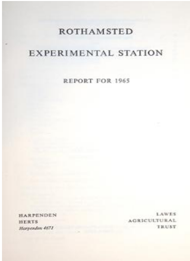

Rothamsted Experimental Station Report for 1965

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Woburn Experimental Station

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WOBURN EXPERIMENTAL STATION

C. A. THOROLD

Total rain (28·03 in.) exceeded the average (24·78 in.), and on the light land at Woburn cereals and roots yielded well.

TABLE 1

Monthly mean temperatures (means of maximum and minimum), total rainfall and daily means of bright sunshine (departures from long-period means in brackets)

	Mean temperature (° C)	Rainfall (in.)	Bright sunshine (daily mean) (hours)
March	5·3 (−0·2)	2·10 (+0·52)	4·18 (+0·27)
April	7·9 (−0·3)	1·88 (−0·05)	3·99 (−0·92)
May	11·3 (+0·1)	2·00 (−0·20)	5·28 (−0·76)
June	13·9 (−0·5)	2·12 (+0·42)	6·00 (−0·61)
July	13·7 (−2·6)	3·19 (+0·75)	3·09 (−2.95)
August	14·7 (−1·3)	2·40 (+0·07)	5·39 (−0·47)
September	12·3 (−1·4)	4·67 (+2·64)	4·07 (−0·56)
October	10·3 (+0·6)	0·61 (−1·69)	3·58 (+0·19)

From April to September mean temperatures and hours of sunshine were less than average, and rain more than average; the September rain (4·67 in.) exceeded twice the average (2·03 in.).

Cereals on the heavier soils and some plots on the lighter ones were severely lodged in July, with much second growth later. Moisture contents of grain at harvest ranged from about 20 to 30%. In spite of adverse conditions, 736 cereal plots were harvested, over 100 more than in 1964.

Wet weather favoured potato growth and blight; four fungicidal sprays increased King Edward yields from 13·13 tons/acre to 17·67 tons/acre. In a fertiliser experiment with this variety, symptoms of *Verticillium* wilt were prevalent on plots without compound fertiliser (13 : 13 : 20) and became less with increasing amounts. *Verticillium dahliae* was isolated, and seems likely to have contributed to the large differences in yield (see p. 132).

Applying formalin and other sterilants to soil again greatly increased the yield of spring wheat, mainly by affecting take-all and cereal cyst-nematode (*Heterodera avenae*) as described on pp. 49, 127 and 149.

A sticky trap operated from May to October caught about the same number of aphids as in 1964, but aphids flew earlier. Although some *Aphis fabae* and *Myzus persicae* were caught in May, sugar-beet yellows was again negligible. The vector of carrot motley dwarf virus (*Cavariella aegopodii*) did not become numerous until June. Menazon granules applied with the seed increased yield of carrots (Clucas New Model) by about 1 ton/acre, as also did spraying with "Saphicol", which adequately controlled aphids (see p. 116).

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Intensive cereals experiment. One-third of the area of the old "continuous wheat and barley land" was allocated to a new experiment. Mustard, sown on 28 June as a protection from wheat-bulb fly, was ploughed in on 13 October. Winter wheat was drilled on some plots of the wheat area on 2 November, and spring barley will be sown on the barley area in 1966. Continuous wheat or barley on their appropriate sites will be compared with a five-course rotation in all phases: clover–ryegrass ley (1 year), potatoes (1 year), winter wheat or spring barley (3 years). The winter wheat plots have received basal PK fertiliser and will get different dressings of "Nitro-Chalk". This "intensive cereals" experiment makes use of the peculiar features of the site, particularly the history of almost continuous cereal cropping since 1876, without any organic manures for the last 40 years.

Irrigation experiment

Wheat. Opal spring wheat was given "Nitro-Chalk" at 0·4, 0·8, 1·2 or 1·6 cwt N/acre immediately after drilling on 29 March. It grew well on all plots at first, but mildew became prevalent later, especially on plots given most N. "Scorch" symptoms did not occur until July, when they were slightly more severe in the north block of eight plots than in the south block. This difference corresponds with a decline in fertility from south to north, known since the start of the irrigation experiments in 1951. The north block averaged 2½ cwt less grain/acre than the south block. Table 2 shows that the grain yield was largest with 0·8 cwt N/acre and the straw with 1·2 cwt N/acre, both in combination with extra water. This agrees with previous experience on this site that water is needed to ensure response of spring wheat to nitrogen. Take-all and cereal cyst-nematode attack were negligible. The mean yield (36·8 cwt grain/acre) considerably exceeded previous cereal yields on this site, where the "scorch" condition has sometimes occurred, particularly on unirrigated plots given most nitrogen.

TABLE 2

Effects of four rates of "Nitro-Chalk" on spring wheat yields with and without irrigation†*

	N, cwt/acre							
	0·4		0·8		1·2		1·6	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
Without irrigation	32·8	26·5	38·1	32·6	36·8	29·7	35·8	31·4
With irrigation	34·8	32·3	42·0	35·1	38·7	36·3	35·2	31·9

* Yields: Grain and straw cwt/acre at 85% dry matter.
† Irrigation: 1·5 in. May–July.

Sugar beet. Seed was drilled on 2 April, and the experiment compared nitrogen at 0·75 cwt and 1·50 cwt N/acre applied to the seedbed and early and late singlings (17 May and 2 June). The first watering (0·5 in.) was to plots getting "full" (C) and "early" (A) irrigation. With more than 2 in. rain in June, more water was not needed until 1 July, when 0·5 in. was given to C and "late" irrigated (B) plots, and this was repeated on 9 July, which was the last watering. Plots singled early yielded on average 63 cwt sugar/acre, and those singled late 61 cwt.

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Some plants showed symptoms of magnesium deficiency and of virus yellows in August, when some also wilted. The unirrigated plots (O) yielded most (65 cwt sugar/acre), almost 6 cwt more than with "full" irrigation (C) and 3 cwt more than with A or B waterings. Roots and tops responded to extra nitrogen (Table 3), but sugar percentage was unaffected (17·6%).

TABLE 3

Effects of nitrogen on sugar-beet yields

	N, cwt/acre	
	0·75	1·50
Yield (tons/acre):		
Roots	17·15	18·03
Tops	16·09	20·89
Sugar	3·03	3·18

Clover. The Dorset Marl clover undersown in barley on 27 April 1964 developed unevenly and grew better under the barley with 0·3 cwt N/acre than with 0·6 cwt. The extra nitrogen gave 7·6 cwt more grain/acre; the straw was not weighed, but was obviously increased by the extra N. The depression of clover growth by the extra N persisted until the first of the three cuts in 1965, but later yields on these plots were larger (Table 4).

TABLE 4

Yields of clover (cwt dry matter/acre) at three cutting dates in 1965

	N, cwt/acre applied to barley in 1964	
	0·3	0·6
First cut (11 June)	34·1	31·8
Second cut (5 August)	15·7	16·1
Third cut (19 October)	17·1	17·8
Total (3 cuts)	66·9	65·7

Irrigation of the clover started on 17 May 1965, with 0·5 in. given to plots receiving "full" (C) and "early" (A) treatments. "Late" (B) and (C) plots were watered again (0·5 in.) on 30 June, 7 July, 18 August. Irrigation depressed yields, and unwatered plots yielded an average of 68 cwt dry matter/acre, 2 cwt more than the average of the three irrigation treatments (A, B, C).

Ryegrass. The Italian ryegrass sown in March gave 19·7 cwt dry matter/acre at the first cut on 11 June. The total yield from five cuts was 93·2 cwt dry matter/acre. There was no response to irrigation (May 0·5 in., July 1·0 in.).

These plots, which have carried leys since 1951, were ploughed and, in combination with others which have carried rotations of arable crops, will be used for a new experiment to test the effect of irrigation on potato cyst-nematode populations.

Green-manuring experiment. The interactions of green manures with fertiliser nitrogen, discussed by Dyke (*Br. Sug. Beet Rev.* (1965) **34**, 94–98), were studied further in a short-term experiment on slightly heavier land in 1965, where sugar beet followed barley, with and without undersown trefoil or ryegrass (Table 5).

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With larger potential yields than previously, the maximum response to nitrogen was reached with 0·6 cwt N, but trefoil increased yield not only with this amount of "Nitro-Chalk" but also with more N. Ryegrass did

TABLE 5

Effects of green manures and different rates of "Nitro-Chalk" on sugar beet

"Nitro-Chalk" applied (N, cwt/acre)	Yield without green manure (sugar, cwt/acre)	Increase from: Trefoil (cwt)	Increase from: Ryegrass (cwt)
None	58·6	+3·6	−5·3
0·6	72·7	+1·0	+2·9
1·2	71·4	+5·4	+7·3
1·8	73·2	+8·8	+1·5

not increase yield without fertiliser nitrogen, and did so most with 1·2 cwt N.

In the 1955–62 period of the long-term experiment on green manuring, when "Nitro-Chalk" was applied to the barley seedbed at 0·23 and 0·46 cwt N/acre, the barley responded less to nitrogen after trefoil than after ryegrass. This difference was perhaps associated with the larger mean nitrogen content of the legume (*Rothamsted Report* for 1962, p. 196). In the new scheme of cropping and treatments started in 1963, N fertiliser is given at 0, 0·3, 0·6 and 0·9 cwt N/acre in barley seedbed. Table 6 shows that yields of barley were increased by each increase in nitrogen, but it is probable that the maximum response was nearly reached at 0·9 cwt, especially as on other plots where green manures have not been given since 1936, 0·9 cwt N/acre gave the same yield as did 1·2 cwt. Table 6 also

TABLE 6

Effects of green manures and different rates of "Nitro-Chalk" on barley

"Nitro-Chalk" applied (N, cwt/acre)	Yield without green manure (grain, cwt/acre)	Increase from: Trefoil (cwt)	Increase from: Ryegrass (cwt)
None	13·2	+18·8	−3·0
0·3	24·8	+10·0	−3·7
0·6	34·8	+ 3·6	−1·5
0·9	37·4	+ 1·4	+0·6

shows that the responses to trefoil were positive and large with small dressings of N, but diminished as the amount of N applied increased. By contrast, ryegrass depressed yields except with the largest amount of N. During this experiment samples of green manures have been taken to provide estimates of amounts of dry matter and nitrogen ploughed in. These estimates have rarely helped to explain effects on crop yields, which have depended greatly on when the green manures were ploughed in; and on the amount of nitrogen given to the barley. From 1955 to 1962 autumn and spring ploughings were compared, but since 1962 the green manures have been ploughed in in the spring. Short-term green-manuring experiments have shown the importance of suitable growing conditions for both "test" crop and green manures for these to be effective (*Rothamsted Report* for 1964, p. 217).

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TABLE 7

Effects of "Nitro-Chalk" applied to barley seedbed in 1964 on amounts of dry matter and nitrogen (cwt/acre) in green manures

	Trefoil		Ryegrass	
"Nitro-Chalk" applied (N, cwt/acre)	Dry matter (cwt)	N (cwt)	Dry matter (cwt)	N (cwt)
None	15·3	0·43	6·2	0·08
0·3	11·6	0·30	5·4	0·07
0·6	8·0	0·17	4·9	0·07
0·9	5·5	0·13	3·4	0·05

Table 7 shows that amounts of green manures, especially of trefoil, ploughed in, varied inversely with amount of nitrogen applied to the barley. The plots were scored for lodging of the barley (L) and awarded marks from 0 (crop standing) to 3 (crop completely lodged). Immediately after the barley was harvested the undersown plots were scored for amount of ground covered (C) and awarded marks from 0 (crop failed) to 5 (full cover). Table 8 suggests that there was more lodging on plots undersown with trefoil in 1964 and 1965 than on plots not undersown or undersown with ryegrass; ground covered by trefoil was lessened by N.

TABLE 8

Effects of "Nitro-Chalk" applied to barley on lodging (L: 0–3) with and without green manures, and on ground covered (C: 0–5) by trefoil and ryegrass

"Nitro-Chalk" applied	Trefoil*		Ryegrass†		Not undersown‡
(N, cwt/acre)	L	C	L	C	L
None	0·3	3·6	0·0	4·5	—
0·3	0·5	3·1	0·0	4·8	0·0
0·6	1·8	2·1	0·2	4·8	0·0
0·9	2·7	0·9	2·0	4·2	1·9
1·2	—	—	—	—	2·3

* Trefoil: undersown in 1964 and 1965.
† Ryegrass: undersown in 1964 and 1965.
‡ Not undersown: no green manures since 1936.

Ley–arable rotations experiment

Sugar beet. Additions of Mg, K and P have accounted for most but not all of the large differences in yield of plots with and without FYM, and for part of the differences in yield between the different rotations. To discover whether the remaining effects of dung and rotation could be accounted for by nitrogen, a test of four rates of N was started in 1965 and will be continued for successive sugar-beet crops. Because the optimal dressings of N are expected to differ greatly from rotation to rotation, larger ones are given in some rotations than others. Table 9 gives the mean yields from 1963 to 1965 and shows that beet after lucerne (LU) did particularly well in 1965. In former years the "arable with hay" (AH) gave the smallest yields and it seems that this was partly from insufficient N.

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TABLE 9

Effects of previous rotation on sugar-beet yields in 1963, 1964 and 1965

Previous rotation:	1963	1964 (sugar, cwt/acre)	1965
L	67·7	68·5	66·0
LU	69·9	60·9	77·4
AH	63·9	52·2	67·4
A	71·9	63·9	70·6
Mean	68·4	61·4	70·3

Table 10 shows the effects of nitrogen; as expected, the optimal nitrogen dressing was larger for plots following the arable rotations (AH, A) than for plots following the ley rotations (L, LU).

TABLE 10

Effects of previous rotation and nitrogen on sugar-beet yields

	Nitrogen applied (N, cwt/acre)					
	0·35	0·70	1·05	1·40	1·75	2·10
Previous rotation:			(sugar, cwt/acre)			
L	65·1	64·8	70·7	63·3	—	—
LU	74·3	79·9	76·2	79·1	—	—
AH	—	—	64·2	68·6	69·9	67·0
A	—	63·4	72·5	72·9	73·6	—

Barley. Maris Badger was drilled on 8 April with basal seedbed "Nitro-Chalk" dressing (0·6 cwt N/acre). In August many plots were lodged, but they differed in the proportions of crop affected, as shown in Table 11, which gives mean scores for lodging (L : 0–3) and barley yields.

TABLE 11

Effects of previous rotation on barley yields and proportion of crop lodged (L : 0–3)†*

Previous rotation:	Grain (cwt)	Straw (cwt)	L (0–3)
L	37·5	50·9	2·5
LU	43·7	35·1	1·8
AH	42·1	31·0	0·8
A	42·2	37·6	0·8

* Yields: grain and straw cwt/acre at 85% dry matter.
† Lodging: scored as for Table 8.

The dressing of 0·6 cwt N/acre was probably excessive for the plots following the ley rotation (L), which produced 16 cwt more straw/acre (with more lodging) than the mean (34·6 cwt) of those following the lucerne (LU) and arable rotations (AH, A).

Rye. This crop grew well, but all plots were lodged, many severely and gave much green second growth when combine-harvested on 14 September. There was more straw than grain, the reverse of 1964, a drier year.

Carrots. The crop was sprayed three times with "Saphicol", which prevented aphid infestation. As in 1964, the variety Autumn King did not

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respond to the FYM. The yields of roots and tops (30·9 and 13·2 tons/acre) exceeded any since carrots replaced sugar beet in 1956 as the third course of the arable rotation; the mean yields of roots and tops up to 1964 were 11·5 and 4·2 tons/acre.

Potatoes. Some plots of Majestic were again affected by potato cyst-nematodes; others less severely affected yielded 15·7 tons tubers/acre.

Sainfoin. This crop in its second year yielded 43·4 cwt dry matter/acre at the first cut on 31 May, but failed to recover after the second cut on 4 August and was reseeded on 19 August.

Seeds hay. The first cut on 31 May gave 59·7 cwt dry matter/acre and the second on 5 August 38·4 cwt, exceptionally large for this experiment. In some past years there was no second cut, and in others it was less than half the amount at the first cut.

Grazed leys. There was more grazing than usual on all plots, in contrast to 1964, when there was less. Table 12 shows these extremes and the mean of the previous 20 years, as numbers of sheep/days grazing/acre.

TABLE 12

Number of sheep/days grazing/acre for 1st-, 2nd- and 3rd-year leys in 1965, 1964 and 1944–63 period

	1st year	2nd year	3rd year
1965	2,168	3,541	2,915
1964	1,253	1,512	1,012
1944–63 (mean)	1,098	1,806	1,708

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