Report for 1930

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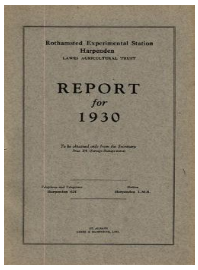

Grassland . Meadow Hay. (Basic Slag Committee)

Rothamsted Research

Rothamsted Research (1931) *Grassland . Meadow Hay. (Basic Slag Committee) ;* Report For 1930, pp 42 - 47 **- DOI: https://doi.org/10.23637/ERADOC-1-63**

phosphatic fertiliser, the dressing for both sets being 0, 1, 2, 3 and 4 units as for the nitrogen group. A basal dressing is given to each group of plots. Each year each plot receives one dose less of the same manure as in the preceding year, then it receives none, after which it receives the full quantity of one of the other fertilisers, and then proceeds to receive one dose less, as before ; after another five years it receives the third fertiliser. This procedure avoids the disturbances caused by cumulative effects. Thus in the first year the five plots of the nitrogen group receive respectively :

4 3 2 1 0 doses of N with 2 K and 2 P.

In the second year the treatment of the first four is :

3 2 1 0 doses of N with 2 K and 2 P,

while that of the fifth is 4 doses of K or P with 2 doses of the other two fertilisers. At the end of the fifteenth year the manurial cycle is complete and each plot is back to its original manurial treatment.

By the fifteenth year, however, the third rotation is half way through its course. After thirty years the second manurial cycle and the fifth rotation are both completed, and the whole begins again, with the difference that one stage in the rotation is omitted before proceeding as before.

As in Rotation 1 there is no replication of plots but the error can be estimated by comparing the yields for different quantities of each fertiliser with a smooth curve.

The data will give valuable information each year, but a specially full and detailed investigation will be possible after thirty years, when an exceptionally complete set of data should have accumulated. The details are given on pp. 128-9.

GRASSLAND

Manuring of Grassland. Fertilisers produce three distinct effects on grassland ; up to a certain point they increase the quantity of their particular nutritive element in the plant (*e.g.*, nitrogenous fertilisers increase the nitrogen, phosphatic fertilisers increase the phosphorus, and potassic fertilisers increase the potassium) ; they may and often do increase the growth and they usually alter the herbage, encouraging some kinds of plants more than others.

Nitrogenous manures have their greatest effect when applied in spring ; they suffer considerable loss when used in autumn. Given in February or March they cause a rapid uptake of nitrogen in the plant shown by a darkening of the green colour ; if the soil and other conditions permit this is followed by an increased growth of young grass valuable for early grazing. Sulphate of ammonia used alone, however, while increasing the early growth, greatly reduced the wild white clover, and so reduced the later growth of herbage.

Phosphatic manures have the opposite effect on the herbage ; they tend to increase the clover, and therefore the amount of protein in the herbage. They increase also the amount of phosphorus taken up by the plant ; usually there is no visible sign of the additional phosphorus except on starved soils ; the grazing animal, however, can usually detect it and chooses the phosphate treated land.

In all the tests so far made superphosphate has put more phosphorus into the herbage in the first year after application than any other phosphatic fertiliser; the next in order has been high soluble basic slag, and the least effective low soluble slag and mineral phosphate. In no case however, is much of the added phosphate recovered; so far not more than 10 per cent at best. Up to a certain point the increased uptake of phosphorus goes on whether the yield increases or not.

The yields of hay and of protein per acre come out in the same order as phosphorus uptake, superphosphate being best, high soluble slag next, then low soluble slag and mineral phosphate.

Certain new basic slags have recently been produced which, although of low solubility, were said to be more effective than the old ones. Pot and field experiments have not supported this claim; the new slags seem little better than the old ones. Like them they have a certain lime value on acid soils, being in our tests as effective as their own weight of calcium carbonate. On certain soils, however, they may, like other slags, so much stimulate the decomposition of the organic matter that the carbonic acid produced more than balances their lime effects on the soil reaction.

No new areas were sown down to grass during 1930, nor is it at present proposed to lay down any more. The characteristic feature of the year was the filling up of the bare space which in 1929 amounted to about 30 per cent, and is now down to 5 or 10 per cent, the steady increase in the amount of wild white clover as the season advanced, the very high proportion of rye grass in the spring falling off later as the wild white clover increased, and the steadiness of the cocksfoot which neither increased nor decreased.

These three plants now dominate Sawyers pasture, and the timothy and rough stalked meadow grass are much reduced, even allowing for the fact that some of the identifications are uncertain. The results of the survey are given in Table IV; the method of survey is being improved this year. Of the other fields laid down in 1928, those sown on a fallow in August without a nurse crop (Sawyers and Harpenden) have given the best result, having now nearly caught up to Little Knott, and those sown in September immediately after a cereal crop (New Zealand, West Barnfield) are the worst; some of the spring sown seeds in cereals have also done badly (Great Knott and Stackyard). All, however, are improving and clover is increasing. Details of seeding are given in the 1928 Report, p. 101.

USE OF THE GRASSLAND

Having obtained the grass, the next problem is to use it efficiently and economically. It has arrived at its present good state largely as a result of good grazing which has kept down all flower heads, stems and rough patches. Sheep have been much used, with a small number of calves and bullocks; it is hoped to extend this work considerably.

Phosphatic Fertilisers for Grassland. For several years the Chemistry Department has been engaged in conjunction with the Permanent Basic Slag Committee of the Ministry of Agriculture in an examination of the chemical nature and fertiliser value of the different types of basic slag available to the British farmer. The results have shown that there are two main types which may be

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TABLE X.

Percentage Area covered by various species of plants, 1930.
Sawyer's Pasture, sown April 25th, 1928.

Name of Species.	Plot 1. Mixture I. May.	Plot 1. Mixture I. Oct.	Plot 2 Mixture VI. May.	Plot 2 Mixture VI. Oct.	Plot 3. Mixture VIII. May.	Plot 3. Mixture VIII. Oct.	Plot 4. Mixture VII. May.	Plot 4. Mixture VII. Oct.	Plot 5. Mixture IV. May.	Plot 5. Mixture IV. Oct.	Plot 6. Mixture V. May.	Plot 6. Mixture V. Oct.
Perennial Rye Grass (*Lolium perenne*) ..	77.5	44.6	—	—	53.7	— 30.1	—	—	57.4	35.3	61.7	43.4
Italian Rye Grass (*Lolium italicum*) ..	—	—	49.2	23.8			57.5	25.9	—	—	—	—
Cocksfoot (*Dactylis glomerata*)	3.3	8.4	15.5	19.9	18.7	21.7	12.6	16.2	13.4	21.1	17.3	18.6
Timothy (*Phleum pratense*)	4.9	2.1	4.8	1.5	5.1	4.7	9.4	7.5	8.8	4.2	0.7	0.5
Tall Fescue (*Festuca elatior*)	—	—	3.2	8.6	—	—	—	—	—	—	—	—
Meadow Fescue (*Festuca pratensis*) ..	0.3	0.2	—	—	2.7	0.9	1.4	—	—	—	—	0.1
Red Clover, late and early flowering (*Trifolium pratense*)	2.1	8.1	5.2	8.9	6.6	14.1	6.4	7.7	6.6	12.2	0.2	0.7
Wild White Clover (*Trifolium repens*) ..	6.5	28.6	11.2	31.1	5.4	22.6	5.5	35.5	5.6	22.0	2.9	29.5
Trefoil (*Medicago lupulina*)	—	—	—	—	—	0.7	0.7	—	—	—	—	—
Chicory (*Cichorium intybus*)	1.4	3.4	5.3	2.6	—	—	—	—	0.3	—	—	—
Weeds	1.4	1.2	1.7	0.6	2.7	0.3	1.0	0.2	3.2	0.1	2.2	0.4
Bent Grass (*Agrostis alba*)	0.2	1.3	—	0.1	—	—	—	0.1	—	—	—	—
Covered with vegetation	97.6	97.9	96.1	97.1	94.9	95.1	94.5	93.1	95.3	94.9	85.0	93.2
Bare Patches	2.4	2.1	3.9	2.9	5.1	4.9	5.5	6.9	4.7	5.1	15.0	6.8

Average of ten samples each of area 1 square foot. For previous figures see 1929 Report, p. 24; for Mixtures see 1928 Report, p.101.

discriminated with sufficient accuracy by the old and conventional citric acid test. In 1930 the work was extended so as to test over a period of years not only the two main types of basic slag but the two alternative phosphatic fertilisers, superphosphate and ground mineral phosphate (Gafsa passing 120 mesh sieve). The tests are conducted in the laboratory, in the pot culture house, and in the field, on both grassland and arable land. Preliminary results on a series of hay experiments are given below to illustrate the extent to which moderate grassland may be improved not merely in the quantity of the hay but in its quality or feeding value. The results of other experiments under conditions more nearly approaching those of pastures are not yet complete.

Seven centres distributed throughout the country were selected and Latin square experiments with 25 plots were laid down in the spring of 1930. Some of them were conducted by the local agricultural authorities and others by the Rothamsted staff. The fertilisers were from single well mixed batches, and were added at the rate of 1 cwt. of phosphoric acid (P_2O_5) per acre. Samples of the produce from individual plots were analysed at Rothamsted for dry matter, nitrogen and phosphoric acid. The results for six centres are given in Table XI.

As only a few months elapsed between the application of the fertilisers and haymaking, little immediate benefit was to be expected from the less soluble and more slowly acting fertilisers. The first year results show only the effect of rapidly available phosphoric acid, and the results in the following years will probably differ considerably from these preliminary ones.

On the average of six centres superphosphate alone showed an appreciable increase in dry matter, though there was a slight benefit from the less soluble phosphates at some of the centres. The effects on the composition of the hay were, however, more striking and more consistent than those on yield. At four centres the average protein content of the dry matter was raised from 9 to 11 per cent by superphosphate, and at six centres the average phosphoric acid content of the dry matter was increased by 50 per cent. At one centre the total phosphoric acid content of the hay per acre was doubled. The hay was thus not merely increased in amount but also in protein and mineral content. In the two Essex centres the improvement in quality was particularly great even though at one of them nearly 3 tons of hay per acre were obtained on the unmanured land. The average gain from superphosphate at the two Essex centres was 6 cwt. of dry matter per acre, but at the same time the protein content of the hay per acre was raised by 1.5 cwt., an amount contained in about 18 cwt. of the unmanured hay. The increase was not merely hay but a richer material with a feeding value comparable with that of dried young grass, and approaching that of a concentrated feeding stuff.

This result illustrates the well known discrepancy between practical experience on the improvement of pastures and stock by slag or other phosphates, and the disappointing results often given by fertiliser trials when similar land is laid up for hay, and the experiment confined to the measurement of yield of hay.

In spite of the great improvement produced at some of these centres the actual recovery of the phosphoric acid added was small ;

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for superphosphate the maximum was 12 per cent and the average 6 per cent. Less than 3 per cent of the phosphoric acid added in high soluble slag was recovered and still smaller amounts were taken from the low soluble slag and mineral phosphate. The immediate availability of the phosphoric acid was closely related to its solubility.

TABLE XI.—Effect of Phosphatic Fertilisers on yield and composition of hay, 1930.

	No Phosphate.	Mineral Phosphate.	Low Soluble Slag.	High Soluble Slag.	Super.
Yield of Hay (as cwts. of dry matter per acre)—					
Purleigh, Essex	50.4	50.8	53.5	52.0	54.7
Braintree, Essex	19.3	20.1	20.2	23.5	27.3
Badminton, Glos.	28.5	28.5	28.5	28.8	30.6
Lydbury, Salop	28.7	31.1	29.7	29.6	31.3
Chesterfield, Derby ..	19.3	18.2	19.4	19.1	20.9
Wetherby, Yorks	28.8	31.2	32.4	31.1	28.0
Mean ..	29.2	30.0	30.4	30.7	32.1
Nitrogen as per cent. of dry matter—					
Purleigh ..	1.31	1.29	1.30	1.47	1.57
Braintree ..	1.55	1.72	1.69	1.70	2.21
Badminton ..	1.61	1.58	1.58	1.56	1.66
Chesterfield ..	1.42	1.48	1.38	1.47	1.49
Mean ..	1.47	1.52	1.49	1.55	1.73
Protein in hay in cwts. per acre—					
Purleigh ..	4.13	4.09	4.35	4.78	5.36
Braintree ..	1.87	2.16	2.14	2.50	3.77
Badminton ..	2.86	2.81	2.82	2.80	3.17
Chesterfield ..	1.72	1.68	1.67	1.75	1.95
Mean ..	2.64	2.68	2.74	2.96	3.56
P_2O_5 *as per cent. of dry matter*—					
Purleigh ..	0.46	0.46	0.50	0.51	0.62
Braintree ..	0.48	0.49	0.51	0.52	0.67
Badminton ..	0.43	0.46	0.44	0.54	0.60
Lydbury ..	0.52	0.60	0.59	0.61	0.71
Chesterfield ..	0.36	0.40	0.36	0.43	0.49
Wetherby ..	0.53	0.52	0.52	0.57	0.59
Mean ..	0.464	0.490	0.485	0.530	0.616
Phosphoric Acid in hay in cwts. per acre—					
Purleigh ..	0.23	0.24	0.27	0.27	0.34
Braintree ..	0.09	0.10	0.10	0.12	0.18
Badminton ..	0.12	0.13	0.13	0.16	0.19
Lydbury ..	0.15	0.19	0.18	0.18	0.19
Chesterfield ..	0.07	0.07	0.07	0.08	0.10
Wetherby ..	0.15	0.16	0.17	0.18	0.17
Mean ..	0.136	0.148	0.151	0.164	0.194
Mean percentage recovery of added P_2O_5 ..	—	1.2	1.5	2.8	5.8

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How much of the added phosphoric acid is taken up by the plant? The few experiments that have been made do not indicate a high percentage utilisation of the added phosphoric acid under normal conditions, even when the necessary nitrogen and potassium are supplied. Some of the results are given in Table XII.

TABLE XII.—Recovery of Phosphoric Acid (P_2O_5) from Phosphatic Fertilisers.

Normal Conditions.	Reference	P_2O_5 applied per acre.	P_2O_5 taken up by crop lb. per acre. No Phosphate.	Phosphate.	Difference.	Percentage recovery.
Superphosphate—						
Swedes, 1st year	Little Hoos, Rothamsted	70	28.5	18.7	10	14
2nd, 3rd and 4th year after application ..					17	24
Barley, 1st year	Little Hoos	70	22	17	5	7
Hay, 1st year ..	Essex	112	26	38	12	11
1st year ..	All centres	112	15	21.6	6.6	6
Basic Slag—						
(1) Hay, 1st year		100	10.2	14.8	4.6	3
1st 4 years			23.2	38.0	14.8	15
(2) Hay, 1st year	Essex	112	26	30	4	3.6
1st year ..	All centres	112	15	18.4	3.4	3
	Conditions of phosphatic starvation:					
Superphosphate—						
Hay	Park Grass	64	10	26	16	25
Barley	Hoosfield	64	10.4	22.4	12	19
Wheat	Broadbalk	64	14.4	23.4	9.0	14

THE ACCURACY OF THE FIELD EXPERIMENTS

The average "standard error" per plot for the different crops at Rothamsted, Woburn, and the various other centres are given in Table XIII; they were in 1930 of the same order as in previous years. At Rothamsted the error per plot varies round about 5 per cent of the total yield for Latin squares, and about 10 per cent for randomised blocks; it tends to be lower for potatoes and higher for wheat. Expressed as weights per acre the "standard error" for Latin squares is about 0.5 tons of roots and 1.3 cwt. of grain; for randomised blocks it is about 0.7 tons of roots and 1.5 to 3 cwt. of grain. At Woburn and the outside centres the figures are as usual somewhat higher, but again the Latin square is the more accurate. Even on commercial farms the "error" per plot amounts only to about 0.5 tons of potatoes in Latin squares and 1 ton or less in randomised blocks; with good yields this gives the same percentage error as at Rothamsted. The Latin square is thus the more accurate and we recommend its use wherever practicable. It is used for manurial trials at our outside centres on commercial farms without difficulty. Its range of usefulness has been still further increased in recent years by splitting each plot so as to test some other treatment superimposed on the entire series, *e.g.*, phosphate or no phosphate on each of a set of plots receiving various nitrogenous manures. For cultivation and variety trials involving