to change, particularly as the small square plots used in the earlier replicated and long-period experiments were not particularly convenient for combine-harvesting. Combine-harvesting of the Rothamsted plots was initiated by J. R. Moffatt, who also worked out and tested methods to suit our special conditions.

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A small tractor-drawn combine, tested on the non-experimental fields in 1948, proved unsuitable for the type of plot then being used. In 1952, however, a forward-cut, self-propelled machine became available, and more elaborate comparisons between the old and new methods were started and continued for 3 years. The mean yields recorded by the two methods sometimes differed by over 10 per cent, but on average of all the results considered the differences were small. For wheat the combine yields were 0·6 cwt./acre below the binder yields, but for barley the combine gave 0·8 cwt. grain more than the binder. The difference between the yields obtained by the two methods of harvesting was not affected by differences in the rates of application of nitrogenous fertilizer. Unexpectedly the combine-harvester gave lower yields than the binder in experiments where the crop was lodged at harvest, though in standing crops the yields from the combine-harvested plots were higher than from the binder plots.

In the meantime some practical problems in operating the combine for plot work in the field, including the determination of straw yields, were solved.

The nearly square plots were replaced where possible by long, narrow ones, so that a single combine cut takes the full plot area except for the guard rows. A new drilling technique was introduced by which a single blank row is left each side of the combine cut. This greatly facilitates harvesting, especially when the crops are lodged. A standard running time, varying with the crop, is allowed between plots so that the small amount of grain carried over from plot to plot remains constant. Straw yields, as a rule, are of little interest, and are taken only when needed for some special purpose.

Combine-harvesting has greatly increased the scope of the annual experiments on cereals on both farms. In 1952, the last year under the old system, there were about 450 annual plots at Rothamsted and 8 at Woburn. In 1958 the figures were 724 and 366 respectively.

The effect of the combine on the precision of cereal experiments is of the greatest importance. A survey of the earlier Rothamsted experiments over the period 1925–38 showed that cereals in ran-

TABLE 4

Cereal Experiments Rothamsted and Woburn 1939–58

Standard errors, cwt./acre and per cent of mean

	Binder			Combine		
	Number of experiments	S.E., cwt.	S.E., %	Number of experiments	S.E., cwt.	S.E. %
Rothamsted	123	2·07	7·87	59	2·07	6·24
Woburn	46	2·14	12·72	17	2·39	10·58
Rothamsted, ley–arable	15	1·97	7·5	15	2·13	5·6

domized blocks had a standard error per plot of 11·3 per cent of the mean yield. The figures for randomized blocks from 1939 to 1958, classified according to the method of harvesting, are given in Table 4.

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The actual values of the standard errors per plot are nearly the same with the two methods, but the percentage values of the combine-harvested experiments are lower, because the relatively high-yielding crops grown in recent years were almost always harvested by combine. The same effect is shown where all the values are derived from the Rothamsted ley–arable experiment: the binder figures covered the period 1949–53, the combine 1954–57. The experiments at Woburn vary more than those at Rothamsted. The great gain in convenience and scope from using the combine seems to be obtained without any loss of accuracy.

The use of the combine on Broadbalk led to big changes in the handling of the straw. Since the beginning of the experiment the " total straw ", i.e., straw, cavings, chaff and dust had been removed from the field. The threshing results of the last 8 years of binder harvest showed that the chaff and dust taken together amounted to 3–6 cwt./acre according to the yield of straw, and the corresponding figures for cavings were 3–10 cwt. The combine could usually be adjusted to leave a stubble of about the same length as after the binder, but the " total straw " was deposited in a windrow about 4 feet wide in the centre of the track of the machine. The baler followed and picked up this windrow as cleanly as possible and the bales were weighed to give the yield of " straw " as picked up after combining.

In 1958 the amount of debris left on the land after baling was estimated. Six plots were chosen just before harvest where the crop was standing well and the yields appeared to be uniform from end to end. These plots were halved transversely and a single combine cut was taken down the centre of each half. On one half-plot the " total straw " was deposited in a sheet carried behind the machine, on the other half the " total straw " was allowed to fall into windrow and as much as possible was baled. The quantities collected by the two methods, reduced to 85 per cent dry matter, are given in Table 5.

TABLE 5

Broadbalk 1958

Small straw, etc., left on land after baling, cwt./acre

Plot	Years after fallow	On sheet	In bale	Difference
3	1	34·7	23·1	11·6
9	1	51·5	46·8	4·7
10	1	28·9	22·7	6·2
10	4	31·1	23·2	7·9
11	3	28·3	19·5	8·8
18	1	39·1	33·6	5·5
Mean		35·6	28·1	7·5

The amount of debris left behind varied considerably from plot to plot, but with a 10-foot cut the mean figure of 7·5 cwt./acre is actually a dressing of about 19 cwt./acre on the area on which it falls. This is an appreciable addition to the crop residues normally ploughed in on Broadbalk, and a scheme of cutting has been worked out whereby these dressed areas traverse the whole surface of each plot in the course of a 3-year cycle.

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