ROTHAMSTED RESEARCH

Report for 1935

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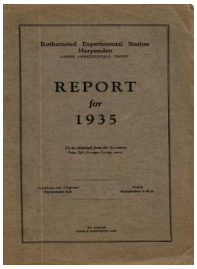

Arable Crops

Rothamsted Research

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GRASSLAND EXPERIMENTS

As in previous years, a number of grassland experiments have been carried out in different parts of the country to compare the values of the different types of basic slag now available or likely to become so, and also to study the effects of an even cheaper material, mineral phosphate. These experiments are carried out under the ægis of the Ministry of Agriculture Basic Slag Committee, and at the request of the slag makers and largely at their expense ; they are being continued and extended to include certain new types of slag resulting from changes in the method of steel making. The result has been to prove the general superiority of high soluble basic slag over other forms, although the low soluble slag and the mineral phosphate both have value in certain conditions which are gradually being discovered. Already these investigations have had the very useful result of increasing the proportion of the agriculturally effective slags as against those of less agricultural value : this is shown by the following figures of deliveries of ground basic slag in Great Britain :—

	Deliveries, Tons			Percentage of Total Deliveries	
	High Soluble (80% or more)	Low Soluble	Total	High Soluble (80% or more)	Low Soluble
1924-1925 ..	126,025	117,514	243,539	51.8	48.2
1929-1930 ..	222,342	83,407	305,749	72.7	27.3
1934-1935 ..	203,070	77,353	280,423	72.4	27.6

The new medium soluble slags, however, present special difficulties in that they show greater differences in effect than can be accounted for by their solubility in citric acid. With the taking over of a considerable area of additional grassland in 1934, it has become possible to arrange for grassland experiments to be made at Rothamsted also, and plans for these are being worked out. An investigation is being undertaken at the request of the Royal Agricultural Society to ascertain the effect on grassland of feeding cake to the animals grazing there : in particular to discover how far any improvement effected can be related to the composition of the cake and how long such improvement lasts. Unfortunately it has not yet been found possible to design a completely satisfactory grazing experiment : the older types of experiment do not satisfy modern statistical tests. An attempt is being made this year to overcome the difficulty by fencing off small areas within the grazed plots for short periods and weighing and analysing the herbage produced.

ARABLE CROPS.

SUGAR BEET. These experiments are carried out under the ægis of the Sugar Beet Research and Education Committee of the Sugar Beet factories and the Ministry of Agriculture.

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Spacing Distance. During the past three years the effects of 10-, 15- and 20-inch spacings have been tested. The results have varied with the season, but on the average of the three years no marked effects have been produced by differences in spacing.

Effect of Spacing: yields of washed roots; tons per acre.

	Rothamsted				Woburn			
	1933	1934	1935	Mean	1933	1934	1935	Mean
20-in. rows ..	5.5	14.5	11.4	10.5	8.5	18.3	11.9	12.9
15-in. rows ..	6.5	13.7	10.7	10.3	9.0	19.2	12.9	13.7
10-in. rows ..	7.6	13.9	11.1	10.9	10.2	17.9	13.0	13.7

In 1933 the yields at both centres increased steadily as the spacing narrowed; but not in the later years. The yields in 1933 were poor, and the beet remained small however wide the spacing, so that a higher plant number meant a higher yield. In 1933, narrower spacing increased the sugar percentage, but it was without effect in 1934 and 1935 and on the average it was not worth the additional hand labour required. The spacings in the factory series of sugar beet experiments vary from 18 to 22 inches.

Effect of sulphate of ammonia at different spacings. Sulphate of ammonia had no effect on yield at Rothamsted in 1933, but in both later years its effects were greatest at the narrowest spacing. At Woburn there were significant responses to sulphate of ammonia in 1933 and 1935; in 1933 the response increased as the spacing narrowed, but not in 1935, and on the average there was little difference between the three spacings, the 15-inch spacing giving the highest mean response.

Responses to sulphate of ammonia (3 cwt. per acre) at different spacings.

Washed roots (tons per acre)

	Rothamsted				Woburn			
Spacing	1933	1934	1935	Mean	1933	1934	1935	Mean
20-in.	−0.15	1.72	1.25	0.94	0.83	0.06	1.15	0.68
15-in.	0.36	0.78	2.22	1.12	2.91	−0.72	1.83	1.34
10-in.	0.09	2.32	2.83	1.75	2.94	−0.48	0.31	0.92
Mean	0.10	1.61	2.10	1.27	2.23	−0.38	1.10	0.98

There are indications that sulphate of ammonia had less harmful effect on sugar percentage at the narrower spacings, but the effect was small and not significant. The mean yields of total sugar, in cwt. per acre for the three years 1933, 1934 and 1935, were:

	Sulphate of ammonia per acre	20-in.	15-in.	10-in.
Rothamsted ..	None	33.4	32.6	33.8
	3 cwt.	35.8	35.8	39.0
Woburn	None	42.6	44.1	44.7
	3 cwt.	43.1	47.6	47.3

At Rothamsted there is little difference between the mean yields with the 20- and 15-inch spacings, whether nitrogen was applied or not; with the 10-inch spacing, however, the application of nitrogen gave an increased response of about 3 cwt. of sugar. At Woburn

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the results for the 15- and 10-inch spacings are similar and show an increased yield over the wide spacing of 2 cwt. in the absence of nitrogen and 4½ cwt. in the presence of nitrogen. The indications at both centres are, as might be expected, that nitrogen produces a greater effect at narrower spacings.

Bolters. In the Rothamsted experiment of 1935 about 18 per cent. of the plants sown at the earliest date (March 15) bolted. In three of the experiments at Bardney and Brigg the proportion was about 5 per cent. and in one it was less than 1 per cent. At one centre about 25 per cent. bolted and an experiment was made involving four treatments : (1) untreated, (2) woody bolters pulled, (3) woody bolters pulled, other bolters cut in July, (4) all bolters cut in July. Some of the plants cut in July did not again bolt. The average weights per root were :

	Good beet	Woody bolters	Non-woody bolters	Cut and not bolted
Average weight per root (lb.) ..	1.28	0.79	1.30	1.18
Sugar, per cent. ..	17.71	17.02	17.11	17.23

The chief loss from bolters is that the woody ones weigh about 40 per cent. less per root than the others, although in all bolters the sugar percentage is slightly reduced. Since about 60 per cent. of the bolters were woody the loss of sugar on all bolters averaged about 25 per cent. and on the whole crop was about 6 per cent. This was much smaller than the rather alarming appearance of the bolters on the field had suggested. This estimate takes no account of the effect which the bolters might have on the growth of neighbouring plants which did not bolt.

At Rothamsted, where most of the bolters were woody, the results were :

	Good beet	Bolters
Average weight per root (lb.)	0.61	0.48
Sugar, per cent.	16.49	16.15

As before the average loss in sugar per bolter is about one quarter.

The cutting of the bolters in July proved very successful, giving an increase of 3 cwt. per acre in total sugar.

The standard fertilisers affected the percentage of bolters as follows :

Percentage of bolters

	Sulphate of ammonia			Superphosphate			Sulphate of potash		
	None	One dose	Two doses	None	One dose	Two doses	None	One dose	Two doses
Caistor ..	2.9	4.7	6.1	4.2	4.8	4.9	4.2	4.9	4.9
Scotton	1.4	2.8	3.4	2.2	2.8	2.8	2.4	2.7	2.6
Methering-ingham	4.7	5.7	7.3	4.8	6.4	6.5	5.0	6.4	6.3
Rothamsted	13.0	20.0	22.3						

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All three fertilisers increased the percentage of bolters, the increase being greatest for sulphate of ammonia, which had also the greatest effect on yield. For potash and phosphate the single and double dressings behaved alike, whereas sulphate of ammonia gave a more uniform increase. However, the effect is unimportant and is well covered by the increases in yield given by the sulphate of ammonia at all four centres.

The amount of bolting at Rothamsted was also affected by the width between the rows, decreasing as the spacing narrowed.

	Spacing.		
	20 in.	15 in.	10 in.
Percentage of bolters	22.3	18.1	14.9

Effect of Fertilisers on Yield.

The Staffs of the Sugar Beet factories generously co-operated in an extensive series of manurial experiments and we wish to record our deep indebtedness to them for their help. An elaborate series of chemical examinations of the various soils is being carried out and is already yielding most valuable information about the relations between soil properties and fertiliser responses. The average yields for all the factory experiments of 1935 were :

	Sulphate of Ammonia.			Super-phosphate.			Muriate of Potash.		
Cwt. per acre ..	0	2	4	0	3	6	0	1¼	2½
Roots, tons per acre	8.94	9.58	10.07	9.46	9.55	9.58	9.43	9.59	9.58
Tops, tons per acre	6.86	8.12	9.42	8.03	8.17	8.20	8.12	8.18	8.10
Sugar, per cent ..	17.22	16.99	16.59	16.95	16.91	16.95	16.80	16.96	17.04
Sugar, cwt. per acre	30.8	32.7	33.5	32.2	32.3	32.6	31.8	32.6	32.7
Purity, per cent. ..	88.2	88.1	87.5	87.9	87.9	88.0	87.8	87.8	88.0

Mean Yield per acre.		Increase in sugar in cwt. per acre for		
Washed Roots. tons.	Sugar. cwt.	4 cwt. sulphate of ammonia.	6 cwt. super-phosphate.	2½ cwt. Muriate of potash.
9.53	32.4	+2.7	+0.4	+0.9

Heart-rot in Sugar Beet.

For the first time at Rothamsted a severe attack of " heart-rot " in sugar beet was found on the plots of the spacing, sowing-date, nitrogen experiment (*see* p. 23). The disease was rather localised in its occurrence. One block of the experiment was much more seriously affected than the rest, and beet in other parts of the same field were practically free from the disease. The percentage of plants showing symptoms decreased with later sowing. The disease is attributed to boron deficiency and is being further studied.

POTATOES. At Rothamsted the effect of time of application of the fertilisers was studied, the dung being either ploughed in during November or applied in the bouts in spring, and the artificials either broadcast before ridging up or applied in the ridges. In each case application in the bouts proved the better. The mean yields were, in tons per acre :

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	Fertiliser Applied. Before bouting.	In the bouts.
Dung	7.15	8.06
Complete artificials	7.58	9.70

The increases due to dung were 3.4 tons per acre where no superphosphate or muriate of potash were given and 1.3 tons per acre where they were present. Sulphate of ammonia applied alone had no effect, but with minerals or dung it gave an increase of 2.1 tons per acre.

The effects of treatments on the percentage of ware were similar to those on yield.

The potatoes were lifted in October, and the produce stored in a clamp in the usual way until February, the produce of the different plots being kept distinct. The loss in weight averaged 4.5 per cent. It was less for dung in the bouts (4 per cent.) than for dung ploughed in (6 per cent.).

About 7 per cent. of the potatoes went bad on storing. Dung and minerals both increased the proportion of bad potatoes by 2 per cent.; sulphate of ammonia had little effect. Further, the potatoes did not keep so well when dung was applied in the bouts as when it was ploughed in, the loss being 8.7 per cent. against 6.3 per cent. On the other hand, artificials applied in the bouts gave in this experiment better keeping potatoes than artificials broadcast before bouting.

Percentage ware. In view of the regulations of the Potato Marketing Board it is now important to study the effects of fertilisers on the proportion of ware as well as on total yields. The numbers of experiments used in the following summary are 3 in 1932, 6 in 1933, 13 in 1934 and 8 in 1935. The amounts of manures were fairly uniform and the results have been reduced to fixed amounts of fertiliser. The size of riddle was generally $1\frac{1}{2}$ to $1\frac{3}{4}$ inches. The average percentage of ware varied, with one exception, from 60 per cent. to nearly 100 per cent.

The mean increases in percentage ware given by sulphate of ammonia (3 cwt. per acre), superphosphate ($3\frac{1}{2}$ cwt. per acre), sulphate or muriate of potash (2 cwt. per acre) and poultry manure (about 1 ton per acre)were :—

	Centres with significant yield response	Other centres.
Sulphate of ammonia	1.65 (20)	−0.36 (10)
Poultry Manure	1.43 (9)	−1.82 (4)
Superphosphate	0.81 (7)	−1.16 (12)
Sulphate or muriate of potash	10.46 (7)	0.82 (8)

The figures in brackets show the numbers of experiments over which the means are taken.

The fertilisers increased the percentage ware only where they also increased yield. Where there was an increase in yield, potash consistently increased the percentage ware, giving a striking average increase of 10 per cent. The other three fertilisers had smaller and less consistent effects. There was a large proportion

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of very small responses for all fertilisers, but these mostly occurred at centres where the mean percentage ware was over 90 per cent. and little further increase was possible.

Four experiments included farmyard manure ; all gave a clear response in yield and two gave a large increase in percentage of ware :—

	Mean per cent. ware	Increase in per cent. ware with farmyard manure
Rothamsted 1932 (15 tons)	93.5	0.5
,, 1934 (20 tons)	87.2	1.2
,, 1935 (15 tons)	70.8	17.7
Wimblington 1935 (8½ tons)	73.3	16.6

Outside Centres. The manurial experiments on potatoes were made as usual at a number of centres, which may be conveniently grouped as fenland and as mineral soils.

Fenland Soils.

Yield, Tons per acre, Total Crop, 1935.

Centre.	Standard Error.	Sulphate of Ammonia. cwt. 0	cwt. 1½	cwt. 3	Super-phosphate. cwt. 0	cwt. 4½	cwt. 9	Sulphate of Potash. cwt. 0	cwt. 1½	cwt. 3
Light peaty soils										
Thorney ..	±0.466	7.98	9.00	8.23	8.05	8.16	9.00	7.86	8.50	8.85
Mepal ..	±0.414	8.81	9.54	10.12	8.91	9.57	9.99	7.16	9.84	11.47
Wimblington	±0.143	6.66	—	7.61[1]	6.90	7.38[1]	—	6.54	—	7.74[1]
Heavy Fen soils										
March ..	±0.314	5.23	7.04	8.13	6.15	6.93	7.32	6.71	7.18	6.51
Little Downham	±0.194	3.50	5.03[2]	6.53[2]	3.91	5.34	5.81	4.73	5.29[3]	5.03[3]

(1) Sulphate of ammonia 2½ cwt. ; Superphosphate 6 cwt. ; Sulphate of potash 2½ cwt.
(2) Sulphate of ammonia 2½ and 5 cwt.
(3) Sulphate of potash 1 and 2 cwt.

At Thorney responses were not very marked, but at Mepal nitrogen and especially potash acted well, the increase for the 3 cwt. of sulphate of potash being 4.3 tons per acre. At Wimblington all three fertilisers gave a significant increase. Dung proved very effective ; 8½ tons of dung gave an increase of 3.70 tons in absence of potash and 1.24 tons when potash was present, this interaction being significant.

On the heavy soils nitrogen and phosphate did well, but there was no response to potash. The experiment at Little Downham was planted with early potatoes, but they were cut down by the great frost of 17th May and allowed to stand later than usual. They yielded well and responded markedly to fertilisers.

Mineral Soils

The experiments on mineral soils fall into two groups, one testing the effects of the separate fertilisers, as above, the other showing the action of increasing levels of a mixed fertiliser.

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Yield, tons per acre, total crop, 1935

Centre.	Standard Error. tons.	Sulphate of Ammonia. None	S'gle	D'ble	Super-phosphate. None	S'gle	D'ble	Sulphate of Potash. None	S'gle	D'ble
Deep silt.										
Wisbech ..	±0.346	10.38	10.67[1]	10.76	10.22	11.02[1]	10.56	10.42	11.12[1]	10.28
Light loam.										
Midland College	±0.279	8.64	8.37[2]	8.61	—	—	—	8.60	8.24[2]	8.79
Warp.										
Owston Ferry Lincs.	±0.396	—	—	—	—	—	—	9.14	10.54[3]	10.97
Heavy.										
Cadishead, Lancs. ..	±0.403	—	—	—	3.63	4.88[4]	—	—	—	—

(1) Single sulphate of ammonia 2 cwt.; single superphosphate 4 cwt.; single sulphate of potash 2 cwt.
(2) Single sulphate of ammonia 1½ cwt.; single sulphate of potash 1½ cwt.
(3) Single sulphate of potash 1 cwt.
(4) Single superphosphate 5 cwt.

There was a response to potash at the warp land centre at Owston Ferry even in presence of dung, and to phosphate on the heavy soil at Cadishead. At the other two centres the usual dressing of dung produced maximum yields.

Yield, tons per acre, total crop, 1935
Increasing levels of complete Fertiliser.

	Fertiliser cwt. per acre. 0	4	8	12	16	Standard Error.
Light loam.						
Midland College, Notts.	7.83	8.02	7.79	7.94	—	±0.355
Sandy.						
Messingham, Lincs. ..	5.26	6.88	8.70	9.74	9.81	±0.379
Limestone						
Grayingham, Lincs. ..	8.47	9.03	9.33	9.31	9.64	±0.396

Dung was given at all centres. At Messingham there was a good response, but a significant falling off in effectiveness at the higher levels of manuring. At Grayingham the response though small was significant and proportional to the dressing applied.

BEANS. In 1934, the effects of dung, nitrochalk and muriate of potash on the yield of beans were studied, and in 1935, superphosphate was included and two spacings of the rows were tried. The mean yields were :—

	Mean Yield cwt. per acre.	Increase due to Dung. 10 tons per acre.	Nitrochalk 0.4 cwt. Nitrogen per acre.	Superphosphate 0.6 cwt. P_2O_5 per acre.	Muriate of Potash 1.0 cwt. K_2O per acre.
1934 Grain	18.7	*2.3*	0.6	—	1.6
Straw	15.0	*2.1*	0.6	—	1.0
1935 Grain	21.0	*5.6*	1.2	−2.0	*2.7*
Straw	26.3	*9.8*	2.4	−1.7	2.8

Significant increases are printed in italics

The mean yields and the effects of fertilisers were greater in 1935 than in 1934. Dung gave large increases in both years but especially in 1935. Nitrochalk gave slight but not significant increases : superphosphate had no effect, the apparent depression in 1935 not being significant. Muriate of potash apparently increased

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the yield in both years ; the effect for grain in 1935 was significant, and that for straw almost so. The result is interesting for, apart from potatoes, most crops on the heavy Rothamsted soil are not very responsive to potash.

The 18 inch spacing of the rows gave an increased yield over the 24 inch spacing of 2.8 cwt. per acre in grain and 4.6 cwt. per acre in straw. The response to muriate of potash was significantly greater for the wide than for the narrow spacing and there was an indication of a similar effect for dung. This result was unexpected, for with narrow spacing individual plants have a more restricted nutrient supply than with wide spacing, and might be expected, therefore, to show greater responses to added fertilisers as indeed the sugar beet did. (p. 23.)

WHEAT. The question when best to apply nitrogenous fertiliser to wheat has been much studied. Very variable results have been obtained, the effect of the nitrogen depending largely on the weather. Excessive rainfall may wash the nitrogen beyond the range of the plant roots, while lack of rain may so limit growth that additional nitrogen, even if taken up by the plant, could not be utilised.

The influence of variable water-supply can be eliminated in pot-culture, and in these conditions Dr. Watson found that nitrate of soda gave the same increase of grain yield at whatever time it was applied from sowing time to the end of May. A still later application, after ear emergence in June, had no effect on yield, although the nitrogen was as fully taken up as before. The yield of straw, however, fell off steadily with later application, but the grain was larger and of higher nitrogen content than for early application. This suggests that application towards the end of May is likely to be most efficient, since the yield of grain is the same as for early application, while the quality is better and the increase of the straw, and consequently the potentiality for lodging, is less.

The results of field experiments at Rothamsted and Woburn are consistent with this view. From 1926 to 1931 seven complex experiments were carried out at Rothamsted, in which early and late dressings of sulphate and muriate of ammonia were applied. The average responses were :—

Increase produced by 0.2 *cwt. N. per acre. Mean of sulphate and muriate of ammonia, Rothamsted.*

		Applied early (March)*	Applied late (May)*	S.E.
Grain	cwt. per acre	1.12	0.81	±0.23
Straw	cwt. per acre	3.63	2.76	±0.27

* Except for one " early " application on April 11th, and one " late " application on June 5th.

The difference was not significant for grain, but it was for straw, late application giving significantly less increase than early application.

A second series of experiments was begun in 1934, at Rothamsted and Woburn, in which a wider range of times of application was tested. In 1934 no significant increases were obtained : at Rothamsted,

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the yield without nitrogen was already very high (35 cwt. grain per acre); and at Woburn the standard error was abnormally large, though a fall in straw yield with later application was suggested. In 1935, January application gave the greatest straw yield at Rothamsted and Woburn. For later applications the increase in straw yield fell steadily, as in the other experiments. The inferiority of seed-bed application compared with the spring dressings is in agreement with the Broadbalk results.

In 1935 nitrogenous fertilisers again gave no significant increase in grain yield at Rothamsted. On the other hand, at Woburn, there was a significant response, though as in the pot experiment, the time of application caused no difference in the result.

Wheat is commonly grown at that stage in a rotation when the fertility of the soil is at its highest. The comparatively small increase of grain yield in the 1926-1931 series of experiments at Rothamsted, and the absence of any response in 1934 and 1935, raises the question whether nitrogenous fertiliser is necessary for wheat on land in good heart.

Early spring applications of nitrogen frequently produce spectacular increases in the thickness, height and colour of the wheat in May, when tillering is at its maximum and elongation of the shoots is beginning, while the effect of later dressings is much less obvious. This was shown by counts of shoots and measurements of height at Woburn in 1934 and 1935. But these marked differences were not accompanied by corresponding increases in grain yield. The popularity of early dressings may be partly due to this obvious effect on spring growth. A lush early growth, however, may mean only a heavier straw crop and difficulties at harvest due to lodging, with no advantage in extra grain yield.

This does not apply, however, to systems of farming involving frequent corn crops, with little dung and where wheat does not follow a ley, a leguminous crop or a fallow.

Malting Barley

In the autumn of 1934 and again in 1935 conferences were held at Rothamsted on the growing of malting barley. They took the form of an exhibition of barley samples sent in by farmers from all parts of the country, and valued by the Barley Valuation Committee of the Institute of Brewing.

In both seasons the summers were dry and the harvesting conditions very good. In 1935, however, the spring was much colder and wetter than in 1934, and growth started in a moister soil. The rainfall at Rothamsted was :—

	1933-34	1934-35
October to May inclusive, inches	11.64	19.94

On May 17th, 1935, a severe late frost caught some of the autumn sown barleys in the early stages of ear formation. After a wet and cheerless early June the weather turned drier than in 1934 and most of the growers had practically no rain from mid-June till after harvest, though some had showers in mid-August.

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The grading of the samples was as follows :—

	1934		1935	
	No.	per cent.	No.	per cent.
Grade I	6	3.2	2	0.7
Grade II	4	2.1	12	4.4
Grade III	13	6.9	37	13.7
Grade IV	22	11.6	58	21.5
Grade V	52	27.5	83	30.8
Grade VI	65	34.4	60	22.2
Grade VII (grinding)	27	14.3	18	6.7
Total	189	100.0	270	100.0

Each stage in grading represents about 5/- per quarter in value. Most of the samples fall into Grades V and VI, and very few reached the top grades of high quality. As observed before, the nitrogen content of the grain was related to the grading for a particular variety : for the Norfolk Spratt Archer of 1935 the values were :

Grades	I	II	III	IV	V	VI	VII
Per cent. Nitrogen in dry grain	1.28	1.33	1.41	1.42	1.45	1.53	1.53

An examination of the varieties sown gave the following results:

Number of samples of Barley 1934 *and* 1935.

	Plumage-Archer.	Spratt-Archer.	New Cross.	Plumage.	Other varieties.
Kent	17	—	—	—	—
Essex	20	10	—	—	5
Norfolk ..	11	85	11	1	7
Suffolk	7	16	3	—	4
Lincolnshire ..	6	18	14	2	3
Yorkshire ..	6	2	—	15	3
Somerset ..	12	11	7	1	1
All Counties ..	133	199	44	27	52

Kent and Essex sent mostly Plumage-Archer : Norfolk sent Spratt-Archer : Plumage was received in any quantity only from Yorkshire. Spratt-Archer and Plumage-Archer together accounted for almost three quarters of the samples.

Most of the samples came from medium and light soils : few from heavy soils : one third were from soils on or close to chalk, limestone, oolite, or stone brash.

	Number of soils, both years.			
	Heavy.	Medium.	Light.	Total.
Calcareous	9	85	52	146
Not calcareous	90	81	115	286
Total	99	166	167	432
Per cent. of Total.				
Calcareous	2	20	12	34
Not calcareous	21	18	27	66
	23	38	39	100

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About 14 per cent. of the samples in each season were autumn sown, and these usually graded better than the spring sown barleys. Thus for the two years :

In grades I, II, and III.	35 per cent. were autumn sown.
In grades IV, V.	12 per cent. ,, ,, ,,
In grades VI, VII.	8 per cent. ,, ,, ,,

Certain districts favoured autumn sowing much more than others, for example, in 1934, nearly half the barleys from Essex had been autumn sown and in 1935 nearly three-quarters.

In Norfolk barley now commonly follows sugar beet instead of swedes and turnips. Elsewhere, however, it still often follows turnips. Apparently it rarely follows potatoes.

Preceding Crops.

Barley after	1934 All counties.	1935 Norfolk.	1935 Others.	1935 All counties.	Both years total.
Cereals ..	90	22	69	91	181
Beet and Mangolds ..	38	58	39	97	135
Swedes, turnips, kale ..	19	10	30	40	59
Clover, peas, etc.	15	5	10	15	30
Potatoes ..	2	—	3	3	5
Bare and half fallow ..	3	—	1	1	4
Other crops ..	1	2	6	8	9

Much information was obtained in regard to the manuring of the barley. It is no longer a starvation crop. The experiments made by Rothamsted under the Institute of Brewing Research scheme during the last ten years showed clearly the advantage of suitable manuring when care was taken not to lodge the crop. This result has clearly passed into practice. Of the 270 samples sent in in 1935, 159 had received manure, 124 had received nitrogenous fertiliser, and no less than 61 of these had followed beet, turnips, or some other crop receiving dung, showing that the growers were prepared to give nitrogen even on land already in good condition. Some 51 crops had received compound fertilisers, which in 21 cases were the new high grade materials containing ammonium phosphate ; but many growers preferred to make their own mixtures.

EXPERIMENTS ON VEGETABLE CROPS

The importance of vegetable crops has considerably increased during recent years. Thus, for certain of the more important crops, the acreage returns for 1922 and 1934 are as follows :

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