THE INSTITUTE OF BREWING RESEARCH SCHEME.

FIFTH REPORT ON THE INFLUENCE OF SOIL, SEASON AND MANURING ON THE QUALITY AND GROWTH OF BARLEY, 1926.

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The first series of experiments had closed in 1925 and showed clearly that except in a few districts, neither phosphates nor potassic fertilisers added appreciably to the yields of barley under the conditions of a good barley growing farm, nor did they improve the valuation. Potassic fertilisers tended to lower the nitrogen content of the grain, but not sufficiently to alter the appearance of the grain, consequently the Valuation Committee were not prepared to award a higher price. Only at the Norfolk centres had superphosphate given an increase in crop, but even there not much.

Sulphate of ammonia, on the other hand, and still more, as far as the experiments went, muriate of ammonia, gave an increased yield of 5 or 6 bushels per acre for 1 cwt. of the fertiliser, costing about 11s.: therefore a distinctly profitable increase for the farmer. The appearance of the grain was not usually affected, and the Valuation Committee in general assessed these samples at the same value as those grown without nitrogen. The percentage of nitrogen in the grain was sometimes lowered and sometimes raised, but only by a small amount in any case. All the samples of barley obtained in the experiments were fully analysed as also were the malts obtained by the stocking method. These also were not appreciably affected. It was not possible at any time during this set of experiments to get a large scale malting done.

Fortunately for the Institute, Mr. H. D. Cherry-Downes came forward and undertook to arrange for large scale maltings to be done in 1926, at Messrs. Gilstrap, Earp & Co. Maltings, at Newark. This enabled the Committee to carry out a new series of experiments, the purposes of which were:—

(1) To test on the large scale the conclusion that nitrogenous manuring at the above mentioned rate does not lower the value of the barley or the malt.

(2) To correlate the analytical data with each other and with the maltsters reports and data, and to discover as far as possible the interpretation to be put upon the analytical data.

These large scale maltings entail much work, and the Institute owes a great deal of gratitude to Mr. Cherry-Downes and to Messrs. Gilstrap, Earp & Co., also to Mr. J. S. Ford, and Messrs. William Younger & Co., Ltd., who malted the Dunbar barley, for their generous assistance and co-operation.

The field plots were so arranged as to provide 30 quarter samples. There were only two treatments except at Fakenham where muriate of ammonia was also used. These were, no manure, and sulphate of ammonia 1 cwt. per acre, but there were two plots of each treatment, making four plots of two acres each. At Chiselborough there were 6 plots. Arrangements were made for bulk experiments at 12 centres. These were Dunbar, Dunmow, Cawkwell, Wellingore, Chiselborough, Fakenham, Sprowston, Beverley, Longniddry, Nynehead, Rothamsted, Wye. At two of these the weights are not available, but the samples were fully examined. Except at Cawkwell, where Mr. Davy used his own supply of Spratt-Archer, the barley grown at each centre was, as before, a uniform stock of Beaven's Plumage-Archer (1924) supplied by Messrs. Hasler, of Dunmow. Small plots with 6 different treatments were laid down at four centres in continuation of the experiments of former years, at Rothamsted and Sprowston, in addition to bulk plots, and at Woburn and Newport small plots only. At one of these, the Harper Adams College, Newport, the plots were so badly laid that harvesting was very difficult, and had to be done with a scythe. At Rothamsted and Woburn there were additional plots with muriate of ammonia. The results are given in Tables 1 and 3.

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TABLE 1.—*Continuation of Series I.*

ROTHAMSTED. SUMMARY OF RESULTS.* (NEW ZEALAND FIELD.)

Average Yield per Acre.	Super + S/Amm. + S/Pot.	Super + S/Amm.	S/Amm. + S/Pot.	Super + S/Pot.	S/Amm.	Super + S/Pot. + M/Amm.	Super + M/Pot. + S/Amm.	Control.	General Mean.	Standard Error.
Grain, pounds ..	2306	2352	2313	2493	2213	2480	2384	2235	2346·7	105·25
Straw, pounds ..	4172	4525	4419	4172	4228	4475	4547	3916	4306·6	108·73
Grain, bushels ..	44·35	45·22	44·49	47·94	42·56	47·69	45·84	42·98	45·13	2·02
Straw, cwt. ..	37·25	40·40	39·45	37·25	37·75	39·96	40·60	34·96	38·45	0·97
Grain, per cent. ..	98·27	100·20	98·57	106·22	94·30	105·65	101·57	95·24	100	4·48
Straw, per cent. ..	96·87	105·07	102·60	96·87	98·18	103·91	105·58	90·92	100	2·52
Total produce, pounds	6478	6877	6732	6665	6441	6955	6930	6151	6653·4	—

* For fuller information, see Rothamsted Report, 1925-6, p. 149. For analysis see p. 328.

WOBURN.

Plot.	Manures per Acre.	Head Corn.		Tail Corn.	Straw, Chaff, etc.			
		Bushels.	Weight per Bushel.					
			lb.	lb.	T.	cwt.	qr.	lb.
1.	Nothing	32·2	53·7	114	1	5	2	2
2.	Super, 3 cwt.; S/Potash, 1½ cwt.; S/Ammonia, 1 cwt.	48·5	52·7	252	1	16	3	8
3.	Super, 3 cwt.; S/Ammonia, 1 cwt. ..	41·6	52·7	126	1	9	0	22
4.	S/Potash, 1½ cwt.; S/Ammonia, 1 cwt. ..	42·9	52·3	175	1	16	0	27
5.	Super, 3 cwt.; S/Potash, 1½ cwt.	35·3	53·4	147	1	4	2	8
6.	S/Ammonia, 1 cwt.	39·3	52·1	160	1	13	3	20
7.	Muriate of Ammonia = 1 cwt. S/Ammonia	47·1	52·9	148	1	13	3	13
8.	Super, 3 cwt.; S/Potash, 1½ cwt.; Muriate of Ammonia = 1 cwt. S/Ammonia ..	41·1	53·1	167	1	10	3	13

The season was unfavourable to high yields of good quality. The winter had been hard and spring was late; there were droughts in March and early April, which interfered with germination, and then much rain; a cold May injured the plant, then came drier and warmer weather in the latter part of June and first part of July, when the crop improved considerably and held out great promise; then in the second half of July heavy rains and gusts of wind severely laid many of the crops—indeed laid cereal crops were a feature of the season. August was drier and favourable for harvest: had the corn not been laid it would have been reaped in record time. Unfortunately, the lodging caused so much delay that barley was still standing out in September, when it was heavily rained upon and began to sprout in the moist warm period that followed. In these circumstances the yields were not high, and wherever the barley was badly laid by the storms there were serious losses. Only at Wye, Rothamsted and Long-niddry did the yields exceed 40 bushels per acre.

The season differed from its predecessors in our experimental series by its sunlessness. Others have been wetter—notably 1924—but none at Rothamsted has been so devoid of sunshine. The deficiency is especially marked in the important months of May, June and July; the number of hours of sunshine at Rothamsted were:—

TABLE 2.—*Sunshine Record.*

	1922	1923	1924	1925	1926
May ..	280·2	166·2	190·9	204·7	153·6
June ..	228·8	116·1	199·6	259·5	180·7
July ..	149·5	223·8	236·1	183·6	151·1
Total ..	658·5	506·1	526·6	647·8	485·8

The effect of the nitrogenous manure also differed from that of previous years. In all the years 1922 to 1925 inclusive, 1 cwt. sulphate of ammonia has increased the yield of barley by some 5 or 6 bushels per acre. In 1926 this increase was obtained only at six centres out of the eleven for which weights are available—at Woburn, Sprowston, Cawkwell, Wellingore, Nynehead, and Chiselborough; at the other five there is no increase; indeed at Rothamsted, Longniddry and Wye there is definite evidence of a decrease; at Dunmow and Beverley the yields of the duplicate plots are not near enough to show whether there has been a decrease or not. The result is of special interest as suggesting that the ineffectiveness of the nitrogenous manure may be the result of the wet sunless conditions; indeed that in these conditions nitrogenous manures may have a harmful effect which does not appear in warmer weather. This is somewhat unexpected, but it is supported by the results of the other series of experiments which is being continued at Rothamsted and Woburn though discontinued elsewhere. At Rothamsted it is on an elaborate plan allowing of calculation of the standard error. In a sunless season potassic fertilisers are expected to act well: this happened at Roth-

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TABLE 3.—*Yields of Barley, Bushels (56 lb. weight) per Acre,* 1926.

	Head Corn.			Seconds.		
	1 cwt. Sul/Amm. per acre.	No Manure.	Gain from Sul/Amm.	1 cwt. Sul/Amm. per acre.	No Manure.	Gain from Sul/Amm.
Eastern Districts.						
Rothamsted	(*a*) 42·56 (*b*) 44·35	42·98 47·94	— 0·42 — 3·6	— —	— —	— —
Woburn	(*a*) 39·3 (*b*) 28·5	32·2 35·3	7·1 13·2	— —	— —	— —
Wye	48·3	50·52	— 2·2	9·1	6·1	+ 3·0
Dunmow ..	21·75	22·75	— 1·00	5·63	9·0	— 3·37
Sprowston (Norwich)	49·5	38·5	+11·0	—	—	—
Wellingore	27·05	21·95	+ 5·10	4·69	4·24	+ 0·45
Cawkwell	30·50	27·63	+ 2·87	8·00	4·84	+ 3·16
Beverley	32·9	32·1	+ 0·8	—	—	—
Longniddry	44·38	48·50	— 4·12	—	—	—
Western Districts. Somerset.						
Chiselborough ..	38·97	33·50	+ 5·47	0·91	1·00	— 0·09
Nynehead	36·29	31·43	+ 4·86	1·06	1·00	+ 0·06

(*a*) No other manure.
(*b*) Superphosphate and sulphate of potash in addition.

amsted; the yield of barley, in bushels per acre, was:—

TABLE 4.

	No Nitrogen	Sulphate of Ammonia	Sulphate of Ammonia and Super.
No Potash ..	42·98	42·56	45·22
Potassium Sulphate	47·94*	44·49	44·35
Gain ..	5	2	—0·87

* and Superphosphate.

The other data on the same line make it unlikely that the superphosphate contributed in an important way to the result. But as soon as nitrogen is added the good effect of the potash is in part counteracted and its advantage is lost.* The harmful action of

* This difference in behaviour between potassic and nitrogenous fertilisers is probably attributable to the fact that potassium increases the efficiency of the leaf as an assimilating organ, while nitrogen increases only its area. In the sunless season the increased efficiency is apparently worth more than the increased area.

TABLE 5.—*Composition of Barley Grain. Series II.*

	Moisture.		Nitrogen.		Valuation in Shillings per Qr.		1,000 Corn weight.		Malting Loss.	
	No. Manure.	Sul. of Amm.	No. Manure.	Sul. Amm.	No Manure.	Sul. of Amm.	No. Manure.	Sul. Amm.	No. Manure.	Sul. Amm
Rothmasted ..	18·5	18·7	1·577	1·662	39	38	40·1	38·1	7·3	7·0
Woburn ..	16·2	16·7	1·522	1·610	46	39	36·2	34·1	8·7	8·9
Wye	16·8	17·3	1·576	1·569	46	44	40·4	38·4	10·5	9·9
Dunmow ..	17·3	17·1	1·535	1·507	43	45	36·9	37·4	8·5	9·1
Sprowston ..	18·4	18·3	1·447	1·623	40	38	33·6	34·0	7·6	7·8
Fakenham ..	18·5	18·3	1·466	1·492	44	40	33·4	32·7	8·3	8·4
Wellingore ..	17·6	16·2	1·396	1·370	42	45	31·2	33·0	10·0	10·3
Cawkwell ..	16·6	17·0	1·663	1·714	39	39	30·5	30·8	10·1	9·3
Beverley ..	16·8	16·7	1·496	1·572	37	37	35·7	32·7	10·6	9·7
Dunbar ..	16·9	16·7	1·516	1·536	46	46	39·7	40·9	7·5	7·7
Longniddry ..	16·9	16·8	1·380	1·424	47	44	38·2	36·9	7·5	7·3
Chiselborough	17·1	17·1	1·435	1·487	56	49	37·0	34·4	7·9	7·5
Nynehead ..	17·4	16·6	1·440	1·393	51	48	43·3	37·6	7·4	8·7

Series I.—1926.

	Moisture, per cent.		Nitrogen per cent. in dry matter.		1,000 corn weight (dry).		Malting Loss.	
	Rothamsted.	Woburn.	Rothamsted.	Woburn.	Rothamsted.	Woburn.	Rothamsted.	Woburn.
No Manure	17·0	16·2	1·604	1·522	38·4	36·2	9·8	8·7
Complete Artificials	17·0	15·9	1·711	1·598	38·8	35·6	9·9	10·2
No Potash	16·9	16·1	1·673	1·545	37·3	33·7	9·6	10·0
No Phosphate	17·5	16·3	1·710	1·625	37·1	35·3	9·0	9·7
No Nitrogen	17·0	15·7	1·599	1·513	38·4	37·6	9·8	9·6
Sulphate of Ammonia only ..	17·0	16·7	1·683	1·610	36·9	34·1	9·8	8·9
Muriate of Ammonia only	—	16·1	—	1·449	—	35·8	—	9·6
Complete Artificials.								
All Sulphates	17·0	15·9	1·711	1·598	38·8	35·6	9·9	10·2
Muriate of Ammonia..	17·2	16·3	1·684	1·491	36·8	36·6	9·3	8·6
Muriate of Potash	17·4	—	1·726	—	36·4	—	9·3	—

nitrogenous manure in this sunless season is shown also in the effect on the grain. In preceding years this effect has been small. In 1926 it is more distinct. At seven centres out of the twelve the sulphate of ammonia raised the percentage of nitrogen; these were Longniddry, Fakenham, Cawkwell, Chiselborough, Sprowston, Beverley, and Rothamsted; at the last three the increase amounted to more than 0·05 per cent.; only at Nynehead, Dunmow, Wellingore, was the percentage lowered, while at Wye and Dunbar it was unaffected. Also the 1,000 corn weight was reduced by nitrogenous manuring at seven centres, viz., Longniddry, Fakenham, Chiselborough, Beverley, Rothamsted, Nynehead and Wye; while it was increased at Dunbar, Dunmow, Wellingore, and unaffected at Cawkwell and Sprowston. This adverse effect of nitrogenous manure showed itself also in the valuations; the brought it down. Thus the Chiselborough unmanured barley was valued at 56s. while that receiving sulphate of ammonia was put at 49s. only, a drop of 7s. per quarter, which almost entirely wiped out the profit from the extra 5·5 bushels per acre given by the fertiliser. Similarly the Nynehead and Longniddry barleys grown with nitrogenous fertiliser were valued below those grown without it. The difference persisted into the malts, where, indeed, it became more pronounced. The analytical data throw but little light on the decreased valuations; the 1,000 corn weight is in all three cases lowered by the nitrogenous manure, which might account for some part of the decreased valuation, but the valuations at the different centres do not correspond with the respective nitrogen percentages.

The data are :—

TABLE 6.

Place.	Barley.						Malt.	
	Valuation Shillings per quarter.		Nitrogen* per cent.		1,000 Corn* Weight.		Valuation.	
	No Manure.	Nitrogenous Manure.	No Manure.	Nitrogenous Manure.	No Manure.	Nitrogenous Manure.	No Manure.	Nitrogenous Manure.
Chiselborough ..	56	49	1·435	1·487	37·0	34·4	82	73
Nynehead ..	51	48	1·440	1·393	43·3	37·6	81	62
Longniddry ..	47	44	1·380	1·424	38·2	36·9	71	58

*On barley dried in current of dry air at 98°C.

first time this has happened in all the five years of the experiments. Where the barley already commanded only a low price, the nitrogenous manure made no consistent difference (Table 5), but where the valuation was high, nitrogenous manuring

Lodging affords some explanation; its influence on valuation at Longniddry is very marked, but here it goes with increased nitrogen content and decreased 1,000 corn weight. The barley that was the worst lodged had the highest nitrogen content, and

TABLE 7.

State of Lodging.	Valuation.	Yield. Bushels per acre.	Treatment.	Nitrogen per cent.	1,000 Corn weight.
No. 2. Badly ..	42/-	43	Sulphate of ammonia	1·466	35·6
No. 1. Half ..	42/-	51	No Nitrogen	1·395	37·5
No. 4. Half ..	44/-	46	Sulphate of ammonia	1·383	38·3
No. 3. Stood up ..	46/-	46	No nitrogen	1·366	38·9

the lowest 1,000 corn weight, that on the other plots varying in the same order as the state of lodging.

INFLUENCE OF NITROGENOUS MANURING ON VALUATION OF THE MALTS.

I.—The Stocking Malts.

The results are set out in Table 8.

Nitrogenous manuring has lowered the valuation of practically all the malts priced 60s. or more, but it has not affected the valuation of the malts of lower price. The diastatic power, however, tends to increase where nitrogenous manure is given wherever the percentage of nitrogen in the grain is also increased; this is seen at Beverley, Fakenham, Rothamsted, and Sprowston, Longniddry and Chiselborough; the diastatic power is not increased, however, at Dunmow, Nynehead, Wellingore, Dunbar and Cawkwell; all, except Cawkwell, centres where the nitrogen content of the grain was not increased by the manuring.

The results show considerable agreement with those of the stocking malting. The valuations of the malts from different centres come out in the same order by both methods; for the unmanured samples Chiselborough comes out first, followed by Dunbar and Longniddry, which are practically equal. There is some disagreement at the bottom of the scale, but nothing of importance. (Table 9).

The bulk and stocking methods, however, show some disagreement as between the manured and unmanured barleys at the same centre. Malts obtained in bulk from barleys receiving nitrogenous manure were not, as a rule, valued lower than those grown without manure; only for the Longniddry and Sprowston samples is there any marked reduction of valuation, and against this is Dunbar, where there is a marked increase in valuation; for the other centres the difference is only a shilling or so, and it is

TABLE 8.

Effect of Nitrogenous Manuring on Composition and Valuation of Malt (Stocking Method).

	Extract.		Colour.		Diastatic Power.		Cold Water Extract.		Valuation.	
	No Manure.	Nitrogenous Manure.	No Manure.	Nitrogenous Manure.	No Manure.	Nitrogenous Manure.	No Manure.	Nitrogenous Manure.	No Manure.	Nitrogenous Manure.
Chiselborough ..	100·6	100·1	3·2	3·2	46·0	49·7	19·2	19·6	82	73
Nynehead ..	99·1	99·7	3·2	3·5	48·5	49·0	19·5	21·5	80	62
Longniddry ..	101·2	99·9	3·0	3·3	50·0	58·0	19·4	20·1	71	58D
Dunbar ..	100·1	100·2	4·0	4·0	43·5	42·7	20·1	19·2	71	72
Dunmow ..	100.0	99.9	4·0	4·4	52·9	48·0	21·7	22·1	63	61
Fakenham ..	99·4	98·6	3·5	3·7	34·2	37·4	19·4	20·2	63	62
Sprowston ..	99·7	99·0	3·3	4·0	50·5	55·5	20·2	21·7	60	58
Wye	99·1	97·4	5·9	5·3	46·2	55·2	22·6	22·5	58	55
Rothamsted ..	99·0	99·1	4·5	4·3	54·5	57·0	20·1	20·5	57	58D
Wellingore ..	98·3	98·7	5·2	5·5	40·4	42·6	23·3	23·5	56	58
Cawkwell ..	97·7	98·1	5·0	4·5	48·9	47·9	23·1	22·0	56	54
Beverley.. ..	98·4	97·1	5·4	4·8	54·2	59·2	23·4	22·3	52	52

It is interesting that the centres where manuring with sulphate of ammonia lowered the valuation of the barley were also usually those where it lowered the valuation of the malt.

II.—*The Bulk Malts.*

Nine of the experimental lots were malted in bulk by Gilstrap, Earp & Co. Ltd., and William Younger & Co. Ltd. sometimes one way and sometimes the other.

Except at Rothamsted, the diastatic power of the malts from manured barley is everywhere greater than from the unmanured, even at Dunbar and Dunmow, where the nitrogen content of the grain had not been increased by the manure.

The other properties, colour and extract were not affected to any significant extent by the manuring.

TABLE 9.

VALUATION OF BULK AND STOCKING MALTS.

Unmanured Barley.

Bulk.	Valuation of Malt. Shillings per qr.	Stocking.	Valuation of Malt.* Shillings per qr.
Chiselborough	83	Chiselborough	82
Dunbar	80	Dunbar	71
Longniddry	75D	Longniddry	71
Dunmow	70	Dunmow	63
Sprowston	70	Sprowston	60
Wellingore	66	Rothamsted	57
Beverley	62	Wellingore	56
Rothamsted	57	Cawkwell	56
Cawkwell	57	Beverley	52

Barleys Manured With Sulphate of Ammonia.

Bulk.	Valuation of Malt. Shillings per qr.	Stocking.	Valuation of Malt. Shillings per qr.
Dunbar	85	Chiselborough	73
Chiselborough	80	Dunbar	72
Dunmow	69	Dunmow	61
Wellingore	67	Wellingore	58
Longniddry	66	Longniddry	58D
Rothamsted	62	Rothamsted	58
Beverley	60	Sprowston	58
Sprowston	58	Cawkwell	54
Cawkwell	58	Beverley	52

*The level of values for the bulk malts is higher than that for the stocking malts, because the latter had not been dressed.

EFFECT OF SOIL AND SEASON ON NITROGEN CONTENT AND 1,000 CORN WEIGHT OF GRAIN.

Nitrogen and Corn Weight.—The data for these are given in Table 3. The nitrogen content of the grain is of the same order as in previous years, but usually slightly less, and as usual it is more influenced by the farm (presumably by the soil) than by season. It has been, on the unmanured plots, at the centres arranged in order of heaviness of soil :—

TABLE 10.—*Per Cent. of Nitrogen in Grain of Unmanured Barley.*

	1922.	1923.	1924.	1925.	1926.	Varies round
Rothamsted	1·60	1·71	1·62	1·66	1·58	1·6
Cawkwell	1·56	1·40	1·27	—	1·66*	—
Beverley	—	1·29	—	1·54	1·50	1·5
Wellingore	1·76	1·49	1·42	1·47	1·40	1·45
Chiselborough	—	1·49	1·46	1·59	1·43	1·45
Wye	—	—	1·74	1·39	1·57	—
Barnoyhill	1·36	1·59	—	—	1·52	—
Dunmow	1·75	2·23†	1·56	1·63	1·53	1·6
Woburn	1·78	1·92	1·23	1·91	1·52	—
Orwell Park	1·43	1·98	1·59	2·26	—	—
Newton St. Faith	—	—	1·33	—	—	—
Sprowston	—	—	—	1·55	1·51	—
Porlock	—	—	1·30	1·21	—	—

* Spratt Archer, not Plumage Archer, like all the rest.
† Not the same Plumage Archer as the rest.

In spite of the very marked differences in the season the percentage of nitrogen in the unmanured plots has altered but little during all the five years at Rothamsted; it runs round about 1·6, though the yields have varied from 21·4 to 43 bushels. At Wellingore for the last four years it ran about 1·45; the yields varying over the same years from 21·9 to 43·3; only in the first year was the value much different. At Chiselborough, out of four years, three are close to 1·45, only the fourth was out of step. At Dunmow the 1923 value is out of line, but in that year a different strain of seed was used. At Woburn and at Orwell Park the values range round two different figures: this is being further studied. What exactly is the farm factor we do not know; the problem will be discussed in the complete summary of the experiments.

The weight per 1,000 corns is less than in previous years; it shows somewhat less variation from season to season on the same farm than does the percentage of nitrogen.

TABLE 11.

The 1,000 Corn Weight * Unmanured Barley.

Unmanured Plots	1922	1923	1924	1925	1926
Rothamsted	39·5	41·0	40·6	39·4	40·1
Cawkwell ..	36·8	42·5	36·9		30·5
Beverley ..		38·5		37·9	35·7
Wellingore ..	40·7	40·4	39·2	37·5	31·2
Chiselborough		40·3	36·4	41·5	35·9
Wye			40·5	42·3	40·4
Barnoyhill ..	46·6	39·2			39·7
Dunmow ..	38·6		39·1	41·2	36·9

*On dry barley.

THE EFFECT OF MURIATE OF AMMONIA.

Muriate of ammonia having given better results than sulphate of ammonia in the tests made at Rothamsted during the preceding years, it was in 1926 tested at three of the centres, Rothamsted, Fakenham, and Woburn. At each of these centres the muriate again came out better than the sulphate. At Rothamsted it caused none of the depression of yield shown by the sulphate. The figures are:—

	Bushels per acre.
Muriate of Ammonia..	47·69
Sulphate of Ammonia	44·35
No Nitrogen	47·94

Superphosphate and sulphate of potash given to all three plots.

While, therefore, in this exceptional season the muriate gave no gain in crop, it was free from the risk of injury shown by the sulphate.

At Woburn the muriate gave a satisfactory increase.

At Fakenham, although no yields are available, the muriate gave greater satisfaction to the grower since it brought the barley into ear rather sooner than the sulphate and so made possible a longer ripening period. It also brought about a lowering of the percentage of nitrogen in the grain at Woburn below that of the barley grown with sulphate of ammonia or without any nitrogen, as in preceding years: but not, however, at Fakenham. It raised the 1,000 corn weight and the valuation of the barley in comparison with sulphate of ammonia at Fakenham and Woburn: at Rothamsted, however, the 1,000 corn weight was somewhat less and the valuation, already low, was not altered. Fakenham was the only centre that gave a good malt, and here the muriate gave by far the best results.

Taken altogether, the results agree with those of previous years in showing a superior value for muriate of ammonia over sulphate of ammonia. The effect is in some way specific to muriate of ammonia; it is not shown by muriate of potash.

TABLE 12.

	Percentage of Nitrogen in Grain.				Valuation.							
					Barley.				Malt.			
	Rothamsted.	Woburn.		Fakenham.	Rothamsted.	Woburn.		Fakenham.	Rothamsted.	Woburn.		Fakenham.
	(a)	(a)	(b)		(a)	(a)	(b)		(a)	(a)	(b)	
No Nitrogen	1·599	1·513	1·522	1·466	41	46	46	44	53	65	60	63
Sulphate of Ammonia..	1·711	1·598	1·610	1·492	39	40	39	40	54	52	52	62
Muriate of Ammonia ..	1·684	1·491	1·449	1·562	39	41	45	42	51	62	60	72

(a) Phosphate and potash in addition (Series I). (b) No other manure.

SUMMARY.

The season of 1926 differed completely from those of the earlier experiments, 1922 onwards, in having far less sunshine during the growing season of the barley. This brought out two important properties of the nitrogenous manuring that had not been observed in any of the previous experiments.

(1) The nitrogenous manure in nearly half the experiments gave no increase in crop ; indeed there was some evidence at Rothamsted and elsewhere of a harmful effect on yield.

(2) It tended to lower the valuation of the barley and of the malt, especially those of higher price and to raise the percentage of nitrogen in the barley and lower the 1,000 corn weight. If 1926 were typical it would be necessary to revise the conclusions of the last four reports : it was, however, distinctly abnormal.

During this season large scale maltings were made as well as stocking maltings. The valuations of the malts from different centres for the unmanured barleys and for the manured barleys respectively came out in substantially the same order by both methods : the only discrepancies are at the lower end of the scale, where differences are not particularly important. As between the manured and unmanured barleys at the same centre, the two methods show some disagreement.

At one centre it was possible to study the effect of " lodging " of the barley on the valuation of the grain and the properties of the malt. The worst lodged barley had the lowest valuation, the highest nitrogen content, the lowest 1,000 corn weight. The least lodged had the highest valuation, lowest nitrogen content and highest 1,000 corn weight, while those lodged to an intermediate degree came intermediate in these various properties. (Table 7.)

The diastatic power of the malts was higher where the barley had received sulphate of ammonia than where it had not. There are indications that diastatic power is increased when the nitrogen of the grain increases.

In spite of the abnormal character of the season the percentage of nitrogen in the barley grain did not differ to any important extent from those of the previous years. Reviewing the results obtained up to the present it appears that nitrogen percentage in the grain is affected more by the farm (presumably the soil) than by the season, or the manuring, provided this is not too heavy. It is difficult to know what the soil factor may be. The 1,000 corn weight is slightly less variable.

As before, muriate of ammonia proved rather better than sulphate of ammonia. It showed none of the harmful effect of the sulphate at Rothamsted, and at Rothamsted and Woburn it lowered the percentage of nitrogen in the grain as compared with sulphate of ammonia. It does not appear that muriate of potash has the same effect. In the 1927 experiments this question is tested more fully.

APPENDIX TO BARLEY REPORT.

LIST OF FARMERS CARRYING OUT EXPERIMENTS IN 1926.

G. H. Nevile, Wellingore Hall, Lincs.

Norfolk Agricultural Station, Sprowston, Norwich.

J. H. Spilman, Gardham, Etton, Beverley, Yorks.

R. A. Clarke & Sons, Manor Farm, Chiselborough, Somerset.

South Eastern Agricultural College, Wye, Kent.

Rothamsted Experimental Station, Harpenden, Herts.

L. Mortimer, Haywood Farm, Nynehead, Somerset.

Sir Harry Hope, Barneyhill, Dunbar.

W. Bruce & Sons, Seton Mains, Longniddry, East Lothian.

Wm. Hasler, Dunmow, Essex.

T. J. Young, Harper Adams Agricultural College, Newport, Salop.

Dr. J. A. Voelcker, Woburn Experimental Farm, Aspley Guise, Beds.

A. E. Davy, Cawkwell, Louth, Lincs.

H. V. Sheringham, South Creake, Fakenham, Norfolk.

Observations on the Plots: Season 1926.

Dunmow.—Phillpott's Field, heavy soil.

Owing to the heavy storms, the field was badly laid in places, which adversely affected both the yield and quality.

Four plots, each of four acres. Previous crop, mangolds, Kohl rabi, and swedes, which, however, ran across the barley plots, so that the conditions applied equally to all. Barley sown, March 22nd; manure applied at same time, rate of seeding, 2½ bushels per acre, seeded rough. Long dry spell after sowing caused barley to come up irregularly. Sulphate of ammonia showed no effect till early in June when the manured plots stood out as darker in colour, and early began to look the best. The roots had received 15 loads of dung per acre.

At the north end, where mangolds had followed lucerne and then failed, the barley was distinctly better than the south end, but, later in the season, the barley was so badly laid that the plots could not be separated. This part was therefore taken out, thus reducing the plots to three-and-a-half acres. The plots were weedy, there being much thistle and charlock.

Yields per Plot (4 Acres) as Returned.

	No Manure. Head Corn. qr.	bu.	lb.	Tail Corn. qr.	bu.	lb.		Sulphate of Ammonia. Head Corn. qr.	bu.	lb.	Tail Corn. qr.	bu.	lb.
No. 1 ...	9	2	20	3	3	19	No. 2 ...	9	7	22	2	1	48
No. 3 ...	10	3	26	2	4	25	No. 4 ...	11	6	34	3	2	52

Longniddry.—Plots four acres. Previous crop, oats. The whole field had light dressing of superphosphate and potash salts. Seed-bed excellent. Plots (1) and (2) were laid, plots (3) and (4) stood up better; they were on the heavier and poorer side of the field. The crops lodged and ripened too quickly. The yields are 2¾ bushels less than expected in a good year, and the sample is thin and lean looking.

Wellingore. High Dyke Field.

1925 crop red clover hay. Second cut left for seed. No manure. 1924 crop barley, which received 3 cwt. superphosphate, 2 cwt. kainit, and 1 cwt. sulphate of ammonia, yield 42½ bushels. Rate of drilling, 12 pecks (=3 bushels). March 4th and 5th. Manures

Yields per plot (4 acres) as returned.

	No Manure. Head corn. tons.	cwt.	lb.	Tail corn.		Sulphate of Ammonia. Head corn. tons.	cwt.	lb.	Tail corn.
No. 1 ...	5	2	0	Not	No. 2 ...	4	5	42	Not
No. 3 ...	4	12	–	stated.	No. 4 ...	4	12	56	stated.

harrowed in March 26th. Crop harvested August 26th. Little rain from February 20th to April 5th, afterwards well distributed rainfall throughout the growing session, but little sun or drying wind. This caused more straw than usual. The crop was cut August 26th, but while it was still in stook in September, there came heavy rain, which, combined with the muggy conditions, caused weathering and loss of brightness, considerably depreciating the value of the crop. The average yield was just under 25 bushels, as against 43 for the two earlier seasons. Rainfall in mm. during the growing season for the four years of the experiments at Wellingore :—

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
Mean	45	40	42	38	50	50	60	66	42
1923	—	88	41	20	59	20	96	48	—
1924	45	17	13	33	67	48	52	60	54
1925	38	48	24	32	74	3	23	35	79
1926	58	27	13	46	71	61	40	60	20

Yields per acre, as returned.

	No Manure. Head corn. bushels.	Tail corn. bushels.		Sulphate of Ammonia. Head corn. bushels.	Tail corn. bushels.
No. 1 ...	23·3	3·63	2	25·6	4·84
No. 3 ...	20·6	4·84	4	28·5	4·54

Nynehead. Big Field, red light soil, good for barley.

Previous crop young grass, folded by sheep. Sown March 8th, 12 pecks per acre ; seed went in well. Manures applied March 8th, drought after sowing, so the crop came up irregularly. Plot 4 (Sulphate of Ammonia) much the best in June, though not in final yield. Plot 2 (duplicate Sulphate of Ammonia) not so good.

Early in April wireworms had been busy on the plot. The land, however, was rolled three times and a plant was secured all over the field, though thin in places.

Yields per plot, as returned.
(3.5 acres, Plot 4, 3.3.)

	No Manure. Head corn. Sacks.	Tail corn. Sacks.		Sulphate of Ammonia Head corn. Sacks.	Tailcor Sacks.
No. 1 ...	26	2	No. 2	32	5
No. 3 ...	29	4	No. 4 ...	30	4

Barneyhill. Sandyknowe. Good red soil, inclined to be dry.

Previous crop, potatoes, receiving farmyard manure and 11 cwt. per acre potato manure. Sown March 24th, 2½ bushels per acre. Seed went in well. Manures applied March 24th. Very wet weather April and first half of May.

Cawkwell. The Helens Field, light loam, chalk.

Previous crop and manures, farmyard manure applied in November on grazed seed ; four acre plots. The seed went in well ; plots receiving ammonia showed up a dark colour. Variety Spratt Archer. Weather bad before seeding in March, dry afterwards until June 21st, when wet weather set in. On the whole, however, the season was good with plenty of sun.

Yields per plot, as returned.
(4 acres.)

	No Manure. Head corn. qr.	st.	Tail corn. qr.	st.		Sulphate of Ammonia. Head corn. qr.	st.	Tail corn. qr.	st.
No. 1 ...	13½	—	2½	4	No. 2 ...	14½	—	4½	—
No. 3 ...	14	4	2	7	No. 4 ...	16	—	3½	—

Chiselborough.

Plot 1 (Sulphate of Ammonia) badly laid, rooks very troublesome. Plots 4 and 5 (both Sulphate of Ammonia) and 2, 3 and 6 (unmanured) stood up better. There were three pairs of plots, two of which were taken after wheat, following flax, following ley, all unmanured. It was very clean, undersown with clover. A little irregularity in the plants, but nothing important. The third pair, at the East end, was taken after mangolds receiving farmyard manure and sulphate of ammonia. On July 12th the crops were all standing well in spite of the fact that there had been little sun. With sunny weather it would have ripened nicely. There was a marked difference between the unmanured and sulphate of ammonia plot. Ultimately the plot receiving sulphate of ammonia following mangolds went down badly. Badly troubled by rooks, and Mr. Clarke estimated that this plot lost quite 3 or 4 sacks. Rainfall in inches, at the nearest station, Merriott, Crewkerne, during the growing season :—

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1923 ...	1·75	8·91	1·64	2·55	1·31	0·50	0·77	2·61	2·99
1924 ...	3·65	0·64	1·72	3·43	4·61	2·90	4·05	3·45	5·37
1925 ...	3·33	3·95	0·65	2·67	3·84	0·01	2·33	2·25	3·82
1926 ...	4·08	1·83	0·48	2·75	2·02	2·45	3·46	1·27	0·78

These figures were supplied by courtesy of Mrs. C. H. Blake.

Yields per plot, as returned.
(Plots 1, 2, 2 acres ; 3, 4, 5, 3 acres ; 6, 2.5 acres.)

	No Manure. Head corn.			Tail corn.		
	ton.	cwt.	qr.	lb.	cwt.	qr.	lb.
No. 2 ...	2	0	3	0	2	1	0
No. 3 ...	2	14	3	0	1	2	12
No. 6 ...	1	10	2	4	—	2	16

	Sulphate of Ammonia. Head corn.				Tail corn.		
	ton.	cwt.	qr.	lb.	cwt.	qr.	lb.
No. 1 ...	1	18	2	14		3	4
No. 4 ...	2	15	1	14	1	3	16
No. 5 ...	3	2	2	14	1	3	14

Beverley. Lime Kilns Field. Wold land with chalk subsoil.

Four plots of four acres. Previous crop, wheat manured with farmyard manure in autumn. Seed sown 23rd and 26th April. Manures applied 22nd and 24th April. 3 bushels per acre. Seedbed rather on the wet side, but barley went in well. The winter was cold and wet after the barley came out. Crop suffered from wireworm, but was rolled and afterwards filled out well. Cutting began August 25th.

Yields per plot (4 acres) as returned.

	No Manure. qr.	st.		Sulphate of Ammonia. qr.	st.
No. 1 ...	17	13	No. 2 ...	14½	9
No. 3 ...	14½	8	No. 4 ...	18	6½

Wye.

On June 15th the plots looked exceedingly well. They were sown with clover, which had germinated nicely. The barley was standing up clean and free from weeds and promised a heavy crop, given sunny weather. Part of the field has been folded and part not, but the plots were so arranged that each had equal areas of the folded land and of the unfolded land.

Yields per acre, as returned.

	No Manure Head.		Tail.		Total.			Sulphate of Ammonia. Head.		Tail.		Total.	
	bu.	lb.	bu.	lb.	bu.	lb.		bu.	lb.	bu.	lb.	bu.	lb.
No. 2	50	4	6	4	56	8	No. 1 ...	47	45	7	34	55	23
No. 4	51	1	6	10	57	11	No. 3 ...	48	43	10	29	59	16

BARLEY 1926. H. V. SHERINGHAM.

(South Creake, Fakenham).

Medium loam. Field name: 100 Acres. Previous crop, mangolds, which received eights loads farmyard manure and 3 cwt. kainit. Land ploughed once, cultivated once, harrowed four times, rolled once, harrowed and rolled after sowing. Seed sown March 11th and 12th at the rate of 10 pecks per acre; went in well. Manures applied March 19th and 20th. Barley receiving muriate came into ear first, then sulphate, and lastly, but only a little later, the unmanured barley. On July 16th the chloride plots looked the best, having had longer ripening period. Barley receiving sulphate showed the green colour.

Season had been dry at first, then wet, and the plots had suffered from rather a bad attack of either wireworm or frit fly.

Rothamsted Experimental Station.—Harpenden, Herts.

The experiments were carried out on two fields. New Zealand field and West Barnfield. In the former was the set of small replicated

Malting Barley Experiments—Road Piece—1926.

Plot.	Manures per Acre.	Head Corn.		Tail Corn.	Straw, Chaff, etc.			
		Bushels.	Weight. per Bushel					
			lbs.	lbs.	Tons.	cwt.	qr.	lbs.
1	Nothing	32·2	53·7	114	1	5	2	2
2	Super: 3 cwt.; S/Potash, 1½ cwt.; S/Ammonia, 1 cwt.	48·5	52·7	252	1	16	3	8
3	Super: 3 cwt.; S/Ammonia, 1 cwt. ...	41·6	52·7	126	1	9	0	22
4	S/Potash, 1½ cwt.; S/Ammonia, 1 cwt. ...	42·9	52·3	175	1	16	0	27
5	Super: 3 cwt.; S/Potash, 1½ cwt. ...	35·3	53·4	147	1	4	2	8
6	S/Ammonia, 1 cwt.	39·3	52·1	160	1	13	3	20
7	Muriate of Ammonia = 1 cwt. S/Ammonia	47·1	52·9	148	1	13	3	13
8	Super: 3 cwt.; S/Potash, 1½ cwt.; Muriate of Ammonia — 1 cwt. S/Ammonia ...	41·1	53·1	167	1	10	3	13

plots which occupied only a small part of the field; of the remainder, part was dressed with sulphate of ammonia and part left unmanured. The field is undulating, the part receiving sulphate of ammonia being some 20 feet lower than the rest of the field. The previous crop was mangolds, which received dung and artificials. The barley germinated well and evenly, and promised to be heavy, though the sulphate of ammonia plot was rather foul. Stormy weather a few weeks before harvest laid the crop badly and harvesting was made very difficult.

West Barnfield, which had previously been cropped with mangolds and potatoes, had four plots, two of which received sulphate of ammonia and two no nitrogen. The previous crop had not been liberally manured, potatoes only being dunged. The mangolds were a poor crop. Germination was rather uneven, and at no time did the crop look well. Little difference was apparent between the plots. Bad weather before harvest laid the crop, most damage being done where dung had been applied previously. The crop was harvested in bad conditions.

Soil.—Clay with flints.

West Barnfield drilled March 18, 1926. Rate 3 bushels/acre. Cut August 30, 1926, carted September 11th and 13th, 1926.

New Zealand, drilled March 16th, 1926. Cut August 27th, 1926, carted September 10th, 1926.

Woburn Experimental Farm, Beds., 1926. *Road Piece.* Clay loam.

These plots were in continuation of the

first series of experiments. Eight treatments were included and were duplicated, there being 16 plots of one-eighth of an acre. Mangolds were the previous crop, and these had received a dressing of mixed artificials, but no dung. The field was drilled on the 19th March, at the rate of 3 bushels to the acre, the manures being applied on the same day. The seed went in well and the fully manured plots were later considered to look better than those unmanured and lacking nitrogen. The crop was good but slightly damaged.

Harper Adams Agricultural College, Newport, Salop.—Strong loam.

The experiment here was also in continuation of the small-scale series. The previous crop was rape, cut and carried, receiving two tons of lime, following mangolds heavily manured. Germination was good, and the crop looked well in the early stages. No differences attributable to manuring could be observed. All plots were badly laid, and harvesting was very difficult.

Harper Adams Agricultural College, Newport, Salop.

1925 Malting barley results, received too late for inclusion in the 1925 report.

Plot No.	Treatment.	Yield of dressed grain in bushels per acre. Mean.		Tail corn.	Total.
1	No manure ...	36·2		1·9	38·1
1a	,, ...	33·0	34·6	1·4	34·4
2	Complete manure	37·1		1·9	39·0
2a	,,	47·3	42·2	2·3	49·5
3	No potash ...	39·6		1·4	41·0
3a	,, ...	36·7	38·2	2·1	38·8
4	No phosphate	23·9		1·8	25·7
4a	,, ...	40·0	31·9	1·9	41·9
5	No nitrogen ...	21·4		0·7	22·1
5a	,, ...	33·0	27·2	1·9	34·9
6	Nitrogen only	44·3		3·3	47·6
6a	,, ...	36·7	40·5	1·8	38·5

Harper Adams Agricultural College, Newport, Salop.

Season 1926.

(Six plots in duplicate, *i.e.*, 12 plots in all. Area of each plot—one-twelfth of an acre.)

Plot No.	Treatment.	Weights per plot corn (lb.)			Yields per acre. Bushels.			Mean yield.	
		Head.	Tail.	Total.	Straw (cwt.)	Head.	Tail.	Total.	Head.	Tail.
1	No manure	150½	32	182½	2¾	32·2	6·83	39·03	32·4	9·6
1a	,, ...	157	58	215	3⅛	32·6	12·4	45·0		
2	Complete artificials	205	32½	237½	2½	43·9	6·86	50·76	41·6	8·4
2a	,, ...	184½	46½	231	3	39·4	9·95	49·35		
3	No potash	204½	48	252½	3¼	43·9	10·3	54·2	40·6	9·0
3a	,, ...	174	35½	209½	3	37·3	7·6	44·9		
4	No phosphate	193	41½	234½	2⅝	41·4	8·85	50·25	45·6	8·5
4a	,, ...	232	37½	269½	3	49·7	8·2	57·9		
5	No nitrogen	196	48½	244½	3½	42·0	10·2	52·2	41·1	10·5
5a	,, ...	187½	50	237½	3½	40·2	10·7	50·9		
6	Nitrogen only	133	61	194	3½	28·5	13·1	41·6	33·3	11·5
6a	,, ...	177½	46½	223¾	3⅜	38·0	9·9	47·9		

N.B.—All plots very badly laid by weather, and difficult to mow, even with a scythe.