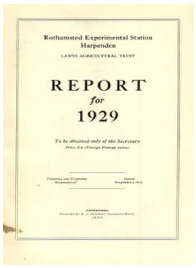
ROTHAMSTED RESEARCH

Report for 1929

Full Table of Content



Changes in the System of Farm Management

Rothamsted Research

Rothamsted Research (1930) *Changes in the System of Farm Management ;* Report For 1929, pp 22 - 26 **- DOI: https://doi.org/10.23637/ERADOC-1-111**

profitably sell what I grow now, so what is the use of growing more?'' is the usual comment. The movement for increased yields overseas is well illustrated by the following average yields per acre of fodder crops :—

	Mangolds, tons per acre		Swedes and turnips, tons per acre		
Average during	England	Denmark	England	Denmark	
				Swedes	Turnips
1889–1893	17.48	17.44	13.29	17.79	15.21
1899–1903	19.54	16.56	11.83	17.12	14.45
1909–1913	19.00	20.46	12.77	18.75	16.00
1923–1927	19.36	21.58	12.88	20.66	17.12

Instead of seeking information about increased yields, farmers usually ask how to reduce costs of production. The most important problems now in agricultural production are those associated with grass land, winter fodder crops and highly priced crops such as sugar beet, potatoes and malting barley. To these problems, therefore, considerable attention is now being paid at Rothamsted.

CHANGE IN THE SYSTEM OF MANAGEMENT OF THE ROTHAMSTED FARM.

Considerable change has recently been made in the management of the farm as distinct from the experimental plots. When it was taken over in 1911 it was used to grow cereals, roots and hay for sale to cow-keepers, from whom dung was purchased in exchange. The system suited us very well, it was neither costly nor laborious to run, and it gave for experiment a considerable area of land in sufficiently low condition for testing the value of fertilisers. It was therefore continued with some modification until 1920. Then came the great fall in prices and it became impossibly expensive. A new system was therefore started which has now been completely installed. Much of the land has been laid down to grass: a grass flock of 150 half-bred ewes (Cheviot ewe by Border Leicester ram) is kept and crossed with Suffolk and Hampshire rams: the lambs mainly miss the early market and are therefore kept on to be finished on sheep-feed grown on the arable land. In addition, 20 Wessex Saddleback sows are kept and mated with a pure Wessex or a Large White boar: they live mainly on the grass, but are brought in for a few weeks before and after farrowing. The pigs are sold for London pork when about 4½ to 6 months old and weighing about 110 to 130 lb. alive, or 80 to 100 lb. dead. Young cattle are bought in late winter to consume whatever food the sheep and pigs will not require, and they are sold in spring as forward stores, or in early summer as fat cattle, according as best suits prices and food supplies. The ordinary arable land is run on a five course rotation, each break consisting of 12 acres : fodder crops : barley : seeds : wheat : winter oats; experiments are distributed over them as occasion requires. A new experimental field of 24 acres (Long Hoos) has been divided into 6 parts, 5 cropped on a rotation including wheat, barley, oats, seeds and forage crops, while the sixth forms an experimental six course rotation of potatoes, wheat, sugar beet, barley, seeds, oats : these areas are

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devoted entirely to experiment: another experimental rotation of 3 acres has been started in Hoos Field.

The division of the land is therefore as follows:—

		Prior to 1924 acres	Present Time acres
ARABLE.	Classical experiments* ...	42½	42½
	New permanent experiments ...	—	27
	Other experiments and non-experimental ...	182½	60
GRASS		27½	123
Roads, buildings, small enclosures ...		27½	27½
	Total	280	280

* Including 7 acres grass.

LAYING DOWN OF LAND TO GRASS.

With the laying down of land to grass there came an opportunity of watching the behaviour of the plants sown. Several mixtures were used, including perennial and italian rye-grasses, cocksfoot, timothy, rough-stalked meadow-grass and the clovers. Botanical surveys were made after the plants were established and again at the end of the drought. The figures at the end of the first year are given in Table I. The most striking results are :—

(1) 30 per cent. of the land is still bare in spite of generous seeding and manuring.
(2) the rye-grasses have increased considerably.
(3) the clovers, especially wild white clover, have increased considerably.
(4) cocksfoot, timothy and meadow fescue have become established, but cover decidedly less ground than corresponds with the seed sown.
(5) meadow foxtail and rough-stalked meadow-grass have failed to become established.

An investigation has been commenced by Messrs. A. R. Clapham and F. J. Richards on competition between various species of grass and clover. Careful growth measurements were taken of some of the common grasses grown singly and in pairs. Species of large growth habit lower the tillering and growth rate of species of smaller growth habit; thus italian rye-grass behaved as an "aggressor" to perennial rye-grass, cocksfoot, timothy and rough-stalked meadow-grass. Although it prevented these others from making their full growth, it did not by itself make its full growth. Indeed, larger weights per plant were obtained when it was grown in admixture with perennial rye-grass and specially with rough-stalked meadow-grass.

THE MANURING OF GRASS LAND.

(1) *Grazing Land.* The difficulties of a grazing experiment were described in the last Report: as no satisfactory way round has yet been discovered we propose keeping this method for demonstration purposes only, restricting its use to cases where the differences are large. In 1929 the effect of phosphatic manure was studied by mowing the grass repeatedly during the season and finding the weight and composition of the cuttings. As in previous experiments, high solubility proved to be of great importance:

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TABLE I.—Areas covered by the various plants, compared with Numbers of Seeds sown.
SAWYER'S GRASS LAND. Sown April 25, 1928.

Name of Species.	PLOT 1.			PLOT 2.			PLOT 3.			PLOT 4.			PLOT 5.			PLOT 6.		
	Percent. of Total No. of Seed sown Apl. 25, 1928	Percentage Area Covered 1929 July	Oct.	Percent. of Total No. of Seed sown Apl. 25, 1928	Percentage Area Covered 1929 July	Oct.	Percent. of Total No. of Seed sown Apl. 25, 1928	Percentage Area Covered 1929 July	Oct.	Percent. of Total No. of Seed sown Apl. 25, 1928	Percentage Area Covered 1929 July	Oct.	Percent. of Total No. of Seed sown Apl. 25, 1928	Percentage Area Covered 1929 July	Oct.	Percent. of Total No. of Seed sown Apl. 25, 1928	Percentage Area Covered 1929 July	Oct.
Perennial rye-grass, *Lolium perenne*	15.7	22.8	49.9	—	—	—	8.4	30.9	48.4	—	—	—	23.5	27.5	46.1	56.7	34.9	61.1
Italian rye-grass, *Lolium italicum*	—	—	—	7.1	21.7	31.7	6.8			5.2	19.7	35.3	—	—	—	—	—	—
Cocksfoot, *Dactylis glomerata* ..	25.2	5.8	8.2	35.4	5.7	10.0	16.8	5.4	9.7	15.5	8.6	7.2	29.5	10.0	9.7	37.8	10.1	10.5
Timothy, *Phleum pratense* ..	15.7	3.6	3.4	14.7	1.9	4.6	16.8	1.5	3.6	26.0	2.5	5.2	29.5	3.8	7.7	—	0.1	1.3
Tall fescue, *Festuca elatior* ..	—	—	—	3.1	4.0	2.1	—	—	—	—	—	—	—	—	—	—	—	—
Meadow fescue, *Festuca elatior var. pratensis*	2.7	—	0.1	—	—	—	7.4	1.1	2.4	11.2	5.3	6.3	—	0.1	—	—	0.1	0.2
Meadow foxtail, *Alopecurus pratensis*	—	—	—	—	—	—	16.8	—	—	7.8	—	—	—	—	—	—	—	—
Rough-stalked meadow-grass, *Poa trivialis*	25.2	0.5	—	14.3	1.0	—	13.6	—	—	20.8	0.4	—	5.9	—	—	—	—	—
Late and early flowering red clover, *Trifolium pratense* ..	5.8	7.5	5.1	6.4	8.2	5.5	8.4	14.8	4.9	6.5	16.8	7.2	7.4	13.9	4.9	—	4.1	0.3
Wild white clover, *Trifolium repens*	4.5	24.0	6.2	5.1	13.9	5.3	4.9	15.0	1.5	3.8	8.0	4.5	4.2	11.1	3.2	5.5	18.1	0.9
Alsike clover, *Trifolium hybridum*	—	—	—	5.1	5.9	—	—	—	—	—	—	—	—	—	—	—	—	—
Trefoil, *Medicago lupulina* ..	—	—	—	—	—	—	—	1.2	—	3.2	8.0	—	—	—	—	—	—	—
Chicory, *Cichorium intybus* ..	5.2	4.9	0.8	5.8	5.4	4.7	—	—	—	—	—	—	—	—	—	—	—	—
Weeds	—	2.2	0.6	—	1.1	2.8	—	0.8	0.4	—	2.1	0.5	—	5.3	0.4	—	5.4	1.3
Bent grass, *Agrostis alba* ..	—	0.2	5.5	—	0.8	0.7	—	—	—	—	—	—	—	—	—	—	—	—
Covered with vegetation ..	—	72.2	79.8	—	69.8	67.4	—	70.8	70.9	—	71.9	66.2	—	71.2	72.0	—	73.2	75.6
Bare patches	—	27.8	20.2	—	30.2	32.6	—	29.2	29.1	—	28.1	33.8	—	28.8	28.0	—	26.8	24.4
Total area	—	100	100	—	100	100	—	100	100	—	100	100	—	100	100	—	100	100

Average, 10 samples, area 1 square foot.

superphosphate gave the best results, followed by high soluble basic slag: low soluble slag was less effective and mineral phosphate still less: indeed in none of our experiments has mineral phosphate proved effective. The results are as follows:—

	Solubility (Warren Method)	Increased yield over Control. Dry matter.	Phosphoric oxide (P_2O_5)	
			per cent. in dry matter.	Total uptake when super. = 100
Superphosphate..	90	100	1.15	100
High soluble slag	53	62	0.98	84
Low soluble slag	18	22	0.96	80
Gafsa phosphate	14	5	0.93	76
No phosphate ..	—	—	0.89	74

The figures for yield are to be taken only as showing the order and not the precise amounts. The figures for phosphorus uptake have more significance: they show that in comparison with the phosphate of low solubility, the high soluble fertilisers not only gave more herbage, but more nutritious herbage, containing per ton more of the phosphate essential to the animal. This experiment is being repeated on a more extensive scale in 1930.

(2) *Hay Land.* The slag experiments were continued in Somerset on old hay land and in Norfolk on new hay land: both are in their fourth year after the dressing and the effect is beginning to wear off.

The yields have been in cwt. of hay per acre:—

	Control.	Basic Slag. Low Soluble.	Medium.	High Soluble.
Somerset (Old Grass)				
Average 3 years, 1926-28..	20.9	23.6	26.0	24.9
1929	20.0	22.5	23.5	22.1
Norfolk (New Grass)				
Average 3 years, 1926-28..	26.5	29.8	32.7	36.7
1929	10.9	12.6	13.6	13.9

SOLUBILITY AND EFFECTIVENESS OF BASIC SLAG.

The experiments described above form part of an extended series carried out by the Rothamsted staff during the past eight years, largely under the ægis of the Ministry of Agriculture Basic Slag Committee, to discover the agricultural values of the different kinds of slag on the market.

There are three types of slag in common use:—

	Type 1.	Type 2.	Type 3.
Per cent. Phosphoric oxide	16 to 18	8 to 17	8 to 15
Equivalent to tricalcic phosphate ..	35 to 39	17.5 to 37	17.5 to 33
Per cent. of total phosphoric oxide soluble in 2% citric acid	80 or more	80 or more	40 or less
Process of production	Bessemer	Open Hearth	Open Hearth with addition of Fluorspar

https://doi.org/10.23637/ERADOC-1-111

In this country the Bessemer process of steel manufacture is not at present used, and Bessemer slags on the British market are entirely of foreign origin. So far as solubility is concerned, the slags fall into two groups only, few if any samples having solubility between 45% and 75%.

In practically all our experiments the high soluble slag has given the better results and there is no question that it is of greater value to the farmer. It acts more quickly and gives larger increases than the low soluble slag. Recent changes in steel making have tended to increase the output of this high soluble material, which is all to the good: and, further, the manufacturers are now prepared to offer slag of less than 45% solubility in the old official citric acid test at lower unit price than they ask for slag of 75% or higher solubility.

While the low soluble slags are inferior to those of high solubility as a source of phosphate, nevertheless they have value in certain humid conditions; fortunately these occur near the works where the slags are obtainable cheaply.

A further result of the investigation has been to show the limits of value of the old citric acid test which had fallen into some disrepute. The grading of the slags into two classes is almost entirely satisfactory, and the analysis is sufficiently easy and rapid.

The method is not, however, of a high order of accuracy, and it fails to place slags in their proper order within each class: a slag of 90% solubility may be less effective as a fertiliser than one of 75%. Occasionally it appears even to class a slag wrongly: it puts into the low soluble group a new type of slag which is said to have high agricultural value, and which is now being tested by the Rothamsted staff. A method has been worked out by Mr. R. G. Warren at Rothamsted (extraction with sodium chloride solution) which places the slags within each class more in accordance with their agricultural value; it is, however, less convenient than the citric acid method and is better suited to an experimental station than to an analysts' laboratory.

LUCERNE.

The inoculation process developed in the Bacteriological Department has proved very successful: in 1929 the issue of cultures to farmers again exceeded the previous records, and sufficed to sow 1,300 acres. The demand rose above our power to supply, and accordingly some of the leading biochemical firms were invited to tender for the taking over of the business. Arrangements were finally made with Messrs. Allen & Hanbury, of Bethnal Green, London, E. 2, to prepare cultures under Rothamsted tests and to supply them to farmers at the rate of 3/- for one acre of land. These arrangements have been in force for some months and are working satisfactorily: the demand has been greater than ever. Dr. Thornton has also devised a method for transmitting the cultures over great distances: cultures sent to Western Australia arrived in good condition and successfully increased yields of lucerne there.

https://doi.org/10.23637/ERADOC-1-111