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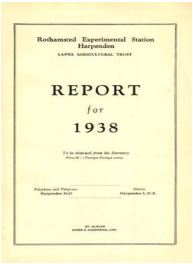
Rothamsted Report for 1938

Full Table of Content



Laboratory and Farm Report for 1938

Rothamsted Research

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WOBURN EXPERIMENTAL STATION REPORT FOR 1937-38.

BY DR. H. H. MANN

Season

The season of 1937-38 was a rather remarkable one. Among the many memorable features were the very wet winter, followed by a serious drought from February to April, the exceptional mildness of the early spring, the severe gales which prevailed at times, particularly at the beginning and end of June, and the series of thunderstorms during the early part of August. The most important feature from the farming point of view was the long spring drought (following on the wet winter) which led to almost record crops of those plants which were sown either before the drought appeared or whose germination was secured in spite of its prevalence, but which also resulted in very light crops of hay and in great difficulty in establishing the later spring crops like kale. The meteorological records from October 1937 to the end of 1938 were as follows :—

METEOROLOGICAL RECORDS FOR 1937-38

Month	*Rainfall*			*Temperature (Mean)*			
	Total Fall	No. of Rainy Days	Bright Sun-shine	Maxi-mum	Mini-mum	1 ft. in Ground	Grass Mini-mum
1937	Ins.		Hours	°F.	°F.	°F.	°F.
Oct. ..	2.75	12	73.7	57.5	42.1	51.3	37.5
Nov. ..	1.84	11	59.4	46.6	34.0	43.0	30.7
Dec. ..	2.44	23	28.7	41.1	31.8	38.6	29.1
1938							
Jan. ..	2.49	21	48.4	46.8	36.9	40.7	33.7
Feb. ..	0.63	12	65.4	45.6	35.2	39.9	32.1
Mar. ..	0.32	5	189.8	58.1	39.2	46.5	34.0
April ..	0.12	5	157.5	54.2	32.4	49.3	26.8
May ..	1.77	16	178.4	59.5	41.5	54.3	36.8
June ..	1.19	10	211.3	67.1	49.8	61.8	46.7
July ..	1.51	13	164.4	68.5	51.6	63.4	48.5
Aug. ..	2.83	14	167.7	69.5	53.1	64.8	50.9
Sept...	1.29	14	124.3	64.6	48.6	58.5	44.6
Oct. ..	2.88	17	128.4	56.8	42.1	50.1	37.7
Nov. ..	2.34	16	88.4	53.8	42.5	47.4	38.6
Dec. ..	3.47	21	47.8	43.3	33.5	39.2	31.1
Total or mean for 1938 ..	20.84	164	1571.8	57.3	42.2	51.3	38.5

CONTINUOUS WHEAT AND BARLEY EXPERIMENTS

The present interest of these experiments, which have been carried on ever since 1877, continues to reside in the study of the effect of fallowing, without further manure, on the crops of wheat or barley. Two two-year fallows have been taken in recent years: in 1926 and 1927, and again in 1934 and 1935. The crop in 1938 was thus the third after a two-year fallow, and thus assists in determining how far the previous manuring for fifty years has affected the power of recovery of the soil through fallowing.

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(*a*) *Continuous Wheat.*—" Red Standard " wheat was sown on November 8th, and a good plant was obtained and developed normally. On the whole the weediness did not appear to have increased much since the fallow, except on the very acid plots (2a, 5a, and 8a and b) but on these the two twitches (*Holcus mollis* and *Agrostis stolonifera*) which prevail in this field proved absolutely uncontrollable, and the condition has reverted almost to the condition before the last two year fallow. There was little of the weed *Vicia hirsuta* or wild vetchling, which has been such a nuisance on certain plots, but this is probably a seasonal matter.

The yield on the various plots is shown in the following table.

TABLE I.

Continuous Growing of Wheat, 1938—*after* 2 *years'* (1934—1935) *fallowing and previous fallowing*, 1927 *and* 1928.

Stackyard Field

Plot	Manures Applied Annually. (Before the Fallow.) For amounts see Report 1927-1928 No manures since 1926	Produce per acre: Dressed corn per acre bushels	Total corn per acre lb.	Weight per bushel lb.	Straw, chaff, etc., per acre lb.
1	Unmanured	12.5	772	60.9	1177
2a	Sulphate of ammonia	0.9	57	—	98
2aa	As 2a, with lime, Jan., 1905, repeated 1909, 1910, 1911	4.7	286	60.0	399
2b	As 2a, with lime, December, 1897	13.3	817	61.0	980
2bb	As 2b, with lime, repeated Jan., 1905	14.2	871	60.5	10·7
3a	Nitrate of soda	10.6	656	61.0	898
3b	Nitrate of soda	10.0	620	61.0	771
4	Mineral manures (superphosphates and sulphate of potash)	14.1	868	61.1	1321
5a	Mineral manures and sulphate of ammonia	14.4	386	61.2	1041
5b	As 5a, with lime, Jan., 1905	13.5	834	62.5	992
6	Mineral manures and nitrate of soda	13.4	829	61.2	1148
7	Unmanured	13.4	820	60.7	1163
8a	Mineral manures and, in alternate years, sulphate of ammonia	2.5	156	—	230
8aa	As 8a, with lime, Jan., 1905, repeated Jan., 1918	8.6	522	60.5	674
8b	Mineral manures and sulphate of ammonia (omitted in alternate years)	2.2	136	—	181
8bb	As 8b, with lime, Jan.,1905, repeated Jan., 1918	12.1	744	61.0	921
9a	Mineral manures and, in alternate years, nitrate of soda	13.2	815	61.2	1197
9b	Mineral manures and nitrate of soda (omitted in alternate years)	16.7	1049	62.4	1451
10a	Superphosphate and nitrate of soda	13.0	802	61.0	932
10b	Rape dust	13.8	853	61.2	1008
11a	Sulphate of potash and nitrate of soda	15.7	973	61.2	1271
11b	Farmyard manure	16.5	1014	61.2	1483

The chief interest of these figures lies in the relation of previous manuring to the capacity for recovery of fertility by means of fallowing. This is shown in the following figures for certain selected plots.

Yield of dressed corn per acre

Plot	1877-86 (with manures)	1917-26 (with manures)	1929 After two years' fallow	1936	1937	1938
			After two years' fallow (no manures since 1926)			
	bushels	bushels	bushels	bushels	bushels	bushels
1	16.8	3.6	11.1	10.7	17.9	12.5
2a	25.4	0.3	0.3	no crop	2.3	0.9
2b	——	4.3	1.1	13.7	12.9	13.3
3b	24.1	7.1	9.5	13.4	11.5	10.0
4	17.7	4.4	17.8	15.8	18.6	14.1
5a	31.5	5.1	10.9	15.3	8.5	14.4
5b	——	7.4	13.3	14.8	13.5	13.5
6	32.4	8.6	12.8	11.4	12.0	13.4
7	17.4	4.0	8.5	13.0	16.0	13.4
11b	26.7	9.5	21.3	14.3	11.6	16.5

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The recovery of the yield after the fallows is very noteworthy; so is the maintenance of the recovered yield even in the third year after the fallow in the present case, in spite of the absence of any manuring since 1926. This applies to all plots, but the outstanding character of the plot to which farmyard manure had been applied for the first fifty years of the experiment seems now almost to have disappeared. There has been little or no recovery of the plots made acid by treatment with sulphate of ammonia either by fallowing or by absence of any further addition of this salt.

(*b*) *Continuous Barley.* "Plumage Archer" barley was sown on February 24th, and a good plant was obtained which grew normally, considering the exceeding poverty of these plots. The yield on the various plots is shown in the following table.

TABLE II

Continuous Growing of Barley, 1938—*after 2 years'* (1934-1935) *following and previous fallowing*, 1926 *and* 1928

Stackyard Field — *Produce per acre*

Plot	Manures Applied Annually (Before the Fallow.) For amounts see Report 1927-1928 No manures since 1926.	Dressed corn per acre bushels	Total corn per acre lb.	Weight per bushel lb.	Straw, chaff, etc., per acre lb.
1	Unmanured	17.3	862	49.7	803
2a	Sulphate of ammonia	0.4	21	—	?
2aa	As 2a, with lime, Mar., 1905, repeated 1909, 1910, 1912 and 1923	15.8	787	49.5	800
2b	As 2a, with lime, Dec., 1897, repeated 1912	12.1	585	48.0	797
2bb	As 2a, with lime, Dec., 1897, repeated Mar., 1905	14.9	728	48.5	636
3a	Nitrate of soda	20.0	1025	51.0	898
3aa	As 3a, with lime, Jan., 1921	16.7	814	48.5	782
3b	Nitrate of soda	16.9	851	50.0	678
3bb	As 3b, with lime, Jan., 1921	10.4	510	48.5	509
4a	Mineral manures (superphosphate and sulphate of potash)	10.5	529	50.2	532
4b	As 4a, with lime, 1915	18.2	916	50.2	784
5a	Mineral manures and sulphate of ammonia	1.5	74	—	?
5aa	As 5a, with lime, Mar., 1905, repeated 1916	6.5	320	49.0	377
5b	As 5a, with lime, Dec., 1897, repeated 1912	18.9	942	49.7	851
6	Mineral manures and nitrate of soda	18.3	993	54.1	646
7	Unmanured	10.4	514	49.1	537
8a	Mineral manures and, in alternate years, sulphate of ammonia	2.8	140	—	?
8aa	As 8a, with lime, Dec., 1897, repeated 1912	17.9	919	51.0	898
8b	Mineral manures and sulphate of ammonia (omitted in alternate years)	2.9	144	—	?
8bb	As 8b, with lime, Dec., 1897, repeated 1912	21.4	1093	51.0	763
9a	Mineral manures and, in alternate years, nitrate of soda	20.5	1038	50.5	788
9b	Mineral manures and nitrate of soda (omitted in alternate years)	20.4	1042	51.1	669
10a	Superphosphate and nitrate of soda	9.5	510	53.2	508
10b	Rape dust	8.1	434	53.5	356
11a	Sulphate of potash and nitrate of sada	14.7	797	54.0	612
11b	Farmyard manure	18.4	1006	54.5	836

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Considering the circumstances, the crop of barley was astonishingly good, and the effect of the two-years' fallow has evidently lasted at least until the third year after the fallow, as the following figures show.

Yield of dressed corn per acre

Plot	1877-86 (with manures)	1917-26 (with manures)	1929 After two years' fallow (no manures since 1926)	1931	1936 After two years' fallow	1938
	bushels	bushels	bushels	bushels	bushels	bushels
1	26.9	8.5	20.4	11.2	19.8	17.3
2a	39.4	1.5	2.7	none	none	0.4
2b	——	8.7	24.9	10.1	19.0	12.1
3b	40.4	8.7	27.2	10.3	19.2	16.9
4a	23.3	10.1	21.1	16.8	18.2	10.5
4b	——	11.5	24.8	9.4	20.2	18.2
5a	43.0	4.9	5.8	none	none	1.5
5b	——	13.4	24.2	13.4	17.4	18.9
6	46.0	16.8	30.6	11.9	22.9	18.3
7	23.0	7.3	20.2	10.0	16.3	10.4
11b	40.0	25.9	34.7	22.0	29.7	18.4

The falling off in the years succeeding the fallow has been of the same order in the two occasions quoted, though it is certainly not greater in the later case, when the soil would presumably be more exhausted than after the first fallow.

GREEN MANURING EXPERIMENTS

A new long-term experiment on the effect of tares, mustard, clover and ryegrass as green manures, either alone or in conjunction with applications of farmyard manure, straw, and varying amounts of sulphate of ammonia on the yield of kale was started in 1936. Unfortunately, as can be seen from pp. 133-134, this experiment has not yet given any definite results as the kale crop has been almost a complete failure in the last two years. The plan of the experiment involves growing the kale crop after the burial of the green manure crop grown in the same year. This is possible provided the weather in or about June is suitable for the burial of the green crops and the sowing of the kale. Neither in 1937 nor 1938 was this the case, and hence the kale crop was sown late and had to be re-sown in the middle of August, with the consequence that the crop was very small. Kale has been used in this experiment because the other green manure experiment now running, in which mustard and tares are buried, has shown that it is a very sensitive means of testing the effect of green manures on the succeeding crop.

ALTERNATE HUSBANDRY EXPERIMENT

In recent years, it has been contended that the best way of maintaining the fertility of land is to have an alternation of "ley" crops such as grass and clover, or lucerne, occupying the land for several years, and arable crops which would utilise the fertility accumulated during the time the "ley" crops were on the land. How far this is more effective than a proper use of artificial manures,

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and small amounts of farmyard manure on a continuous arable rotation, in maintaining the fertility of land is a doubtful question, and it seemed of importance for a direct test to be made of the two methods in a light soil such as occurs at Woburn. Such an experiment has, therefore, been established in Stackyard Field at Woburn in 1938, and the present report contains, in a separate section, the first year's results. The experiment consists of a five year rotation, three years of which may be under either a seeds ley or under lucerne. Reference for details may be made to the separate section of this report dealing with the experiment in question, pp. 135-139.

LUCERNE INOCULATION EXPERIMENT

In 1932 a series of plots was laid down to test the effect of inoculation of the seed on the yield and character of lucerne and so 1938 is the seventh year of the growth of the crop. The results have shown no increase of yield due to the inoculation, though the nitrogen content of the fodder from the inoculated plots was greater in the earlier years. The plots have continued to yield very heavy crops, though, in spite of all that could be done, weeds and grass are now tending to smother out the lucerne. The crop has, however, been maintained by very thorough harrowing of the area after the final cutting has been taken in each year, repeated several times during the succeeding winter, and, in the last four years, a dressing of farmyard manure (10 tons per acre) applied as a top dressing in January of each year. The actual yield of lucerne hay for each year since it was planted is shown in the following table.

Yield of lucerne hay per acre

Plots	1932	1933	1934	1935	1936	1937	1938	Total
	tons	tons	tons	tons	tons	tons	tons	tons
Uninoculated ..	0.70	3.28	4.07	6.55	4.37	5.02	3.42	27.41
Inoculated ..	0.68	3.12	3.96	6.48	4.29	4.98	3.11	26.62
Mean of all plots	0.69	3.20	4.01	6.52	4.33	5.00	3.27	27.02

It is anticipated that it will not be possible to maintain this area under lucerne for more than another year, owing to the increase of grasses and weeds, which have now seriously invaded the area in spite of the annual and frequent harrowing.

OTHER FIELD EXPERIMENTS

An account of the following experiments will be found in the statistical section of this report.

1. *Six Course Rotation Experiment.* This has been carried out ever since 1930, using no outside organic manures, but applying varying amounts of nitrogen (in the form of sulphate of ammonia), potash (in the form of muriate of potash), and phosphoric acid (in the form of superphosphate) for each crop. 1938 is the ninth crop of the series. The rotation used consists of barley, clover, wheat, potatoes, rye, and sugar beet.

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2. *The Manuring of Sugar Beet.* This is a study of the effect of farmyard manure applied in the autumn, and of common salt, superphosphate, and muriate of potash, applied either in the previous autumn, in the early spring, or at the time of sowing, on the sugar beet crop in the light sandy soil at Woburn.

3. *The Manuring of Market Garden Crops with Concentrated Organic and other Nitrogenous Manures.* The crop used in 1938 was kale and the manures investigated were soot, dried poultry manure, rape dust, compared with sulphate of ammonia, with or without the addition of dressing of farmyard manure.

POT CULTURE EXPERIMENTS

The work in the pot culture house outlined in the last report has been continued. The experiments on clover sickness have reached the point that we have been able definitely to cure this disease by heating the soil to 135-140° F. though it reappears if clover is again continuously grown on this soil. In 1936 the still more important discovery was made that a liberal application of farmyard manure was successful in preventing clover sickness from appearing in the crop, while artificial manures had no such effect. The results have now been published in detail (see Paper IX, p. 75, of this Report). We are now preparing further lots of soil sufficiently clover sick for further experiments on the subject.

The study of questions relating to the nutrition of barley on the extremely acid soils produced by the continued use of sulphate of ammonia has been continued, and an account of them and the results obtained are now almost ready for the press. It is hoped that these will be published during the present year.

Work has also continued on the effect of manuring with various forms of organic material chiefly with those that might be used as green manures, in comparison with farmyard manure and with sulphate of ammonia. The results are now being prepared for publication.

FARM REPORT

From the point of view of yield, the season of 1937-38 was a good one, at least in certain cases. All the autumn-sown crops did well, and also those that were sown early enough in the spring to be established before the drought became serious. Record yields were, in fact, obtained with wheat, barley and potatoes, and, even with sugar beet, the early sowing enabled a very good crop to be obtained. On the other hand, the hay crop was very light, and the late spring crops such as kale were inferior and only yielded moderately.

On Stackyard Field the area known as " Series C " was fallowed in preparation for another experiment, and the year appeared to be suitable for the purpose, the spring drought allowing a large part of the " twitch " to be eliminated. The area known as " Series D " in the same field, which was similarly cleaned in the previous year, has now been devoted to the long period experiment (see above) on alternate husbandry.

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As far as livestock are concerned, cattle, sheep and pigs did very well during the year, but the very high price of feeding stuffs did away with any possibility of large profits. A number of prizes for both sheep and pigs were obtained at the County Show in July 1938, including the first prize for a bacon pig. The farm shepherd (D. B. McCallum) obtained a prize for percentage of lambs to ewes in the season 1937-38.

The year closed with a breeding flock of 88 ewes, all being cross bred with two Hampshire rams. The number of pigs was reduced during the year owing to the very high price of feeding stuffs, but the year closed with a herd of 128 animals.