ROTHAMSTED RESEARCH

Report for 1927-28

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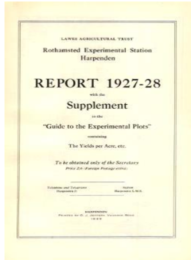
Rothamsted Experimental Station
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The New Nitrogenous Manures

Rothamsted Research

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The high increments are associated with years of 3 to 4 inches March and April rain and 200 or more hours of July sunshine, 1927 being the only exception. A higher increment might have been expected in 1924, but the abnormally wet summer and autumn greatly encouraged the growth of weeds and protracted the harvest.

The New Nitrogenous Manures.

Four nitrogenous fertilisers have been compared in detail. The results were, at Rothamsted, for barley :—

	1927. Grain, bushels per acre. Single dose.	1927. Grain, bushels per acre. Double dose.	1927. Straw, cwt. per acre. Single dose.	1927. Straw, cwt. per acre. Double dose.	1928. Grain, bushels per acre. Single dose.	1928. Grain, bushels per acre. Double dose.	1928. Straw, cwt. per acre. Single dose.	1928. Straw, cwt. per acre. Double dose.
Sulphate of ammonia	34.0	37.8	20.4	22.2	35.5	34.6	32.1	34.5
Muriate of ammonia	36.2	47.0	20.0	27.0	34.6	37.5	31.3	36.2
Urea...	32.8	43.8	20.0	24.3	35.0	35.8	31.1	32.8
Cyanamide	36.0	35.8	20.8	20.7	33.4	37.5	28.8	33.8
No nitrogen ...	23.6		15.4		28.6		24.4	

All fertilisers markedly increase the yield, with muriate of ammonia coming out best as usual in 1927, and quite well in 1928. In both years cyanamide has done well : it was applied a few days before sowing. Urea does not come up to muriate of ammonia.

These nitrogenous manures act best when they are applied with the seed—cyanamide should go on even earlier. Used as top dressing, even ammonium nitrate (nitrochalk) is ineffective, and when given late it only raised the percentage of nitrogen in the grain.

Barley sown.	No top dressing.	Nitrochalk applied : May 12.	Nitrochalk applied : June 4.	Nitrochalk applied : June 19.
Grain, bushels per acre	31.1	30.8	33.0	31.4
Straw, cwt. per acre	30.1	31.9	32.1	29.5
Nitrogen per cent. in grain	2.075	2.118	2.110	2.160

Superphosphate on barley. The Hoosfield barley plots afford the best demonstration in the world of the effects of phosphate, potash and nitrogen starvation on the barley plant. In British practice, phosphate starvation is rare, the barley being grown only one or two years after a root crop which has been manured with a phosphatic fertiliser. The farmer is more interested in the other problem : the effect of doses of phosphate larger than are needed to supply the bare necessities of the plant. This depends very much on the season, but also on the soil. In the outside experiments the glacial drift soils at each of the three Norfolk centres have always responded to superphosphate. On other soils, however, the response varies from season to season : *e.g.*, at Rothamsted, a response was obtained in 1927, but hardly in 1928 :—

Rothamsted.

	Grain, bushels per acre. 1927.	1928.	Straw, cwt. per acre. 1927.	1928.
Superphosphate	35.0	33.6	20.7	30.3
No superphosphate	31.4	32.8	18.9	29.4
Effect of superphosphate	+3.6	+0.8	+1.8	+0.9

The figures for the straw vary in the same direction. No connection between the meteorological data and the response to phosphate has yet been traced.

Potassic fertilisers on barley. The effect of potassic fertiliser, like that of phosphate, is much less marked than that of nitrogenous fertiliser. Few soils, except perhaps the thin chalks and light sands, show signs of potash starvation, and it is not clear that excess of potash over and above a margin of safety is advantageous: indeed, in some seasons, especially the good ones, sulphate of potash appears to be harmful. During its 77 successive years under barley, Hoosfield has passed through three stages: the first, when sulphate of potash not infrequently reduced the yield; the second, when it had no effect; and the third, when it increased the yield, potash starvation having set in at the end of about 32 years. The yields of grain have been, in bushels per acre:—

	Plot.	Early years. 1st 8 yrs. 1852-59.	1863.	1864.	1865.	1866.	Mean of 40 years. 1852-91.	Mean of 8 years. 1908-15.	Mean of 12 years 1916-27.
Complete artificials	4A	45.4	55.4	55.4	46.5	47.0	43.5	40.4	32.0
No potash	2A	44.9	61.6	58.5	48.4	50.5	42.75	28.5	26.5
Difference[1]		+0.5	—6.2	—3.1	—1.9	—2.5	+0.75	+11.8	+5.5

(1) Sulphates of soda and of magnesia are also omitted as well as sulphate of potash, but other plots show that their effects are relatively small.

Sulphate of potash caused a marked depression in yield of malting barley at Rothamsted in 1924 and at certain of the outside centres in other years: this is not common, but it appears to be a true result. The present data suggest that:—

(1) in years of high spring rainfall and good ripening weather, *i.e.*, years favourable to the formation of well-matured grain of low nitrogen content, sulphate of potash may decrease the yield of barley;

(2) in years unfavourable to ripening, sulphate of potash has less depressing effect and may even raise the yield of barley.

These variations are of the same kind as for wheat and potatoes, on both of which sulphate of potash acts beneficially in unfavourable seasons, and has less effect in good seasons, the badness of the season being in each instance measured by the yield of crop receiving no potash.

Actual depression of crop, however, seems to be confined to

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barley, and apparently to sulphate of potash, for it has been observed with muriate of potash only in 1924; whether the chlorine ion is beneficial and the sulphate ion harmful, is not known.

Effect of Fertilisers on Composition and Quality of the Grain.

The percentage of nitrogen in the grain of barley depends on the amount of nitrogen the plant has taken from the soil and on the amount of carbohydrate it has synthesised during its growth. A high nitrogen uptake makes possible considerable growth and sufficient carbohydrate formation to over-balance the nitrogen: the grain then has a low nitrogen content. It depends on the favourableness of the conditions whether this possibility eventuates. Late sowing, or a check in growth due to drought, or a late supply of nitrogen to the plant, may so cut down the available time that the plant cannot make the necessary carbohydrate: the nitrogen content of the grain then becomes high. On the other hand, high rainfall in the weeks after sowing, by reducing the nitrate in the soil, but otherwise favouring growth, lowers the nitrogen content of the grain, as shown by the following data, obtained at Woburn :—

Nitrogen per cent.	2.01	1.95	1.71	1.57	1.23
Year	1925	1922	1923	1926	1924
Barley sown ...	March 31	April 19	April 10	March 4	March 11
Rainfall in inches after sowing.					
March ...	—	—	—	0.09	0.35
April ...	1.59	1.93	1.34	2.59	2.97
May 1st-15th inclusive	1.18	0.35	0.79	1.43	1.35

In sufficiently favourable conditions, sulphate of ammonia may still further increase the carbohydrate production and thus further reduce the proportion of nitrogen in the grain; in less favourable seasons, however, insufficient carbohydrate is produced and the nitrogen content of the grain may be raised. As the nitrogen content is already low in favourable and high in unfavourable seasons, it follows that sulphate of ammonia tends to lower the nitrogen content of the grain in years when it is low and to raise it in years when it is high. Larger quantities (2 cwt. per acre) tend to raise it in any case. The Rothamsted results have been :—

Percentage of Nitrogen in Grain.

	1925.	1926.	1927.	1928.	
No Nitrogen...	1.597	1.599	1.452	1.915	
				Single.	Double dressing.
Sulphate of Ammonia ...	1.585	1.711	1.442	2.029	2.220
Muriate of Ammonia ...	1.552	1.684	1.438	1.985	2.112

As in previous years muriate of ammonia gave grain of lower nitrogen content than sulphate of ammonia. Potassic fertilisers counteract to some extent the tendency for sulphate of

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