ROTHAMSTED RESEARCH

# Report for 1937

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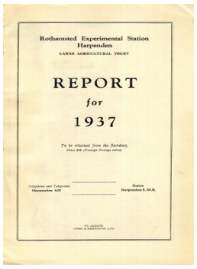


## Grassland

### Rothamsted Research

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## GRASSLAND

Rothamsted experiments on grassland fall into three groups :

(1) the effects of fertilizers on the yield and composition of hay and on the grazing value of pasture land ;

(2) the effect of management on the flora of grassland ;

(3) the effects of cake feeding on the composition and nutritive value of the herbage.

The general results of the first two groups of investigations were summarised in the Report for 1936 ; it is not, therefore, necessary to go over the ground again in detail. It is sufficient to say that the investigations on basic slag were continued and extended.

The Rothamsted Park Grass plots, begun in 1856, show in a striking way the changes brought about by continued fertilizer treatment in the flora of grassland. The changes are determined primarily by the fertilizers supplied, but they are modified by weather conditions ; they are studied by making periodical botanical analyses of the herbage of the various plots.

In this experiment a fairly uniform grass field has been changed into some 15 or 20 different floral types by varying the manurial treatment. The converse experiment was started in 1928. An arable field was divided into six parts, each of which was sown with a separate grass mixture, then the whole field was put under uniform management, and botanical analyses of the herbage were made periodically. The differences in flora rapidly diminished and by 1936 the plots were all very similar. Grasses and clovers occur in approximately the same proportions on all plots irrespective of the original mixture ; rye grass has become dominant on all plots, Cocksfoot has diminished, Fescue and Timothy have almost disappeared but Rough Stalked Meadow Grass forms a definite though small part of each flora.

In another field part was sown with commercial strains of grass and part with indigenous strains. Here the differences still persist and are very noticeable in the early part of the season.

### The Effects of Cake Feeding

The investigation of the effects of cake feeding on the composition and nutritive value of the herbage was commenced in 1936 under the aegis of the Royal Agricultural Society which makes an annual grant towards the cost.

Among the fields that came into our possession in 1934 was a level and fairly uniform grass field, Highfield, of about 60 acres, which had been indifferently grazed and manured for many years and had, therefore, become distinctly poor though capable of better things. This field was devoted to the experiment.

Nine plots were laid out, each of 5 acres in extent : they were fenced, water was laid on, and a weighbridge was installed in the centre so as to be easily accessible from all plots.

The plots were arranged in three blocks, each of three plots. In each year one block of three plots will be grazed by bullocks and on one of the plots cake will be fed. All liveweights will be recorded.

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In the next year there will be no cake fed, but another of the three plots will receive during winter and spring artificial fertilizers containing the estimated manurial equivalents of the cake. The third of the plots will be left unmanured. All three plots will then be grazed by bullocks and sheep in the proportion of 3 sheep to 1 bullock : again all weights will be recorded. From the increases in liveweight we shall be able to compare the residual values of the manure with the values of artificials supplying their supposed equivalents. In the third year no plot will be manured, so that any subsequent effect of cake feeding or of artificials can be estimated.

The arrangement of the plots is as follows :—

| Year | *Block* 1 | | | *Block* 2 | | | *Block* 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| Plot | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| 1937 | – | – | – | – | – | – | – | – | – |
| 1938 | – | C | – | C | – | – | – | – | – |
| 1939 | – | – | M | – | – | M | C | – | – |
| 1940 | – | – | – | C | – | – | – | M | – |
| 1941 | – | C | – | – | – | M | – | – | – |
| 1942 | – | – | M | – | – | – | C | – | – |
| 1943 | – | – | – | C | – | – | – | M | – |
| 1944 | | | | – | – | M | – | – | – |
| 1945 | | | | – | – | – | | | |

C is the plot receiving cake and M the one receiving artificial manures.

The experiment will thus be in triplicate, though in each year only one plot receives cake.

In order to save time at the outset Block 2 is at first treated as Block 1 : this avoids considerable delay and it gives some additional information.

The changes in herbage are measured by botanical analyses ; samples being obtained from small cages fixed on the plots so as to keep off grazing animals.

The first year, 1937, was devoted to uniform grazing for estimating the irregularities of the field and also for improving the technique of the experiment. In 1938 the cake feeding began.

The rates of feeding proposed are as follows :—

*Cake Year.* 5 fattening cattle per 5 acres receiving

| | Per cent. N | Per cent. $P_2O_5$ | Per cent. $K_2O$ |
|---|---|---|---|
| in Early Summer (50% flaked maize, 50% undec. cotton cake) .. .. | 2.6 | 1.6 | 0.9 |
| in Late Summer (50% flaked maize, 50% dec. ground nut cake) .. | 4.5 | 1.0 | 0.9 |

It is proposed to increase the rate of cake-feeding steadily throughout the year but taking averages we may assume per 5 acres in early summer 5 cattle with an average of 6 lb. cake per head per day for 50 days giving a total of 1,500 lb.or 13.4 cwt. food, and in late summer 5 cattle with an average of 10 lb. per head per day for 70 days giving a total of 3,500 lb. or 31.3 cwt. food.

These totals may be expressed on an acre basis as follows :—

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*Cwt. for one beast on one acre*

| | Days | Cake | N | $P_2O_5$ | $K_2O$ |
|---|---|---|---|---|---|
| Early summer .. | 50 | 2.7 | 0.07 | 0.04 | 0.02 |
| Late summer .. | 70 | 6.3 | 0.28 | 0.06 | 0.06 |
| Per annum .. | 120 | 9.0 | 0.35 | 0.10 | 0.08 |

In the following winter or spring a neighbouring plot will receive the following manures :—

| | Cwt. per acre | N | $P_2O_5$ | $K_2O$ |
|---|---|---|---|---|
| ¼ cake N as hoof and horn meal .. | 0.68 | 0.09 | — | — |
| ¼ cake N as sulphate of ammonia | 0.43 | 0.09 | — | — |
| ¾ cake $P_2O_5$ as steamed bone flour | 0.27 | — | 0.08 | — |
| ¾ cake $K_2O$ as sulphate of potash .. | 0.12 | — | — | 0.06 |
| Total fertilizer .. .. .. | 1.50 | 0.18 | 0.08 | 0.06 |

The lengths of the grazing period will, naturally, have to vary with seasonal conditions but we shall aim at getting on a fixed amount of cake per acre per annum. In the event of seasonal changes the necessary adjustments can be made in the following year in the amounts of fertilizers added.

In the two years following the cake year the stocking will be altered from time to time according to the state of the herbage, but the proportion of one bullock to three sheep will be maintained. All animals will be weighed fortnightly. The plots will be closed from some time in November and December until the herbage is ready for grazing in May or thereabouts.

## Manuring of Hay

The immediate and first year residual effects on the hay crop of 8 tons compost (mainly from grass mowings) were compared with those of artificials consisting of 2 cwt. nitrate of soda, 3 cwt. superphosphate and 1 cwt. of 30 per cent. potash salt per acre. The experiment was conducted at Lady Manners School, Bakewell, Derby, and commenced in 1932. Certain plots receive their manuring only in 1932 and alternate years, others only in 1933 and alternate years, while a third set are manured every year.

TABLE II

*Meadow Hay—Immediate Effects of Artificials and Compost*

| | Mean yield cwt. per acre | No manure in previous year | | Manured in previous year | |
|---|---|---|---|---|---|
| | | Response to | | Response to | |
| | | Artificials | Compost | Artificials | Compost |
| 1933 | 39.5 | +19.2 | +16.4 | +21.0 | +9.4 |
| 1934 | 43.1 | +8.5 | +4.5 | −0.3 | −2.4 |
| 1935 | 44.3 | +18.9 | +14.2 | +13.8 | +8.9 |
| 1936 | 62.8 | +14.9 | +14.4 | +10.5 | +6.0 |
| 1937 | 70.5 | +27.2 | +20.7 | +19.5 | +7.6 |

The immediate response to artificials is greater than the immediate response to compost every year. Further, as is to be

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expected, the responses to both manures are greater on plots without manuring in the previous year than on plots which were then manured. The average differences between the increases to artificials and the increases to compost are 3.7 cwt. per acre on plots unmanured and 7.0 cwt. per acre on plots manured. This indicates that artificials are more effective relatively to compost at higher levels of yield.

TABLE III

*First Year Residual Effects of Artificials and Compost*

| | No manure in current year | | Manured in current year | |
|---|---|---|---|---|
| | Response to | | Response to | |
| | Artificials | Compost | Artificials | Compost |
| 1933 | +0.7 | +2.8 | −0.8 | −0.9 |
| 1934 | +9.8 | +21.7 | +8.1 | +7.8 |
| 1935 | +2.8 | +9.7 | −3.2 | +5.2 |
| 1936 | +7.5 | +10.2 | +1.4 | +3.4 |
| 1937 | +3.2 | +13.4 | −1.8 | −2.3 |

In most years there were also good responses to a previous year's dressing of manures on plots receiving no manure in the current year. The relative effectiveness of the two manures has, however, been reversed, compost giving about 6.7 cwt. per acre more than artificials. On plots manured in the current year, the residual effects were small or negligible except in 1934, in which the residual responses to the two manures were roughly equal; at these higher levels of yield compost has apparently little residual value, a result in accordance with that indicated above.

## ARABLE LAND

### The Liming Programme

Some of the results of the 1936-37 experiments have an important bearing on the liming programme of the Ministry of Agriculture. In many parts of England there is a dislike of magnesian limestone and of the lime prepared from it. We have made a number of experiments in different parts of the country but so far obtained no evidence that the magnesian limestones are detrimental. When used in the quantities indicated by the ordinary lime requirement methods they give fully as good results as the corresponding high-calcium products. In some pot experiments, indeed, magnesium proved beneficial, but not in any of the field experiments. No full survey has been made but there is no present evidence of widespread magnesium deficiency in English soils.

### Residual Effects of Chalk

The residual effects of chalk have been studied in three experiments, in two of which there were several dressings of chalk so as to determine the most effective amount to apply.

At Tunstall on an acid sandy soil, chalk was applied in 1932 but nothing was added afterwards. Sugar-beet was grown by Mr. A. W. Oldershaw, for the first four years, 1932-5.

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