Report for 1927-28

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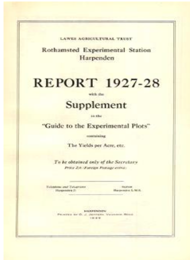
Rothamsted Experimental Station
Harpenden
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Supplement
"Guide to the Experimental Plots"

Lucerne

Rothamsted Research

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LUCERNE.

The value of lucerne as fodder is well recognised, but only a comparatively small area has hitherto been grown, and this is mainly restricted to the south-eastern part of England : elsewhere it often fails to survive. Investigations made by Mr. Thornton during the past five years have revealed both the cause and the remedy. Like other leguminous plants, lucerne is dependent on the bacteria living in the nodules of its roots, and as these are not normally carried in the seed they must enter the plant from the soil : if they do not occur there, the plant fails to grow well. The experiments show that the organisms are absent from many of the soils of the north and west of England, but they occur in the home counties and East Anglia, where lucerne has been grown for many years : they occur also, though probably in smaller numbers, in the flat region stretching away from the home counties to Cheshire—the region known to geographers as the Midland Gate. Mr. Thornton has developed a method of adding the necessary organisms by a process of inoculation which is both successful and inexpensive, increasing the yield of crops by 20 per cent. or more in districts where the appropriate bacteria are absent from the soil, and usually increasing the nitrogen content and therefore the feeding value. Inoculated lucerne seems to have as good a chance of survival in the north and west as in its old home in the south-east and East Anglia. Inoculation is particularly advantageous where lucerne is sown with a cover crop.

Inoculation, however, is not the only thing necessary to ensure success. Lucerne is very liable to weed infestation, in spring with the usual annuals, in autumn with special weeds like groundsel and chickweed. Trials showed no advantage, however, in delaying the sowing for the sake of extra cleaning : spring sowing in a cover crop has given the best results in our trials as widely separated as Somerset, Monmouth, Montgomery, Cumberland and Rothamsted.

Soil acidity is a potent cause of failure of lucerne, being harmful both to the plant and the organism. Acid soils must be limed before inoculation. Alway has obtained evidence that in Minnesota a second crop of lucerne sown immediately after the ploughing in of a first crop that has partially failed has a greater chance of success. No evidence for this was found at Rothamsted, nor of any acid resistant strain of organism that could be used on acid soils. Up to the present liming remains the only way of making an acid soil fit for lucerne.

Mr. Thornton, assisted by Mr. P. H. H. Gray and by generous grants from the Research Fund of the Royal Agricultural Society of England, has developed methods for preparing cultures of the bacteria on a large scale for distribution to farmers ; he has also worked out a simple and effective way of putting the cultures on to the seed. The bacteria travel safely and are still vigorous at the end of their journey : indeed a package of them is being sent round the world to see if they will tolerate the 12 weeks of travel thereby involved. The cultures can be kept on the farm for at least two months before they need be used.

Although no advertising has been attempted the demand for cultures has increased rapidly. In 1927, 900 were sold, sufficient to inoculate 6,300 lb. of seed. In 1928, the cultures were further improved so that each one would inoculate twice as much seed: 1,750 were sold, representing 24,500 lb. of seed or nearly 1,000 acres of lucerne. The business of selling cultures, however, is not suited to the Rothamsted organisation; it is, therefore, being handed over to a trustworthy and efficient firm who are undertaking to keep close touch with the Rothamsted workers and embody in the process such improvements as from time to time may be effected.

THE ACCURACY OF THE FIELD EXPERIMENTS.

A new method of field experiments was introduced here in 1925 and has been used exclusively in all the new field experiments both at Rothamsted and at Woburn. Its purpose is to get over the difficulty of soil variation, and to measure the probability that the result is due to the treatment and not to soil differences or mistakes by workers. Dr. R. A. Fisher and the staff of the Statistical Department have worked out suitable arrangements of plots, the most convenient in practice being a grouping into blocks each of which contains one each of the proposed treatments, or into a latin square, each row and each column of which contains one, but no more, of each treatment. From the figures for yield, a standard error is worked out which shows the degree of trustworthiness of the result. A difference in yield equal to the standard error of this difference can be obtained about once in three trials even when the experimenter is convinced that he has given exactly the same manuring and cultivation to each of the plots, but a difference twice this size would be obtained by chance only once in 22 times: it is therefore much more likely to be true. The chances against the difference in yield being due to causes other than the difference in treatment are:—

For difference	equal to its	Standard error		...	3 to 1
,,	,,	double	,, ,,	...	22 to 1
,,	,,	three times	,,	...	370 to 1
,,	,,	four times	,,	...	15,780 to 1

For most agricultural purposes a chance of about 30 to 1 is good enough. The " standard errors " given in the following tables are those for the yield values, and they have to be multiplied by 1·414 (*i.e.*, $\sqrt{2}$) in order to give the standard error of the difference between treated and untreated plots—the figure one usually wants. To attain a probability of 30 to 1, a difference must be roughly three times the standard error given in the tables. [1]

The method necessitates a large number of plots: during the year 1928 there were at Rothamsted and Woburn:—

Cereals	... ...	240
Potatoes	... ...	250
Sugar Beet	... ...	222

Remarkable accuracy can, however, be obtained: in 1927, the potato experiment of eighty-one plots testing different quantities of nitrogen and different quantities and kinds of potassic fertiliser had a standard error of only 1.14 per cent. The values for all the experiments so far done are given in Table 1.

[1] Full Report.