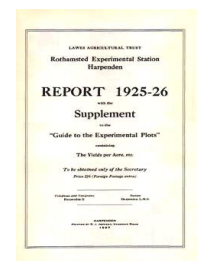


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Woburn Report for 1925, 1926

Dr J. A. Voelcker

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WOBURN EXPERIMENTAL FARM

REPORTS FOR 1925 & 1926 BY DR. J. A. VOELCKER.

SEASON 1924-5.

The season 1924-5 was very abnormal. The autumn and winter were wet, and the spring markedly deficient in sunshine. Crops struggling against these adverse influences were not able to withstand the drought that came later in June and July. This period, however, helped in making the hay crop. The weather broke before harvest, which was conducted under difficulties, some of the grain sprouting in the sheaves. The wheat crop never recovered from its early bad start, and, although the barley was sown in better conditions, it could not withstand the drought, and was especially short in the straw. Of the roots, mangolds and potatoes did fairly well, but swedes, that could not be drilled until the end of July, were naturally a failure.

The wet winter markedly affected the soil conditions. On Stackyard Field in January, 1925, the nitrate of soda plots (3, 6, 9) and the farmyard manure plot (11b) were wet and sticky, while the sulphate of ammonia series (2, 5, 8) were comparatively dry and friable. Differences were also observed in the young plants, those on the sulphate of ammonia being much superior. Later on these differences were reversed as the familiar effects of soil acidity began to show. The abnormal soil conditions were also evident on the area of Stackyard Field intended for swedes. Although the land is a light sandy loam, the ploughed land dried into clods that became hardened in the June drought, and no satisfactory seed bed could be prepared.

SEASON 1925-6.

The season 1926 was one of a distinctly mild character, with an average rainfall, but a deficiency of sunshine.

The period of autumn sowing was quite favourable; there was a little frost in December, 1925; March, 1926, was a singularly dry month, but April, May and June were all very unsettled, with prolonged cold periods and absence of warmth. July and August were fair and warm, and the early harvest was got in in good condition. Intervals of fine and wet weather followed, and the rest of the harvest was gathered with difficulty.

RAINFALL.

	1924-25. Inches.	No. of days on which rain fell.	1925-26. Inches.	No. of days on which rain fell.
October	4.03	16	2.99	9
November	2.58	10	1.50	7
December	3.65	13	1.89	11
January	1.41	9	2.74	12
February	2.39	15	2.67	15
March ... ..	.82	7	.17	3
April	1.59	15	2.59	16
May	2.26	16	2.38	17
June ... ..	.05	2	2.47	12
July	2.85	10	1.99	12
August	2.33	17	1.19	8
September	2.68	13	1.84	10
	26.64	143	24.42	132

FIELD EXPERIMENTS.

1. *Continuous Growing of Wheat (Stackyard Field).* 1925 (49th Season).

Farmyard manure (giving 100 lb. ammonia per acre) was spread and ploughed in (plot 11b), November 7th, 1924, and "Yeoman" wheat—12 pecks per acre—was drilled on November 18th, 1924. Rape Dust was given to plot 10b and the mineral manures to the several plots on the same day. A fair plant of wheat came up, and displayed in January the marked appearance already described.

Coltsfoot appeared thickly on the nitrate plots, and by the middle of March the crop began to fail on the sulphate of ammonia plots. By May the farmyard manure plot had to some extent recovered. The first top-dressings of sulphate of ammonia and nitrate of soda were given on June 9th, and the second dressings on July 16th. The crop was cut August 11th—14th, carted and stacked August 16th, and threshed early in December. The results are given in Table I.

The yield was a very miserable one, and worse than the poor crop of 1924, which was the previous lowest record. The unmanured produce was only 2 bushels per acre, and the highest yield 6.8 bushels per acre, whereas in 1924 it was 18 bushels.

With results so low as those shown in Table I, there is little point in discussing the figures in detail. Despite their bad start, the nitrate of soda plots turned out superior to the sulphate of ammonia ones. The highest crop was 6.8 bushels of corn per acre with nitrate of soda (50 lbs. ammonia per acre) alone, the farmyard manure (5.9 bushels) coming next; these two plots also gave the highest yields of straw.

1926 (50th Season).

Farmyard manure, as in the previous year, was spread, and ploughed in, October 13th, the quantity being 4 t. 12 c. 2 qr. 20 lb. to the acre. Mineral manures and rape dust (403.2 lb. per acre) were applied October 16th, "Yeoman" wheat—12 pecks to the acre—having been drilled October 14th—15th. The wheat came up well, and even the usually "weak" plots (such as 8a, 8b) looked better than usual. The plot 2b (last limed in 1897) still continued to show clearly the influence of lime; on the other hand, the expected failure of 5a (where no lime had been given) did not materialise. The farmyard manure plot (11b) was the best of the series, and the rape plot (10b) not greatly inferior.

The first top-dressings of nitrogenous salts were applied on March 27th, the second on June 10th. Through an error the whole amount for plot 6 was put on one half of it only, while the top-dressings were applied to the "a" instead of the "b" series of plots 8 and 9.

The same mistakes were, at the same time, made in the case of the continuous barley plots. To remedy the error as far as possible, the second half of plot 6 was subsequently given, in each case, the proper dressing of 25 lb. per acre of nitrate of soda, and the two halves were reaped separately.

By the middle of July the crop had become very uneven, and weeds made their appearance in quantity, notably on the nitrate

plots—a species of *Vicia* (*Vicia hirsuta*) and of *Convolvulus* were the chief pests, in addition to coltsfoot, wild oats and *Holcus mollis*—but it was noticeable that on the sulphate of ammonia plots there was no *Vicia*.

The wheat was cut on August 25th, but, owing to bad harvest weather, could not be carted until September 13th. In the case of a few sheaves there was some sprouting of the grain.

After the wheat had been carried, the stubble was found to be in a very dirty condition, and this, together with the fact that the 50 years' period of continuous wheat cultivation had been concluded, led to the determination to fallow the land and give it a thorough cleaning before embarking on a new series.

The harvest results are given in Table I.

The rapid growth of weeds, and of *Vicia hirsuta* in particular, was responsible, in great measure, for the extremely high amounts of tail corn recorded, it being almost impossible to separate the corn and the tares.

The produce in general was much like that of 1923. The unmanured plots gave an average yield of 4.3 bushels with 10 cwt. 3 qr. of straw per acre.

On plot 2b (sulphate of ammonia), which received 2 tons of lime applied in 1897, the yield was 8.7 bushels, double that on the unmanured. On plot 2a (sulphate of ammonia), where no lime was added, no weighable crop has been recorded for the past thirty years.

Nitrate of soda gave, all round, higher results than sulphate of ammonia, the addition of minerals to it showing no benefit this season.

The farmyard manure plot looked about the best of all earlier in the season, but fell off towards the close. The weight per bushel of the corn was generally low, and the tail corn exceptionally high.

2. *Continuous Growing of Barley (Stackyard Field).*

1925 (49th Season).

The land, after ploughing in March, 1925, was in better and drier condition than the corresponding wheat area. Nevertheless, the difference between the nitrate plots and those treated continuously with sulphate of ammonia was very observable, the former being of darker colour and closer texture.

Farmyard manure (giving 100 lb. ammonia per acre) was spread on plot 11b on March 19th—the quantity being at the rate of 3 tons 13 cwt. 3 qr. 9 lb. per acre.

“Plumage Archer” barley was drilled on April 17th at the rate of 12 pecks per acre. Mineral manures and rape dust were put on the respective plots the same day. The land, at this period, was still somewhat lumpy.

The barley came up well, and the land was rolled about the middle of May. At this time the crop looked very promising. The sulphate of ammonia plots that had had no lime soon began to go off, as usual, those receiving lime keeping quite good. Coltsfoot was particularly noticeable in the nitrate of soda plots. The first top-dressings of sulphate of ammonia and nitrate of

TABLE I.
Continuous Growing of Wheat, 1925 (49th Season) and 1926 (50th Season).
 Wheat grown year after year on the same land, the manures being applied every year.
 Stackyard Field—Produce per acre.

1926.

1925.

Plot.	Manures per acre.	Head Corn.		Tail Corn.		Straw, Chaff, &c.		Head Corn.		Tail Corn.		Straw, Chaff, &c.	
		No. of bushels.	Weight per bushel, lb.	lb.	Weight.	lb.	cwt. q. lb.	No. of bushels.	Weight per bushel, lb.	No. of bushels.	Weight per bushel, lb.	lb.	cwt. q. lb.
1	Unmanured	2.0	56.0	2	—	1	1 26	4.0	58.0	—	—	—	—
2a	Sulphate of Ammonia (=25 lb. Ammonia)	—	—	—	—	—	—	—	—	—	—	—	—
2aa	As 2a, with 5 cwt. Lime, Jan., 1905, repeated 1909, 1910, and 1911	—	—	—	—	—	—	—	—	—	—	—	—
2b	As 2a, with 2 tons Lime, Dec., 1897	1.4	58.0	2	—	1	0 24	3.4	58.0	—	—	—	—
2bb	As 2b, with 2 tons Lime, repeated Jan., 1905	1.2	58.0	2	—	1	1 12	8.7	60.9	—	—	—	—
3a	Nitrate of Soda (=50 lb. Ammonia)	6.8	58.5	8	—	4	2 20	13.7	53.7	—	—	—	—
3b	Nitrate of Soda (=25 lb. Ammonia)	5.6	59.0	8	—	2	2 16	7.2	62.0	—	—	—	—
4	Mineral Manures (Superphosphate 3 cwt., Sulphate of Potash $\frac{1}{2}$ cwt.)	1.0	56.0	6	—	2	0 26	5.1	56.7	—	—	—	—
5a	Mineral Manures and Sulphate of Ammonia (=25 lb. Ammonia)	—	—	—	—	—	—	—	—	—	—	—	—
5b	As 5a, with 1 ton Lime, Jan., 1905	1.2	56.0	2	—	3	3 4	10.8	55.2	—	—	—	—
6	Mineral Manures and Nitrate of Soda (=25 lb. Ammonia)	3.2	58.0	4	—	2	2 26	8.1	53.7	—	—	—	—
7	Unmanured	2.0	56.0	2	—	1	0 18	4.6	56.2	—	—	—	—
8a	Mineral Manures and, in alternate years, Sulphate of Ammonia (=50 lb. Ammonia)	2.1	59.0	12	—	2	2 8	—	—	—	—	—	—
8aa	As 8a, with 10 cwt. Lime, Jan., 1905, repeated Jan., 1918	5.3	60.0	16	—	3	0 16	4.8	60.0	—	—	—	—
8b	Mineral Manures, Sulphate of Ammonia (=50 lb. Ammonia) omitted in alternate years	—	—	—	—	—	—	—	—	—	—	—	—
8bb	As 8b, with 10 cwt. Lime, Jan., 1905, repeated Jan., 1918	—	—	—	—	—	—	—	—	—	—	—	—
9a	Mineral Manures and, in alternate years, Nitrate of Soda (=50 lb. Ammonia)	4.0	58.0	8	—	1	1 4	4.8	62.0	—	—	—	—
9b	Mineral Manures, Nitrate of Soda (=50 lb. Ammonia) omitted in alternate years	2.2	59.0	4	—	1	1 24	5.4	58.0	—	—	—	—
10a	Superphosphate 3 cwt., Nitrate of Soda (=25 lb. Ammonia)	2.2	58.0	6	—	1	2 20	8.7	55.7	—	—	—	—
10b	Rape dust (=25 lb. Ammonia)	5.2	58.0	8	—	2	0 20	4.7	60.0	—	—	—	—
11a	Sulphate of Potash 1 cwt., Nitrate of Soda (=25 lb. Ammonia)	2.7	59.0	4	—	2	0 12	8.3	54.0	—	—	—	—
11b	Farmyard Manure (=100 lb. Ammonia)	5.9	59.5	10	—	4	2 12	5.1	56.0	—	—	—	—

G

soda were given on June 10th, and the second dressings on July 16th.

Up to June 24th, the crops stood the drought quite well, but, though the ultimate yields were much superior to those of the Wheat series, and also to the Barley crops of 1924, they were well below the average. In particular the straw was very short, and there were many weeds cut with the straw and retained in the sheaves. As a result, the stack heated, and the contents (which included the produce from the Malting Barley experimental plots), were seriously damaged.

The barley was threshed and weighed December 1—5, and the results are given in Table II.

The unmanured produce averaged 7.4 bushels of corn, with 7 cwt. 1 qr. of straw per acre—minerals alone giving practically the same, and showing little further benefit from addition of lime, except for an increase in the straw.

Sulphate of Ammonia without lime gave no crop to record (2a, 5a, 8a, 8b), but where lime was given as well (2aa, 2b, 2bb, 5aa, 5b, 8aa, 8bb), in every case the crop was more or less restored. Nitrate of soda, on the whole, gave crops rather better than those from Sulphate of Ammonia, but the addition of lime to it (plots 3aa and 3bb) proved, as in the two previous years, the reverse of beneficial.

Rape-dust gave but a small crop compared with farmyard manure, which latter produced much the highest yield of the series, viz., 17.6 bushels with 15 cwt. of straw per acre. The next highest yield, 12 bushels per acre, was from Sulphate of Ammonia with minerals and lime (plot 8aa).

1926. (50th Season).

Farmyard manure (6 tons, 4 cwt. per acre), was applied April 8th, and ploughed in, Barley ("Plumage Archer"—10 pecks per acre) being drilled on April 9th. Mineral manures and Rape dust (364 lbs. per acre) were put on at the same time.

The first top-dressings of nitrogenous salts were given, as for the wheat, on May 27th, the second on June 16th, the same mistakes as in the wheat series being made with plots 6, 8a, 8aa, 9a, and subsequently partially rectified.

The barley grew distinctly better than the wheat. Weeds were not so troublesome, though both *Vicia hirsuta* and *convolvulus* were to be seen on the weaker plots. The barley was cut on August 24, and not carted until September 13th, but did not suffer nearly as much as the wheat. As the 50 years period was over, it was decided to fallow this land also, although it was not so weedy as the continuous wheat plots.

The harvest results for 1926 are given in Table II.

The crop generally was light. The unmanured produce was 2.6 bushels of corn with 3 cwt. 1 qr. of straw per acre. Mineral manures alone gave an increase of 5.5 bushels of corn, but the addition of lime to this showed no benefit.

The Sulphate of Ammonia plot (2a), which generally is quite bare, now gave 3.5 bushels of corn per acre. The corresponding plot (5a), with minerals added, showed the same feature, giving 10 bushels of corn per acre, though no lime had been applied to

TABLE II.
Continuous Growing of Barley, 1925 (49th Season), and 1926 (50th Season).
 Barley grown year after year on the same land, the manures being applied every year.
 Stackyard Field—Produce per acre. 1925. 1926.

Plot.	Manures per acre.	Head Corn.		Straw, Chaff, &c.	Head Corn.		Straw, Chaff, &c.	Tail Corn.		Straw, Chaff, &c.
		No. of bushels.	Weight per bushel.		No. of bushels.	Weight per bushel.		lb.	Weight.		lb.	Weight.
1	Unmanured	8.4	50.5	7 0 4	3.1	52.0	5 1 12	32	18	3 0 25
2a	Sulphate of Ammonia (= 25 lb. Ammonia)	—	—	—	3.5	54.0	6 0 8	—	—	1 3 4
2aa	As 2a, with 5 cwt. Lime, Mar., 1905, repeated 1909, 1910 and 1912, and 10 cwt. Lime applied Jan., 1923	6.2	51.0	—	4.8	54.0	5 1 12	28	28	8 3 0
2b	As 2a, with 2 tons Lime, Dec., 1897, repeated 1912	5.7	52.5	—	4.1	56.0	6 0 8	24	24	8 0 20
2bb	As 2a, with 2 tons Lime, Dec., 1897, repeated Mar., 1905	4.1	51.7	—	8.8	52.0	3 0 8	16	16	10 3 16
3a	Nitrate of Soda (= 50 lb. Ammonia)	8.3	52.0	—	12.1	56.0	7 1 4	24	24	10 0 20
3aa	As 3a, with 2 tons Lime, Jan., 1921	4.1	51.0	—	6.3	52.0	3 3 4	16	16	7 3 24
3b	Nitrate of Soda (= 25 lb. Ammonia)	7.3	52.5	—	5.8	52.0	7 2 24	18	18	7 3 24
3bb	As 3b, with 2 tons Lime, Jan., 1921	4.7	51.5	—	6.9	50.9	2 1 12	8	8	8 3 24
4a	Mineral Manures ¹	6.9	52.0	—	4.5	52.0	4 1 14	20	20	5 2 18
4b	As 4a, with 1 ton Lime, 1915	7.2	53.0	—	7.7	52.0	6 2 20	28	28	11 0 4
5a	Mineral Manures and Sulphate of Ammonia (= 25 lb. Ammonia)	—	—	—	10.0	56.0	—	—	—	72 10 3 8
5aa	As 5a, with 1 ton Lime, Mar., 1905, repeated 1916	7.6	52.5	—	18.7	48.5	8 2 8	16	16	10 1 8
5b	As 5a, with 2 tons Lime, Dec., 1897, repeated 1912	10.0	52.8	—	10.2	50.2	7 3 20	18	18	8 2 6
6	Mineral Manures and Nitrate of Soda (= 25 lb. Ammonia)	8.6	52.2	—	15.1	49.7	6 0 8	15	15	11 3 0
7	Unmanured	6.3	52.2	—	2.1	52	7 2 20	8	8	3 1 4
8a	Mineral Manures and, in alternate years, Sulphate of Ammonia (= 50 lb. Ammonia)	—	—	—	3.0	44.0	—	—	—	2 1 14
8aa	As 8a, with 2 tons Lime, Dec., 1897, repeated 1912	12.0	52.0	—	4.2	56.0	10 3 4	16	16	7 3 12
8b	Mineral Manures, Sulphate of Ammonia (= 50 lb. Ammonia) omitted in alternate years	—	—	—	2.2	52.0	—	—	—	2 0 7
8bb	As 8b, with 2 tons Lime, Dec., 1897, repeated 1912	7.4	51.5	—	9.5	52.0	6 0 16	20	20	11 1 0
9a	Mineral Manures and, in alternate years, Nitrate of Soda (= 50 lb. Ammonia)	11.7	51.7	—	22.9	49.9	12 0 24	10	10	15 3 16
9b	Mineral Manures, Nitrate of Soda (= 50 lb. Ammonia) omitted in alternate years	—	—	—	9.9	52.2	—	—	—	13 1 2
10a	Superphosphate 3 cwt., Nitrate of Soda (= 25 lb. Ammonia)	10.4	52.1	—	6.0	50.7	8 2 10	12	12	8 2 12
10b	Rape dust (= 25 lb. Ammonia)	6.4	52.0	—	7.1	52.0	6 3 20	18	18	9 3 10
11a	Sulphate of Potash 1 cwt., Nitrate of Soda (= 25 lb. Ammonia)	3.8	52.0	—	10.9	50.7	3 2 8	8	8	9 1 0
11b	Farmyard Manure (= 100 lb. Ammonia)	7.4	51.7	—	24.5	51.2	6 3 12	14	14	23 1 26
		17.6	52.2	—	—	—	15 0 0	22	22	—

¹ Superphosphate 3 cwt., Sulphate of Potash $\frac{1}{2}$ cwt.

either. Where lime had been put on additionally (plot 5aa), however, the produce was increased to 18.7 bushels of barley per acre.

In the case of Nitrate of Soda, the higher amounts, whether alone or with minerals, produced a considerable increase, but the addition of lime had no further benefit.

As between phosphate and potash, the comparison of plots 10a and 11a, shows a decided advantage to attend the inclusion of potash. Farmyard manure (plot 11b) gave the highest crop of all, viz., 24.5 bushels of corn per acre, it being greatly superior to the rape dust plot (10b) which, however, yielded this year better than usual.

The quality of grain was fair for the season, with the tail corn somewhat higher than usual.

3. Rotation Experiments.

The Unexhausted Manure Value of Cake and Corn (Stackyard Field).

(a) Series C.

1925. *Wheat.*

After the clover ley of 1924 had been ploughed in, "Yeoman" wheat, at the rate of 10 pecks per acre, was drilled on Nov. 4—5, 1924. It came up well, and, though it looked inferior to the wheat on the green-manuring plots (Series A), after April it became distinctly superior; the "cake" plots, moreover, were darker-coloured and seemed much better than the corresponding "corn" plots. The crop was cut August 8th, 10th, 11th, carted and stacked August 17th, and threshed and weighed December 1st—5th. The results were as follows:—

TABLE III.

Rotation Experiments—Series C (Stackyard Field), 1925. Wheat after Clover. Produce per Acre.

Plot		Head Corn		Tail Corn Weight	Straw, Chaff, etc.			
		Bushels	Weight per Bushel		Tons	cwts.	qrs.	lb.
1	Corn-fed Plot ...	24.6	60.2	204	1	1	1	14
2	Cake-fed Plot ...	25.8	60.2	225	1	3	2	14

The weighings did not bear out the appearances noted during growth, for there were only 1.2 bushels more corn and 2 cwt. 1 qr. more straw per acre on the "cake" fed plot than on the "corn" one. At the same time the yields were much higher than with the continuous wheat plots and the green-manure plots on the same field. It will be noted that the tail corn was much higher than usual.

This wheat crop concluded the four-course rotation begun with swedes in 1922 and, as this rotation has been carried on practically since the commencement in 1876, it will be convenient to summarise briefly the conclusions to be drawn from the last two rotations.

In the previous rotation (beginning 1918), on this particular area (series C), the growing of clover had been resumed, and the swedes of 1918 were fed on the land by sheep which consumed, in the one case, 4 cwt. of corn (barley and oats) per acre, and supplying about 7.25 lbs. of Nitrogen per acre, and in the other case, 4 cwt. of cake (Linseed and Cotton) per acre, supplying about 18 lbs. per acre of Nitrogen. A little clover-chaff was given as well to all the sheep. Barley, clover and wheat followed as the crops of 1919, 1920, and 1921.

In the new rotation, beginning with 1923 (swedes), it was decided to increase the difference between the Nitrogen applied in the two cases. Accordingly, the amounts were now increased from 4 cwt. of corn, and of cake, to 16 cwt. per acre of corn and 14 cwt. per acre (all that the sheep would eat) of mixed cake.

The corresponding nitrogen figures were, corn plot, 29.25 lb., and cake plot, 67 lb. per acre.

In Table IV. are given the results in either rotation. It will be remembered that in each case when swedes were grown (1918-1922), the amount of roots fed on the land by the sheep was the same on the corn-fed and cake-fed plots, the quantity so fed being supplemented—when necessary—by mangels, and the same amount of clover-chaff given to the two lots.

TABLE IV. ROTATION EXPERIMENTS.

(a) 1918-1921. RESULTS PER ACRE.

4 cwt. per acre Corn (7.25 lbs. Nitrogen per acre), or 4 cwt. per acre. Cake (18 lbs. Nitrogen per acre) fed with the root-crop.

	1918	1919. Barley	1920 Red Clover Hay				1921 Wheat
			Swedes about	Bushels	Tons	cwts.	qrs.	lb.	Bushels
Corn-fed Plot ...	11 tons	17.4	2	16	2	21	37.4
Cake-fed Plot ...		18.2	2	16	2	11	31.2

(b) 1922-1925. RESULTS PER ACRE.

16 cwt. per acre Corn (29.25 lbs. Nitrogen per acre), or 14 cwt. per acre Cake (67 lbs. Nitrogen per acre) fed with the root-crop.

	1922. Swedes	1923 Barley	1924 Clover (Mixed) Hay				1925 Wheat
			small crop	Bushels	Tons	cwts.	qrs.	lb.	Bushels
Corn-fed Plot ...	small crop	14.2	1	18	2	22	24.6
Cake-fed Plot ...		16.2	1	17	0	11	25.8

The results show that in both rotations, corn-feeding gave results equal to cake-feeding.

Even on the first crop (Barley) immediately succeeding the feeding of the roots, there was no significant difference in favour of the cake-feeding.

The whole subject is a very perplexing one, requiring much further study, as the result has been obtained so often that its accuracy can hardly be doubted.

1926. *Roots.*

The root crop (Swedes) began a new rotation in 1926, the intention being to use the increased amounts of food, first adopted in 1922, when feeding off the roots. This was in order, before coming to a definite conclusion, to test once more the seemingly abnormal results recorded in the last rotation.

The land after preparation for swedes was sown on June 16th with "Up to date" Swede seed at the rate of 3 lbs. per acre. Three cwt. of mineral Superphosphate and 1 cwt. of Sulphate of Potash were given per acre, June 16th and 17th, and on August 10th a top-dressing of 1 cwt. per acre Nitrate of Soda.

Quite a good plant was obtained, but the swedes were sown too late, planted too wide, and singled too late to give a really good crop even for this land, to which, because of its distance from the farm buildings, no dung can be carted out.

It was, however, a very even plant all over, and the roots were sound.

The yields were:—

		Tons		Cwt.
Plot 1.	Corn-fed plot	13	18	per acre
Plot 2.	Cake-fed plot	13	0	„

Feeding-off the roots on the land with sheep (70) began on December 31st, and barley will follow.

(b) Series D.

1925. *Swedes.*

After the close of the last rotation (wheat, 1924), the land was ploughed and prepared, as far as possible, for swedes. As already explained, the land set into large hard blocks under the influence of the June drought. Nothing could be done with the land until rain came on July 20th, when the area was prepared, and swede seed was ultimately drilled on July 24th—25th, at the rate of 5 lbs. per acre. Quite a good plant came up, but the late-sowing prevented any chance of the roots attaining any size, and, with the early frosts of October, growth ceased, and there was nothing to do but to run sheep over the land to eat the roots. Portions were weighed and gave:—

		Swedes per Acre.			
		Tons	cwt.	qrs.	lb.
Corn-fed plot	... ..	1	8	2	8
Cake-fed plot	... ..	1	8	2	7

The whole crop was fed off by sheep towards the end of January, 1926, the land then ploughed and got ready for Barley.

1926. *Barley.*

The failure of swedes in 1925 prevented the usual feeding of the root crop with cake and corn, so that the barley crop of 1926 was practically unaffected by any manurial difference between corn-feeding and cake-feeding. Much the same happened in 1921, hence this area has not had corn or cake-feeding since 1916. This fact must be remembered when comparing C. and D.

"Plumage Archer" barley, at the rate of 12 pecks per acre, was drilled, March 29th—30th, 1926, a manuring of 3 cwt. Superphosphate, $\frac{1}{2}$ cwt. Sulphate of Potash, and 1 cwt. Sulphate of

Ammonia being given at the same time. A good plant was obtained, and on May 27th, mixed clovers (red clover 7 lb., alsike 3 lb., and trefoil 3 lb. per acre) were sown in the barley.

A capital and level crop of barley was grown; this was cut August 23rd, and carted August 28th, in good condition. The harvest results were :—

Produce per Acre.

Plot		Head Corn		Tail Corn Weight	Straw, Chaff, etc.			
		Bushels	Weight per Bushel		Tons	cwts.	qrs.	lb.
1	Corn-fed Plot ...	26.4	54.3	191	2	10	1	8
2	Cake-fed Plot ...	28.0	53.4	78	2	14	2	23

The differences between the two plots are not significant.

4. *Green-manuring Experiments.*

(a) STACKYARD FIELD. Series A.

Upper Half.

1925.

After the green crops—Tares and Mustard (both quite good crops)—of 1924 had been fed off by sheep, which received also 3 cwt. per acre of cake (linseed cake and cotton cake), they were ploughed up, and on November 6th, 10 pecks per acre of “Yeoman” wheat were drilled over the two-acre area.

The wheat came up well, and during the winter the Tares plot looked rather the better of the two. The soil of the Mustard plot seemed looser in texture; on the other hand, there was more weed on the Tares plot. In April, 1925, the wheat on these green-manuring plots was decidedly the best on the whole farm. From May onwards, the crops, however, fell back, and in June were distinctly inferior to the wheat on adjoining land in the same field (Rotation Experiment, Series C). By the end of June both crops (after Tares or after Mustard) were very poor and so continued until harvest time. The wheat was cut on August 10th, carted and stacked on August 17th, and threshed and weighed, December 1st—4th.

The results are given in Table V. It will be remembered that one half of each of the acre plots (upper half of field) had been limed in autumn, 1923.

TABLE V.

Green-manuring Experiment. Stackyard Field. Series A (upper half). 1925. Wheat after Green Crops fed off with Cake :—

Produce per Acre.

Plot		Head Corn		Tail Corn	Straw, Chaff, etc.		
		Bushels	Weight per Bushel		cwts.	qrs.	lb.
1	After Tares fed off ...	7.4	58.7	27	8	1	4
2	After Tares fed off, limed 1923 ...	5.4	59.2	22	6	2	21
3	After Mustard fed off ...	6.4	59.7	32	4	2	24
4	After Mustard fed off, limed 1923 ...	5.0	59.0	22	4	0	6

The crops were very poor, averaging 6.4 bushels per acre only for the Tares plot and 5.7 bushels for the Mustard plot. This slight advantage to the Tares was increased in the case of the straw. The liming of the land, however, exercised no benefit, and seems to offer no solution of the problem. These limed plots were, however, to some extent damaged by hares.

Along with the above results might be taken those of the Wheat (Series C) grown in Rotation (see Table IV.) in the same field, only a short distance off, and where wheat had followed clover made into hay (1924) and carted off the land. Up to May, 1925, these crops had looked decidedly inferior to the green-manure set, but now, at harvest, they yielded, on the average, 25.2 bushels of corn with 1 ton 2½ cwt. of straw per acre, as against 6 bushels of corn and 6 cwt. of straw per acre only on the green-manure plots.

That the growing of really good crops of Tares and Mustard and feeding off these on the land with 3 cwt. per acre of cake, should have resulted in the production of only 6 bushels of wheat per acre, whilst wheat after clover removed as hay gave 25 bushels per acre on similar land, is at present inexplicable, but repetition of the experiment year after year has confirmed the fact. Further, there is the invariable observation that the wheat crop looks excellent right through to early summer, and then unaccountably drops off.

1926.

The wheat stubble was ploughed in September, 1925, and it was noticeable that there was more weed—mostly thistles—on the Tares portion than on the Mustard. The land was ploughed rather deeper than usual.

On April 10th, Tares were drilled at the rate of 2 bushels per acre, 3 cwt. Superphosphate and 1 cwt. Sulphate of Potash per acre being given to them and also to the Mustard land. An excellent crop of Tares was grown. Mustard was sown on June 8th at the rate of 20 lbs. per acre, and this, too, came very well. The green crops were ready to feed off towards the end of July, and sheep and lambs were put on them, beginning on July 30th with the Mustard. When this was finished, the sheep passed on to the Tares. Between July 30th and August 10th, they consumed on each acre plot, 3 cwt. cake (half Linseed, half Cotton). The land was ploughed after the sheep, and wheat sown.

Lower Half.

1925.

After removal of the wheat crop of 1924, lime, at the rate of 2 tons per acre, was spread on the 2 acres that were to be put into green-crops for 1925. This was done on October 8th, 1924, and the land ploughed and got ready. Tares, at the rate of 2 bushels per acre, were drilled on April 24th, 1925, and Mustard—20 lbs. per acre—on June 4th. Owing to the drought, the crops had a very hard time of it, but came up and held out better perhaps than could have been expected, the Tares being much the superior crop. The Mustard plot was then partly re-seeded in the hope of getting a crop sufficient to feed off. Ultimately 12 ewes and 100 lambs were put on early in September, and they fed off, first the Mustard, and then the Tares. On the Tares plot it was found possible to consume the requisite amount of cake—3 cwt. per acre (Linseed and Cotton cake mixed), but on the Mustard plot the full amount could not be consumed and the balance (after deduction for live-weight increase) was spread on the land in the form of meal, (96 lb. half linseed, half cotton cake, was so spread). The land was then ploughed and put into wheat.

1926.

On October 15th, "Yeoman" wheat—12 pecks per acre—was drilled. The wheat came up well, both after Tares and after Mustard. Then, as usual, from June onwards, a progressive failure set in. It was noticed that the wheat fell off unaccountably after the flowering stage; up to then it had been quite good. The wheat was cut on August 24th, and carted September 13th. The harvest results are given in Table VI.

TABLE VI.

Green-manuring Experiment. Stackyard Field—Series A (lower half) 1926. Wheat after green crops fed off with cake.

Produce per Acre.

Plot		Head Corn		Tail Corn	Straw, Chaff, etc.		
		Bushels	Weight per Bushel				
1	After Tares fed off ...	4.5	lb. 52.6	lb. 66	8	2	9
2	After Tares fed off, limed 1924 ...	4.7	54.1	80	8	2	22
3	After Mustard fed off ...	3.2	56.2	40	6	2	7
4	After Mustard fed off, limed 1924 ...	2.3	56.7	30	4	0	11

The plots gave, as will be seen, very miserable crops.

The following table shows the low yields of corn for the last five seasons.

Plot		1922 Bushels	1923 Bushels	1924 Bushels	1925 Bushels	1926 Bushels
1	After Tares fed off ...	6.9	8.0	7.3	6.4	4.6
2	After Mustard fed off	7.5	5.6	9.1	5.7	2.8

(b) LANSOME FIELD.

1925.

On these plots, which had been limed in autumn, 1923, wheat followed the green crops of 1924, which, as usual, had been ploughed in. "Yeoman" wheat—at the rate of 12 pecks per acre—was drilled on October 28th, 1924. The plant, however, was a very uneven one, owing to the adverse weather conditions. In January, 1925, the plant was so reduced in places that re-sowing had to be resorted to.

Subsequently the crops recovered to some extent as the ground got drier, but the drought of June and July caused them to go back and to favour the growth of a quantity of weed—mainly may-weed. As a consequence, the crops never attained to any evenness, and the results recorded were obtained in most cases by weighing a portion only of each plot. The limed halves suffered so badly that the returns are not included.

Ultimately the wheat was cut August 6th—7th, carted and stacked August 17th, and threshed and weighed December 1st—4th. The produce is given in Table VII.

TABLE VII.

Green-manuring Experiment. Lansome Field, 1925. Wheat after Green Crops ploughed in.

Produce per Acre.

Plot	Head Corn		Tail Corn Weight	Straw, Chaff, etc.		
	Yield per Acre	Weight per Bushel				
Old Plots { 1 After Mustard ploughed in	Bushels 6.9	lb. 59.6	lb. 23	cwts. 13	qrs. 0	lb. 16
2 After Tares ploughed in ...	4.5	59.0	17	11	1	20
New Plots { 3 After Mustard ploughed in	4.8	59.0	12	13	1	4
4 After Tares ploughed in ...	4.5	59.5	19	11	3	4
5 Control (no green crop) ...	4.0	59.5	16	13	2	24

Here, as in former years, and also as in Stackyard Field, the yields were unaccountably small, and that no larger crops than these should follow the ploughing-in of two successive green-crops in the previous year points to the existence of some disturbing factor, such as has been suspected in the case of Stackyard Field. Owing to the uneven crop, no fair comparison between Mustard and Tares can be made. The average of all plots was 4.9 bushels per acre only, as against 6.8 bushels in 1923—the last corn year on this land.

1926.

The plots were ploughed after the wheat crop of 1925, and on April 13th, 1926, Tares were sown at the rate of 2 bushels per acre, 3 cwt. of Superphosphate and 1 cwt. of Sulphate of Potash per acre being given at the same time to both the Tares and the Mustard land.

The Tares came up quite well, and on June 7th, Mustard was sown, and this, too, came up well. A good deal of weed, however—mostly may-weed—appeared on these plots, chiefly on the Tares area. The green crops were ploughed in, July 20th—24th, and second crops sown on August 18th, which again were ploughed in, October 13th—15th, the land being then got ready for wheat.

Supplementary Experiment on the ploughing-in of Mustard.

In the autumn of 1924, although the season was late, it was decided to compare Oats grown after a crop of Mustard ploughed-in as against the same without a green crop. Four plots of 1 acre each were set out on Road Piece field. Mustard was sown on August 19th, 1924, on two plots, and the crop was ploughed in, October 2nd, 3rd, 4th, grey Winter Oats being sown on October 24th, at the rate of 4 bushels per acre, over the whole four plots. The Oats came up very well, but suffered much from the subsequent drought. Owing to unfavourable weather, although the Oats were cut on July 15th, it was not possible to cart and stack them until August 17th, and they suffered much through the delay, ultimately giving, on threshing, but poor returns. The results suggest a small benefit attaching to the ploughing-in of the green crop. The produce was :—

Oats with or without previous green-crop.
1925. Road Piece.

Plot		Head Corn		Tail Corn	Straw, Chaff, etc.		
		Yield per Acre	Weight per Bushel		lb.	qrs.	lb.
1	Mustard ploughed in ...	Bushels 10·4	lb. 40·1	lb. 20	15	2	18
2	Control (no green crop) ...	9·9	39·8	14	12	3	16
3	Mustard ploughed in ...	10·7	40·0	17	14	0	16
4	Control (no green crop) ...	8·9	40·2	22	11	3	22

5. *The Relative Values of Lime and Chalk for Liming Purposes.*
Stackyard Field—Series B. 1924 Swedes. 1925 Barley. 1926 Seeds.

1925.

The sheep began feeding the swedes on the land on February 25th, 1925, and went on until April 5th. They had about 1 lb. per head daily of mixed cake (half Linseed, half Cotton) given to them, the same amount being fed on each plot, and the total consumed during the period being 11 cwt. of mixed cake per acre.

When the swedes were finished, the land was ploughed and sown, April 17th—18th, with “ Plumage Archer ” Barley, at the rate of 12 pecks per acre.

It was very noticeable that the land after the sheep-feeding was in much superior condition to that of the continuous barley plots adjacent, and a much better barley crop resulted. “ Seeds ” (mixed grasses and clovers) were drilled in the barley on May 19th. At a later period (September 9th), after removal of the

TABLE VIII.

Lime and Chalk Experiment—Stackyard Field—Series B.
Produce of Swedes, 1924, of Barley, 1925, and of Hay, 1926.
Produce per Acre.

Plot	Applications per Acre in 1919	1924 Swedes			1925 BARLEY			1926 Hay (Per Acre)						
		Tons	cwts.	qrs.	lb.	Head Corn		Tail Corn	Straw, Chaff, etc.					
						Bushels	Weight per Bushel		lb.	qrs.	lb.	qrs.	lb.	
1	No Chalk ...	*2	0	1	17	*10.9	53.2	19	12	0	10	1	18	0
2	Chalk=10 cwt. of Lime ...	†4	2	3	6	20.8	52.9	27	15	1	20	1	15	18
3	" = 1 ton "	6	18	1	26	19.0	53.0	23	13	1	22	1	16	24
4	" = 2 tons "	7	8	2	6	25.6	53.3	21	15	3	12	1	16	3
5	" = 3 " "	8	18	3	12	25.6	53.6	25	18	2	19	1	19	2
6	" = 4 " "	8	8	2	22	29.6	53.0	31	20	3	14	1	18	2
7	No Lime ...	6	8	1	18	20.0	52.9	17	18	0	0	1	12	0
8	Lime 10 cwt. ...	8	8	2	22	22.7	52.8	25	17	3	10	2	0	2
9	" 1 ton "	6	15	3	24	24.0	53.0	29	18	1	8	1	10	0
10	" 2 tons "	7	3	2	2	23.8	52.9	21	21	1	2	2	1	18
11	" 3 " "	7	13	2	10	22.1	53.2	22	18	0	24	1	10	3
12	" 4 " "	8	11	0	24	23.0	53.0	26	17	3	7	2	0	26

† Much damaged by fly.

* This plot, being on the headland, was badly damaged by hares and rabbits.

barley crops, more "seeds" were spread over the surface and harrowed in, as the plant had suffered a good deal during the drought. The re-seeding appeared to have been followed with success.

Meantime, the Barley stood the drought better than most of the other barley crops, and was ultimately cut August 14th, carted and stacked August 18th, and threshed and weighed December 1st—6th. The results—along with those of the swede crop of 1924 and the hay crop of 1926—are recorded in Table VIII.

The Swede crop of 1924 was considerably injured by "fly" and the results are, therefore, not strictly comparable.

Omitting plots 1 and 2, the "chalk" plots gave an average of 7 tons 18 cwt. 2 qrs. 11 lb. per acre, and the "lime" plots, 7 tons 14 cwt. 2 qrs. 11 lb. per acre. The increase over the unlimed plots was a marked one.

The Barley crop of 1925 was much superior to that of the continuous barley series; the highest yield in the latter was 17.6 bushels per acre (farmyard manure), while the general average of these limed plots was 23.6 bushels of corn per acre. The "chalk" plots averaged 24.1 bushels of corn per acre, and the "lime" plots 23.1 bushels. The superiority of the "lime" plots shown with the Oat crop of 1923—amounting to nearly 4 bushels per acre—was thus not maintained, the "chalk" series now giving, on the average, 1 bushel more per acre. Again, while with the chalk there was something like a progressive increase as more chalk was used, this was not the case with the "lime" series. The increase over the unlimed (plot 7) produce was, on the average, 4.1 bushels of corn per acre with "chalk," and 3.1 bushels with "lime." On the other hand, the "lime" series gave nearly 2 cwt. more straw per acre than the "chalk."

As previously noticed, spurry grew freely on the unlimed portions, but was absent elsewhere.

1926.

The "seeds" sown in the Barley crop of 1925 stood the winter quite well, but later on in spring appeared rather thin. They made a fresh start, however, in June, and promised quite a fair crop of hay. This was cut on July 19th, and carted July 31st. The results are given in Table VIII.

Putting the plots of each series together, we have an average of 1 ton 17 cwt. 1 qr. 14 lb. per acre for the Chalk plots, and 1 ton 16 cwt. 2 qrs. 11 lb. for the Lime plots. There was not, however, any regularity in the results, and nothing to indicate that the crop was increased as the lime was increased. Again, as between chalk and lime, the disparity between the two unlimed plots prevented any fair deductions being drawn.

6. *Inoculation of Lucerne—Stackyard Field—Series B.*

1925-1926.

One half (2 acres) of Series B in Stackyard Field was devoted to this trial, eleven plots, sown alternately with inoculated seed and seed not inoculated, being set out.

The seed was Provence Lucerne, and was drilled on June 3rd, at the rate of 20 lb. per acre.

The drought that ensued and continued to the middle of July proved a most unfortunate starting point for the experiment. Still, the lucerne managed to struggle through, and, despite the plentiful crop of groundsel, a growth of lucerne appeared on all the plots and maintained itself during the following winter.

Improvement followed on hand-picking in autumn, 1925, and horse-hoeing in February, 1926. In practically every case the inoculated plots were better; the experiment did not recover from the difficulties experienced at sowing time, and, ultimately, it was decided to cut and weigh the crop and then plough the plots up, restarting the experiment in 1927 on another field. The Lucerne was cut September 18th, carted September 22nd, and weighed September 28th. The weights as hay were:—

CONTROL PLOTS					INOCULATED PLOTS						
			cwt.	qrs.	lb.			cwts.	qrs.	lb.	
1	8	1	0	2	...	...	12	1	14
3	12	1	14	4	...	...	13	3	0
5	11	2	21	6	...	...	14	1	21
7	11	2	21	8	...	...	13	0	7
9	12	1	14	10	...	...	12	1	14
Total	56	1	14	Total	...	...	66	0	0
Average per Acre			11	1	3	Average per Acre			13	0	22

7. Manuring and Liming of Grass Land—Broad Mead—1925.

These experiments were divided into three series:—

- (a) Manurial Experiments.
- (b) Experiments on *Varieties* of Lime.
- (c) Experiments on *Forms* of Lime.

It was decided to renew the different applications in the winter of 1924, and, at the same time, as the position of the plots in series (c) was not altogether satisfactory (being alongside a hedge where the cattle generally lay), this series was removed to another part of the same field, and fresh plots, but similarly treated as before, were laid out.

The applications were all put on early in December, 1924, with the exception of Farmyard manure (12 tons per acre), in series (a), which was applied on February 18th, 1925. Plot 5 of series (a) had 2 tons per acre of lime renewed, but no further minerals.

The whole field was grazed with cattle, receiving a little cake, from October 11th, 1924, to April 1st, 1925, when the stock were removed and the grass was allowed to go for hay. The hay was cut June 29th—30th, and gathered in excellent condition July 2nd—4th, being then stacked.

- (a) Manurial Experiments—Commenced 1901—Manures applied 1901, 1904, 1906, 1909, 1913, 1920, 1924.

The results were : —

Plot	Manures per Acre.	Produce of Hay per Acre			
		Tons	cwt.	qrs.	lb.
1	Basic Slag 10 cwt., Kainit 3 cwt.	1	9	1	0
2	Superphosphate 5 cwt., S/Potash 1 cwt.	0	10	0	16
3	Basic Slag 10 cwt., S/Potash 1 cwt.	0	17	0	0
4	No Manure	0	18	2	0
5	Lime 2 tons	0	13	0	0
6	Farmyard Manure 12 tons	1	14	0	0

The highest weights of hay were yielded by the Farmyard manure plot and that treated with Basic Slag and Kainit, the next highest yield being that from the unmanured plot. But the weights of hay were no measure of the relative excellence of the individual plots. Indeed, almost the precise opposite might well be urged, for, while plots 1 and 6 were incomparably the roughest, and plot 4 not much better, the appearances of plots 2, 3, and 5 were immeasurably better, these being closely grazed by the cattle and looking—more especially the lime plot (5)—far more like a good pasture. It had been noticed particularly that the lime plot retained, throughout the season, a fresh and bright appearance that marked it from all the others; the cattle were more on it than on the other plots, and when they were taken off, one could almost draw the outlines of this plot from the daisies that were on it.

Series (b) Varieties of Lime.

Series (c) Forms of Lime.

1925.

The analyses of the different materials used in these series were as follows :—

	Lump Lime	Chalk Lime	Magnesian Lime	Lias Lime
Oxide of Iron and Alumina...	.29	1.57	4.65	10.50
Lime (CaO)	93.64	92.46	47.94	56.94
Magnesia	—	—	29.14	2.00
Carbonic Acid, etc.	2.91	1.74	14.81	9.36
Silica	3.16	4.23	3.46	21.20
	100.00	100.00	100.00	100.00

	Oolite Lime	Ground Lime	Ground Limestone	Ground Chalk
Oxide of Iron and Alumina ...	4.36	.89	.79	.89
Lime (CaO)	87.08	92.59	*53.34	†53.66
Magnesia	—	—	—	—
Carbonic Acid	5.99	2.27	42.42	42.78
Silica	2.57	4.25	3.45	2.67
	100.00	100.00	100.00	100.00

* Equal to Carbonate of Lime, 95.26. † Equal to Carbonate of Lime, 95.83.

In the case of (b) the experiments began in 1910, when the lime applications—2 tons per acre in each case—were given, these being repeated in February, 1916, and in December, 1924.

In (c) the plots, as stated, were new ones, and the applications were now applied for the first time.

The weights of hay were :—

Plot	Applications per Acre	Produce of Hay per Acre.			
		Tons	cwts.	qrs.	lb.
Series (b)	1 ... Derbyshire Lime, 2 tons ...	1	3	1	0
	2 ... Chalk Lime, " ...	0	17	0	0
	3 ... Magnesian Lime, " ...	0	18	3	0
	4 ... No Lime ...	0	18	2	0
	5 ... Lias Lime " ...	0	19	0	0
	6 ... Oolite Lime, " ...	1	0	0	0
Series (c)	1 ... Lump Lime, " ...	0	18	3	0
	2 ... Ground Lime, " ...	0	18	0	0
	3 ... No Lime... ...	1	0	0	0
	4 ... Ground Limestone, 4 tons ...	0	19	0	0
	5 ... Ground Chalk, " ...	0	18	0	16

Series (b).

These plots had not the general coarseness of series (a) unlimed plots, but, again, the weights of hay were not indicative of the true benefit, for, while all the limed plots were, in appearance, better than the unlimed one, the best looking was plot 2—chalk lime—then the Derbyshire lime (plot 1), with Magnesian lime (plot 3) inferior to either the Lias or Oolite lime, between which latter two there was little to choose.

Series (c).

In these plots the applications had been too recently made to expect any marked result.

In 1926, the experimental plots in this field were all fed by bullocks.

8. *Phosphatic Manures on "Seeds" Hay.*

An experiment was tried in 1924 to test the relative effect of different phosphatic materials on "seeds" cut as hay, and was repeated in 1925. A clover and grass mixture was laid down in Barley on May 14th, 1923. The phosphates used were Mineral Superphosphate, Basic Slag, North African Phosphate, and Steamed Bone Flour, and these were applied on November 30th, 1923, to give, in each case, the same amount of phosphoric acid (75 lb. per acre). The plots were half-acre ones, and the actual quantities given were :—Superphosphate 292 lb.; Basic Slag 223 lb.; North African Phosphate 125 lb.; Steamed Bone Flour 132 lb. per half-acre plot. The "seeds" grew well and were cut for hay, the first crop the first week in July, the second at the end of September, 1924.

The "seeds" were kept down for the following year, when one crop of hay was taken, this being cut on June 16th and carted June 21st, 1925. The results for the two years were as follows :—

*Phosphatic Manures on " Seeds " Hay—Butt Close—1924 & 1925.
Produce of Hay per Acre.*

Plot	Manuring	HAY PER ACRE															
		1924			1925			Total of 2 Years									
		1st Crop		2nd Crop													
		T.	c.	qrs.	lb.	T.	c.	qrs.	lb.	T.	c.	qrs.	lb.				
1	Control	2	5	1	0	1	0	1	0	1	17	1	0	5	2	3	0
2	Basic Slag	2	9	2	16	1	1	3	8	1	19	2	0	5	10	3	24
3	Superphosphate...	3	5	2	0	1	0	2	6	1	18	2	0	6	4	2	6
4	Steamed BoneFlour	2	19	1	4	1	1	0	0	1	18	1	0	5	18	2	4
5	N. African Phosphate	2	14	1	16	1	0	2	0	1	19	2	0	5	14	1	16

In all cases the phosphatic application did good. In the first year the best return came from the most active form—superphosphate—the next best from steamed bone-flour. In the second year all the plots gave approximately equal yields, so that over the two years, the best return came from superphosphate, followed by steamed bone-flour.

9. *Leucite and Sulphate of Potash compared—on " Seeds " Hay and Pasture.*

- (a) Butt Close (" seeds " hay)—1924 and 1925.
- (b) Broad Mead (pasture)—1925.

Work previously done at Woburn on Wheat, Mangels, and Potatoes, as well as in the Pot-culture experiments, had indicated that the new form of potash supply—Leucite—containing its potash in a less soluble form, was, potash for potash, little inferior to Sulphate of Potash. It was decided now to try it on " seeds " hay and on pasture. The Leucite contained 16.2 per cent. of Potash, soluble to a large extent in dilute hydrochloric acid; 3 cwt. of the Leucite contained as much total potash (K₂O) as 1 cwt. of Sulphate of Potash.

The experiment with " seeds " hay was in Butt Close, a seed mixture being put down in the barley crop of 1923. Leucite and Sulphate of Potash were applied on April 24th, 1924. Two crops of hay were taken in 1924 and one in 1925.

The experiment on pasture was in Broad Mead, the applications being given in April, 1924, and the one hay crop of 1925 weighed.

The results were as follows :—

*Produce of Hay from (a) " seeds "—Butt Close—1924 and 1925.
Produce of Hay from (b) pasture—Broad Mead—1925.*

" Seeds " Hay.

Plot	Manuring	1924 1st Crop		1924 2nd Crop		1925		Total of 2 Years		Pasture 1925												
		T.	C.	qrs.	lb.	T.	C.	qrs.	lb.	T.	C.	qrs.	lb.									
1	Leucite 5 cwt.*	2	0	2	0	1	4	1	0	1	19	2	0	5	4	1	0	0	19	0	0	
2	Sulphate of Potash 1½ cwt.*	2	0	0	0	1	3	2	14	1	16	0	0	4	19	2	14	0	19	2	16	
3	Control	—		—		—		—		—		—		—		—		0		18	2	0

* Being equivalent amounts of K₂O.

The differences between the two materials were not very marked; in the "seeds" hay the Leucite was rather more effective, but in the pasture land in 1925 the Sulphate of Potash plot, though hardly yielding more hay, was undoubtedly the nicer pasture and showed more clover.

10. *Potash Salts for Mangels and Potatoes.*

(a) Mangels—Road Piece—1925.

(b) Potatoes—Great Hill—1925.

These experiments were planned to provide a comparison between Sulphate of Potash, Muriate of Potash and Kainit.

(a) MANGELS—ROAD PIECE.

On Road Piece, where Mangels were grown in 1925, the seed "Giant Model Windsor" was drilled at the rate of 7 lb. per acre on May 12th, 13th, the general manuring per acre being Farmyard manure 9 tons; Superphosphate 3 cwt.; Sulphate of Ammonia 1 cwt. Potash Salts were given additionally according to the plan. Two cwt. per acre of Sulphate of Potash was taken as the standard, and the other salts were used in quantity to supply as much potash as this gave. The Sulphate of Ammonia was given subsequently as a top-dressing, the other artificials being applied at the time of sowing.

An excellent plant was obtained, and, by dint of careful cultivation and constant stirring of the land, a really good crop on this light land was obtained, despite the prolonged drought. On July 13th an additional top-dressing of 1 cwt. per acre of Nitrate of Soda was given.

The potash applications increased the growth of leaf; Sulphate of Potash gave dark green leaves, while Muriate of Potash and Kainit turned these more yellow. The Muriate of Potash seemed to give the larger bulbs. The crop was lifted October 17th, and the Mangels were weighed and pitted by October 30th.

The respective weights were:—

Potash Manures on Mangels. Road Piece. 1925.

Plot	Manuring	Roots per Acre			
		Tons	cwts.	qrs.	lb.
1	No Potash	19	3	2	24
2	Muriate of Potash	23	5	0	0
3	Sulphate of Potash	22	11	3	16
4	French Kainit	23	2	1	24

The results show that the potash applications materially increased the crop, the differences in yield between the three forms being within the experimental error.

(b) POTATOES—GREAT HILL.

On Great Hill, potatoes ("Red King") were planted, at the rate of 18 cwt. per acre from May 22nd onwards, the general manuring per acre being Farmyard manure 6 tons; Superphosphate 3 cwt.; Sulphate of Ammonia 1 cwt.

Potash salts, according to the plan set out, and supplying

the same amount of potash as contained in 2 cwt. of Sulphate of Potash, were applied May 21st, 22nd. The crop grew well and, as with the Mangels, in the early periods the potash additions gave the bigger tops, the Kainit and Muriate giving lighter coloured tops than the Sulphate.

The potatoes were lifted from October 30th onwards, early frosts, however, affected some of the tubers.

The weights were :—

Potash Manures on Potatoes—Great Hill—1925.

Plot	Manuring	Tubers per Acre			
		Tons	cwts.	qrs.	lb
1	No Potash	10	16	1	0
2	Muriate of Potash	15	4	1	14
3	Sulphate of Potash	12	11	2	0
4	French Kainit	13	9	3	0

Here, as in the Mangel experiment, the addition of potash in any form produced a marked increase in crop. Much the best return (an increase of nearly 4½ tons per acre over no potash) was obtained from Muriate of Potash, the Kainit following next, and giving nearly a ton per acre more than Sulphate of Potash.

11. *“ Bolting ” of Mangels and Sugar-Beet.*

“ Bolted ” roots were analysed and compared with normal roots.

The following analyses were made to measure, with special reference to Sugar Content, the changes occurring in bolted roots :—

	MANGELS				SUGAR-BEET			
	Sound Roots per cent.		“ Bolted ” Roots per cent.		Sound Roots per cent.		“ Bolted ” Roots per cent.	
Water	90.07	90.27	75.40	77.65				
Sugar	6.20	4.80	17.50	16.50				
Fibre ... ..	.60	.74	.96	1.16				
Mineral Matter	1.22	1.30	.69	.88				
Weight of Roots (washed & trimmed)	lb. 15 oz. 6	lb. 16 oz. 3	lb. 6 oz. 4	lb. 7 oz. 6				

POT CULTURE EXPERIMENTS.

1. *The Hills’ Experiments.*

The Influence of Titanium Compounds.

The selected materials were Titanium Oxide (pure) and the minerals Rutile (titanium oxide) and Ilmenite (Titaniferous iron ore). These were used in quantities to supply .05 per cent. and .10 per cent. of Titanium respectively in the soil (from Stackyard

Field), and the applications were made to the whole of the soil before sowing.

The crop grown was wheat, sown on December 14th, 1924.

Because of the poverty of the soil in lime, 2 tons per acre was added and also mineral superphosphate (3 cwt. per acre); later on (June) a top-dressing of Nitrate of Soda ($1\frac{1}{2}$ cwts. per acre) was given. Each treatment was in duplicate.

No abnormal appearances were noted during growth. The crop was cut on July 25th.

The following Table gives the treatment and results :—

Plot	Treatment			Weight of		Percentage of Untreated		
				Corn	Straw	Corn	Straw	
			% Ti.	grammes	grammes			
1	Control	...	...	19.2	33.8	100	100
2	Titanium Oxide (pure)		.05	20.8	33.3	108	98	
3	"	"	.10	21.9	33.3	113	98	
4	Rutile (crude Titanium Oxide)05	24.4	36.0	127	106
5	"	"	.10	23.7	34.8	123	103	
6	Ilmenite05	22.9	34.1	118	101
7	"10	23.4	33.0	122	98

It will be seen that all the compounds exercised some benefit, more marked with the Rutile than with the other compounds. At the same time the larger quantities of Titanium used did not show any general advantage over the smaller ones. It is probable that Titanium compounds exercise a slight stimulating effect.

2. Aluminium Compounds—with and without Potash—on Wheat.

(a) 1ST YEAR, 1923-4.

This experiment was started in 1924 to ascertain whether the presence of soluble compounds of aluminium in conjunction with potash exercises an influence on the acidity of the soil, or has some effect on liberating potash from the soil.

The soil used was that from Stackyard Field, one very deficient in Lime, and also poor in Potash.

The compounds of aluminium tried were the sulphate, the chloride, the oxide, and the silicate, each of these being used at the rate of 2 cwt. per acre with the exception of the silicate, of which 5 cwt. per acre was given. Two such sets were put up, one being given no potash, and the other being supplied with 1 cwt. per acre of sulphate of potash. The materials were mixed with the whole of the soil in each pot, and wheat was sown on December 17th, 1923. Until March, 1924, no differences were noted, but, subsequently, the potash set appeared superior. Towards the end of July the oxide and the silicate of the potash series stood out as the best.

The wheat was cut on August 18th, and the comparative results recorded were :—

	WITHOUT POTASH		WITH POTASH	
	Corn	Straw	Corn	Straw
Aluminium Sulphate	98	108	97	39
Aluminium Chloride	93	96	104	102
Aluminium Oxide	100	104	132	159
Aluminium Silicate	108	103	125	151
No Aluminium	100	100	98	104

The results showed, in the first place, no practical benefit to follow the use of Aluminium compounds by themselves. When, however, potash in addition was supplied, increase of crop above that given by potash alone resulted in the case of the oxide and the silicate of Alumina, in both corn and straw.

(b) 2ND YEAR. 1924-5.

The experiment was carried on for a second year, no further additions being given, but wheat being sown again (November 20th) after removal of the old stubble and roots.

In June a top-dressing of Nitrate of Soda ($1\frac{1}{2}$ cwt. per acre) was given to all the pots.

Again the potash set showed a manifest improvement on that without potash.

The crop was cut July 25th, and the subsequent weighings showed the following comparative figures :—

	WITHOUT POTASH		WITH POTASH	
	Corn	Straw	Corn	Straw
Aluminium Sulphate	102	98	104	104
Aluminium Chloride	111	103	119	107
Aluminium Oxide	110	106	128	112
Aluminium Silicate	103	101	112	116
No Aluminium	100	100	101	118

The duplicates, with the exception of the Chloride of Aluminium used with the potash, were in good agreement. Here, as in the first year, the Potash set was the better, and again a benefit was shown from the oxide and silicate of Alumina.

Taking the two seasons together, it appears that the oxide and the silicate, when used in conjunction with potash exercise a beneficial action, though Aluminium compounds by themselves are of no avail in setting potash free. The action of the sulphate and chloride of Aluminium is doubtful.

3. *Green-manuring Experiment.*

The experiment of 1923 and 1924 was repeated in 1925 and will be continued. The object was to ascertain whether any addition of lime or other materials would succeed in producing more

satisfactory corn crops on the land of Stackyard Field and of Lansome Field, where green-manuring with Tares and Mustard had been carried on for a number of years, but where the corn crops following the green crops (whether fed off or ploughed in) had always been very inferior.

Fresh soil was in each case taken from the respective plots of the two fields, and the whole contents of a pot were mixed with the several applications given in the accompanying Table, these being the same as formerly.

Wheat was sown on November 20th, 1924. During the growth of the crop the effects of adding lime were clearly visible in several instances, though not as marked as in the experiments of 1923 and 1924. Further, it was seen more in the Tares soil than in the Mustard soil, and more so in Stackyard Field than in Lansome Field, though the crops of the latter were, on the whole, the heavier. The wheat was cut on July 25th, and the comparative yields are set out in the following Table:—

Green-manuring Experiment—Wheat after green crops, 1925.

	(a) STACKYARD FIELD SOIL		(b) LANSOME FIELD SOIL	
	Corn	Straw	Corn	Straw
<i>i. Wheat after Tares.</i>				
Untreated	100	100	100	100
Lime—2 tons per acre	120	150	160	125
Superphosphate—3 cwt. per acre ...	93	108	130	112
Sulphate of Potash—1 cwt. per acre	94	96	114	103
Lime, Superphosphate and S/Potash	160	167	111	134
<i>ii. Wheat after Mustard.</i>				
Untreated	100	100	100	100
Lime—2 tons per acre	102	120	116	136
Superphosphate—3 cwt. per acre ...	96	78	113	105
Sulphate of Potash—1 cwt. per acre	94	93	107	107
Lime, Superphosphate and S/Potash	92	100	105	122

The results were not nearly as marked as in the former experiment; still, the beneficial influence of lime was clearly seen in the case of the Tares soil on either field, though not appreciably so on the Mustard soil of either. It was shown, however, that none of the other applications were likely to do any good without lime.

4. *The Relative Values of Lime and Chalk, 1925.*

The experiments begun afresh in 1924—and in which, contrary to earlier practice, phosphates and potash were used additionally—were continued in 1925, the same soil (from Stackyard Field) without further additions being used, and wheat being sown on November 20th, 1924.

In June, 1925, a top-dressing of Nitrate of Soda (1½ cwt. per acre) was given to all the pots.

The plant grew very fairly throughout and there was not the difference in germination noted with the higher amounts of lime

and chalk when applied in the first year; the marked differences in growth between the lime series and the chalk series previously recorded, were also absent.

The wheat was cut on July 25th and the following comparative results were recorded, the figures for 1924 being repeated for convenience of reference:—

Lime and Chalk upon Wheat—Stackyard Field Soil, 1924 and 1925.

Treatment	1924		1925	
	Corn	Straw	Corn	Straw
No Lime	100	100	100	100
Lime (CaO) 10 cwt. per acre	113	100	105	118
" " 1 ton " "	136	133	126	130
" " 2 tons " "	145	167	109	119
" " 3 " " " "	168	196	113	117
" " 4 " " " "	179	194	121	116
Chalk=10 cwt. CaO " "	94	88	111	123
" = 1 ton " " " "	94	79	114	131
" = 2 tons " " " "	101	94	116	116
" = 3 " " " " " "	99	93	117	124
" = 4 " " " " " "	92	78	127	118
Ground Limestone, 1 ton per acre	84	72	130	124
" " 2 tons " " " "	85	76	137	119

It will be seen that in the second year the increase due to lime was less than before, while chalk, that showed no effect in the first year, was not equal in its results to lime. A similar result was noticed in a corresponding set of experiments carried on over the 4 years 1919-22 (see report of 1922, p. 72).

Further, it would appear that ground limestone—which had shown no benefit at all the first year—was now beginning to come into action, it giving the highest results of all.

This experiment will be continued.

5. *Magnesia and Magnesium Carbonate on Wheat, 1925.*

This series, also started afresh in 1924 on Stackyard Field soil and with addition of phosphate and potash, was continued in 1925, the same soil, without further additions, being used and wheat being sown on November 20th.

This year only the two highest amounts of magnesia (3 and 4 tons per acre) affected the plant or reduced the produce. A partial explanation is that in the first year the magnesia applications were given to the top 6 inches of soil only, whereas the soil was turned out and mixed before the second crop was sown. Magnesium carbonate in the higher amounts of 3 tons and 4 tons per acre seemed also to exert some toxic effect.

A top-dressing of Nitrate of Soda ($1\frac{1}{2}$ cwt. per acre) was given to all the pots in June, 1925.

The wheat was cut on July 25th, and the comparative results are recorded, along with those of 1924, in the following Table :—

Magnesia and Magnesium Carbonate upon Wheat—Stackyard Field Soil, 1924 and 1925.

Treatment	1924		1925	
	Corn	Straw	Corn	Straw
No Magnesia ...	100	100	100	100
Magnesia (MgO) 10 cwt. per acre ...	185	189	183	122
" " 1 ton " ...	180	216	152	104
" " 2 tons " ...	—	—	155	133
" " 3 " " ...	—	—	6.1	90
" " 4 " " ...	—	—	—	32.4
Magnesium Carbonate = 10 cwt. MgO per acre	148	158	147	125
" " = 1 ton ...	191	199	119	114
" " = 2 tons ...	201	230	113	77
" " = 3 " " ...	226	240	13.4	53
" " = 4 " " ...	191	235	17.3	55
Ground Magnesian Limestone =				
" " 1 ton per acre	108	108	138 (?)	107
" " 2 tons ...	108	108	131(?)	97

The more potent action of Magnesia over Magnesium carbonate, both in improving the crop when used in small amount, and in injuring it when used in large amounts, is well brought out this second year.

Similarly, 10 cwt. of Magnesium carbonate per acre gave quite a marked increase, one shared to lesser extent with 1 ton and 2 tons, but, as with Magnesia, failure came with the 3 tons and 4 tons applications. This, however, had not been the case in 1924.

The results as regards ground Magnesian limestone are somewhat uncertain owing to irregularities of the duplicates. As yet no injurious effects have shown.

These experiments, which are quite in line with those of former years, will be continued.