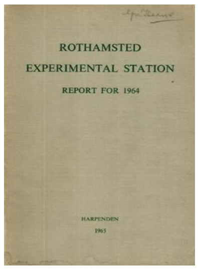
ROTHAMSTED RESEARCH

Report for 1964

Full Table of Content



The Saxmundham Experiments

G. W. Cooke

G. W. Cooke (1965) *The Saxmundham Experiments ;* Report For 1964, pp 228 - 232 **- DOI: https://doi.org/10.23637/ERADOC-1-57**

but for other manurial treatments the extra acidity will develop slowly by allowing the present drift to continue. Increases in pH on other subplots will come quickly after liming, but there will be an unavoidable pH gradient down the profile, probably for several years in the top 9 in. of soil, and the subsoil will only slowly become less acid.

Subplots *b* and *c* are to be limed to give pH values of 6 and 5 respectively. Subplots *a*, which are to be maintained at present pH values, are half-way through the current 4-year liming cycle, and maintenance dressings will therefore be deferred for 2 years. Subplots *d* will be allowed to develop "maximum acidity", which for the Park Grass surface 0–9 in. is pH 3·7–3·8, the current value now on most of the ammonium sulphate plots. Subplots *a* and *d* provide the continuity of the present Park Grass experiment. The liming treatments are an initial dressing of ground chalk to bring the surface soil (0–9 in.) to the required pH, followed by maintenance dressings applied every second year. The initial dressings were determined from titration curves with $Ca(OH)_2$ solution. In the calculation of the dressings a "field factor" was not used, but the acidity of the mats on the ammonium sulphate plots was allowed for. Table 2 shows the initial dressings of ground chalk to be applied in January 1965.

TABLE 2

Initial chalk dressings, Park Grass, January 1965

Tons $CaCO_3$/acre

	Subplot			
Plot	*a*	*b*	*c*	*d*
1	—	—	2½	—
2	—	—	—	—
3	—	—	—	—
4/1	—	—	—	—
4/2	—	1	4½	—
7	—	—	—	—
8	—	—	—	—
9	—	2	3½	—
10	—	1	4	—
11/1	—	5	4	—
11/2	—	3	4	—
13	—	—	1	—
14	—	—	—	—
16	—	—	—	—
17	—	—	—	—
18/1 + 3	—	—	2	—

If after two years these amounts were not enough to establish the correct pH values supplementary dressings will be applied. The maintenance dressings will be based on subsequent changes in soil reaction.

The Saxmundham Experiments

By G. W. Cooke

Long-term experiments began in 1899 on land sited a mile west of Saxmundham in East Suffolk. They were controlled by a sub-committee of the Education Committee of the East Suffolk County Council and supervised

https://doi.org/10.23637/ERADOC-1-57

by Mr. Harry Fiske, a local farmer, until 1909. Mr. A. W. Oldershaw directed the work for the County Council from 1911 to 1947, when the National Agricultural Advisory Service became responsible for the Station and Mr. P. J. O. Trist became Director. The foreman for the first 40 years was Mr. C. Cattermole, then Mr. H. Neal for 9 years and since 1948 Mr. V. Woolnough. The Station was acquired by the Agricultural Research Council in 1964 and placed in charge of Rothamsted. The current experiments are planned by a Sub-Committee of the Field Plots Committee and supervised by R. Hull from Broom's Barn.

There were originally 20 acres of land for the experiments. Only Harwood's Field of 7·7 acres remains; it contains the two rotation experiments that began in 1899. (The other land, Fiske's Field, was much used for grassland experiments reported by A. W. Oldershaw (*Jl R. agric. Soc.* 1934, **95**, 18–33), and later for annual experiments with arable crops, until it was sold in 1951.)

The soil. The clay-loam soil is stiff and difficult to work; it is derived from Chalky-Jurassic boulder clay containing sandy layers or lenses, and has more coarse sand than is usual on this formation. The topsoil, which is very plastic when wet and hard when dry, works well only within a narrow range of moisture contents. Aggregates formed by cultivation are unstable when wetted; the finer material is easily eroded by rain, and the coarser sand remains as a superficial coating on exposed surfaces. The subsoil is variable in texture, depth and chalk content; it remains waterlogged for long periods in most years, as drainage is restricted by the compacted lower horizons. The tendency of aggregates to slake, and the compaction and "smearing" caused by cultivation, are thought to allow water to "perch" in the ploughed layer. A typical mechanical analysis of surface soil (containing 0·9% $CaCO_3$) reported by B. W. Avery (Soil Survey) is shown below. The subsoil usually contains less sand and in places has 50% of clay.

		%
Sand	200 μ–2 mm	31·4
	50 μ–200 μ	15·0
Silt	20 μ–50 μ	4·4
	2 μ–20 μ	15·4
Clay	$<2\ \mu$	27·5

The mechanical analysis of the surface soil is akin to that of some clay-loam soils at Rothamsted, but the Saxmundham soil behaves quite differently and slakes so easily when wet that it is much more difficult to work and to drain. Saxmundham soil is neutral, and at variable depth the subsoils have reserves of chalk; when cropped continuously it releases much potassium but supplies little soluble phosphorus. In contrast, unlimed Rothamsted soils are acid, and although they contain about as much total potassium as Saxmundham soil, they release little in continuous cropping (P. W. Arnold related this difference in potassium release to more fine clay ($<0·3\ \mu$) in Saxmundham soil). Most crops respond well to phosphate but not to potash fertilisers at Saxmundham; at Rothamsted responses to potash are usually larger than to phosphate. These contrasts

https://doi.org/10.23637/ERADOC-1-57

between the soils make the opportunity to increase work at Saxmundham particularly valuable.

The Rotation Experiments. The first of the two experiments that survive (***Rotation I***) was designed by Mr. A. Harwood, Chairman of the Education Sub-Committee. It began in 1899 and is a four-course "Norfolk" rotation of wheat, roots, barley and legumes. There are four half-acre blocks each containing 10 plots for different manurial treatments, and each crop is represented on one block each year. Although turnips, mangolds, swedes and sugar beet have been grown as the root crops, mangolds were the usual. The legumes grown have been peas, beans and clover, but the sequence of types of crops has not deviated, and each of the four types has appeared in successive blocks in turn. The weights of manures applied each year have been constant. Eight of the 10 treatments consist of a $2 \times 2 \times 2$ factorial test of nitrogen (0·3 cwt N/acre supplied by 2 cwt sodium nitrate/acre), phosphorus (approximately 0·3 cwt P_2O_5 supplied by 2 cwt superphosphate/acre) and potassium (0·5 cwt K_2O from 1 cwt muriate of potash/acre). The other two treatments are FYM (6 tons/acre) and bonemeal (4 cwt/acre). No other rotation experiment in this country has so long a history without major modification, and the only change in the fertiliser treatments in 65 years was small increases in amounts of P and K caused by increased concentration of the superphosphate and muriate of potash used. The early results of the experiment were described by A. W. Oldershaw (*Jl R. agric. Soc.* 1934, **95**, 136–155), and a complete account of the work is now being prepared by Mr. P. J. O. Trist (N.A.A.S.) and D. A. Boyd.

Rotation II Experiment was designed by Sir William Somerville (First Draper's Professor of Agriculture at Cambridge), who gave its object: "to determine how farmyard manure and artificials might best be distributed over the crops of a rotation". The crops on the four blocks of the experiment were the same as in Rotation I, but the manures to each plot depended on the crop being grown. One plot had no manure, a second had only 10 tons/acre of FYM to the wheat crop of the rotation. Five of the remaining eight plots compared the yields of the four crops when given fixed total amounts of FYM, superphosphate and nitrate of soda at different points in the rotation; two other plots were given extra N and one extra P. The information sought was much too complex to be answered with so few plots, and in 1952 two-thirds of the area was abandoned. Seven of the 10 plots in two of the blocks were retained with unchanged manuring and cropping until 1964; this area will be used to study the reserves of P in the soil, by a modified scheme of treatments to start in 1965.

Crops in 1964. Cappelle winter wheat, sown under good conditions in 1963 in both experiments, grew and yielded well. The spring crops were sown in bad seedbeds caused by excessive rain in March and April. Although satisfactory plants were established, both sugar beet and mangolds (each was grown on half of each plot of the root break) grew slowly

https://doi.org/10.23637/ERADOC-1-57

in spring and early summer and were then checked from July onwards by drought. Barley grew well only where N and P were supplied either by fertilisers or by FYM; on other plots much of the grain produced was taken by birds, which also broke down the short straw, and the recorded yields must be under-estimates. Peas sown on the legume break were severely damaged by birds before they flowered; they were ploughed and the plots fallowed for the rest of the year. Table 1 shows yields of the crops harvested in 1964.

TABLE 1

Yields per acre of crops in Rotation I and Rotation II Experiments at Saxmundham

	Wheat†		Barley†		Mangolds	Sugar Beet		
	Grain (cwt)	Straw	Grain (cwt)	Straw	Total crop (roots + tops) (tons)	Roots (tons)	Sugar (cwt)	Tops (tons)
ROTATION I								
Annual treatment *								
None	13·9	21·6	2·8	5·9	1·4	1·1	4·1	0·7
N	21·3	33·8	11·7	13·2	1·6	0·7	2·5	0·6
P	19·7	28·5	5·2	6·1	3·8	3·1	11·8	1·1
K	9·9	16·4	2·0	3·6	1·0	0·6	2·4	0·4
NP	27·4	38·4	14·4	15·5	7·6	5·5	21·4	1·5
NK	20·8	36·3	11·1	20·2	1·1	0·9	3·6	0·5
PK	18·1	27·9	3·1	6·1	2·6	2·3	8·9	0·9
NPK	25·2	43·3	16·1	22·4	8·2	7·1	28·5	2·5
Bone meal	18·2	33·0	7·4	8·2	4·0	3·2	12·1	1·3
FYM	25·3	62·6	21·3	25·4	11·9	9·8	39·0	3·0

* The manuring is: N, 2 cwt/acre of sodium nitrate; P, 2 cwt/acre of superphosphate; K, 1 cwt/acre of muriate of potash; bone meal, 4 cwt/acre; FYM, 6 tons/acre.

ROTATION II

Plot no.	1964 treatment: To wheat	To roots	Wheat Grain	Wheat Straw	Barley Grain	Barley Straw	Mangolds Total crop	Sugar Beet Roots	Sugar	Tops
1	None	None	10·6	18·4	—	—	0·8	0·9	3·5	0·5
2	FYM	None	26·7	43·2	—	—	4·4	2·7	11·3	0·9
3	FYM	N + P	28·0	40·5	—	—	13·0	7·8	32·9	2·2
4	N + P	FYM	29·3	45·3	—	—	7·7	4·4	18·5	1·2
5*	N	FYM	27·4	46·0	—	—	10·9	6·1	25·7	1·8
6	FYM + N	P	33·3	55·6	—	—	9·1	6·8	28·0	2·0
7*	FYM	P	30·2	45·2	—	—	8·0	7·0	29·0	2·2

* The only other manures used in Rotation II are 1½ cwt/acre of sodium nitrate for barley on Plot 7 and 7½ cwt of super for legumes on Plot 5.

Rates of manure/acre are 10 tons of FYM, 7½ cwt of superphosphate (P) and 1½ cwt of sodium nitrate (N).

† Wheat and barley grain and straw yields contain 15% moisture.

Wheat yields were well above the averages for both 1940–61 and for the whole 60 years; they were much increased by N and P, but decreased by K. Barley given nitrogen yielded little less than the 60-year averages, but without N yields were only one-third to one-half of the long-term averages; the outstanding response was to N, but P also caused large increases. Mangolds and sugar beet yielded much less than average; even with both N and P, mangolds yielded less than half of the averages for 1900–61. Only where fertilisers (or FYM) supplied N and P was the yield of sugar over 1 ton/acre.

Weather greatly affects the yields of crops at Saxmundham, mainly by rain affecting soil condition. D. A. Boyd showed that above-average rain during winter diminishes yields, and that almost all the good mangold yields were in years with summer rainfall close to average. The small yields from the root crops in 1964 undoubtedly reflected the wet spring, which was aggravated by summer drought.

https://doi.org/10.23637/ERADOC-1-57

Further work at Saxmundham

Cultivations. When the experiments began the land was ploughed and cultivated, as was customary on the heavy soils of East Suffolk, in "stetches" 9 ft wide with open furrows between to help drain the land; furrows across the headlands of the plots were also needed to drain off rain water. Each plot had 2 stetches and was 18 ft wide; cultivations and drilling were always along the plots. The work was done by horses until 1949, when tractor ploughing was started and the 9-ft-wide stetches were abandoned. Each plot was then cultivated as one stetch 18 ft wide, but deep furrows between the plots were retained. Although from 1949 the land was cultivated more deeply and thoroughly than before, still deeper working was needed, so a more powerful tractor with a one-way reversible plough was used in autumn 1964 to plough 10 in. deep over most of the field. Pans below the old plough-sole were broken by the deeper ploughing and much subsoil was turned up. As it is expected that the deeper cultivated layer will accept more rain and drain better now that the pans are broken, ploughing was continuous and the stetch system with furrows between the plots was abandoned.

Although the field is thought to have been pipe-drained, no records exist, and supplementary pipe drains were laid in 1949. To improve drainage further the whole field was mole-drained 22 in. deep in the dry autumn of 1964. It is hoped that the deeper and better cultivations now possible, and the better drainage, will improve the physical condition of the soil, so making the crops depend less on good weather and give more consistent yields.

The Experiments. Rotation I will be continued with little change for a few seasons; only sugar beet will be grown as the root crop, and the "legume" block will be fallowed to clean the land. Because of the form of the fertiliser tests (the amounts used are small by present standards and all nitrogen is given as sodium nitrate) and strict adherence to the Norfolk Four Course Rotation, the results of the experiment have little relevance to present-day East Anglian farming. (The main value of the experiment at present is as a source of soils treated in known ways for over 60 years.) When the newer methods of cultivating the plots of Rotation I have been established, both cropping and fertiliser treatments will be modified so that the experiment will help to solve some of the problems that arise in cultivating and manuring heavy soils in Eastern England.

The Rotation II Experiment now serves no practical purpose; it is useful solely as a site where different levels of phosphate (as superphosphate or FYM) have been applied once or twice in each rotation for the past 60 years. Analyses made in 1964 confirm that the dressings given have produced three soils containing different amounts of phosphate. New plans for the experiment entail studies during the next 4 years of the values of the reserves of soil P that have accumulated. New reserves will be created by giving some plots large dressings of fresh phosphate, and the "old" and "new" residues will then be valued in microplot experiments superimposed on the large plots of the old experiment.

https://doi.org/10.23637/ERADOC-1-57