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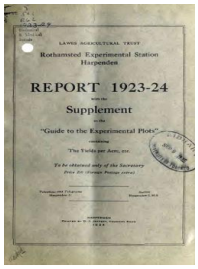
Report for 1923-1924 With the Supplement to the Guide to the Experimental Plots Containing the Yields per Acre Etc.



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Woburn Experimental Farm Report 1923-1924

Dr J. A. Voelcker

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WOBURN EXPERIMENTAL FARM.

REPORTS FOR 1923 & 1924 BY DR. J. A. VOELCKER.

SEASON 1923.

A late harvest made cultivation of the land backward, but open and fairly dry weather in October and November gave favourable conditions for sowing winter crops. This continued throughout December and January, rainfall not being excessive and frost nearly absent. The whole winter, 1922-3, indeed, was marked by absence of frost. February and March were wet months, and the soil was left in somewhat sticky condition for spring sowing. April, May and June were all cold and unseasonable, with absence of sunshine and late frosts in May, and crops made but little progress. About June 25th a spell of very hot and dry weather set in, giving good conditions for hay-making, though the yield was small. A violent thunderstorm in July with heavy rainfall saved the swede and other root crops, and also clovers and "seeds," which were beginning to show the effect of the drought; corn crops also grew rapidly. The fine weather continuing until August 14th, oats and wheat were safely reaped, and good crops of roots and aftermath (clover and "seeds") were promised. The drought had a bad effect on spring-sown corn crops, the first shoots ripening prematurely, and, when the rain came, fresh shoots were sent up which never developed properly. The general result was to give an exceedingly poor corn yield, and the weights at threshing were even less than the appearance in the field had indicated. The early-sown barley ripened well, but the late-sown was practically a failure. On August 14th there was a severe thunderstorm, during which 1½ inches of rain fell, and, the remainder of the month proving cold and showery, the harvesting of barley was delayed until August 31st.

The total rainfall for the 12 months to September inclusive was 23.2 inches, there being 175 rainy days. The heaviest rainfall was in July, viz., 3.53 inches, February giving 3.03 inches, August and September 2.94 and 2.48 inches respectively.

SEASON 1924.

The season 1923-4 was an altogether exceptional one. Heavy rainfall and long continued absence of sunshine and warmth combined to retard the growth of corn crops and to prevent their proper maturing. Weeds spread rapidly, and it was difficult to keep the land clean. Under these conditions only poor yields of low quality corn could be expected, especially as harvesting took place in bad weather.

The rainfall for the whole season, October 1923 to October 1924, was 30.30 inches as against 23.2 in 1923, with 201 rainy days (over .01 inch) against 175 in 1923. May—just the time when dryness and warmth were required—was by far the wettest month of the whole year, with 6.06 inches of rain, and 20 rainy days. On the other hand, February was the driest month, with only 0.48 inches of rain—in February, 1923, it was 3.03 inches.

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The harvest months of July, August and September were alike wet, with 3.07, 2.32 and 3.17 inches of rain respectively.

The untoward weather influences were felt in very marked measure on the continuous wheat and barley plots, the returns for which were lower than for many years past. The highest yield of barley on the continuous plots was only 13 bushels per acre, whereas land close by in the same field gave, under rotation cropping, 27.3 bushels per acre where no nitrogen but only mineral manures had been applied.

Great difficulties also were experienced with the root crops, through the excessive washing of the soil and the floods that came in the latter part of May. One field was under water for some days, and in another the newly-planted potatoes were, in places, washed out and carried some distance away. The lucerne inoculation experiment was ruined by the flooding, and had to be abandoned. A great deal of the manure put in the land for the root crops must have been washed out, and so caused a diminution in the returns.

The one really good crop was hay—alike from rotation grasses, clover and from permanent pasture—and abundant crops were gathered in excellent condition.

FIELD EXPERIMENTS.

1. *Continuous Growing of Wheat* (Stackyard Field), 1923.

1923 (*47th Season*).

"Red Standard" wheat, 2½ bushels per acre, was drilled on October 26th, 1922, farmyard manure having been ploughed in on 11b on October 19th and 20th, while mineral manures (phosphates and potash) were applied just previously to the sowing of the wheat, and rape dust (plot 10b) on November 14th. Nitrogenous top-dressings of sulphate of ammonia and nitrate of soda were given on May 15th and June 20th, 1923.

The wheat was cut on August 13th, stacked August 21st, and threshed November 14th, 1923.

The yield was exceptionally poor, the unmanured produce averaging 5.6 bushels of corn and 7 cwt. of straw per acre, against 8.5 bushels and 7.25 cwt. in the previous year. One has to go back to 1914 to find so bad a yield on these plots, the return for these two years being, indeed, very similar. Added to the difficulties of season was the fact that the damage done by pheasants to some of the normally weak plots was so great that they had to be resown later with spring wheat. This never came up satisfactorily and, for purposes of comparison and comment, the ammonia plots must be left out of account.

1924 (*48th Season*).

"Red Standard" wheat, at the rate of 3 bushels per acre, was drilled on October 19th, 1923, plot 11b having received its farmyard manure and plot 10b its rape dust on October 16th, and mineral manures having been given to the other plots to receive them, on October 18th. The nitrogenous top-dressings were applied, the first halves on May 5th-6th, 1924, and the second

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Continuous Growing of Wheat, 1923 (47th Season) and 1924 (48th Season).

(Wheat grown year after year on the same land, the manures being applied every year.)

Stackyard Field—Produce per acre.

Plot.	Manures per acre.	1923. Head Corn. No. of bushels.	1923. Head Corn. Weight per bushel.	1923. Tail Corn. Weight.	1923. Straw, Chaff, &c.	1924. Head Corn. No. of bushels.	1924. Head Corn. Weight per bushel.	1924. Tail Corn. Weight	1924. Straw, Chaff, &c.
			lb.	lb.	cwt. q. lb.		lb.	lb.	cwt. q. lb.
1	Unmanured	5·2	62·0	4	5 0 6	1·8	56·0	2	4 1 4
2a	Sulphate of Ammonia (=25 lb. Ammonia)	—	—	—	—	—	—	—	—
2aa	As 2a, with 5 cwt. Lime, Jan., 1905, repeated 1909, 1910, and 1911 ...	6·0	61·5	8	8 2 0	3·6	55·0	4	9 0 0
2b	As 2a, with 2 tons Lime, Dec., 1897	2·0	60·0	10	2 0 24	2·7	56·0	2	5 1 4
2bb	As 2b, with 2 tons Lime repeated Jan., 1905	3·4	61·7	6	4 3 12	6·6	56·5	4	9 1 4
3a	Nitrate of Soda (=50 lb. Ammonia)	11·7	61·5	8	10 3 4	15·0	56·0	4	18 2 4
3b	Nitrate of Soda (=25 lb. Ammonia)	10·6	61·7	8	9 2 12	14·3	56·0	12	18 0 20
4	Mineral Manures (Superphosphate 3 cwt., Sulphate of Potash ½ cwt.) ...	8·9	61.0	4	9 2 4	3·5	57·0	4	5 3 14
5a	Mineral Manures and Sulphate of Ammonia (=25 lb. Ammonia) ...	1·5	60·0	4	2 0 24	4·0	56·0	4	7 3 20
5b	As 5a, with 1 ton Lime, Jan., 1905	6·4	61·5	8	7 1 16	6·4	55·5	2	10 0 0
6	Mineral Manures and Nitrate of Soda (=25 lb. Ammonia)	13·0	61·0	6	11 1 0	15·2	55·5	11	20 3 10
7	Unmanured	6·1	62·2	7	5 3 2	1·4	56·0	2	4 2 2
8a	Mineral Manures and, in alternate years, Sulphate of Ammonia (=50 lb. Ammonia)	1·5	62·0	8	2 0 8	—	—	—	—
8aa	As 8a, with 10 cwt. Lime, Jan., 1905, repeated Jan., 1918...	2·8	61·5	8	5 1 12	6·8	56·0	4	16 3 12
8b	Mineral Manures, Sulphate of Ammonia (=50 lb. Ammonia) omitted in alternate years	1·2	62·0	4	2 8	—	—	—	—
8bb	As 8b, with 10 cwt. Lime, Jan.. 1905, repeated Jan., 1918...	6·4	60·0	12	6 2 24	4·0	56·0	4	8 3 4
9a	Mineral Manures and, in alternate years, Nitrate of Soda (=50 lb. Ammonia)	10·0	60·5	10	9 4 24	14·5	56·7	12	21 3 20
9b	Mineral Manures, Nitrate of Soda (= 50 lb. Ammonia) omitted in alternate years	3·8	60·5	4	3 2 24	5·5	56·0	3	11 4 16
10a	Superphosphate 3 cwt., Nitrate of Soda (=25 lb. Ammonia)	11·9	61·5	8	12 1 20	16·7*	56·0	16	24 1 12
10b	Rape dust (=25 lb. Ammonia)	8·8	61·5	12	10 0 16	9·5	57·2	8	15 0 24
11a	Sulphate of Potash 1 cwt., Nitrate of Soda (=25 lb. Ammonia)	10·5	62·0	8	10 1 20	18·0*	54·5	18	31 2 0
11b	Farmyard Manure (=100 lb. Ammonia)	11·7	62·0	12	14 1 24	17·5	54·1	30	32 3 24

* Nitrate of Soda = 50 lb. Ammonia was, in error, applied in 1924 to plots 10a and 11a.

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halves on June 18th. The wheat, though it came up quite well, was, for a considerable time afterwards, almost at a standstill, and was late in making a start. It looked better in January, 1924, but another period of stagnation occurred in March and April, and the crop moved but slowly. In June the farmyard manure plot (11b) looked the best; it was also specially noticeable that the nitrate of soda plots were better than the sulphate of ammonia ones, but much more weedy than any of the other plots. The crops being but small, stood up well and were cut on August 14th, carted on September 2nd and stacked, being threshed out the week before Christmas, 1924.

The produce, on account of the untoward conditions, was very poor—as low as any recorded during the whole 48 years. The unmanured produce was only 1.6 bushels of corn with 4 c. 1 qr. 17 lbs. of straw, etc., per acre; nitrate of soda was markedly superior to sulphate of ammonia throughout, but the heavier dressings were not better than the lighter ones. Lime still continued to show its influence, even in plot 2b (last limed in 1897).

The results for both years are given on page 79.

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

1923 (*47th Season*).

Farmyard manure was applied (plot 11b) March 21st, 1923, mineral manures and rape dust on April 4th, and barley—"Plumage Archer"—at the rate of 2½ bushels per acre was drilled on April 5th. The first nitrogenous top-dressings were given on June 12th, the second on July 10th. On plot 2aa a further application of lime—10 cwt. per acre—was made in January 1923.

The season was very unfavourable for barley, and the crop was specially short in the straw. The farmyard manure plot (11b) was the only one to look even fair, and a small yield generally characterised the harvest which began on August 31st, the barley being stacked on September 1st and threshed November 11th, 1923.

The unmanured produce was only 3.9 bushels of corn with 6 cwt. 3 qrs. straw per acre, a yield below even the poor one of 1921. Nitrate of soda, both alone and with minerals, did much better than sulphate of ammonia, even when lime was given as well.

1924 (*48th Season*).

"Plumage Archer" barley, at the rate of 3 bushels per acre, was drilled on March 10th, 1924. Rape dust and farmyard manure had been previously (February 11th) applied to plots 10b and 11b. The barley was slow in coming up and was never more than a thin crop and not of good healthy colour; further, weeds were very abundant, especially on the nitrate of soda plots. The first top-dressings of nitrogenous salts were given on May 15th and 16th, the second on June 25th. A very poor crop only—as low as any during the whole 48 years' experiments—was obtained. This was cut on August 13th, carted and stacked on

Continuous Growing of Barley, 1923 (47th Season), and 1924 (48th Season).

(Barley grown year after year on the same land, the manures being applied every year.)

Stackyard Field—Produce per acre.

Plot.	Manures per acre.	1923. Head Corn. No. of bushels.	1923. Head Corn. Weight per bushel.	1923. Tail Corn. Weight.	1923. Straw, Chaff, &c.	1924. Head Corn. No. of bushels.	1924. Head Corn. Weight per bushel.	1924. Tail Corn. Weight.	1924. Straw, Chaff, &c.
			lb.	lb.	cwt. q. lb.		lb.	lb.	cwt. q. lb.
1	Unmanured	4·1	52·5	2	7 2 16	1·8	51·2	2	3 1 2
2a	Sulphate of Ammonia (=25 lb. Ammonia)	—	—	—	—	—	—	—	—
2aa	As 2a, with 5 cwt. Lime, Mar., 1905, repeated 1909, 1910 and 1912, and 10 cwt. Lime applied Jan., 1923	1·7	52·7	4	3 1 12	4·9	51·6	2	8 0 20
2b	As 2a, with 2 tons Lime, Dec., 1897, repeated 1912	3·2	52·0	4	5 2 8	4·1	51·0	4	5 2 12
2bb	As 2a, with 2 tons Lime, Dec., 1897, repeated Mar., 1905	3·3	51·0	2	6 0 0	3·6	49·8	2	6 1 12
3a	Nitrate of Soda (=50 lb. Ammonia)	11·1	51·5	12	14 0 0	5·0	50·5	4	8 3 20
3aa	As 3a, with 2 tons Lime, Jan., 1921	8·0	51·2	8	9 2 24	3·6	49·0	4	7 1 16
3b	Nitrate of Soda (=25 lb. Ammonia)	5·0	50·0	4	8 2 0	4·5	50·2	4	7 3 0
3bb	As 3b, with 2 tons Lime, Jan., 1921	4·8	51·0	2	8 1 8	4·6	50·0	4	8 2 12
4a	Mineral Manures[1]	5·8	50·2	4	5 2 10	2·1	49·8	2	3 1 6
4b	As 4a, with 1 ton Lime, 1915	6·1	51·2	6	8 0 12	4·6	50·0	4	3 2 4
5a	Mineral Manures and Sulphate of Ammonia (=25 lb. Ammonia) ...	2·2	51·7	4	3 1 12	—	—	—	—
5aa	As 5a, with 1 ton Lime, Mar., 1905, repeated 1916	6·2	51·5	8	8 1 4	10·8	50·5	8	10 3 8
5b	As 5a, with 2 tons Lime, Dec., 1897, repeated 1912	6·5	51·5	8	8 2 20	7·1	50·5	4	5 1 18
6	Mineral Manures and Nitrate of Soda (=25 lb. Ammonia)	8·5	50·5	4	10 3 10	13·0	49·4	12	9 3 2
7	Unmanured	3·7	52·0	4	6 0 10	1·6	50·5	2	3 1 25
8a	Mineral Manures and, in alternate years, Sulphate of Ammonia (=50 lb. Ammonia)	—	—	—	—	—	—	—	—
8aa	As 8a, with 2 tons Lime, Dec., 1897, repeated 1912	8·7	52·0	8	8 1 4	13·9	51·0	4	10 3 12
8b	Mineral Manures, Sulphate of Ammonia (=50 lb. Ammonia) omitted in alternate years	—	—	—	—	—	—	—	—
8bb	As 8b, with 2 tons Lime, Dec., 1897, repeated 1912	6·3	52·0	8	8 3 4	6·6	51·0	4	6 1 16
9a	Mineral Manures and, in alternate years, Nitrate of Soda (= 50 lb. Ammonia)	13·1	52·0	4	16 0 20	8·5	51·5	6	7 0 24
9b	Mineral Manures, Nitrate of Soda (= 50 lb. Ammonia) omitted in alternate years	5·9	52·5	2	9 0 0	5·7	51·0	6	4 3 6
10a	Superphosphate 3 cwt., Nitrate of Soda (=25 lb. Ammonia)	5·6	52·0	6	7 0 12	8·5	51·0	6	8 0 14
10b	Rape dust (=25 lb. Ammonia)	5·3	53·2	6	6 0 0	2·6	52·1	2	5 0 0
11a	Sulphate of Potash 1 cwt., Nitrate of Soda (=25 lb. Ammonia)	11·4	52·5	8	10 1 8	6·7	51·4	4	6 1 6
11b	Farmyard Manure (=100 lb. Ammonia)	21·8	53·0	8	18 0 0	13·0	52·0	6	9 0 18

[1] Superphosphate 3 cwt., Sulphate of Potash ½ cwt.

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August 31st and September 1st, and threshed just before Christmas.

The unmanured produce was only 1.7 bushels of corn with 3 c. 1 qr. 14 lb. of straw, etc., per acre. Sulphate of ammonia by itself, or with minerals and no lime, as usual, gave no crop, but with lime gave marked increases, going up to a yield of 13.9 bushels per acre (plot 8aa). Nitrate of soda did not, on the whole, do as well as sulphate of ammonia with lime, the highest yield with it being 13 bushels (plot 6).

The heavier dressings of nitrate of soda had no advantage over the lighter ones, nor did the use of lime on the nitrate plots produce any benefit.

The results for both years are given on page 81.

3. *Rotation Experiments.*

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

1923. *Barley.*

(*a*) Series C.

As the swede crop of 1922 was quite small, mangels were carted on to augment the root supply. The sheep were on from December 20th, 1922, to February 7th, 1923. They consumed, on the corn plot (2 acres) 22 cwt. of oats and 10 cwt. of barley, equivalent to 29.25 lb. nitrogen per acre; on the cake plot (2 acres) 7 cwt. of linseed cake, 6 cwt. decorticated cotton meal and 14 cwt. 42 lb. of undecorticated cotton cake, equivalent to 67 lb. nitrogen per acre.

"Plumage Archer" barley, at the rate of 2½ bushels per acre, was drilled on March 28th, and a clover mixture—Red Clover 7 lb., Alsike 3 lb., Trefoil 3 lb. per acre—(red clover alone having been taken four years previously) was sown in the barley on May 1st, 1923. The barley grew fairly well in spite of the unfavourable season. The crop was cut on August 16th.

1924. *Clover.*

The clover grew well in 1924, promising an excellent crop. This was cut and gathered on June 27th—30th, 1924. The second growth was small and was ploughed in.

The results were :—

	Barley, 1923				Hay, 1924
	Head Corn		Tail Corn	Straw, Chaff, etc.	Yield per Acre
	Yield per Acre	Weight per bushel	Weight		
	bushels	lb.	lb.	cwt.	cwt.
Corn fed	14·2	55	21	9·7	38·7
Cake fed	16·2	55	28	10·1	37·1

Neither in the barley crop of 1923 nor in the succeeding clover of 1924 has there been anything to show the value of the richer cake-feeding as against that of corn. This result is

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striking, as not only were the amounts of corn and cake much greater than previously used, but the margin between the cake and corn fed was nearly 38 lb. of nitrogen, equivalent to 2 cwt. of nitrate of soda per acre.

(*b*) Series D. 1923, *Clover*. 1924, *Wheat*.

Red clover had been sown in the barley crop of 1922 on May 22nd, and it looked very well through the winter. It was twice cut for hay in 1923, viz., on June 25th and on August 13th, and "Red Standard" wheat, 3 bushels per acre, was drilled October 18th. It came up fairly well, but was rather slow in growth. The cake-fed plot looked rather better than that corn-fed. The crop improved towards harvest and was cut August 26th and carted September 2nd. The results were :—

	Clover, 1923			Wheat, 1924			
	Yield per Acre			Head Corn		Tail Corn	Straw, Chaff, &c.
	1st Cut	2nd Cut	Total	Yield per acre	Weight per bushel	Weight	
	cwt.	cwt.	cwt.	bushels	lb.	lb.	cwt.
Corn fed	34·0	13·5	47·5	19·3	54·0	20	13·2
Cake fed	35·1	13·3	48·4	19·5	55·8	20	16·0

The differences are not significant, but it must be remembered that no cake or corn had been fed since 1916.

4. *Green-manuring Experiments.*

(*a*) Stackyard Field. Series A.

1923.

As noticed in the 1922 report, a change in these plots was introduced in 1922, they being now so arranged that every year there will be a corn crop on one-half of the area and a green-crop on the other half.

Upper Half.—The green crops grown and fed off by sheep in July and October, 1922—1½ cwt. of cotton cake per acre being given as well—were followed by wheat—"Red Standard"—which was drilled on November 9th at the rate of 2½ bushels per acre. On December 15th 3 cwt. per acre of superphospate were given to the wheat. It was never more than a poor crop, but now, for the first time, the wheat after tares seemed to be better than that after mustard. It was cut August 13th, stacked August 21st, and threshed November 15th.

The results were :—

Plot		Head Corn		Tail Corn	Straw, Chaff, etc.
		Yield per acre	Weight per Bushel	Weight	
		bushels	lb.	lb.	cwt.
1	After Tares fed off	8·0	62·3	9	9·3
2	After Mustard fed off ...	5·6	62·0	8	5·3

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The crops were miserably small, and it is hard to understand how they came to be so, seeing that not only were two crops of tares and mustard respectively fed off on the land, but that 1½ cwt. of cotton cake per acre were given as well to the sheep. Yet a wheat crop of only 8 bushels per acre was the result. For the first time, however, in the history of the experiment, a slight superiority was shown with the tares as compared with the mustard, similarly fed.

Lower Half.—Here tares were drilled—2 bushels per acre—on November 3rd, 1922, and were fed off by sheep receiving also 3 cwt. cotton cake per acre (increased from the 1½ cwt. per acre of former years). It was only possible to take one crop of tares. Two crops of mustard, however, were grown, the seed being sown on May 4th, 1923, and on August 4th, at the rate of 20 lb. per acre. Each crop was similarly fed off with cake, and, after ploughing the land, wheat was sown.

1924.

On the upper half, green crops followed the wheat of 1923. Previous to their sowing, an application of two tons of lime per acre was given to one half of each acre plot—September 25th, 1923. Tares—2 bushels per acre were drilled on March 19th. 1924, and gave an excellent crop. Mustard—20 lbs. per acre—was sown broadcast on May 30th, and also grew well. Sheep were put on the mustard on July 22nd, and passed on to the tares on August 12th, consuming on each plot 3 cwt. per acre of cake (half linseed and half cotton cake). Only one green crop of each kind was grown, and after the sheep had eaten these off, the plots were ploughed up in October and wheat again sown.

On the lower half, wheat (" Red Standard ") was drilled on November 5th, 1923, at the rate of 3 bushels per acre. It showed about the middle of December and grew well right on to May, 1924, the wheat after tares looking decidedly better than that after mustard, and being as good as, or even better than, any other wheat plot on the field. After this however came the usual falling off, and by the middle of June the wheat looked poor and short in straw on both plots. It was cut on August 14th, carted September 2nd, and threshed just before Christmas.

The yields were :—

Plot		Head Corn		Tail Corn	Straw, Chaff, etc.
		Yield per Acre	Weight per bushel	Weight	
		bushels	lb.	lb.	cwt.
1	After Tares fed off	7·3	57·0	6·0	8·7
2	After Mustard fed off ...	9·1	57·7	6·5	9·5

Thus the old order of things—broken in 1923—was restored, the mustard once more showing itself the better preparation, though both crops were miserably and unaccountably poor, the wheat crop on Series D (Rotation) in the same field being 19.5 bushels per acre.

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(*b*) *Lansome Field.*

On the extended area, now consisting of five plots, wheat followed the ploughing-in of the green crops, 5 cwt. of basic slag and 1 cwt. of sulphate of potash per acre having been previously (1921) given to these crops. "Red Standard" wheat—2½ bushels to the acre—was drilled on all the plots on October 25th, 1922. Throughout the period of growth the crop looked better on the tares plots than on the mustard ones, and these appearances were borne out at harvest. The crop was cut August 14th, stacked August 21st, and threshed November 12th, 1923.

The results were :—

		Head Corn		Tail Corn	Straw, Chaff, etc.
		Yield per Acre	Weight per bushel	Weight	
	Plot	bushels	lb.	lb.	cwt.
Old Plots	1. After Mustard ploughed in	6·9	63·0	8	8·9
	2. After Tares ploughed in ...	7·0	63·2	8	12·4
New Plots	3. After Mustard ploughed in	7·2	63·0	6	9·3
	4. After Tares ploughed in ...	7·2	63·2	6	13·9
	5. Control (no green crop) ...	5·7	63·2	4	8·6

The differences in weight of corn are but small, but the tares have, in each case, given appreciably more straw, and the general tendency is to confirm the results in Stackyard Field. At the same time, the crops are unaccountably small, and, following on work carried out with these soils in the Pot-culture Station, it was decided to lime one-half of each series in Lansome Field and Stackyard Field, and to see whether the small crops obtained might not be due to the poverty of the soils in lime.

1924.

Lime, as contemplated above, was given to one-half of all the plots on September 25th, 1923, at the rate of 2 tons per acre. Tares—2 bushels per acre—were sown on March 29th, 1924, and mustard—20 lb. per acre—on May 29th. The green crops were decidedly better on the new plots than on the old ones. They were ploughed in on July 31st and second crops sown on August 19th, these being, in turn, ploughed in green, September 26th-30th, and wheat sown.

5. *Malting Barley Experiments.*

1923.

The field chosen was Butt Close, a light sandy loam. The area used had previously carried a moderate crop of swedes, to which farmyard manure had been given.

The barley was drilled on April 10th at the rate of 2½ bushels per acre, the manures being put on the same day. The barley came up nicely and promised to be an excellent crop. Early in June the control, plot 1, looked a bit patchy, while plot 5 (no nitrogen) was much less vigorous than plots 2, 3 and 4. These appearances continued until July. The crop was cut and shocked August 30th-31st. Pots 2—5 were all dead ripe. Plot 1 had a fair proportion of green or only partially ripe straw.

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1924.

The experiment of 1924 was in Stackyard Field, following oats. "Plumage Archer," as before, was drilled—3 bushels per acre—on March 11th, the various manures being applied at the same time. The barley grew well. The plot to ripen quickest was plot 2 (complete manuring), and the phosphate plot (3) ripened more quickly than the potash one (2).

The barley was cut on August 12th.

The yields generally were lower than in 1923 and the relative yields of the no-phosphate and no-potash plots are reversed in the two years. The results for the two years are given in the following table :—

Manures per Acre	1923				1924			
	Head Corn		Tail Corn	Straw, Chaff, etc.	Head Corn		Tail Corn	Straw, Chaff, etc.
	Yield per acre	Weight per bushel	Weight		Yield per acre	Weight per bushel	Weight	
	bushels	lb.	lb.	cwt.	bushels	lb.	lb.	cwt.
No Manure	35·1	53·3	9·5	21·0	22·5	52·9	22·0	11·2
Superphosphate 3 cwt., Sulphate of Potash 1½ cwt., Sulphate of Ammonia 1 cwt.	43·4	55·6	9·0	21 0	29 4	53·1	26·0	17·85
Superphosphate 3 cwt., Sulphate of Ammonia 1 cwt.	41·0	55·5	10·0	21·2	32 8	52·7	26·0	18·25
Sulphate of Potash 1½ cwt., Sulphate of Ammonia 1 cwt.	38·8	55·0	10·0	17·75	38·8	53·5	30·0	21·45
Sulphate of Potash 1½ cwt., Superphosphate 3 cwt.	31·9	53·5	6·0	14·4	27·3	53 7	18·0	15·6

6. *Experiments with Sulphate and Muriate of Ammonia.*

Comparisons of these two manures were carried out in 1923 on wheat and barley and in 1924 on wheat, mangolds and swedes. The details of cultivation, etc., follow. In each experiment 1 cwt. of sulphate of ammonia and the equivalent quantity of muriate were employed :—

Wheat, 1923 : Road Piece, thin light sandy loam. Drilled, 2½ bushels per acre, October 23rd, 1922. Top dressings applied May 31st. Cut August 10th, the previous crop being "seeds," ploughed in. No basal manuring was given.

Barley, 1923 : Butt Close, light sandy loam. Drilled, 2½ bushels per acre, April 10th. Top dressing applied June 2nd. Cut August 30th. Previous crop, swedes fed off with sheep.

Wheat, 1924 : Great Hill, light sandy loam. Drilled, 3 bushels per acre, November 1st-2nd, 1923. Top dressing applied June 3rd. Cut August 15th-18th. Previous crop, red clover (cut twice).

Mangolds, 1924 : Warren Field, Oxford clay. Dung, 8 tons per acre, April 26th. Super, 2 cwt. and Kainit 3 cwt. per acre, May 13th, seed drilled 6 lb. per acre, May 15th. Top dressings applied July 22nd-23rd. Roots pulled November 15th-25th.

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Swedes, 1924: Warren Field, Oxford clay. Dung 12 tons per acre, May 10th-15th. Super 4 cwt. and Kainit 4 cwt., May 16th, seed drilled 5 lb. per acre, June 23rd. Roots pulled January 1st-23rd, 1925.

Note.—The swedes and mangolds experiments were subjected to heavy rainfall and flooding during May (p. 78).

The results follow :—

Crop	Plot	Produce per Acre: Head Corn, Yield per Acre	Head Corn, Weight per Bushel	Tail Corn, Weight	Straw, etc.
		bushels	lb.	lb.	cwt.
Wheat, 1923...	2. Control	15·6	61·0	17	11·3
	1. Sulphate of Ammonia ...	17·6	61·5	13	13·1
	3. Muriate of Ammonia ...	19·8	61·5	16	14·8
Barley, 1923...	2, 5 Control	36·6	53·5	6	17·0
		35·6	53·7	6	18·9
	1, 4 Sulphate of Ammonia ...	41·6	53·7	9	19·9
		40·0	53·8	10	19·4
	3, 6 Muriate of Ammonia ...	46·7	54·0	7	22·5
		45·5	53·9	8	21·1
Wheat, 1924...	1. Sulphate of Ammonia ...	43·0	57·3	20	32·2
	2. Muriate of Ammonia ...	45·8	56·8	22	34·4

		Mangolds	Swedes
		Tons	Tons
Mangolds and Swedes, 1924	1. Dung and Minerals only	11·85	14·56
	2. Dung and Minerals with Sulphate of Ammonia	14·07	17·21
	3. Dung and Minerals with Muriate of Ammonia	12·85	15·76
	4. Dung and Minerals with Muriate of Ammonia	12·87	16·80

Although the differences in some cases are small, it appears that for corn the muriate gives a bigger yield than sulphate of ammonia, while the reverse holds for roots.

7. *The Relative Values of Lime and Chalk for Liming Purposes* (Stackyard Field). Series B.

1923.

This experiment—one conducted on the crops of an ordinary 4-course rotation—was started in 1919, when 12 plots in Stackyard Field, each one-sixth of an acre in extent, were set out in two series, the one consisting of plots to which caustic (burnt) lime was given in different quantities, the other of plots which received ground chalk in quantities supplying the same amount of lime (CaO) as given to the corresponding caustic lime plots. There were also two unlimed plots.

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The lime and chalk were spread in January, 1919, and the land ploughed.

The crops were :—1919, barley; 1920, swedes; 1921, barley; 1922, tares followed by mustard; 1923, oats. The ordinary course of cultivation, manuring, etc., was followed over the whole area, the only difference being in the application of lime or of chalk.

It would naturally take some time for the lime and chalk to distribute themselves fairly over the soil; for the first few years there was little beyond the general indication that lime produced rather the better crop; this was the case with the swedes of 1920 and the barley of 1921; the tares of 1922 and subsequent mustard crop were fed off by sheep and not weighed. Black Winter oats followed as the crop of 1923, and were drilled on October 31st at the rate of 4 bushels per acre. The crop was cut August 2nd-3rd, stacked August 16th, and threshed November 12th and 13th, 1923.

The harvest results were as follows :—

Plot	Applications per acre	Head Corn		Tail Corn	Straw, Chaff, etc.
		Yield per acre	Weight per bushel		
		bushels	lb.	lb.	cwt.
1	No Chalk	22·1	38·0	3·5	8·5
2	Chalk = 10 cwt. Lime	19·9	39·0	2·5	7·3
3	,, = 1 ton Lime	20·6	37·5	3·0	7·6
4	,, = 2 tons ,, ...	24·9	37·2	3·5	8·7
5	,, = 3 ,, ,, ...	28·1	36·7	4·5	10·6
6	,, = 4 ,, ,, ...	26·2	36·5	3·5	9·0
7	No Lime	23·0	38·5	3·5	7·8
8	Lime, 10 cwt.	26·2	39·0	4·0	8·5
9	,, 1 ton	30·9	39·0	4·5	10·6
10	,, 2 tons	26·8	39·0	4·0	10·9
11	,, 3 ,, ...	31·1	38·5	3·5	11·1
12	,, 4 ,, ...	25·7	38·5	3·5	10·1

These results, taken as a whole, run very consistently, and point to what had been previously noticed, viz., that the lime series gave better crops than the chalk. Adding up the chalk series, a total of 141.8 bushels of corn is shown as against 163.7 bushels with the lime series. The duplicate unlimed plots are in very fair agreement. The lime series shows a more or less regular increase as more lime is added, up to 4 tons per acre, which latter amount would appear to be too much. With the chalk plots there is a similar, though not so marked, increase. The increase from lime is equally marked in the straw as in the corn.

It is worthy of remark that the exact duplicate of these observations is to be found in the pot-culture experiments on the same subject (see page 94).

Examining the stubble after harvest, it was noticed that, as the quantity of lime or chalk was increased, so the spurry became less and less prominent, and its absence was more marked on the limed plots.

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1924.

After the oat crop of 1923 swedes were to follow. These were put in—June 12th—with 5 cwt. superphosphate and 1 cwt. sulphate of potash per acre, and came a fair plant. The lime plots looked, throughout, somewhat superior to the chalk ones. The roots will be weighed and then fed off on the land by sheep.

11. RAINFALL AT WOBURN EXPERIMENTAL FARM, 1923 and 1924.

(292 ft. above Sea Level.)

1922-23			1923-24		
Month	Total inches	No. of days with ·01 in. or more recorded	Month	Total inches	No. of days with ·01 in. or more recorded
1922			1923		
October	0·76	14	October	3·58	23
November	1·07	11	November	1·25	15
December	2·38	18	December	2·37	20
1923			1924		
January	1·28	13	January	2·25	21
February	3·04	25	February	0·48	12
March	2·10	17	March	0·69	9
April	1·50	12	April	2·71	13
May	1·63	17	May	6·05	20
June	0·53	10	June	2·33	15
July	3·52	12	July	3·06	17
August	3·02	12	August	2·31	17
September	2·48	12	September	3·17	19
Total	23·31	173	Total	30·25	201

POT-CULTURE EXPERIMENTS, 1923.

1. *The Hills' Experiments.* (*a*) Lead Chloride. (*b*) Uranium Compounds.

(*a*) Lead Chloride.

In 1922, work with different compounds of lead had shown that, for wheat, 1% of lead as the oxide, carbonate, or sulphate, was not toxic, but that with lead chloride, so soon as .25 per cent. of lead was exceeded, a toxic effect was produced. It was thought well to continue the lead chloride series for a second year. At the same time a fresh series was started, using lead chloride in smaller and intermediate amounts.

i—Old Series.

The quantities of lead used in 1922 were .25 per cent., .50 per cent., and 1 per cent., as chloride. The soil was from Stack-yard Field, and the salts were mixed with the whole of the soil

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in a pot, each experiment being in duplicate. In 1922, .25 per cent. of lead had produced a crop somewhat in excess of the control, but with .50 per cent. only a few stunted plants were left, and with 1 per cent. everything was killed.

Wheat was sown again in the old pots on December 23rd, 1922, after the soil had been turned out, sieved, and replaced. The plants came up quite well with the .25 per cent. and .50 per cent., but with 1 per cent. only a few weak plants appeared, and these gradually died off. For a time the .25 per cent. and the .50 per cent. looked about as good as the control, but about July, 1923, the .50 per cent. began to show a marked toxic effect. The crops when reaped gave the following comparative results :—

Lead Chloride upon Wheat, 1923. (2nd year).

Treatment	Corn	Straw
Untreated	100	100
Lead Chloride ·25 per cent Lead	79	92
,, ,, ·50 ,, ,, ,, ...	3	37
,, ,, 1·0 ,, ,, ,, ...	—	—

From this it is clear that the toxic influence of 1 per cent. and .50 per cent. of lead used as chloride will continue for a second year, and that even .25 per cent. will show, in a second year, some ill effect. It is true that in the first year .25 per cent. gave some increase of crop, but it has to be remembered that then some of the plants were destroyed, while the rest, as is often the case with pot experiments, developed abnormally. In the form of chloride 0.25 per cent. of lead must, therefore, be considered harmful.

ii—New Series.

The quantities decided on were .20 per cent., .30 per cent., .40 per cent. and .50 per cent. of lead as chloride. The soil now used was from Lansome Field, and the salts were mixed with the whole soil; experiments were, as usual, in duplicate.

The wheat was sown on December 23rd, 1922, and came up well in all the pots, none of the plants being killed off. The .20 per cent. application, and possibly the .30 per cent., seemed to show an improvement on the control, but with the higher amounts there was a gradual diminution. The crops were cut on August 13th, when they gave the following comparative returns :—

Lead Chloride upon Wheat, 1923.

Treatment	Corn	Straw
Untreated	100	100
Lead Chloride ·20 per cent Lead	126	124
,, ,, ·30 ,, ,, ,, ...	129	119
,, ,, ·40 ,, ,, ,, ...	70	83
,, ,, ·50 ,, ,, ,, ...	14	37

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The results in general were not as marked as in 1922 when, however, a different soil was used. But the results are in each case in the same direction and tend to show that lead as chloride will be toxic, and almost entirely destroy a crop at a concentration of .50 per cent. It was noticed after removal of the soil from the pots at the close of the experiment that, with the higher concentrations, viz., .50 per cent. and 1 per cent., a deposit of metallic lead formed round the edge of the soil on the inside of the pots.

(*b*) Uranium Compounds.

In 1919, experiments had been made with ores stated to be "radio-active," but no benefit was found from their use. As the activity of these ores was believed to be dependent upon the presence of compounds of uranium, experiments were made with salts of this metal. Wheat was used, and the soil was from Lansome Field. The oxide (as sodium diuranate) and uranyl chloride, sulphate and nitrate were tried, each concentration supplying .05 per cent. and .10 per cent. respectively of uranium. The quantities were mixed with the whole of the soil in each pot, these being filled on December 19th-20th, 1922, and sown with wheat on December 23rd.

Germination was quicker with the untreated pots. The poorest lots were those with the chloride and sulphate. About the end of April the treated pots improved. The absence of sun in May prevented any marked change, except that in some cases —chiefly with the sulphate and chloride—one or two plants developed abnormally. The wheat was cut on August 13th, and the comparative results obtained were :—

Uranium Compounds on Wheat, 1923.

Treatment	Corn	Straw
Untreated	100	100
Sodium diuranate containing Uranium ·05 per cent. ...	95	102
,, ,, ,, ,, ·10 ,, ...	126	120
Uranyl chloride ,, ,, ·05 ,, ...	78	88
,, ,, ,, ,, ·10 ,, ...	74	68
Uranyl sulphate ,, ,, ·05 ,, ...	76	84
,, ,, ,, ,, ·10 ,, ...	6	9
Uranyl nitrate ,, ,, ·05 ,, ...	96	99
,, ,, ,, ,, ·10 ,, ...	100	146

With the doubtful exception of the .1 per cent. dose of sodium diuranate, uranium had no good effect, and in most forms it was actually harmful.

2. *Green-manuring Experiments.*

New interest having been aroused in the subject of green-manuring, it was decided to revert to the experiments at the Woburn Pot-culture Station which had been previously carried on in conjuncion with the Field Experiments, but which had been temporarily suspended.

Briefly to recapitulate, field experiments conducted on Lansome Field since 1895, and on Stackyard Field since 1911, had shown that, without exception, better cereal crops (both of wheat

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and of barley) followed the ploughing-in, or the feeding-off, of mustard than of tares, this being contrary to what would be expected from scientific considerations as to the power of tares to utilise atmospheric nitrogen, a power not possessed by the mustard crop.

Whether this unexpected result was due to the particular nature of the soil in question or to considerations of moisture, mechanical condition, etc., was unknown, though one set of experiments conducted at the Pot-culture Station seemed to point to the fact that if the tares were plentifully supplied with water all through the growing period, then they would give the better succeeding cereal crop. Such conditions, however, could not obtain in practice, and the experiments had no further interest beyond showing that the experience of the superiority of tares on a heavy soil, where moisture is better retained, may in this way be accounted for. Repeated analyses of the soils and of the crops grown and ploughed in or fed off had shown more nitrogen to accrue from the growing of tares than of mustard, and yet, for some reason, it could not be utilised for the following corn crop.

1923.

In renewing the enquiry by pot-culture methods, it was now determined to try the addition to the soils of the respective plots (the soil being taken direct from the plots in the fields), of materials such as lime, superphosphate, and sulphate of potash, and to see if these brought about any change.

The quantities so added were :—

Lime	at the rate of	2	tons	per acre.
Superphosphate (30%)	,, ,,	3	cwt.	,,
Sulphate of potash (90%)	,, ,,	1	cwt.	,,

These were used both singly and, in a fourth instance, all of them together. The additions were given to the soils previous to sowing of wheat, they being mixed with the whole of the soil, and wheat was sown on December 23rd, 1923.

In the case of Stackyard Field soil, the green crops had been fed off by sheep in 1922; in that of Lansome Field the green crop had been ploughed in. In each field wheat had been sown in November (1922), so that the crops in the field and at the Pot-culture Station were in the same stage.

(*a*) Stackyard Field Soil.

The plants grew satisfactorily, and up to the middle of February no changes were noticeable. Then, however, the tares series as a whole looked rather better than the mustard. Also the pots in which lime had been used, either alone or in conjunction with the two mineral manures, began to show to advantage, both with tares and with mustard; these differences remained more or less throughout the summer. The influence of superphosphate and of sulphate of potash was hardly apparent.

The weather was very unfavourable in June, and when warmer weather came in July it was almost too late to allow the plants to benefit fully.

It should be noted here that the entire Stackyard Field series was somewhat inferior to the Lansome Field series.

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(*b*) Lansome Field Soil.

Much the same comparative observations as just recorded were made in this series, the crops being, however, as stated, slightly superior to the Stackyard Field soil ones.

After threshing in November, the following comparative results were obtained :—

Green-manuring Experiment—Wheat after green crops, 1923.

	(*a*) Stackyard Field Soil		(*b*) Lansome Field Soil	
	Corn	Straw	Corn	Straw
i. Wheat after Tares.				
Untreated	100	100	100	100
Lime—2 tons per acre	143	166	202	174
Superphosphate—3 cwt. per acre ...	97	96	91	92
Sulphate of Potash—1 cwt. per acre	99	96	83	96
Lime, Superphosphate and S/Potash	153	160	174	177
ii. Wheat after Mustard.				
Untreated	100	100	100	100
Lime—2 tons per acre	244	206	327	205
Superphosphate—3 cwt. per acre ...	99	133	125	91
Sulphate of Potash—1 cwt. per acre	101	117	128	103
Lime, Superphosphate and S/Potash	233	191	275	179

These results are most consistent and point clearly to the benefit resulting from the use of lime. This is the case with both soils and with both green crops. Superphosphate and sulphate of potash, on the other hand, produced no benefit in either, and the advantage obtained in the mixed dressing was clearly due to the lime.

Taking the actual crop returns and not those stated in the Table (given in percentages of the untreated produce), there was no very marked difference between the tares soil and the mustard soil. The actual weights for the untreated and limed pots were :—

	Stackyard Field Soil		Lansome Field Soil	
	Corn	Straw	Corn	Straw
i. Wheat after Tares.	grammes	grammes	grammes	grammes
Untreated	13·9	20·3	11·8	18.6
Limed	19·9	33·3	23·8	32·4
ii. Wheat after Mustard.				
Untreated	8·3	14·0	8.3	17·7
Limed	20·3	28·7	27·2	36·1

In pot-culture work, too much importance must not be attached to actual crop-weighings, and the above results must be taken purely as an indication, but a very clear one, as to the benefit likely to accrue from liming both lands and both sets of plots. Whether doing this will result in bringing out in practice differences between the two green crops, remains to be seen; but. acting upon the above results, it was determined to lime one half of each of the plots in Stackyard Field and Lansome Field in the winter of 1923, lime being put on at the rate of 2 tons per acre, the other halves being left unlimed.

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1924.

The experiment was carried on for a second year, the green crops, tares and mustard, being grown, but no further manurial applications given. The green crops were sown on March 26th, and were cut June 23rd, the weights, both green and dry, being recorded. There is no occasion for dealing with these in detail, but it may be said generally that the differences were not marked; what indications of increased crop were given bore, as with the wheat of 1923, on the result of applying lime or a complete manure including lime.

3. *The Relative Values of Lime and Chalk.*

1923.

In previous experiments on this subject the soil had not had any applications given it beyond the lime and chalk respectively. The experiment was therefore repeated, with the addition of superphosphate and sulphate of potash, at the rates of 3 cwt. and 1 cwt. per acre respectively. The soil used came, not from Stackyard Field as usual, but from Lansome Field. The 40-lb. pots were filled with soil, the whole of which was previously mixed with lime or with chalk, so as to give the equivalent of 10 cwt., 1 ton, 2 tons, 3 tons and 4 tons of lime per acre. The superphosphate and sulphate of potash were added to the top 16 lb. of soil used, wheat being sown on December 23rd.

All the plants came up well. About the middle of March, both lime, and to a lesser extent chalk, showed a clear improvement over the control (unlimed) pots. In the case of the lime applications the improvement was greater with the heavier dressings. This held good until July, when the lime series showed a progressive increase of crop up to 3 tons, but with 4 tons the crop was shorter, though individual plants were greener and stronger. With chalk, however, though there was a general increase over the control, the heavier applications were not better than the 10 cwt. per acre. The crop was cut on August 13th, and the following comparative results were obtained :—

Lime and Chalk upon Wheat—Lansome Field Soil, 1923.

Treatment	Corn	Straw
No Lime	100	100
Lime (CaO) 10 cwt. per acre	129	125
,, ,, 1 ton ,, ,, ...	140	145
,, ,, 2 tons ,, ,, ...	191	183
,, ,, 3 ,, ,, ,, ...	228	225
,, ,, 4 ,, ,, ,, ...	207	254
Chalk = 10 cwt. CaO ,, ,, ...	137	128
,, = 1 ton ,, ,, ,, ...	126	135
,, = 2 tons ,, ,, ,, ...	139	132
,, = 3 ,, ,, ,, ,, ...	141	129
,, = 4 ,, ,, ,, ,, ...	157	141

The weights are in close accordance with the appearances already discussed, and with previous experiments made with the

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soil of Stackyard Field, and show that the gains already recorded do not depend upon the presence or absence of phosphates and potash, but are the direct result of the applications of lime and chalk respectively.

1924.

A return was made in 1924 to Stackyard Field soil, phosphates and potash being used additionally as in 1923. The same amounts of lime and chalk were used as in 1923, and mixed, as then, with the top six inches of soil. An addition of ground limestone, at the rate of 1 ton and 2 tons per acre respectively, was, however, made this year. Wheat was sown on December 18th, 1923. It was noticed that the higher amounts of chalk retarded the germination, but eventually all plants came well. By April the lime pots showed an increasing improvement up to 3 tons per acre, a slight drop occurring with 4 tons. The chalk pots, on the other hand, were not so good, but more level, while limestone showed no increase.

These appearances were maintained more or less to the end of the growing period, and the crops were cut on August 18th. The recorded comparative results were :—

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

Treatment	Corn	Straw
No Lime	100	100
Lime (CaO) 10 cwt. per acre	113	100
,, ,, 1 ton ,, ,, ...	136	133
,, ,, 2 tons ,, ,, ...	145	167
,, ,, 3 ,, ,, ,, ...	168	196
,, ,, 4 ,, ,, ,, ...	179	194
Chalk = 10 cwt. CaO ,, ,, ...	94	88
,, = 1 ton ,, ,, ,, ...	94	79
,, = 2 tons ,, ,, ,, ...	101	94
,, = 3 ,, ,, ,, ,, ...	99	93
,, = 4 ,, ,, ,, ,, ...	92	78
Ground Limestone 1 ton per acre	84	72
,, ,, 2 tons ,, ,, ...	85	76

The results again confirm the preceding ones, and also indicate that limestone is ineffectual in the first year.

4. *Magnesia and Magnesium Carbonate on Wheat,* 1924.

As a counterpart of the last-named experiment, a repetition of earlier experiments with magnesia and magnesium carbonate on Stackyard Field soil was made in 1924, phosphates and potash being given also, magnesium limestone also being added to the series. The applications were mixed, as before, with the top six inches of soil, and the respective quantities used were the same as in the lime and chalk experiment (3). Wheat was sown on December 18th, 1923.

From the beginning, magnesia in the higher amount exercised a bad effect upon the young plants, this not being apparent

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with magnesium carbonate. By the end of May, 1924, all the plants in the 2, 3 and 4 tons per acre of magnesia lots were killed. One ton per acre showed some ill effect at first, but the crop recovered. With magnesium carbonate there was no failure, but, on the contrary, a slight proportional increase all round.

The crops were cut on August 18th, and the comparative results were :—

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

Treatment	Corn	Straw
No Magnesia	100	100
Magnesia (MgO) 10 cwt. per acre	185	189
,, ,, 1 ton ,, ...	180	216
,, ,, 2 tons ,, ...	—	—
,, ,, 3 ,, ,, ...	—	—
,, ,, 4 ,, ,, ...	—	—
Magnesium Carbonate = 10 cwt. MgO per acre	148	158
,, ,, ,, = 1 ton	191	199
,, ,, ,, = 2 tons	201	230
,, ,, ,, = 3 ,, ...	226	240
,, ,, ,, = 4 ,, ...	191	235
Ground Magnesian Limestone = 1 ton per acre	108	108
,, ,, ,, 2 tons	108	108

The Table shows that an increase of crop is given with a half-ton and 1 ton of magnesia, but that 2 tons per acre or more will absolutely kill a wheat crop, whereas higher amounts of magnesia as carbonate will improve the crop. Magnesian limestone, however, is ineffective, at least in the first year.

These experiments on lime and magnesia (3 and 4), confirmed, as they have been, on different soils of the farm, and with and without mineral manures, leave no doubt that there is a very marked difference between the effect of caustic lime and that of carbonate of lime, and again, between lime and magnesia. Caustic lime has clearly been proved to be a far more active form than chalk, and, while its addition, within reason—say up to 2 and 3 tons per acre—will produce much benefit on land requiring lime, magnesia, in the caustic state, will in that amount prevent the growth of the crop. The further information is now given that ground limestone, be it magnesian or not, exercises no influence, for a time at least.

These experiments have now been, in the main, so frequently repeated, and with like general results, as to leave practically no room for doubt as to their bearing on agricultural practice, and on the respective use of caustic lime, chalk, caustic magnesia or carbonate of magnesia. Incidentally, as I have pointed out elsewhere, they have a marked bearing on the practical treatment of land which contains magnesia in excess of the lime present.

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5. *Sulphate of Ammonia and Muriate of Ammonia Compared.*

Along with the field experiment on this subject (see page 86) a similar one was carried out at the Pot-culture Station. The soil was from the headland of Stackyard Field, the crop, wheat. A dressing of superphosphate and sulphate of potash was given to each lot at sowing time, and the ammonia salts were given later as top-dressings. These latter consisted of sulphate of ammonia, 1 cwt. per acre, and muriate of ammonia equivalent in ammonia to 1 cwt. per acre of sulphate of ammonia.

Wheat was sown on December 23rd, 1922; the top-dressings were given on June 11th. Towards the end of July the muriate pots looked the better, though the ripening of the crops was retarded.

The crops were cut on August 14th and gave the following comparative returns :—

Sulphate of Ammonia and Muriate of Ammonia, 1923.

Applications per acre	Corn	Straw
Superphosphate 3 cwt. + S/Potash 1 cwt.	100	100
Superphosphate 3 cwt. + S/Potash 1 cwt. + S/Amm. 1 cwt.	145	131
Superphosphate 3 cwt. + S/Potash 1 cwt. + M/Amm. = 1 cwt. of S/Amm.	171	138

The results were confirmatory of the field ones, and indicated the superiority of the muriate in the case, at least, of corn crops.