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Rothamsted Field Experiment

Rothamsted Research

Rothamsted Research (1949) *Rothamsted Field Experiment* ; Report For 1948, pp 83 - 89 - DOI: <https://doi.org/10.23637/ERADOC-1-70>

FIELD EXPERIMENTS

By the PLOT COMMITTEE

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.

Rothamsted Field Experiments, 1948

The season 1948, though dull in the summer months, was not unfavourable to crop growth. Work on the plots proceeded without serious hindrance: cereal and root yields were up to standard while potatoes were excellent.

The drought of 1947 continued till the end of November, consequently the autumn sown wheat and beans were drilled in very dry seedbeds. The beans that were drilled were completely lost through birds, but the ploughed-in beans and the wheat made good plants and came through the very mild winter without appreciable loss. After a rather wet January the spring was dry, mild, and bright and generally favourable. There was plenty of moisture in May and June, but July with less than an inch of rain was unusually dry. In a summer when the press was full of complaints about ruined harvests, the August rainfall at Rothamsted at 2.6" was practically the average while September was drier than usual. There were, however, a rather large number of wet days during the harvest period, but none the less crops were secured in good condition. October and November were also drier than usual but the weather broke for the lifting of late sugar beet and mangolds. The whole year with 27.2 inches of rain was 1.3 below average.

The number of plots handled by the experimental staff is shown in the following table:—

	Corn and Linseed	Potatoes and Roots	Hay	Grazing	Total
Classical	101	39	47	—	187
Long Period					
Rotations	215	232	56	3	506
Annual Experiments	501	287	—	—	788
Total	817	558	103	3	1481

Unfortunately 64 plots of beans and two plots of turnips on Agdell were lost through birds and disease respectively so the number of plots harvested was 1,415.

CLASSICAL FIELDS

Broadbalk (Continuous wheat, 105th year)

The wheat was drilled in a very dry seedbed on October 24th. There was a good germination and the plant wintered well. Section II, after bare fallow, was shorter in the straw and weaker than usual. There was little lodging except on the heavier plots of Section I near the Wilderness. The field was hand pulled for wild oats between mid June and the end of July and very few of the panicles

reappeared before harvest. Bird damage was probably less severe than usual. The crop was cut on August 19th and carted a week afterwards in very good order: it was one of the brightest pieces of wheat carted in a year when much of the corn was blackened.

Wheat and fallow (93rd year)

This was drilled at the same time as Broadbalk. On the whole the crops were better than usual, and better than the continuously unmanured plot on Broadbalk, and appeared to show a slight benefit from the three years' fallow as compared with the one year fallow.

Hoosfield (Continuous barley, 97th year)

The barley was sown on 31st March and early growth was good. Wild oats were pulled during the summer on all plots except 50, 5A, and 3C which were cut green with the exception of a small area that was hand pulled and left to ripen. Before harvest a second lot of oat panicles much less numerous than the first had appeared on all plots. The dung plot was badly laid this year and very weedy on the west end. Elsewhere the field was fairly clean apart from the oats. The promise of the yield was quite up to average.

Barnfield (Continuous mangolds, 73rd year)

The first sowing of mangolds and sugar beet made under good conditions on April 28th was completely ruined by flea beetle in spite of all attempts to save the plant. On June 9th the field was redrilled with mangolds only, and the second sowing grew fast and continued to make growth well into the mild autumn. Lifting commenced in early November and later the conditions became very wet and sticky. In view of the late sowing the crop was better than might have been expected.

Park Grass (Continuous meadow hay, 93rd year)

It was a good year for hay. There was a taller growth of grass than usual on most plots, but legumes were not so conspicuous. The first cut was taken on 16th June; the second crop came away quickly and was cut on the 9th of October to give a much better yield than average.

Agdell Field (Four course rotation. Swedes, barley, clover or fallow, wheat, 101st year, 1st crop of 26th course)

The field was due to carry swedes in 1948, but for many years negligible yields of roots have been obtained on account of finger and toe disease. Only plots 1 and 2, where the disease is most serious, were sown in order to maintain an area of infection in view of the possibility of carrying out field experiments on controlling this disease. There was a splendid plant up to the time of singling, but as usual the roots on plots 1 and 2 were practically entirely destroyed later in the season and no yields were taken.

LONG PERIOD ROTATION EXPERIMENTS

Four course rotation (potatoes, barley, ryegrass, wheat 19th year)

The experiment measures the first year and residual effects of dung, straw compost, raw straw plus artificials, and two phosphatic fertilizers. A summary of the results of 14 years of this Rotation will be found in the Report for 1946, p. 82. The potato crop of

1948 was particularly promising and showed the effect of the extra nitrogen applied to half plots. Barley was about average, the plots receiving straw and extra nitrogen looked very well in the spring but as usual was completely lodged before harvest, nevertheless the direct application gave a yield of 36.5 cwt. grain per acre. Autumn sown wheat failed twice through rough seedbed and bird damage and was finally replaced by Atle spring wheat drilled on March 8th. This germinated well but never made good growth and the wheat came to harvest short, thin, with very poor ears. The ryegrass was poorer than usual particularly on the rock phosphate plots where bare patches were noticeable.

Six course (sugar beet, barley, clover, wheat, potatoes, rye, 19th year)

The experiment measures the responses to each of the three common nutrients yearly. Most of the crops in this rotation were above average in 1948. Potatoes at 9.5 tons were good and responded well to nitrogen and potash, sugar beet 11.5 tons was much above average and an even plant, but apart from the usual increase for nitrogen in the tops, fertilizer responses were small. Rye was tall and even, some of the plots being over 6 feet in height; barley clean, standing and uniform, a very fine crop averaging 36 cwt. per acre. The red clover cropped well with a full plant but haymaking conditions were unsettled and the crop was secured with great difficulty. Potash was the most effective manure for this crop. Wheat was the worst crop; the first sowing failed and a late autumn sowing on November 12th gave an irregular crop which lost further plant in spring, the yield, however, was better than appearances suggested and averaged 26.6 cwt., slightly more than the rye which looked much more impressive in the field. All cereals gave good responses to nitrogen. This rotation is summarized over the 19-year period 1930-48 on (p. 90).

Three course (potatoes, barley, sugar beet, 16th year)

The experiment measures the direct and residual effect of straw compost, raw straw plus artificials, and fertilizers only without organic matter. All the crops in this rotation did well. The barley as usual was a good even clean crop yielding on the average 33.5 cwt. grain. Potatoes at 10.4 tons per acre were well above the average and made such rapid spring growth that they had to be earthed up much earlier in the season than usual. Straw gave quite marked direct and residual effects on potatoes. A strip on the east side of the sugar beet was damaged on May 14th by the drift of weed killer from a neighbouring crop, but was redrilled at once with soaked seed and in the good growing weather which followed the new plants caught up with the rest. The final crop at 34.6 cwt. of sugar was slightly below average.

Two course rotation (7th year)

A long period experiment testing the cumulative effects of various levels of agricultural salt applied to sugar beet, with half rates on the following barley crop. Both sugar beet and barley in this rotation were good crops. One strip of plots of the sugar beet were damaged by weed spraying but immediately repaired (see note on adjoining sugar beet three course rotation). Salt gave an increase

of up to 10 cwt. of sugar per acre, whether applied in winter or in the seedbed. Muriate of potash had little effect on either beet or barley.

Deep cultivation rotation—six course (5th year)

A rotation of sugar beet, barley, seeds, wheat, potatoes, oats testing 7" v. 14" ploughing (for beet, wheat, potatoes only); 0 v. dung; 0 v. superphosphate; 0 v. muriate of potash (for beet and potatoes only). The deep ploughing for sugar beet exposed much subsoil and the plant on these plots was slightly thinner and more irregular than elsewhere. A serious attack of flea beetle was successfully controlled by three dustings. Later in the season the crop made wonderful growth. Heavy yields of 16 tons per acre were recorded, and the final result of the deep ploughing was a loss of 1.1 tons roots per acre. Barley gave the excellent crop of 41 cwt. grain per acre which tended to lodge on the plots previously dunged for sugar beet. On the land deep ploughed in 1947 the barley looked a little better and had a brighter colour than on the shallow ploughed areas, but this was not reflected in the final yield. A good crop of seeds was secured with grasses tall and predominating over the clovers. The wheat on this rotation was the best on the farm with a yield of 41 cwt. There was a slightly thinner plant on the deep ploughed plots which showed much subsoil. These plots looked poorer throughout autumn and winter but they filled out well and all looked excellent at harvest time; they yielded 3.4 cwt. less than the shallow ploughed plots. The potato section was ploughed to full depth (13") for the first time in 1948. In 1943 the full depth could not be reached and in 1946-47 the ground was too wet to plough deep for wheat. In spite of this the subsoil that came up in 1948 showed less red clay than elsewhere and crumbled easily in the winter. Potatoes made a fine crop of 15 tons per acre and showed big response to dung and potash. Oats started with a rather thin plant in spring but filled out to an excellent crop, tall and heavy headed, in July the oats on plots that had been deep ploughed for potatoes had a better colour than the rest, and the land was somewhat less weedy. There were no marked treatment effects in the final yields. A few plots showed excessive amounts of raw subsoil which on these particular areas appeared to depress the yield.

High Field grazing experiment

This experiment, carried out for the Royal Agricultural Society of England, measures the residual effect of cake fed on pasture as compared with the conventional manurial equivalent applied as fertilizer, the control plots having neither cake nor fertilizer. It was begun in 1937 and was in full cycle by 1940. In 1948 plots 4, 5 and 6 were grazed with cattle and sheep to measure the second year effect of cake or fertilizers applied in 1946. By this time every block of the experiment had completed three cycles and the experiment was terminated.

THE ANNUAL EXPERIMENTS

Potatoes

The annual potato experiments were put down in Sawyers II which had previously carried four corn crops. The experiments were repetitions of those carried out in previous years with only slight

modifications. The season was excellent for potatoes and all plots grew well and were clean and full of growth right up to lifting time.

Experiments with dungs and organic manures. Ten different types of farmyard manure were tested at single and double rates in this experiment which also included rotted bracken. Rates of application of dung ranged from 2.6 to 8.7 tons per acre in the single dose according to the amount of litter and period of storage. All dung at the single dose gave increases ranging from 1.5 to 3.0 tons per acre; the lightest dressing, 2.6 tons, of an overyear dung from bullock boxes gave an increase of 2.6 tons of potatoes. There was marked falling off at the double rates, the increases ranging from 2.1 to 3.1 tons. In the absence of organics there was no response to nitrogen but a large response to potash of 3.8 tons. In presence of organics the response to nitrogen was good, particularly at the lower level of organic manuring. All dungs and also bracken greatly reduced the potash responses.

Time of planting experiment. This experiment now in its 4th season was designed to test the spread of virus diseases in the potato crop and is more fully discussed by the Plant Pathology Department. The earliest planting, April 10th, gave 12.2 tons of potatoes, the latest, May 22nd, gave 6.9 tons. Potash was by far the most effective nutrient.

Cultivation experiment. This was a continuation of an experiment testing the effect of earthing up and of shallow v. deep inter-row cultivation of potatoes. A further treatment was a straw mulch applied along the rows after the first deep cultivation. There was also a test of fertilizers on the flat v. fertilizers in the ridges. The crop was a very good one, and grew so fast in the early summer that it had to be earthed up a fortnight earlier than usual and consequently only one deep inter row cultivation was possible. Neither earthing up nor the inter-row cultivations had any effect on the crop, but the straw mulch increased the yield by 1.8 tons per acre. Fertilizer in the ridges produced 1.1 tons more potatoes than the same quantity of fertilizers broadcast on the flat before ridging. Both earthing up and mulching reduced the proportion of greened tubers.

Linseed experiments

Two experiments were put down on Bones Close.

- (1) Testing times of sowing, seed rates, and each of the three common nutrients.
- (2) Testing two rates of a complete fertilizer broadcast, and half rates drilled.

The plant came away well but was attacked by flea beetle. The effects of this was very much more serious on the late sown plots which practically failed. There was some indication in the field that the heavier dose of fertilizer drilled with the seed had injured the plant. Both experiments were marred by a very bad infestation of 'goose grass' which in certain cases completely obscured the crop. The weed was worst on plots generously manured. Threshing was exceedingly difficult and there was much weed seed with the grain. The best plots, yielding 11 cwt. per acre, were early sown and without fertilizer. Late sowing owing to flea beetle damage only gave 2

cwt. per acre. Fertilizers either individually or in mixture had very little effect, and the application of $4\frac{1}{2}$ cwt. with the seed was slightly detrimental.

Wheat

Six experiments were set down on this crop.

(1) Eyespot experiment, Little Knott, a continuation of work carried out by the Plant Pathology Department and reported by them.

(2) Wireworm experiment, Little Hoos, two experiments testing modern fumigants and their method of application against wireworms. These are reported by the Insecticides Department.

(3) Inoculation experiment, Long Hoos. The purpose of this experiment was to test on spring wheat bacterial inoculum containing heteroauxins for which good results had been claimed in France. A fair crop of 22 cwt. of wheat was grown which showed a good response to nitrogen applied as sulphate of ammonia but no effect of the inoculum.

(4) Residuals in autumn wheat of organic manures applied to potatoes in 1947, Great Harpenden. The measurement of dung residuals in cereal crops has been carried out for many years. A heavy crop of 41.9 cwt. of wheat was grown which showed visible residual effects due to the organics in the early stages. These effects were less marked at harvest time but still noticeable. Raw straw plus artificials, which was one of the worst treatments in the potato crop of 1947, gave the most conspicuous residual effect in wheat amounting to 7.2 cwt. for the double dose of straw.

(5) A small experiment was put down to compare 5 varieties of spring wheat and three varieties of autumn wheat sown in the spring. Three nitrogen levels were also tested. Of the varieties used Fylgia and April Bearded were the earliest, but the autumn wheats were very late to harvest and the last of these was not cut till September 12th.

Spring sown cereals

Long Hoos, second year. This was a repetition of the experiment of 1947 on exactly the same lines. The seed was sown on March 17th. The mean yields without nitrogen for the various crops were oats (S.84) 14.6 cwt., spring wheat (Atle) 18.2 cwt., autumn wheat (Bersee) 13.4 cwt., barley (Plumage Archer) 22.5 cwt. All crops responded well to nitrogen up to a level of 3 cwt. of sulphate of ammonia per acre; but the further responses to $4\frac{1}{2}$ cwt. of sulphate of ammonia were negligible. At all nitrogen levels barley was the most productive crop, though at 3 cwt. of sulphate of ammonia and still more at $4\frac{1}{2}$ cwt. lodging occurred. Phosphate responses were insignificant, but barley and Bersee wheat responded to potash.

Beans

Great Field I. Two bean experiments were put down in this field, but one testing the combine drilling of fertilizer was completely destroyed by birds. An experiment testing variety and cultivation factors had all the seed ploughed in, and on the whole gave a very good plant. Two early sown blocks drilled on October 28th, looked better during winter and early spring than the remaining two that were sown on November 18th. Four different strains of seed all yielded much the same, the average yield being 24.5 cwt. grain per

acre, a very satisfactory crop. As usual a high seed rate, 3 cwt. per acre, was distinctly more satisfactory than a lower rate, 2 cwt. per acre. The extra cwt. of seed gave a further $3\frac{1}{2}$ cwt. grain. The yield of straw was nearly 2 tons per acre for the crop grew very tall.

Fertilizer placement experiments

Two of these were carried out on Long Hoos using the special drill made by the National Institute of Agricultural Engineering, one on sugar beet and the other on peas for threshing. These experiments are part of a series carried out for the most part at outside centres; they are reported by the Chemistry Department.

Woburn Field Experiments, 1948

CLASSICAL EXPERIMENTS

The permanent wheat and barley land was once again fallowed in 1948 making two years' fallow since the last crops were taken.

LONG PERIOD ROTATION EXPERIMENTS

Six-course rotation, 19th year

This experiment is on exactly the same lines as the one at Rothamsted except that in recent years the variety of wheat grown has been Square Heads Master instead of Yeoman. Crops were on the whole satisfactory in 1948. Sugar beet gave an average yield of 9.5 tons which is very close to the mean of all years. Potatoes at 8.9 tons were slightly better than usual. Barley produced the excellent crop of 27.5 cwt. per acre, whereas wheat yielded 20.8 cwt. and rye 21.0 cwt. All crops except the clover which this year was trifolium owing to a failure of the main sowing, responded well to nitrogen, but phosphate and potash were ineffective.

The first sowing of wheat failed through bird damage and the crop was resown on November 14th, a fair crop resulted but there was much shrivelled grain. Rye sown on November 15th did not suffer from bird damage. The results of this experiment over the 19-year period 1930-48 are summarized on p. 90.

New green manuring experiment, 11th year

This experiment compares undersown clover, undersown ryegrass, lupins and rape as green manures for autumn cabbages followed by barley. In 1948 a fair crop of barley, 22.4 cwt., was grown which showed a striking response of 8 cwt. of grain for 2 cwt. of sulphate of ammonia. Of the green manures turned in for the previous cabbages, clover was the best and ryegrass the worst in its effects on the barley.

Ley arable rotation, 11th year

This experiment tests the value of three years' ley and three years' lucerne as a means of building up soil fertility in comparison with rotations without leys (for full description see Rothamsted report, 1938, p. 135). Block 3 now begins its third rotation. Potatoes showed a pronounced residual effect of 2.23 tons due to 15 tons of dung applied two years previously. The level of cropping was excellent, mean yield 16 tons. The ley plots were sown at the end of March and gave no less than 7 grazings. The grass cuttings from these plots expressed as hay yielded 4.3 tons per acre. This