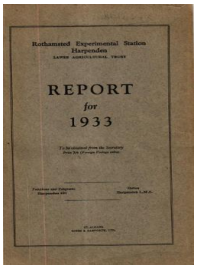
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ROTHAMSTED RESEARCH

Report for 1933

Full Table of Content



Rothamsted Experimental Plots 1933

Rothamsted Research

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YIELDS OF EXPERIMENTAL PLOTS 1933

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Notes on the Construction and Use of the Summary Tables.

The presentation of the results of simple experiments is an easy matter, it being usually sufficient to give the mean yields of the individual treatments with an associated standard error by which differences may be compared ; a difference of three times the standard error of a treatment mean may be regarded as significant. In the case of complex experiments, however, where there are all combinations of several groups of treatments, the mere presentation of the mean yields of the sets of plots receiving all the different combinations of treatments does not give an adequate or easily comprehended survey of the results.

In order to illustrate the points involved we will first consider the simple type of complex experiment in which there are all combinations of two standard fertilisers, nitrogen and phosphate, each at one level in addition to no application. This is called a 2×2 arrangement, and involves the four treatments

O, N, P, NP.

Each treatment will be replicated several times, using a randomised block or Latin square layout. In what follows the symbols are taken to represent the mean yields of each particular combination of treatments.

There are two responses to N, one in the absence of P, namely (N—O), and one in the presence of P, namely (NP—P). These two responses may differ, but frequently the difference is small—too small to be distinguished from experimental error—and in such cases it is often sufficient in considering the results of the experiment to take the average response to N when P is both present and absent. The average response is clearly

$$\tfrac{1}{2}[(N-O)+(NP-P),]$$

or

$$\tfrac{1}{2}(NP+N-P-O).$$

The differential response to N in the presence and absence of P, usually called the *interaction* between N and P, is the difference between the response to N when P is present, and the response when P is absent. It is given by

$$[(NP-P)-(N-O),]$$

or

$$NP-N-P+O.$$

Note that with this convention there is no factor $\frac{1}{2}$ as there was in the average response, also that the differential response to N in the presence and absence of P is the same as the differential response to P in the presence and absence of N, i.e., there is only one interaction between N and P.

If potash is also included in the experiment we have a $2\times2\times2$ arrangement with the eight treatments

O, N, P, K, NP, NK, PK, NPK.

The average response to N is the average of four responses and is therefore

$$\tfrac{1}{4}[(N-O)+(NP-P)+(NK-K)+(NPK-PK)\,],$$

or

$$\tfrac{1}{4}(NPK+NP+NK-PK+N-P-K-O).$$

The interaction between N and P is the average of the interaction when K is present and the interaction when K is absent, i.e.,

$$\tfrac{1}{2}[(NPK-NK-PK+K)-(NP-N-P+O),]$$

or

$$\tfrac{1}{2}(NPK+NP-NK-PK-N-P+K+O).$$

The difference between the interactions between N and P when K is present and absent is called the *second order* interaction between N, P and K, and is given by

$$[(NPK-NK-PK+K)-(NP-N-P+O)],$$

or

$$NPK-NP-NK-PK+N+P+K-O.$$

Just as there is only one interaction between two treatments, so there are three first order interactions between three treatments, one between each of the pairs of the treatments, but only one second order interaction between the three treatments.

The summaries of this report are so arranged that as far as possible the main effects and first order interactions are available without the necessity of taking out any means. The first order interactions are often given in the form of response to one treatment in the presence of, and in the absence of the other, under the heading of "differential responses." The standard errors (prefaced by the sign $\pm$) applicable to all comparisons which are likely to be of interest are also shown. They are deduced from the standard errors per plot, which are given in the details of the experiment.

The rough rule for use with standard errors is that a quantity is significant if it is greater than twice its standard error, and the difference between two quantities having the same standard error is significant if it is three times that standard error. Thus the mean response to sulphate of ammonia in the 1934 Brussels Sprouts experiment at Woburn is given as 9.01 cwt. $\pm$1.89 cwt.,

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which is therefore significant, since the response is almost 5 times its standard error. The responses in the absence and presence of poultry manure are 12.38 cwt. and 5.64 cwt., each with a standard error of ±2.67, and the differential response (or interaction) which is the difference of these, though suggestive, is not significant, being only about two and a half times the standard error of each of them. The response to sulphate of ammonia in the presence of poultry manure, 5.64 ,is significant, being more than twice its standard error. The same interaction can be looked at from the point of view of response to poultry manure in the absence and presence of sulphate of ammonia. These responses are 8.18 and 1.44 cwt., again with a standard error of ±2.67, giving a mean response of 4.81 cwt. with a standard error of ±1.89. The mean response and the response in the absence of sulphate of ammonia are therefore significant, but the response in the presence of sulphate of ammonia is small and not significant. We have here a case of common occurrence where one of two quantities is significant and the other is not, but where the two quantities do not differ significantly from one another.

Standard errors, besides their use for testing the significance of comparisons from one particular experiment, are of importance when the results of a number of experiments are combined, since they serve as a measure of the reliability of each experiment, and also give the information necessary for telling whether the variation from experiment to experiment in the effect under survey is a real one or whether it can be attributed to experimental errors.

The second and higher order interactions are likely to be of even less importance than the first order interactions, and this fact is made use of in *confounding*, which is a modification of the randomised block method, introduced in order to keep the number of plots per block small while allowing a large number of different treatments. In confounded experiments certain comparisons representing high order interactions are confounded (i.e. mixed up) with differences between blocks. Thus in the 2×2×2 arrangement given above, the plots receiving the treatments NPK, N, P and K might be put in one set of sub-blocks of 4 plots, and the plots receiving treatments NP, NK, PK and O in another set of sub-blocks of 4 plots. The second order interaction would then be completely confounded. On irregular land a considerable increase in precision may result from keeping the blocks small. There are many examples of confounding of varying complexity in the experiments of this report. There is not space to discuss all the implications of confounding here, but it will be seen that in general the results of interest, namely the main effects and first order interactions, are unaffected by confounding, and tables involving these interactions only can be used without regard to the confounding. In certain cases, e.g., 3×2×2 and 3×3×2 experiments, where some of the first order interactions are unavoidably slightly confounded,these interactions have slightly higher standard errors than the others ; this is indicated in the tables themselves, the correct standard errors being given.

The high order interactions are not only unimportant, but it can often be confidently predicted that they are likely to be very small in magnitude compared with the experimental errors. They can therefore be used to provide an estimate of experimental error instead of the usual estimate provided by replication. This makes possible complex experiments in which each combination of treatments occurs once only, thus enabling greater complexity to be attained with a reasonable number of plots. The 1933 potato experiment at Wisbech is an example of this type of layout.

CONVERSION TABLE.

1 acre	0.405 Hectare	0.963 Feddan.
1 bushel (Imperial)	0.364 Hectolitre (36.364 litres)	0.184 Ardeb.
1 lb. (pound avoirdupois)	0.453 Kilogramme	1.009 Rotls.
1 cwt. (hundredweight, 112 lb.)	50.8 Kilogrammes	113.0 Rotls. 1.366 Maunds.
1 ton (20 cwt. or 2,240 lb.)	1016 Kilogrammes.	
1 metric quintal or Doppel Zentner (Dz.)	100.0 Kilogrammes. 220.46 lb.	
1 metric ton (tonne)	1000 Kilogrammes.	
1 bushel per acre	0.9 Hectolitre per Hectare	0.191 Ardeb per Feddan
1 lb. per acre	1.12 Kilogramme per Hectare	1.049 Rotls. per Feddan
1 cwt. per acre	1.256 dz. per Hectare	117.4 Rotls. per Feddan
1 ton per acre	25.12 dz. per Hectare.	
1 dz. per Hectare	0.796 cwt. per acre.	
1 kg. per Hectare	0.892 lb. per acre.	

In America the Winchester bushel is used = 35.236 litres. 1 English bushel = 1.032 American bushels.

The yields of grain in the replicated experiments are given in cwt. per acre. One bushel of wheat weighs 60 lb., of barley weighs 52 lb., of oats weighs 42 lb., approximately.

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CHEMICAL ANALYSIS OF MANURES USED IN REPLICATED EXPERIMENTS, 1933.

Manures.	% N	$\%P_2O_5$	$\%K_2O$
Sulphate of Amm.	20.8—21.1	—	—
Bicarbonate of Amm.	17.7	—	—
Nitrate of Soda	15.8—16.1	—	—
Nitrochalk	15.5	—	—
Poultry Manure (1)	3.85	3.22	1.67
Poultry Manure (2)	4.38	4.05	1.94
Poultry Manure (3)	3.58	2.89	1.63
Poultry Manure (4)	3.68	—	—
Poultry Manure (5)	4.37	—	—
Poultry Manure (fresh)	1.25	1.80	—
Guano	6.50	16.4	—
Dung	0.68	0.25	0.89

	$\%P_2O_5$		
	Total.	Soluble in Water.	Soluble in Cit. Acid.
Basic Slag High Sol.	14.9	—	14.4
Basic Slag Low Sol.	15.1	—	3.5
Mineral Phosphate— (90% through 12 mesh) ..	25.9	—	—
Superphosphate (6)	16.1	—	—
Superphosphate	17.5	16.4	—

Sulphate of Potash	49.2	$\%K_2O$
Potash Manure Salt 30%	30.9	
Muriate of Potash	52.3	

Poultry Manures Nos. 1-5 were obtain in a dried, ground form.

(1) Used in all poultry manure experiments except at Rothamsted, Woburn, Portobello, Honeydon.

(2) Used at Rothamsted.

(3) Used at Woburn.

(4) Used at Portobello.

(5) Used at Honeydon.

(6) Used only in experiments testing basic slags.

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Three Course Rotation, 1933

Manures.	% Organic Matter.	% N	% P_2O_5	% K_2O
Chaffed Straw	77.3	0.301	0.097	1.053
Adco	14.1	0.302	0.265	0.160
Superphosphate	—	—	17.0(1) 17.5(2)	—
Sulphate of Ammonia	—	21.2(1) 21.2(2)	—	—
Muriate of Potash	—	—	—	52.1(1) 52.3(2)
Sulphate of Potash	—	—	—	49.2
Nitrate of Soda	—	15.8	—	—

[1] Applied in Autumn. [2] Applied in Spring.

Four Course Rotation, 1933

Manures.	% Organic Matter.	% N	% P_2O_5	% K_2O
Chaffed Straw	77.3	0.301	0.097	1.053
Dung	18.6	0.507	0.203	0.859
Adco	14.1	0.302	0.265	0.160
Superphosphate	—	—	17.0	—
Mineral Phosphate—				
90% through 120 mesh ..	—	—	26.7	—
Muriate of Potash	—	—	—	52.1
Sulphate of Ammonia	—	21.2	—	—

Six Course Rotation, 1933

Sulphate of Ammonia ..	21.2% N.
Muriate of Potash ..	52.1% K_2O
Superphosphate	17.0% P_2O_5

AVERAGE WHEAT YIELDS OF VARIOUS COUNTRIES

Country.	Mean yield per acre, 1923-32. cwt.	Country.	Mean yield per acre, 1923-32. cwt.
Great Britain	17.5	Denmark	22.5
England and Wales ..	17.3	Argentine	6.7
Hertfordshire	16.1	Australia	6.4
France	11.4	Canada	9.2
Germany	15.8	United States	7.7
Belgium	20.4	U.S.S.R. (Europe and Asia)	5.6*

Note.—Figures for Great Britain, England and Hertfordshire are taken from the Ministry of Agriculture's "Agricultural Statistics," Vol. 67. Other figures from "International Year Book of Agricultural Statistics," 1925-33.

*1924-32, excluding 1931.

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METEOROLOGICAL RECORDS, 1933

	Rain.		Drainage through soil.				Temperature (Mean).				
	Total Fall 1/1000th Acre Gauge.	No. of Rainy Days (0.01 inch or more) 1/1000th Acre. Gauge.	20 ins. deep.	40 ins. deep.	60 ins. deep.	Bright Sun-shine.	Max.	Min.	1 ft. in gr'd.	Solar Max.	Grass Min.
1933—	Inches.	No.	Inches.	Inches.	Inches.	Hours.	°F.	°F.	°F.	°F.	°F.
Jan. ..	1.972	15	1.505	1.679	1.654	70.4	39.4	30.3	37.0	62.0	26.1
Feb. ..	2.151	16	1.542	1.830	1.656	102.4	44.3	33.1	37.5	82.3	29.7
Mar. ..	2.922	16	1.888	2.110	2.057	196.9	53.2	36.2	41.3	101.3	30.3
April ..	0.925	7	0.000	0.016	0.014	153.4	55.4	39.5	46.7	115.6	33.9
May ..	1.593	16	0.173	0.158	0.148	168.2	61.4	45.2	53.4	124.3	41.0
June ..	1.033	14	0.000	0.002	0.002	240.6	68.4	49.7	59.8	128.2	44.0
July ..	1.425	12	0.000	0.000	0.000	246.2	73.5	55.3	64.4	133.1	50.9
Aug. ..	0.653	7	0.000	0.000	0.000	243.2	74.5	54.1	64.3	133.0	48.6
Sept. ..	2.452	12	0.496	0.442	0.432	183.3	67.3	51.4	59.5	118.2	46.5
Oct. ..	1.484	14	0.179	0.118	0.063	94.6	55.4	44.1	51.4	96.3	39.8
Nov. ..	1.471	15	0.890	0.857	0.831	51.3	45.1	37.6	43.4	71.7	33.7
Dec. ..	0.534	8	0.159	0.093	0.071	41.4	36.4	29.4	35.2	53.7	25.9
Total or Mean	18.615	152	6.832	7.305	6.928	1791.9	56.2	42.2	49.5	101.6	37.5

RAIN AND DRAINAGE.
MONTHLY MEAN FOR 63 HARVEST YEARS, 1870-1—1932-3.

	Rain-fall.	Drainage.			Drainage % of Rainfall.			Evaporation.		
		20-in. Gauge.	40-in. Gauge.	60-in. Gauge.	20-in. Gauge.	40-in. Gauge.	60-in. Gauge.	20-in. Gauge.	40-in. Gauge.	60-in. Gauge.
	Ins.	Ins.	Ins.	Ins.	%	%	%	Ins.	Ins.	Ins.
Sept. ..	2.371	0.810	0.787	0.726	34.2	33.2	30.6	1.561	1.584	1.645
Oct. ..	3.127	1.779	1.759	1.629	56.9	56.3	52.1	1.348	1.368	1.498
Nov. ..	2.869	2.189	2.245	2.118	76.3	78.3	73.8	0.680	0.624	0.751
Dec. ..	2.809	2.390	2.492	2.379	85.1	88.7	84.7	0.419	0.317	0.430
Jan. ..	2.399	1.968	2.163	2.065	82.0	90.2	86.1	0.431	0.236	0.334
Feb. ..	2.001	1.488	1.602	1.529	74.4	80.1	76.4	0.513	0.399	0.472
March ..	1.982	1.058	1.185	1.122	53.4	59.8	56.6	0.924	0.797	0.860
April ..	2.038	0.663	0.742	0.708	32.5	36.4	34.7	1.375	1.296	1.330
May ..	2.096	0.508	0.576	0.543	24.2	27.5	25.9	1.588	1.520	1.553
June ..	2.172	0.514	0.544	0.523	23.7	25.0	24.1	1.658	1.628	1.649
July ..	2.716	0.715	0.743	0.695	26.3	27.3	25.6	2.001	1.973	2.021
Aug. ..	2.622	0.704	0.718	0.676	26.8	27.4	25.8	1.918	1.904	1.946
Year ..	29.202	14.786	15.556	14.713	50.6	53.3	50.4	14.416	13.646	14.489

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CROPS GROWN IN ROTATION, AGDELL FIELD

PRODUCE PER ACRE.

Year.	Crop.	O. Unmanured since 1848.		M. Mineral Manure.‡ No Nitrogen.		C. Complete Mineral and Nitrogenous Manure	
		5. Fallow.	6. Clover or Beans.	3. Fallow.	4. Clover or Beans.	1. Fallow.	2. Clover or Beans.
Average of first twenty-one Courses, 1848-1931.							
	Roots (Swedes) .. cwt.*	32.0	16.1	174.0	206.5	352.0	310.0
	Barley—						
	Dressed Grain .. bush.	21.6	19.8	22.7	26.6	30.3	35.0
	Total Straw .. cwt.†	13.3	13.2	13.6	15.6	18.4	21.7
	Beans—						
	Dressed Grain .. bush.‡‡	—	13.1	—	18.2	—	22.3
	Total Straw .. cwt.‡‡	—	9.2	—	13.2	—	15.3
	Clover Hay .. cwt.§	—	25.6	—	52.1	—	52.0
	Wheat—						
	Dressed Grain .. bush.	23.1	21.6	26.9	29.4	27.5	29.0
	Total Straw .. cwt.†	22.9	21.2	28.2	29.8	29.4	29.3
Present Course (22nd), 1932 and 1933.							
1932	Roots (Turnips) .. cwt.	20.2	5.4	86.0	118.0	120.0	98.6
1933	Barley—						
	Dressed Grain .. bush.	6.0	2.2	9.5	13.9	3.7	5.4
	Total Grain .. cwt.	3.3	1.3	5.2	7.4	2.0	2.9
	Weight per bushel .. lb.	54.8	50.2	55.2	55.0	52.9	53.0
	Total Straw .. cwt.†	6.3	4.8	7.4	11.4	9.1	14.0

*Plots 1, 3 and 5 based upon 19 courses. Plots 2, 4 and 6 based upon 18 courses.

†Includes straw, cavings and chaff.

‡Mineral Manure: 528 lb. Superphosphate (35%); 500 lb Sulphate of Potash; 100 lb. Sulphate of Soda; 200 lb. Sulphate of Magnesia, all per acre. Nitrogenous Manure—206 lb. Sulphate of Ammonia and 2,000 lb. Rape Dust per acre. Manures applied once every four years, prior to sowing of Swedes.

‡‡Based on 8 courses.

§Based on 13 courses.

CULTIVATIONS, ETC.—Ploughed: December 13th-15th. Harrowed: March 23rd and May 3rd. Seed sown: March 23rd. Variety: Plumage Archer. Manures applied May 31st-June 2nd, 1932. Harvested: August 18th.

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WHEAT AFTER FALLOW—HOOS FIELD

Without Manure, 1851 and since.

SCHEME FOR COMPARING A THREE YEAR FALLOW WITH A ONE YEAR FALLOW.

Each of the two strips on Hoos Wheat after Fallow is to be divided into four parts. In the year when a strip is in crop, one quarter is to continue to be fallowed, so that this quarter has a three-year fallow. Different quarters are to be selected for fallow in successive years in the rotation given in the following table :

A	N	B
1		1
2		2
3		3
4		4

Cropping of strips A and B.

C=Crop. F=Fallow.

Year.	A1.	A2.	A3.	A4.	B1.	B2.	B3.	B4.
1932	F	C	C	C	F	F	F	F
1933	F	F	F	F	C	C	F	C
1934	C	F	C	C	F	F	F	F
1935	F	F	F	F	C	C	C	F
1936	C	C	F	C	F	F	F	F
1937	F	F	F	F	F	C	C	C
1938	C	C	C	F	F	F	F	F
1939	F	F	F	F	C	F	C	C
1940	F	C	C	C	F	F	F	F

A comparison of the effect of a three year fallow with the effect of a one year fallow will be possible in every year.

Half the experiment will continue to be wheat after one year fallow, and continuity with previous results will thus be maintained.

PRODUCE PER ACRE, 1933.

	B1	B2	B4	Mean.	Average, 77 years, 1856-1932.
Dressed Grain—bushels	21.7	20.8	16.2	19.6	14.2
Total grain—cwt.	12.7	11.8	9.3	11.3	8.1
Weight per bushel—lb.	62.6	61.2	60.4	61.4	58.8
Total straw—cwt.	19.1	19.1	17.1	18.4	12.6

CULTIVATIONS, ETC.—Cropped sections. Ploughed : September 2nd. Harrowed : October 15th and March 31st. Seed sown : October 15th. Variety : Red Standard. Harvested : July 26th. Fallowed sections. Ploughed : September 2nd, May 31st and June 1st. Harrowed : March 31st.

https://doi.org/10.23637/ERADOC-1-3 *pp 9*

MANGOLDS—BARNFIELD, 1933

Roots each year since 1856. **Mangolds each year since 1876.**

PRODUCE PER ACRE.

	Strip.	Strip Manures. (Amounts stated are per acre.)	1933. Cross Dressings O	N	A	AC	C	52 Year Average, 1876-1932 † Cross Dressings. O	N	A	AC	C
			None.	Nitrate of Soda (550 lb.)	Sulphate of Ammonia (412 lb.)	Sulphate of Ammonia (412 lb.) & Rape Cake.	Rape Cake (2,000 lb.)	None.	Nitrate of Soda (550 lb.)	Sulphate of Ammonia (412 lb.)	Sulphate of Ammonia (412 lb.) & Rape Cake.	Rape Cake (2,000 lb.)
			Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Roots	1	Dung only (14 tons)	15.15	18.48	10.60	14.48	16.43	17.49	26.29	21.78	23.55	23.57
	2	Dung, Superphosphate (3½ cwt.), Sulphate of Potash (500 lb).	16.98	17.37	14.24	16.32	19.44	19.04	26.89	24.88	27.68	26.64
	4	Complete Minerals : Super. and Potash as 2, Salt (200 lb.) Sulphate of Magnesia (200 lb.)	4.25	(*a*) 8.75** (*b*) 6.67**	9.25	15.01	13.69	4.65	(*a*) 17.58 (*b*) 18.47 *	14.58	26.18	21.09
	5	Superphosphate only (3½ cwt.)	2.88	5.00	2.50	2.30	3.40	4.50	14.90	6.88	9.47	10.20
	6	Super. (3½ cwt.) Sulphate of Potash (500 lb.)	2.42	5.15	6.13	4.78	8.21	4.08	15.35	13.70	22.63	18.21
	7	Super. (3½ cwt.) Sulphate of Magnesia (200 lb.) and Sodium Chloride (200 lb.)	2.81	8.92	9.70	7.55	11.56	4.87	16.30	14.90	22.25	19.18
	8	No Minerals	2.26	5.11	1.44	1.09	5.55	3.36	9.85	5.48	8.52	8.93
	9	Sodium Chloride (200 lb.), Nit. Soda (550 lb.), Sulph. Potash (500 lb.) and Sulph. Mag. (200 lb.)	8.96	—	—	—	—	—	—	—	—	—
Leaves	1	Dung only (14 tons)	2.68	2.86	2.39	3.08	3.45	3.03	4.63	4.88	5.20	4.52
	2	Dung, Superphosphate (3½ cwt.), Sulphate of Potash (500 lb.)	2.57	3.05	2.80	3.37	3.47	3.14	5.15	5.46	6.24	4.79
	4	Complete Minerals : Super. and Potash as 2, Salt (200 lb.) Sulph. of Magnesia (200 lb.)	1.14	(*a*) 2.19 (*b*) 1.97	2.29	3.30	2.51	1.04	(*a*) 3.86 (*b*) 4.09*	2.88	5.29	3.37
	5	Superphosphate only (3½ cwt.)	0.99	1.49	1.75	1.82	2.09	1.05	3.19	2.60	3.24	2.82
	6	Super. (3½ cwt.) Sulphate of Potash (500 lb.)	0.76	1.44	1.52	1.44	1.83	0.93	3.04	2.80	5.16	2.86
	7	Super. (3½ cwt.) Sulphate of Magnesia (200 lb.) and Sodium Chloride (200 lb.)	1.03	2.36	2.48	2.76	2.79	1.10	3.32	3.02	5.18	3.31
	8	No Minerals	0.84	1.56	0.82	0.75	1.09	0.98	3.19	2.52	3.27	2.84
	9	Sodium Chloride (200 lb.), Nit. Soda (550 lb.), Sulph. Potash (500 lb.) and Sulph. Mag. (200 lb.)	2.10	—	—	—	—	—	—	—	—	—

** From 1904 onwards plot 4N has been divided, 4(a) receiving Superphosphate, Sulphate of Potash, Sulphate of Magnesia, Sodium Chloride and Nitrate of Soda, amounts as above; (4b) receiving Superphosphate, Calcium Chloride, (190 lb.), Potassium Nitrate (570 lb.), and Calcium Nitrate (100 lb.). Nitrogenous manures are applied as to one-third at time of sowing and two-thirds as top dressing at a later date, except with Rape Cake which all goes on with the seed.

† Excluding 1885 when nitrogenous fertilisers were not applied, owing to poor crop, 1908 and 1927 when the crop was swedes, 1930 when the spacing of the rows was changed and 1931 when the crop was a mixture of mangolds and swedes.

* 25 years only, 1904-1932, excluding 1908, 1927, 1930 and 1931. For this period the average yield of plot 4(a) was 18.53 for roots and 4.02 for leaves.

CULTIVATIONS, ETC.—Ploughed: January 19th-20th. Cultivated: April 11th and 12th. Harrowed: April 12th and 14th. Rolled: April 13th and 14th. Hoed: May 29th, July 3rd, 4th, 5th, 11th and 24th. Singled: June 3rd-14th. Seed sown: April 13th. Variety: Prizewinner Yellow Globe. Manures applied: April 6th, 7th, 8th, 10th and July 7th. Lifted: October 20th-31st.

https://doi.org/10.23637/ERADOC-1-3 pp 10

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HAY—THE PARK GRASS PLOTS, 1933

Plot.	Manuring (amounts stated are per acre.)		Yield of Hay per acre. 1st Crop.	Dry Matter per acre. 1st Crop.
			cwt.	lb.
1	Single dressing (206 lb.) Sulphate of Ammonia (=43 lb. N.), (with Dung also 8 years, 1856-63)	not limed	8.9	763
		limed	17.0	1,390
2	Unmanured (after Dung 8 years, 1856-63)	not limed	9.9	785
		limed	8.2	609
3	Unmanured	not limed	9.3	672
		limed	6.1	454
4–1	Superphosphate of lime (3½ cwt.)	not limed	10.7	791
		limed	5.2	402
4–2	Superphosphate of lime (3½ cwt.), and double dressing (412 lb.) Sulphate of Ammonia (=86 lb. N.)	not limed	25.2	2,097
		limed	25.8	2,198
5–1	(N. half) Unmanured following double dressing Ammonia salts (=86 lb. N.) 1856-97	not limed	7.8	601
5–2	(S. half) Superphosphate (3½ cwt.) Sulphate of Potash (500 lb.) following double dressing Amm. salts (=86 lb. N.) 1856-97	not limed	12.1	1,001
6	Complete Mineral Manure as Plot 7; following double dressing Amm. salts (=86 lb. N.) 1856-68	not limed	20.1	1,651
7	Complete Mineral Manure: Super. (3½ cwt.); Sulphate of Potash (500 lb.); Sulphate of Soda (100 lb.); Sulphate Magnesia (100 lb.)	not limed	20.2	1,721
		limed	23.5	2,022
8	Mineral Manure without Potash	not limed	17.4	1,697
		limed	10.3	810
9	Complete Mineral Manure and double dressing (412) lb. Sulphate of Ammonia (=86 lb. N.)	not limed	51.2*	4,265*
		limed	60.9	4,995
10	Mineral Manure (without Potash) and double dressing Amm. salts (=86 lb. N.)	not limed	27.0	2,324
		limed	34.2	3,036
11–1	Complete Mineral Manure and treble dressing (618 lb.) Sulphate of Amm. (129 lb. N.)	not limed	52.6	4,571
		limed	61.5	5,034
11–2	As Plot 11–1 and Silicate of Soda	not limed	62.8	5,513
		limed	68.5	5,368
12	Unmanured	not limed	10.6	863
13	Dung (14 tons) in 1905, and every fourth year since (omitted 1917), Fish Guano (6 cwt.) in 1907 and every fourth year since	not limed	45.3	3,672
		limed	39.9	3,195
14	Complete Mineral Manure and double dressing (550 lb.) Nitrate of Soda (=86 lb. N.)	not limed	58.7	4,507
		Limed Sun	55.5	4,363
		,, Shade	37.7	3,108
15	Complete Mineral Manure as Plot 7; following double dressing Nitrate of Soda (=86 lb. N., 1858-75)	not limed	19.0	1,644
		limed	14.7	1,248
16	Complete Mineral Manure and single dressing (275 lb.) Nitrate of Soda (=43 lb. N.)	not limed	36.1	3,067
		limed	31.0	2,569
17	Single dressing (275 lb.) Nitrate of Soda (43 lb. N.)	not limed	21.2	1,728
		limed	19.4	1,686
18	Mineral Manure (without Super.), and double dressing Sulphate of Amm. (= 86 lb. N.), 1905 and since; following Minerals and Amm. salts supplying the constituents of 1 ton of hay, 1865-1904	not limed	23.7	1,973
		limed (6788 lb.)	35.6	2,834
		limed (3951 lb.)	32.1	2,588
19	Farmyard Dung (14 tons) in 1905 and every fourth year since (omitted in 1917), following Nitrate of Soda (=43 lb. N.) and Minerals, 1872-1904	not limed	31.2	2,491
		limed (3150 lb.)	23.7	1,944
		limed (570 lb.)	28.6	2,180
20	Farmyard Dung (14 tons) in 1905 and every fourth year since (omitted in 1917); each intervening year Plot 20 receives Sulphate of Potash (100 lb.); Superphosphate (200 lb.) and 1½ cwt. Nitrate of Soda (=26 lb. N.); following Nitrate of Potash and Superphosphate, 1872-1904	not limed	32.3	2,894
		limed (2772 lb.)	22.6	1,899
		limed (570 lb.)	28.7	2,384

Ground Lime was applied to the southern portion (limed) of the plots at the rate of 2,000 lb. to the acre in the Winters of 1903-4, 1907-8, 1915-16, 1923-24, 1927-28, 1931-32, and at the rate of 2,500 lb. to the acre in the Winter of 1920-21, except where otherwise stated.

Up to 1914 the limed and unlimed plot results were not separately given in the Annual Report but the mean of the two was given. From 1915 onwards the separate figures are given.

*Botanical sample sorted before weighing and is not included in the total weight.

CULTIVATIONS, ETC.—Manures applied: February 21st-23rd, March 28th, 29th and May 12th. Cut: June 20th-22nd.

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PARK GRASS PLOTS

BOTANICAL COMPOSITION PER CENT.

1930 (1st Crop)

Plot	Manuring.	Liming.	Gramineae.	Leguminosae.	Other Orders.	"Other Orders" consist largely of
3	Unmanured	Limed	53.7	17.5	28.8	—
		Unlimed	47.6	9.3	43.1	*Leontodon hispidus*
7	Complete Mineral Manure.	Limed	51.0	43.1	5.9	*Achillea millefolium*, *Heracleum sphondylium*
		Unlimed	43.4	35.3	21.3	*Achillea millefolium*
9	Complete Mineral Manure and double Amm. Salts.	Limed	99.4	0.1	0.5	—
		Unlimed	100.0	—	—	—
14	Complete Mineral Manure and double Nitrate of Soda.	Limed (sun)	90.5	6.3	3.2	*Taraxacum vulgare*
		Limed (shade)	89.7	7.1	3.2	*Conopodium denudatum*
		Unlimed	96.8	1.1	2.1	*Anthriscus sylvestris*
15	As plot 7 following double Nitrate of Soda, 1858-75.	Limed	not analysed			
		Unlimed				
17	Single Nitrate of Soda.	Limed				
		Unlimed				
18	Mineral Manure (without Super) and double Sulphate Amm. 1905 and since.	L.6,788 lb.	94.0	0.3	5.7	*Heracleum sphondylium*
		L.3,951 lb.	93.6	—	6.4	*Achillea millefolium*
		Unlimed	87.1	—	22.9	*Rumex acetosa*
19	Farmyard Dung in 1905 and every fourth year since (omitted 1917).	L. 3,150 lb.	80.3	12.6	7.1	*Achillea millefolium*
		L. 570 lb.	82.1	11.4	6.5	*Rumex acetosa*
		Unlimed	86.9	6.8	6.3	*Cerastium vulgatum*
20	Farmyard Dung in 1905 and every fourth year since (omitted in 1917) each intervening year Sulphate of potash, Super., and Nitrate of Soda.	L.2772 lb.	72.9	9.8	17.3	*Taraxacum vulgare*, *Conopodium denudatum*
		L. 570 lb.	66.1	24.2	9.7	*Achillea millefolium*
		Unlimed	84.3	10.0	5.7	*Achillea millefolium*

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WHEAT—BROADBALK FIELD, 1933

Plot.	Manurial Treatment (amounts stated are per acre).	Dressed Grain, bushels per acre (in some cases estimated from half or quarter-bushel).					Total Grain, cwt. per acre.					74-year Average 1852-1925 (prior to fallow). Total Grain, cwt.
		I	II	III	IV	Mean	I	II	III	IV	Mean	
2A	Farmyard Manure (14 tons)	31.4	43.6	28.3	38.6	35.5	19.2	26.3	17.0	23.0	21.4	16.3 **
2B	Farmyard Manure (14 tons)	30.0	33.4	38.6	38.2	35.0	18.4	20.6	22.0	22.5	20.9	19.4
3	Unmanured since 1839	13.5	33.9	11.9	8.4	16.9	8.0	19.9	7.2	5.2	10.1	6.7
5	Complete Mineral Manure§§	10.8	32.6	9.7	7.7	15.2	6.6	19.0	6.0	5.0	9.2	7.8
6	As 5, and 206 lb. Sulphate of Ammonia	18.9	34.1	21.7	20.9	23.9	11.4	19.6	12.1	12.4	13.9	12.5
7	As 5, and 412 lb. Sulphate of Ammonia	36.5	35.7	27.2	29.0	32.1	21.4	20.5	15.4	17.4	18.7	17.6
8	As 5, and 618 lb. Sulphate of Ammonia	36.7	31.4	41.5	36.9	36.6	21.4	19.2	24.3	21.3	21.6	20.1
9	As 5, and 275 lb. Nitrate of Soda	28.3	35.3	26.4	25.5	28.9	16.5	20.2	16.0	15.1	17.0	13.9††
10	412 lb. Sulphate of Ammonia	29.1	38.2	25.8	22.8	29.0	17.7	22.3	15.3	13.9	17.3	10.9
11	As 10, and Superphosphate (3½ cwt.)	26.5	32.9	21.5	17.6	24.6	15.8	18.7	13.2	10.6	14.6	12.3
12	As 10, and Super (3½ cwt.) and Sulph. Soda (366 lb.)	28.3	36.5	24.2	26.4	28.8	16.9	21.4	13.9	15.2	16.8	15.7
13	As 10 and Super (3½ cwt.) and Sulph. Potash (200 lb.)	29.0	34.3	24.9	24.4	28.2	17.4	20.7	14.6	14.6	16.8	17.0
14	As 10, and Super. (3½ cwt.) and Sulph. Magnesia (280 lb.)	28.9	34.6	25.6	26.4	28.9	17.4	20.3	15.0	15.6	17.1	15.5
15	As 5, and 412 lb. Sulphate Amm. all applied in Autumn	24.4	32.2	25.7	23.1	26.4	14.3	19.2	15.2	13.8	15.6	16.1
16	As 5, and 550 lb. Nitrate of Soda	33.9	39.1	31.7	27.7	33.1	20.2	23.1	19.3	16.5	19.8	17.8††
17	Minerals alone as 5 or 412 lb. Sulphate of Amm-	M10.2	34.3	8.9	7.4	15.2	6.2	20.2	5.5	4.6	9.1	M8.1
18	alone in alternate years	A25.5	31.3	31.3	26.9	28.8	15.1	19.0	18.8	16.3	17.3	A16.1*
19	Rape Cake (1,889 lb.)	24.3	41.6	25.9	19.8	27.9	14.6	25.0	15.5	12.2	16.8	12.6‡
20	As 7, without Super.	30.0	27.6	—	—	28.8	17.8	16.8	—	—	17.3	10.3§

Fallowing Rotation. After the fallows of 1925-6 to 1928-9 a regular cycle of fallowing was started in the season 1930-31. This cycle and the preceding fallows are shown in the accompanying diagram (C=crop, F=fallow). The sections (I. to V.) are numbered in order from the upper or western end of the field. Preparatory to the first fallow the field was harvested in five separate sections (1924-5).

Season	I.	II.	III.	IV.	V.	Season.	I.	II.	III.	IV.	V.
1925-26	F	F	F	C	C	1930-31	F	C	C	C	C
1926-27	F	F	F	C	C	1931-32	C	F	C	C	C
1927-28	C	C	F	F	F	1932-33	C	C	C	C	F
1928-29	C	C	F	F	F	1933-34	C	C	C	F	C
1929-30	C	C	C	C	C	1934-35	C	C	F	C	C

For notes, see next page.

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WHEAT—BROADBALK FIELD, 1933

Plot.	Manurial Treatment (amounts stated are per acre).	Bushel Weight in lb. (in some cases estimated from half or quarter-bushel).					Total Straw†, cwt. per acre.					74-year Average 1852-1925 (prior to fallow). Total Straw, cwt.
		I	II	III	IV	Mean	I	II	III	IV	Mean	
2A	Farmyard Manure (14 tons)	63.2	63.0	62.6	63.4	63.0	43.9	63.8	39.3	40.9	47.0	32.1**
2B	Farmyard Manure (14 tons)	63.7	62.6	60.8	62.9	62.5	49.8	63.8	43.6	45.2	50.6	34.2
3	Unmanured since 1839	62.8	62.7	62.3	62.4	62.6	12.6	29.0	11.6	8.4	15.4	9.8
5	Complete Mineral Manure§§	62.8	63.2	62.0	62.6	62.6	10.3	33.0	10.1	9.0	15.6	11.5
6	As 5, and 206 lb. Sulphate of Ammonia	62.9	62.3	60.3	62.3	62.0	19.5	37.5	22.5	19.9	24.8	20.3
7	As 5, and 412 lb. Sulphate of Ammonia	62.9	61.6	61.5	63.5	62.4	36.0	46.4	32.6	30.8	36.4	32.1
8	As 5, and 618 lb. Sulphate of Ammonia	62.6	62.7	63.1	62.2	62.6	49.5	50.8	45.4	45.8	47.9	39.8
9	As 5, and 275 lb. Nitrate of Soda	62.8	61.8	63.1	62.6	62.6	32.4	42.1	28.2	26.5	32.3	24.6††
10	412 lb. Sulphate of Ammonia	62.3	63.1	62.4	62.0	62.4	29.4	38.8	23.0	21.0	28.0	17.8
11	As 10, and Superphosphate (3½ cwt.)	61.4	61.3	61.4	60.9	61.2	26.4	32.4	19.8	17.4	24.0	21.4
12	As 10, and Super (3½ cwt.) and Sulph. Soda (366 lb.)	62.2	62.3	62.0	61.5	62.0	30.5	35.8	23.9	24.6	28.7	26.8
13	As 10, and Super (3½ cwt.) and Sulph. Potash (200 lb.)	63.6	63.2	62.6	62.8	63.0	34.1	43.3	30.3	31.5	34.8	30.6
14	As 10, and Super. (3½ cwt.) and Sulph. Magnesia (280 lb.)	62.9	62.5	62.0	62.7	62.5	33.4	39.3	27.5	27.7	32.0	26.8
15	As 5, and 412 lb. Sulphate Amm. all applied in Autumn	62.8	63.4	63.2	63.3	63.2	27.1	39.1	27.3	26.0	29.9	28.2
16	As 5, and 550 lb. Nitrate of Soda	63.7	63.7	63.4	63.7	63.6	35.1	44.2	32.2	31.8	35.8	35.2††
17	Minerals alone as 5 or 412 lb. Sulphate of Ammonia	M63.0	63.8	62.6	62.6	63.0	11.2	35.7	9.3	8.1	16.1	M12.3
18	alone in alternate years	A63.0	63.5	63.2	63.0	63.2	28.9	40.8	34.2	35.0	34.7	A28.1*
19	Rape Cake (1,889 lb.)	63.0	63.6	62.3	62.8	62.9	25.9	40.6	26.6	27.7	30.2	22.0‡
20	As 7, without Super.	63.2	64.8	—	—	64.0	32.3	28.4	—	—	30.3	18.6§

† Includes straw, cavings, and chaff. *A=Ammonia series. M=Mineral series.
**Twenty-six years only, 1900-25. †† Forty-one years only, 1885-1925. ‡ Thirty-three years only, 1893-1925. § Eighteen years only, 1906-1925 (no crop in 1912 and 1914).

§§ Complete mineral manure: 3½ cwt. Super., 200 lb. Sulph. Potash, 100 lb. Sulph. Soda, 100 Sulph. Magnesia. Sulphate of Ammonia is applied as to one-third in Autumn and two-thirds in Spring except for Plot 15. Nitrate of Soda is all given in Spring, there being two applications at an interval of a month on Plot 16.

CULTIVATIONS, ETC.—Cropped sections. Ploughed: August 19th—Sept. 5th. Cultivated: Sept. 15th-16th. Harrowed: Oct. 17th-May 8th. Seed sown; Oct. 17th. Variety; Red Standard. Manures applied: Oct. 10th-11th, Mar. 29th-30th, and May 22nd. Harvested: July 27th-28th. Fallowed section.—Ploughed: Aug. 19th-Sept. 5th, Apr. 24th-25th, and July 7th-10th. Cultivated: Sept. 15th-16th, and Mar. 29th-April 12th. Harrowed: Sept. 15th-June 12. Rolled: May 10th-June 2nd.

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FOUR COURSE ROTATION EXPERIMENT, ROTHAMSTED

RESIDUAL VALUES OF HUMIC AND PHOSPHATIC FERTILISERS.

For details, see 1932 Report, p. 127.

MANURES APPLIED, SEASON 1932-3.

Treatment.	Organic Fertilisers (cwt. per acre).				Additional Artificial Fertilisers (cwt. per acre).		
	Organic Matter.	N.	K_2O	P_2O_5	N. as S. of A.	K_2O as Mur. Pot.	P_2O_5 as Super.
1 ..	50 (as F.Y.M.)*	1.363	2.309	0.546	0.437	0.691	0.654
2 ..	50 (as Adco)	1.071	0.567	0.940	0.729	2.433	0.260
3 ..	97.26 (as straw)	0.379	1.325	0.122	1.421	1.675	1.079
4 ..		None			0.36	0.6	1.2
5 ..		None			0.36	0.6	1.2†

For analysis of fertilisers, see page 101.

†As Mineral Phosphate.

* In 1932, owing to a mistake, 35.26 cwt. of organic matter was applied as F.Y.M., instead of 50 cwt. The total N, K_2O and P_2O_5, however, were correct.

CULTIVATIONS, ETC.

	Barley.	Seeds.	Potatoes.	Wheat.
Variety	Plumage Archer	Italian ryegrass and commercial white clover	Ally	Yeoman
Date of Sowing ..	March 22	April 29	April 12	November 11
Manures Applied—				
Dung and Adco ..	Oct. 14	Oct. 14	Oct. 13 and 14	Oct. 13 and 14
Artificials to Adco and Dung ..	Oct. 29	Oct. 29	Oct. 18	Oct. 18
Straw ..	Dec. 5	Oct. 27	Nov. 7	Nov. 7 and 8
Artificials to straw	Dec. 5, Feb. 4, March 15	Oct. 29, Feb. 28, March 30	Feb. 28, Mar. 30, April 7	Nov. 9, Feb. 28, March 30
Treatments 4 and 5	March 10	March 7	April 7	Nov. 9, March 8
Date of Harvesting	August 1	Failed	Oct. 3	August 1
Previous Crop ..	Potatoes	Barley	Wheat	Seeds
Cultivations—				
Ploughing ..	Dec. 5		November 7	July 4, Nov. 7 & 8
Harrowing ..	Mar. 22, April 29		May 2	Nov. 11, Mar. 31
Hoeing ..			June 26	
Ridging ..			April 6 & 7, May 11	
Grubbing ..			May 23, June 26	

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PLAN AND YIELDS

Barley—AB, Plots 1-25.
Yields in lb. grain above, straw below.
N.W.

5 60.3 72.0 I	**2** 50.2 58.3 IV	**1** 54.3 68.0 II	**3** 32.6 42.4 —	**4** 60.1 74.9 III
5 56.6 67.2 III	**1** 36.4 46.6 —	**3** 42.3 52.7 IV	**4** 70.5 78.5 I	**2** 46.1 56.6 II
3 47.0 56.8 III	**2** 57.1 73.2 I	**5** 49.6 65.4 —	**4** 56.2 73.8 II	**1** 34.9 45.6 IV
1 43.1 45.9 III	**3** 71.8 91.2 I	**4** 57.3 70.2 IV	**5** 42.5 68.8 II	**2** 29.0 40.5 —
4 55.4 68.4 —	**1** 64.3 77.2 I	**5** 37.7 61.0 IV	**3** 28.9 44.1 II	**2** 38.4 52.1 III

Seeds Hay—AH, Plots 26-50.
Crop failed.
N.W.

3 III	**2** IV	**5** —	**4** II	**1** I
4 IV	**2** II	**1** III	**5** I	**3** —
1 II	**4** —	**3** I	**5** IV	**2** III
4 I	**5** III	**3** II	**2** —	**1** IV
2 1	**4** III	**3** IV	**1** —	**5** II

Potatoes—AP, Plots 51-75.
Yields in lb.
N.W.

3 153.8 IV	**4** 251.8 I	**1** 143.0 —	**2** 87.5 II	**5** 108.0 III
3 123.0 —	**4** 192.5 III	**5** 162.5 IV	**2** 128.0 I	**1** 94.5 II
2 163.8 IV	**4** 152.8 —	**3** 148.8 III	**1** 159.0 I	**5** 90.0 II
5 167.8 —	**1** 148.5 IV	**3** 193.8 I	**4** 144.2 II	**2** 81.8 III
4 188.5 IV	**2** 98.2 —	**1** 148.0 III	**5** 153.0 I	**3** 146.5 II

Wheat—AW, Plots 76-100.
Yields in lb. grain above, straw below.
N.W.

4 71.2 90.8 III	**2** 66. 6 81.9 IV	**5** 72.0 57.5 II	**3** 53.0 60.2 —	**1** 74.7 106.8 I
5 71.8 94.4 —	**2** 82.3 121.7 I	**1** 61.0 75.8 III	**4** 71.4 88.8 II	**3** 58.4 84.4 IV
2 62.8 77.2 II	**1** 61.8 79.7 IV	**5** 63.4 98.8 I	**4** 57.9 80.6 —	**3** 62.4 85.6 III
2 56.8 80.2 III	**4** 61.2 84.3 I	**1** 53.8 72.2 —	**5** 56.8 77.2 IV	**3** 60.4 87.1 II
5 66.3 88.2 III	**2** 43.6 62.4 —	**3** 76.2 118.8 I	**1** 59.9 84.1 II	**4** 68.1 97.9 IV

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SUMMARY OF RESULTS, 1933

Manure.	Year of Cycle.	Wheat. Cwt. per Acre.		Potatoes, tons per acre.	Barley. Cwt. per Acre.		Seeds Hay. Cwt. p.a. dry matter.
		Grain.	Straw.		Grain.	Straw.	
	—	20.6	27.6	2.62	13.3	17.1	—
Manure as F.Y.M.	I	28.6	40.8	2.91	23.6	28.3	—
	II	22.9	32.2	1.73	19.9	24.9	—
	III	23.3	29.0	2.71	15.8	16.8	—
	IV	23.6	30.5	2.72	12.8	16.7	—
	—	16.7	23.9	1.80	10.6	14.8	—
Manure as Adco	I	31.5	46.5	2.34	20.9	26.8	—
	II	24.0	29.5	1.60	16.9	20.7	—
	III	21.7	30.7	1.50	14.1	19.1	—
	IV	25.5	31.3	3.00	18.4	21.4	—
	—	20.3	23.0	2.25	11.9	15.5	—
Manure as Straw	I	29.1	45.4	3.55	26.3	33.4	—
	II	23.1	33.3	2.68	10.6	16.2	—
	III	23.9	32.7	2.73	17.2	20.8	—
	IV	22.3	32.3	2.82	15.5	19.3	—
	—	22.1	30.8	2.80	20.3	25.1	—
Super.	I	23.4	32.2	4.61	25.8	28.8	—
	II	27.3	34.0	2.64	20.6	27.0	—
	III	27.2	34.7	3.53	22.0	27.4	—
	IV	26.0	37.4	3.45	21.0	25.7	—
	—	27.4	36.1	3.08	18.2	24.0	—
Rock Phosphate	I	24.2	37.8	2.80	22.1	26.4	—
	II	27.5	22.0	1.65	15.6	25.2	—
	III	25.4	33.7	1.98	20.7	24.6	—
	IV	21.7	29.5	2.98	13.8	22.4	—

The number I denotes application of manure at the beginning of the present season (1932-3); II application in the previous season, etc. The plots above the lines have not yet had any manure, except those due to receive superphosphate and rock phosphate, which in the seasons 1931-2 and 1932-33 received one -fifth of their quinquennial total of potash and nitrogen. In the two previous seasons these plots, like the corresponding plots due to receive organic manures, were untreated.

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SIX COURSE ROTATION EXPERIMENT

SEASONAL EFFECTS OF N, P_2O_5 AND K_2O

(For details see 1932 Report, p. 131)

CULTIVATIONS, ETC.—ROTHAMSTED

	Forage.	Clover.	Wheat.	Potatoes.	Sugar Beet.	Barley.
Variety		Broad Red	Yeoman II	Ally	Kuhn	Plumage Archer
Date of Sowing	Oct. 8	April 29	Oct. 4	April 12	May 8	March 22
Manures applied	Nov. 7, Mar. 9	Nov. 1, Mar. 9	Nov. 1, Mar. 9	April 11	May 4	March 10
Date of Harvesting	June 5	failed	July 26	Oct. 2	Nov. 11-13	Aug. 1
Previous crop	Potatoes	Barley	Clover	Wheat	Forage	Sugar Beet
Cultivations—						
Ploughing	Oct. 4	May 17	Aug. 16 & 17, Oct. 3	Sept. 16, April 5	Aug. 17, April 5	Nov. 17
Harrowing	Oct. 8, Mar. 31	May 19	Oct. 4, Mar. 31	April 10, May 2, May 18	Oct. 4, April 10 May 4, 8 & 10	March 22
Rolling		May 19	May 1	April 10	April 10, May 8 & 11	April 14
Singling					June 19-22	
Hoeing			April 19		June 14, July 17	
Ridging				April 11 & 15, May 18		
Grubbing				May 23, June 14 & 22		

CULTIVATIONS, ETC.—WOBURN

	Sugar Beet.	Barley.	Forage.	Wheat.	Clover.	Potatoes.
Variety	Kuhn	Plumage Archer		Yeoman II	Broad Red	Ally
Date of Sowing	May 8	March 23	Oct. 14	Oct. 14	May 9	April 21
Manures applied	May 11	March 23 & 27	Oct. 27, Mar. 14	Oct. 27, Mar. 14	Oct. 28, Mar. 14	April 20
Date of Harvesting	Nov. 10	July 28 & 29	June 22 & 23	July 31	June 26	Sept. 14
Previous crop	Forage	Sugar Beet	Potatoes	Clover	Barley	Wheat
Cultivations—						
Ploughing	July 11, Sept. 9 April 24	Mar. 15	Oct. 14	Sept. 9		Oct. 4, April 5
Harrowing	July 15, Oct. 12 April 29, May 8	Mar. 15, 23 & 29 April 11 & 29, May 12	Oct. 14	Oct. 12 & 14, Mar. 24, April 11 & 29		Oct. 14, April 11, April 19
Rolling	April 29, May 13	Mar. 29				April 19
Singling	June 22 & 23					
Hoeing	May 27, June 25 & 27			April 29		
Ridging						April 19 & 21

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ROTHAMSTED, 1933

Forage—BF, Plots 1-15.
Yields in lb., hay as carted.

1P 135	3N 141	3K 111	2K 119	0K 125
2N 152	0P 141	1N 108	3P 118	4P 132
4N 149	0N 92	4K 97	1K 104	2P 109

N

Clover—BC, Plots 16-30.
Crop failed.

1N —	2P —	0P —	1P —	1K —
3P —	0N —	4K —	3N —	2N —
4P —	3K —	2K —	0K —	4N —

Wheat—BW, Plots 31-45.
Yields in lb., grain above, straw below.

0K 55.0 90.8	3P 60.0 97.8	3N 53.3 95.7	0P 44.9 84.8	1N 46.8 87.0
1K 62.7 90.8	4P 65.8 96.7	2N 69.0 103.0	2K 60.2 94.8	3K 63.4 100.6
2P 53.5 79.5	1P 59.5 91.0	4N 68.2 110.3	0N 49.5 76.2	4K 43.2 77.8

N

Potatoes—BP, Plots 46-60.
Yields in lb.

1P 212	3K 275	4N 282	2N 276	0N 233
4K 273	2K 284	0K 164	1N 237	4P 298
0P 211	3N 231	1K 293	3P 276	2P 245

Sugar beet—BS, Plots 61-75.
Yields in lb., roots (dirty) above, tops centre, sugar percentage below.

2P 124 145 14.18	3P 134 161 14.35	4N 140 171 14.64	3N 163 168 14.38	4K 140 144 14.21
1K 162 138 14.64	4P 178 150 14.27	0P 172 143 14.73	3K 213 162 14.99	2K 144 163 14.38
0K 114 152 14.30	1P 135 166 14.82	2N 118 157 14.61	0N 153 162 14.41	1N 162 154 14.35

N

Barley—BB, Plots 76-90.
Yields in lb., grain above, straw below.

2K 60.1 75.2	3K 58.8 75.4	1K 61.4 77.6	3N 61.6 78.4	3P 76.8 91.7
0P 60.8 74.4	1P 59.3 78.0	2N 66.9 87.4	0N 58.2 73.3	1N 69.9 87.8
4K 73.2 93.6	0K 60.3 79.0	4N 63.8 94.4	2P 68.6 92.9	4P 75.4 98.6

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WOBURN, 1933

Sugar beet—CS, Plots 1-15.

Yields in lb., roots (dirty) above, tops centre, sugar percentage below.

0N 538 303 17.76	2K 647 362 17.30	1K 660 355 17.50	0K 736 344 17.59	1P 673 327 16.66
1N 540 283 17.53	3K 567 293 17.12	3P 617 315 16.98	3N 645 332 16.63	0P 639 305 16.75
4K 576 369 17.73	2P 535 313 16.75	4P 569 320 16.20	4N 693 400 16.40	2N 671 331 17.41

N.W. ↑

Barley—CB, Plots 16-30.

Yields in lb., grain above, straw below.

0K 55.8 125	3N 74.5 143	2P 77.2 136	1N 72.5 124	0P 67.2 130
4N 80.8 136	2N 67.0 127	4P 83.0 132	3K 78.2 139	2K 80.0 139
1K 67.8 116	0N 61.5 89	3P 79.0 128	1P 80.5 128	4K 75.0 121

Forage—CF, Plots 31-45.

Yields in lb., green weights.

1N 308	2K 383	1K 385	4P 394	4N 424
3K 375	0N 301	3P 380	3N 354	0P 409
4K 371	0K 324	2P 455	2N 399	1P 379

N.W. ↑

Wheat—CW, Plots 46-60.

Yields in lb. grain above, straw below.

4P 30.8 60	3P 33.0 66	1P 34.5 73	3K 53.5 100	3N 66.0 125
0N 23.8 53	1N 25.2 56	4K 42.8 84	1K 55.8 106	2N 61.8 117
2P 27.0 65	0P 33.0 75	2K 47.8 94	4N 60.2 134	0K 57.8 119

Clover—CC, Plots 61-75.

Yields in lb., green weights.

4P 212	3P 226	0P 344	2N 327	1N 384
2P 235	0K 252	3N 268	4K 408	3K 475
1K 251	1P 262	4N 285	2K 453	0N 412

N.W. ↑

***Potatoes—CP, Plots 76-90.**

Yields in lb.

3N 442	4N 501	2P 516	3P 508	4K 492
0K 458	2N 620	1N 518	3K 548	2K 505
1K 479	4P 542	0N 451	0P 490	1P 466

*Owing to a mistake the ploughing ridge was made in the middle of the row of plots 86-90. The soil was as far as possible turned back again.

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ROTHAMSTED, 1933

1.—Mean yields per acre and increments in yield per cwt of N, P_2O_5 and K_2O.

		Average, 1930-32	1933	Standard error, 1933			Average, 1930-32	1933	Standard error, 1933
Sugar Beet	Yield.	6.80	2.13		**Clover Hay**	Yield.	24.7		
Roots (washed) tons	N	0.80	−0.23	±0.90	Dry matter cwt.	N	20.5	*	
	P	0.65	0.11	±0.90		P	0.9		
	K	−0.08	0.58	±0.54		K	1.8		
Tops tons	Yield	11.27	2.78		**Wheat** Grain cwt.	Yield	24.6	20.3	
	N	3.58	0.38	±0.39		N	0.3†	10.5	±5.9
	P	−0.16	0.11	±0.39		P	−1.2	10.1	±5.9
	K	−1.20	0.06	±0.23		K	2.7	−3.3	±3.5
Sugar percentage	Mean	17.15	14.48		Straw cwt.	Yield	55.9	32.8	
	N	−0.10	0.33	±0.54		N	30.2†	**18.3**	±5.7
	P	−0.27	−0.93	±0.54		P	2.7	7.2	±5.7
	K	0.41	0.07	±0.32		K	3.5	−2.3	±3.4
Barley Grain, cwt.	Yield	27.3	23.2		**Potatoes** tons	Yield	7.18	4.51	
	N	7.9	0.7	±3.6		N	2.12	1.10	±1.21
	P	−1.0	**11.1**	±3.6		P	0.09	**2.83**	±1.21
	K	0.2	3.3	±2.2		K	3.61	1.42	±0.73
Straw cwt.	Yield	31.8	29.9		**Forage** Dry matter cwt.	Yield	36.5	32.5	
	N	13.1	7.7	±4.9		N	19.3	**26.1**	±7.4
	P	6.7	**14.8**	±4.9		P	0.9	−6.5	±7.4
	K	4.8	3.8	±2.9		K	−1.8	−5.2	±4.4

* Crop failed. † 1931 and 1932 only.
Significant results in heavy type. Negative sign means depression.

2.—Average percentage increments in yield for each application of N, P_2O_5 and K_2O.

	N		P		K		Standard error, 1933
	Average 1930-32	1933	Average 1930-32	1933	Average 1930-32	1933	
Sugar Beet—Roots (washed)	1.91	−1.59	1.49	0.75	−0.34	6.85	±6.31
Tops	5.66	2.05	−0.39	0.61	−2.48	0.54	±2.11
Sugar percentage	0.66	0.34	0.10	−0.96	0.62	0.12	±0.55
Barley—Grain	5.11	0.43	−0.47	**7.15**	0.00	3.58	±2.33
Straw	6.74	3.87	·3.18	**7.41**	3.78	3.21	±2.46
Clover Hay—dry matter	10.99	*	0.42	*	2.05	*	—
Wheat—Grain	2.08†	7.72	−1.07	7.47	2.64	−4.03	±4.33
Straw	10.22†	**8.39**	0.21	3.30	1.36	−1.74	±2.63
Potatoes	4.60	3.66	−0.40	**9.42**	12.61	7.89	±4.04
Forage—dry matter	8.14	**12.02**	0.67	−3.01	−1.48	−4.00	±3.42

* Crop failed. † 1931 and 1932 only.
Significant results in heavy type. Negative sign means depression.

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WOBURN, 1933

1.—Mean yields per acre and increments in yield per cwt. of N, P_2O_5 and K_2O.

		Average 1930-32	1933	Standard error, 1933			Average 1930-32	1933	Standard error, 1933
Sugar Beet	Yield	5.58	9.15		**Clover Hay**	Yield	23.8*	26.3	
Roots	N	0.79	**4.07**	±1.26	Dry	N	−6.2*	−15.0	±8.4
(washed)	P	−0.13	−1.92	±1.26	matter	P	−3.6*	−18.0	±8.4
tons	K	2.02	**−2.44**	±0.76	cwt.	K	4.4*	**13.7**	±5.0
Tops	Yield	6.84	5.89		**Wheat**	Yield	8.2*	15.5	
tons	N	1.09	**2.89**	±0.96	Grain	N	10.3*	**27.1**	±5.9
	P	0.99	0.20	±0.96	cwt.	P	−0.7*	−1.4	±5.9
	K	2.87	−0.08	±0.58		K	−1.6*	−4.6	±3.6
Sugar	Mean	17.09	17.09		Straw	Yield	27.4*	31.6	
percent-	N	−1.31	**−2.41**	±0.55	cwt.	N	24.6*	**54.9**	±7.8
age	P	0.04	−0.52	±0.55		P	1.6*	−8.9	±7.8
	K	0.85	−0.04	±0.33		K	−6.4*	**−10.8**	±4.7
Barley					**Potatoes**				
Grain	Yield	20.2	26.2		tons	Yield	9.40	8.97	
cwt.	N	19.6	**9.5**	±4.1		N	6.87	0.29	±1.94
	P	0.4	7.1	±4.1		P	0.55	1.74	±1.94
	K	3.8	**7.0**	±2.4		K	0.83	0.97	±1.17
Straw					**Forage**				
cwt.	Yield	41.7	45.5		Dry	Yield	34.2*	47.5	
	N	22.7	**26.9**	±7.6	matter	N	28.8*	**24.9**	±7.7
	P	−2.7	0.9	±7.6	cwt.	P	2.4*	−6.9	±7.7
	K	9.5	2.2	±4.6		K	−1.0*	3.8	±4.6

* 1931 and 1932 only.
Significant results in heavy type. Negative sign means depression.

2.—Average percentage increments in yield for each application of N, P_2O_5 and K_2O.

	N		P		K		Standard error, 1933
	1930-32 Average	1933	1930-32 Average	1933	1930-32 Average	1933	
Sugar Beet—Roots	2.54	**6.67**	−0.92	−3.14	8.23	**−6.66**	±2.06
(washed) Tops	2.03	**7.36**	1.99	0.51	9.96	−0.36	±2.44
Sugar percentage	−0.54	**−2.12**	0.05	−0.46	1.22	−0.06	±0.48
Barley—Grain	15.36	**5.46**	0.15	4.05	5.17	**6.68**	±2.33
Straw	8.16	**8.87**	−0.90	0.31	6.11	1.18	±2.51
Clover Hay—dry matter	−4.10*	−8.56	−2.28*	−10.27	4.57*	**13.04**	±4.77
Wheat—Grain	16.80†	**26.11**	−0.16†	−1.35	−4.78†	−7.33	±5.72
Straw	13.50†	**26.09**	0.86†	−4.21	−5.93†	**−8.58**	±3.69
Potatoes	12.36	0.49	−0.18	2.91	1.67	2.71	±3.25
Forage—dry matter	13.24†	**7.87**	0.18†	−2.17	−0.88†	2.02	±2.44

* 1931 and 1932 only. (1931 crop was tares).
† 1931 and 1932 only.
Significant results in heavy type. Negative sign means depression.

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THREE COURSE ROTATION EXPERIMENT, ROTHAMSTED, 1933

EFFECT OF PLOUGHING IN STRAW, AND OF WINTER GREEN-MANURE CROPS

Object.

1. To examine the possibility of using straw in autumn to conserve nitrogen, improve tilth and finally to improve crop yield.
2. To compare the direct application of straw and artificials with Adco compost made from equal straw, and also with dressings of artificial fertilisers.
3. In combination with the above to measure the improvement in soil fertility by winter cropping with rye or vetches.

Rotation

The rotation is barley, sugar beet, potatoes.

Treatments.

(*a*) 1. No straw. Artificials applied in spring. (Ar)
2. Straw in autumn, artificials in spring. (St 1)
3. Straw in autumn, part of artificials in autumn, remainder in spring. (St 2)
4. Straw made into Adco compost applied in autumn. (Ad)

(*b*) There are two series of plots which receive the above treatments in alternate years.
Series I. 1932-3 and alternate years thereafter.
Series II. 1933-4 and alternate years thereafter.

(*c*) 1. No winter green-manure crop. (O)
2. Winter green-manure crop of rye. (R)
3. Winter green-manure crop of vetches. (V)

Treatments (*c*) are given every year.
There are thus 24 combinations of these treatments, and each is represented every year on every crop.

Arrangement.

There are three blocks of land, each of which carries a different crop. The crops rotate from block to block in successive years. Each block consists of twenty-four plots, carrying the twenty-four treatments arranged at random. A plot continues to receive the same treatment throughout the experiment. The experiment is situated in Long Hoos field (VI). Area of each plot : 1/50th acre.

Rates of Application.

Straw is applied at the rate of 5$3\frac{1}{3}$ cwt. per acre.

The quantity of Adco compost applied per acre is the amount derived from the rotting of 5$3\frac{1}{3}$ cwt. of straw.

Wherever artificials are applied in the experiment they consist of N, P_2O_5 and K_2O in the ratio 1 : 1 : 1.25.

Wherever straw is applied, artificials are given as follows : 0.4 cwt. N per acre, 0.4 cwt. P_2O_5 per acre, 0.5 cwt. K_2O per acre. In treatment St 2, half these quantities are given with the straw in the autumn.

The Adco compost is made with standard Adco powder used at a rate to give 0.4 cwt. N and 0.4 cwt. P_2O_5 to 5$3\frac{1}{3}$ cwt. of straw. When the Adco compost is applied to the plots, a dressing of 0.5 cwt. K_2O per acre is given with it. Treatments Ar, Ad, St 1 and St 2 are thus equalised in respect of N, P_2O_5 and K_2O. In addition ground chalk is applied with treatments Ar, St 1 and St 2 at a rate equivalent to the CaO contained in the Adco powder used in making the quantity of Adco compost applied in treatment Ad.

Basal dressings are given to every plot of the potatoes and sugar-beet blocks in addition to the above application. Barley receives no additional basal dressing.

Sugar Beet : 0.2 cwt. N, 0.2 cwt. P_2O_5, 0.25 cwt. K_2O per acre ; *Potatoes* : 0.4 cwt. N, 0.4 cwt. P_2O_5, 0.50 cwt. K_2O per acre.

Form of Fertilisers.

P_2O_5 is given as superphosphate throughout the experiment.

	N	K_2O
Autumn applications. All crops (treatment St 2)	Sulphate of Ammonia	Muriate of potash
Spring applications.		
Barley	Sulphate of Ammonia	Muriate of Potash
Potatoes	Sulphate of Ammonia	Sulphate of Potash
Sugar-beet	Nitrate of Soda	Muriate of Potash

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Notes.

(1) Green crops are sown as soon as possible after harvesting the previous crop, and are ploughed in 3 to 4 weeks before sowing the next crop, *i.e.*, there is no uniform time for sowing and ploughing in throughout the experiment. Weight of crop ploughed in is estimated by sampling.

(2) Sugar-beet tops are carted off.

(3) Departures from the scheme made in 1932-3, the first year of the experiment.
  (*a*) Adco was applied in Spring.
  (*b*) Straw was given at the rate of 60 cwt. per acre, with Adco corresponding.

(4) The Adco used for this experiment was taken from the same batch as for the Four Course Rotation. (*See page* 101). For analysis of other fertilisers *see page* 101.

CULTIVATIONS, ETC.

	Barley	Potatoes	Sugar Beet
Variety	Plumage Archer	Ally	Kuhn
Date of Sowing	April 5	April 21	May 8
Manures applied			
Artificials—	November 4, April 5	November 4, April 21	November 4, May 6
Adco	March 31	April 21	May 2
Straw ..	November 8, April 4	November 8	November 8
Date of Harvesting	August 14	October 3	October 19
Cultivations—			
Ploughing ..	November 9 & 10, April 4	November 9 & 10, April 18	November 9 & 10, May 3 & 4
Harrowing ..	November 11 & 15, April 5	November 11 & 15, April 20, May 6 & 18	November 11 & 15, May 5, 8 & 10
Rolling ..	April 14	April 20	May 8 & 11
Singling ..			June 22 & 23
Hoeing ..		June 24	June 13, July 17, 21 & 22
Ridging ..		April 20, May 15 & 18 June 29	
Grubbing ..		June 14 & 22	
Previous Crop ..	Wheat, Oats and Barley	Wheat, Oats and Barley	Wheat, Oats and Barley

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PLAN AND YIELDS

Sugar-Beet—DS, Plots 49-72.
Yields in lb., roots (dirty) above, tops centre, sugar percentage below.

N

St 1 R I 96.7 146.5 14.94	Ad R I 92.2 129.0 14.98	Ad V II 72.4 109.0 14.60	Ad V I 127.8 171.0 14.78	Ad R II 93.7 105.5 14.85	St 1 V I 119.4 142.0 14.89
St 1 O I 106.6 154.0 14.73	St 2 V II 115.6 154.0 15.02	St 1 V II 103.4 136.0 14.40	St 2 V I 158.8 198.0 14.78	St 2 R I 141.7 148.0 15.57	St 2 O I 147.6 154.0 15.07
Ar R I 97.4 132.0 15.00	Ar R II 119.2 143.5 15.14	Ar OI 130.1 172.0 14.92	Ad O I 171.2 178.0 15.35	St 1 O II 118.9 122.5 14.25	Ar V II 123.4 141.5 14.44
St 1 R II 119.6 165.0 15.05	Ad O II 148.9 186.5 15.25	St 2 R II 132.3 172.0 15.16	St 2 O II 158.4 179.5 14.62	Ar V I 193.7 215.5 15.04	Ar O II 154.6 163.0 14.52

Potatoes—DP, Plots 25-48. Yields in lb.

N

St 1 O II 158	Ad O I 199	Ad R II 116	Ar V II 127	Ar R I 214	St 2 O I 242
St 2 O II 177	Ad V II 183	St 2 R I 227	St 2 V I 220	St 1 R II 122	Ar O I 227
Ar R II 148	Ad O II 201	St 2 R II 175	St 1 V I 258	St 1 R I 240	Ad V I 180
Ad R I 184	Ar V I 255	St 1 O I 248	Ar O II 143	St 2 V II 126	St 1 V II 128

Barley—DB, Plots 1-24. Yields in lb., grain above, straw below.

N

St 1 R II 17.4 30.1	St 2 R I 28.3 44.7	Ar R I 33.5 48.8	St 2 O II 26.2 45.0	Ar O II 21.2 34.8	Ad O I 20.5 32.5
St 1 O I 35.8 62.2	St 2 R II 26.9 41.8	St 1 O II 26.8 40.0	Ar V II 33.4 48.6	Ad O II 31.0 48.5	St 2 O I 32.4 48.8
Ar R II 26.8 46.0	St 2 V II 24.6 44.4	Ar V I 40.0 65.5	St 1 R I 37.0 52.2	Ad R I 29.9 34.8	St 1 V II 25.0 38.2
Ad V II 38.7 69.8	Ar O I 29.2 55.3	Ad V I 34.3 46.0	St 2 V I 37.6 51.4	St 1 V I 34.0 46.8	Ad R II 22.5 28.5

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SUMMARY OF RESULTS

		Manured, 1932-33.					Not yet Manured.				
		Artifi-cials.	Adco.	Straw. (St 1)	Straw. (St 2)	*Mean.*	Artifi-cials.	Adco.	Straw (St 1)	Straw (St 2)	*Mean.*
Sugar Beet Roots t.p.a. (±0.361)	None	2.47	3.25	2.02	2.80	*2.64*	2.94	2.83	2.26	3.01	*2.76*
	Vetches	3.68	2.43	2.27	3.02	*2.85*	2.34	1.38	1.96	2.20	*1.97*
	Ryegrass	1.85	1.75	1.84	2.69	*2.03*	2.26	1.78	2.27	2.51	*2.20*
	Mean	*2.67*	*2.48*	*2.04*	*2.84*	*2.51*	*2.51*	*2.00*	*2.16*	*2.57*	*2.31*
Tops Tons p.a. (±0.589)	None	3.84	3.97	3.44	3.44	*3.67*	3.64	4.16	2.73	4.01	*3.64*
	Vetches	4.81	3.82	3.17	4.42	*4.06*	3.16	2.43	3.04	3.44	*3.02*
	Ryegrass	2.95	2.88	3.27	3.30	*3.10*	3.20	2.35	3.68	3.84	*3.27*
	Mean ..	*3.87*	*3.56*	*3.29*	*3.72*	*3.61*	*3.33*	*2.98*	*3.15*	*3.76*	*3.31*
Sugar percentage (±0.305)	None	14.92	15.35	14.73	15.07	*15.02*	14.52	15.25	14.25	14.62	*14.66*
	Vetches	15.04	14.78	14.89	14.78	*14.87*	14.44	14.60	14.40	15.02	*14.62*
	Ryegrass	15.00	14.98	14.94	15.57	*15.12*	15.14	14.85	15.05	15.16	*15.05*
	Mean ..	*14.99*	*15.04*	*14.85*	*15.14*	*15.00*	*14.70*	*14.90*	*14.57*	*14.93*	*14.78*
Total Sugar Cwt.p.a.	None	7.4	10.0	6.0	8.4	*8.0*	8.5	8.6	6.4	8.8	*8.1*
	Vetches	11.1	7.2	6.8	8.9	*8.5*	6.8	4.0	5.6	6.6	*5.8*
	Ryegrass	5.6	5.2	5.5	8.4	*6.2*	6.8	5.3	6.8	7.6	*6.6*
	Mean ..	*8.0*	*7.5*	*6.1*	*8.6*	*7.6*	*7.4*	*6.0*	*6.3*	*7.7*	*6.8*
Potatoes Tons p.a. (±0.597)	None	5.07	4.44	5.54	5.40	*5.11*	3.19	4.49	3.53	3.95	*3.79*
	Vetches	5.69	4.02	5.76	4.91	*5.10*	2.83	4.08	2.86	2.81	*3.14*
	Ryegrass	4.78	4.11	5.36	5.07	*4.83*	3.30	2.59	2.72	3.91	*3.13*
	Mean ..	*5.18*	*4.19*	*5.55*	*5.13*	*5.01*	*3.11*	*3.72*	*3.04*	*3.56*	*3.36*
Barley Grain Cwt. p.a. (±2.34)	None	13.0	9.2	16.0	14.5	*13.2*	9.5	13.8	12.0	11.7	*11.8*
	Vetches	17.8	15.3	15.2	16.8	*16.3*	14.9	17.3	11.2	11.0	*13.6*
	Ryegrass	15.0	13.3	16.5	12.6	*14.4*	12.0	10.0	7.8	12.0	*10.4*
	Mean ..	*15.3*	*12.6*	*15.9*	*14.6*	*14.6*	*12.1*	*13.7*	*10.3*	*11.6*	*11.9*
Straw Cwt. p.a. (±4.47)	None	24.7	14.5	27.8	21.8	*22.2*	15.5	21.6	17.8	20.1	*18.8*
	Vetches	29.2	20.5	20.9	22.9	*23.4*	21.7	31.2	17.0	19.8	*22.4*
	Ryegrass	21.8	15.5	23.3	20.0	*20.2*	20.5	12.7	13.4	18.7	*16.3*
	Mean	*25.2*	*16.8*	*24.0*	*21.6*	*21.9*	*19.2*	*21.8*	*16.1*	*19.5*	*19.2*

Standard errors are computed from plots not yet manured.

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BARLEY

The fertiliser values of sulphate of ammonia and ammonium bicarbonate, applied early and late.

RB—PASTURES 1933

Plan and yields in lb., grain above, straw below.

	BEL	**SL**	**SE**	**O**	**SE**	**BE**	**SL**	**O**	**O**	**SEL**	**SL**	**BE**	
1	42.1	39.5	32.5	27.8	29.0	35.2	44.3	47.8	46.4	52.0	51.6	49.6	12
	63.9	58.8	50.0	39.0	43.8	51.3	61.0	64.2	62.6	73.2	71.2	68.6	
N	**BL**	**SEL**	**O**	**BE**	**BEL**	**O**	**SEL**	**BL**	**O**	**BEL**	**SE**	**BL**	
↑	47.1	44.0	42.4	45.4	40.0	41.1	47.2	55.0	45.3	48.9	51.2	53.3	
	72.6	67.0	53.4	60.6	53.5	53.2	66.0	53.2	60.2	66.6	70.6	74.7	
	O	**SL**	**BE**	**SE**	**O**	**BL**	**SEL**	**SL**	**O**	**BE**	**SE**	**O**	
	36.8	38.0	35.0	41.2	39.6	38.5	37.2	35.0	39.8	49.8	49.0	35.7	
	55.7	57.0	57.2	68.0	57.9	54.5	60.0	54.8	56.7	72.0	72.2	58.8	
	O	**SEL**	**BEL**	**BL**	**SE**	**BE**	**O**	**BEL**	**SEL**	**BEL**	**BL**	**SL**	
37	33.4	36.0	42.0	36.5	34.8	37.9	34.9	42.0	42.9	42.2	37.4	32.0	48
	45.4	60.5	68.5	60.2	62.2	59.4	45.6	62.8	62.8	58.0	51.1	50.5	

SYSTEM OF REPLICATION : 6 randomised blocks of 8 plots each.
AREA OF EACH PLOT : 1/50th acre (35 by 57.1 links).
TREATMENTS : All combinations of :

(a) **S** Sulphate of Ammonia
B Ammonium bicarbonate
} at the rate of 0.2 cwt. N per acre.

(b) **O** No application.
E Early application (in the seed-bed).
L Late application (as a top dressing).
EL Both early and late applications (double dressing).

CULTIVATIONS, ETC. : Harrowed : March 24th, 27th, and May 15th. Seed sown : March 25th. Early manures applied : March 27th. Late manures applied : May 11th. Rolled : April 1st Harvested : August 16th. Variety : Plumage Archer. Previous crop : Beans.
STANDARD ERRORS PER PLOT : Grain : ±2.36 cwt. per acre or ± 12.8 per cent. Straw : 3.19 cwt. per acre or ±12.0 per cent.

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SEPARATE TREATMENTS—COMPARISON OF BICARBONATE AND SULPHATE

Grain, cwt. per acre. (±0.967; no N, ± 0.683.)
Mean yield = 18.4.

	No Nitrogen	Nitrogen early	Nitrogen late	Nitrogen early and late
Ammonium bicarbonate Sulphate of Ammonia ..	17.5	18.8 17.7	19.9 17.9	19.1 19.3
Diff. (Bic.-Sul.) (±1.37)	—	*+1.1*	*+2.0*	*−0.2*

Straw, cwt. per acre. (± 1.304; no N, ±0.922).
Mean yield = 26.7.

	No Nitrogen	Nitrogen early	Nitrogen late	Nitrogen early and late
Ammonium bicarbonate Sulphate of Ammonia ..	24.3	27.5 27.3	27.2 26.3	27.8 29.0
Diff. (Bic.-Sul.) (±1.84)	—	*+0.2*	*+0.9*	*−1.2*

OTHER EFFECTS—MEAN OF BICARBONATE AND SULPHATE

	Grain : cwt. per acre (±0.683)			Straw : cwt. per acre (±0.922)		
	No N.	Single N.	Double N.	No N.	Single N.	Double N.
Early .. Late ..	17.5	18.2 18.9	19.2	24.3	27.4 26.8	28.4
Mean ..	*17.5*[1]	*18.6*[2]	*19.2*[1]	*24.3*[4]	*27.1*[5]	*28.4*[4]
Increase	—	*+1.1*[3]	*+0.6*[3]	—	*+2.8*[6]	*+1.3*[6]

Standard Errors : (1) ±0.683, (2) ±0.483, (3) ±0.837, (4) ±0.922, (5) ±0.652, (6) ±1.13.

CONCLUSIONS

The response to nitrogen is significant in the case of the straw, but barely so in the case of the grain. There is no significant difference between the two times of application, nor is the additional response to the double dressing significantly less than the response to the single dressing. The differences between ammonium bicarbonate and sulphate of ammonia are not significant.

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WHEAT

Effect of full year's fallow, summer fallow and of temporary leys of clover and ryegrass, the increase due to top dressing with sulphate of ammonia being used as a standard for comparison. (See 1931 report, p. 142, and 1932 report, p. 136, for previous stages of this experiment).

RW—FOSTERS, 1933
Plan and yields in lb., grain above, straw below.

Arrangement of treatments in the third year.

101	S_3 18.1 24.4	O 16.5 22.2	S_3 45.4 69.8	O 36.6 52.6	S_3 33.6 50.6	O 31.6 45.9	S_3 23.6 35.9	O 19.8 27.2	108
	O 21.3 25.2	S_3 23.2 28.0	O 38.1 59.2	S_3 36.3 53.2	O 34.4 42.8	S_3 32.8 43.7	O 27.3 34.7	S_3 28.5 33.2	
	S_3 22.1* 33.8*	O 25.4 31.1	S_3 39.9 63.1	S_3 40.0 53.5	S_3 39.3 45.7	S_3 35.6 41.6	S_3 25.5 30.2	S_3 35.0 45.2	
	O 22.7* 32.6*	S_3 21.0 33.2	O 41.0 61.2	O 35.4 49.6	O 35.1 43.2	O 34.2 40.3	O 22.3 26.0	O 34.1 41.4	
N	S_3 36.1 63.6	O 47.2 71.0	S_3 15.9 28.4	S_3 23.0 30.0	S_3 29.3 37.7	O 30.3 37.2	O 35.6 40.9	O 38.2 45.0	
	O 51.9 70.8	S_3 45.7 65.8	O 26.2 32.6	O 27.9 31.6	O 28.3 33.4	S_3 37.2 45.6	S_3 37.3 44.0	S_3 39.1 46.9	
	S_3 45.7 73.0	S_3 46.8 65.2	O 22.0 22.8	S_3 25.1 28.6	O 26.1 27.9	O 29.9 32.6	S_3 40.6 56.4	O 41.8 53.0	
	O 36.7 68.8	O 49.3 63.4	S_3 25.5 28.0	O 19.8 20.0	S_3 28.6 31.9	S_3 28.8 31.2	O 39.0 46.2	S_3 40.3 51.2	
	O 31.3 39.7	S_3 28.6 32.4	S_3 37.2 49.8	S_3 36.1 47.9	S_3 23.5 27.2	O 15.3 16.4	S_3 44.4 56.8	S_3 47.6 65.9	
	S_3 34.1 53.2	O 29.4 33.4	O 37.5 50.5	O 39.5 50.0	O 21.4 23.4	S_3 20.3 24.2	O 40.2 52.6	O 48.0 65.0	
	S_3 29.0 34.0	S_3 26.6 40.9	S_3 42.5 51.0	S_3 44.7 53.8	S_3 31.2 38.3	S_3 26.0 32.0	O 47.7 63.8	S_3 48.0 65.5	
	O 28.0 29.0	O 24.4 40.6	O 40.1 47.2	O 38.6 43.2	O 23.2 31.0	O 23.2 26.6	S_3 42.3 59.4	O 42.8 57.4	
	S_3 32.9 47.6	S_3 25.4 53.6	O 29.6 40.4	S_3 31.3 36.7	O 47.2 66.8	S_3 38.0 56.5	O 21.1 24.2	O 27.0 35.8	
	O 29.2 39.6	O 32.8 48.7	S_3 34.1 47.9	O 31.2 33.8	S_3 44.4 61.6	O 39.3 51.4	S_3 22.7 26.6	S_3 27.8 36.4	
	S_3 30.3 39.2	O 28.7 35.3	O 25.3 27.4	O 34.0 41.0	O 43.7 60.6	S_3 40.5 58.8	O 27.3 33.7	S_3 25.3 30.2	
221	O 30.3 33.7	S_3 35.2 43.6	S_3 26.5 29.5	S_3 30.3 37.7	S_3 39.0 52.5	O 40.7 56.8	S_3 28.7 39.0	O 17.4 20.1	228

* Estimated.

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Arrangement of treatments in the first and second years.

Ryegrass 2 2 S_1 — O 1 1	Fallow L I O — S_1 I L	Clover 1 1 O — S_1 2 2	Cl. & Ryegr. 1 2 S_1 — O 2 1
Fallow L L O — S_1 I I	Ryegrass 1 1 S_1 — O 2 2	Cl. & Ryegr. 1 1 S_1 — O 2 2	Clover 2 2 S_1 — O 1 1
Cl. & Ryegr. 1 2 O — S_1 2 1	Clover 1 1 O — S_1 2 2	Ryegrass 2 2 S_1 — O 1 1	Fallow L I S_1 — O I L
Clover 1 1 S_1 — O 2 2	Cl. & Ryegr. 1 2 S_1 — O 2 1	Fallow I L S_1 — O L I	Ryegrass 2 1 O — S_1 1 2

SYSTEM OF REPLICATION : 4×4 Latin Square, each plot subsequently split into 8 sub-plots by three successive divisions into halves.

AREA OF EACH EIGHTH PLOT : 1/80 acre (21 links × 59.5 links).

TREATMENTS: First year : Leys sown under barley. No ley, clover, ryegrass, and clover and ryegrass. Half plots received no nitrogen (**O**) or sulphate of ammonia ($\mathbf{S_1}$) at the rate of 0.2 cwt. N per acre.

Second year : Half plots subdivided for leys cut once and summer fallowed (1), or cut twice (2). The plots without leys were subdivided for light fallow (**L**) or intensive fallow (**I**).

Third year : Each quarter plot subdivided for no nitrogen (**O**) or sulphate of ammonia ($\mathbf{S_3}$) at the rate of 0.2 cwt. N. per acre.

CULTIVATIONS, ETC. : Ploughed : October 1st-5th. Harrowed : October 5th, 6th, 7th and April 8th. Seed sown : October 6th and 7th. Variety : Victor. Top dressed : March 13th. Harvested : July 31st. Previous crop : Hay.

STANDARD ERRORS PER PLOT

	Grain		Straw	
	Cwt. per acre	Per cent.	Cwt. per acre	Per cent.
Per whole plot	±1.73	±7.4	±2.24	±7.3
Per half plot	±1.34	±5.7	±1.87	±6.1
Per quarter plot	±1.63	±7.0	±2.08	±6.8
Per eighth plot	±2.36	±10.1	±2.36	±7.7

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YIELDS OF SEPARATE TREATMENTS

		Fallow		Ryegrass		Clover		Clover and Ryegrass	
		No Nitrogen	Nitrogen (1931)	No Nitrogen	Nitrogen (1931)	No Nitrogen	Nitrogen (1931)	No Nitrogen	Nitrogen (1931)
		GRAIN : cwt. per acre							
1 cut or light fallow	No nitrogen ..	30.7	29.7	18.5	17.7	26.2	24.9	23.2	19.6
	Nitrogen (1933)	29.9	30.2	17.6	17.3	24.4	25.4	24.4	20.3
2 cuts or intensive fallow	No Nitrogen ..	29.7	32.3	13.0	14.7	25.4	24.8	19.4	18.4
	Nitrogen (1933)	31.0	30.3	16.3	16.5	27.9	26.4	21.0	19.5
		STRAW : cwt. per acre							
1 cut or light fallow	No Nitrogen ..	42.6	41.7	22.0	23.6	34.8	32.4	28.4	26.6
	Nitrogen (1933)	45.6	40.8	24.0	24.4	36.6	34.9	32.4	29.0
2 cuts or intensive fallow	No Nitrogen ..	45.0	44.0	14.8	16.3	30.5	28.2	21.9	20.5
	Nitrogen (1933)	46.6	42.7	19.2	19.6	33.4	31.9	24.1	22.1

EFFECT OF LEYS, FALLOW AND NITROGEN WITH BARLEY
(Mean of one and two cuts, N and no N with wheat)

	Fallow	Ryegrass	Clover	Clover and Ryegrass	*Mean*
	GRAIN : cwt. per acre				
No Nitrogen with Barley	30.3	16.4	25.9	22.0	*23.6*
Nitrogen with Barley	30.6	16.5	25.4	19.4	*23.0*
Mean (±0.472)	*30.4*	*16.4*	*25.6*	*20.7*	*23.3*
Difference (±0.943)	*+0.3*	*+0.1*	*−0.5*	*−2.6*	*−0.6* (±0.472)
	STRAW : cwt. per acre				
No Nitrogen with Barley	44.9	20.0	33.8	26.7	*31.4*
Nitrogen with Barley	42.3	21.0	31.9	24.6	*30.0*
Mean (±0.661)	*43.6*	*20.5*	*32.8*	*25.6*	*30.7*
Difference (±1.32)	*−2.6*	*+1.0*	*−1.9*	*−2.1*	*−1.4* (±0.661)

EFFECT OF CUTS AND FALLOWS
(Mean of Nitrogen and No Nitrogen with wheat and barley)

	Fallow	Ryegrass	Clover	Clover and Ryegrass	*Mean of all leys*
	GRAIN : cwt. per acre				
1 cut (or light fallow)	30.1	17.8	25.2	21.8	*21.6*
2 cuts (or intensive fallow) ..	30.8	15.1	26.1	19.6	*20.3*
Difference (±0.817)	*+0.7*	*−2.7*	*+0.9*	*−2.2*	*−1.3* (±0.472)
	STRAW : cwt. per acre				
1 cut (or light fallow)	42.7	23.5	34.7	29.1	*29.1*
2 cuts (or intensive fallow) ..	44.6	17.5	31.0	22.2	*23.6*
Difference (±1.04)	*+1.9*	*−6.0*	*−3.7*	*−6.9*	*−5.5* (±0.599)

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EFFECT OF NITROGEN APPLIED WITH WHEAT

		Fallow	Ryegrass	Clover	Clover and Ryegrass	*Mean of all leys*
		GRAIN : cwt. per acre				
1 cut or light fallow	No Nitrogen..	30.2	18.1	25.5	21.4	*21.7*
	Nitrogen 1933	30.0	17.5	24.9	22.3	*21.6*
Difference (±1.18)		−0.2	−0.6	−0.6	+0.9	−0.1 (±0.681)
2 cuts or intensive fallow	No Nitrogen..	31.0	13.8	25.1	18.9	*19.3*
	Nitrogen 1933	30.7	16.4	27.1	20.2	*21.2*
Difference (±1.18)		−0.3	+2.6	+2.0	+1.3	+1.9 (±0.681)
Mean Difference (±0.834).. ..		−0.2	+1.0	+0.7	+1.1	+0.9 (±0.482)
		STRAW : cwt. per acre				
1 cut or light fallow	No Nitrogen..	42.2	22.8	33.6	27.5	*28.0*
	Nitrogen 1933	43.2	24.2	35.8	30.7	*30.2*
Difference (±1.18)		+1.0	+1.4	+2.2	+3.2	+2.2 (±0.681)
2 cuts or intensive fallow	No Nitrogen	44.5	15.6	29.4	21.2	*22.1*
	Nitrogen 1933	44.7	19.4	32.7	23.1	*25.1*
Difference (±1.18)		+0.2	+3.8	+3.3	+1.9	+3.0 (±0.681)
Mean Difference (±0.834) ..		+0.6	+2.6	+2.8	+2.6	+2.6 (±0.482)

CONCLUSIONS

The previous leys produce large differences of yield in the wheat crop, both of grain and of straw. The yield following fallow is greatest, that following clover alone next, that following the mixture of clover and ryegrass next, and that following ryegrass alone least, the difference between fallow and ryegrass alone being no less than 14.0 cwt. of grain and 23.1 cwt. of straw.

The nitrogen applied to the barley shows no fully significant effects either on the wheat grain or straw, though there is some indication of a depression in yield of straw on all plots except those following the ley of ryegrass alone.

On the leys with ryegrass the taking of a second cut of the ley significantly depresses the subsequent yield of the grain (−2.4 cwt.), and straw (−6.4 cwt.), there being little difference between the clover and ryegrass and ryegrass alone.

On the clover ley the second cut depresses the yield of the straw only, this depression (−3.7 cwt.) being significant. The depression is less than that of the other leys, though not quite significantly so.

The differences between the light and intensive fallow are not significant.

After the three leys the nitrogen applied to the wheat increases the average yield of grain by 0.9 cwt., and that of the straw by 2.6 cwt., both increases being significant. In the case of the grain, but not of the straw, the increase only appears on the plots with two cuts, this increase being 1.9 cwt. The effects of the nitrogen after fallow are small and not significant.

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WHEAT

Seed-bed preparation by deep and shallow ploughing or rotary cultivation. Effect of spring rolling and harrowing, and of top-dressing with sulphate of ammonia.

RW—Pastures, 1933

Plan and yields in grammes

24 — 48 — 72 — 96

Treatment.	Grain.	Straw.	Grain.	Straw.
S Dp—H	N 557	866	O 715	1,154
S Sh——	O 640	880	N 682	1,153
P DpR —	O 576	1,056	N 650	1,609
P Sh ——	N 574	1,094	O 597	1,072
P Sh R H	O 510	686	N 777	1,088
S DpR —	O 478	696	N 541	869
P Dp—H	O 671	1,021	N 870	1,246
S Sh R H	O 475	632	N 486	794
P Sh ——	O 588	823	N 676	1,044
P Dp—H	O 653	896	N 730	1,099
S Sh —H	N 495	590	O 679	952
P DpR —	O 780	1,121	N 636	1,096
S DpR H	N 591	834	O 758	974
S Sh R —	N 771	1,376	O 726	1,050
P Sh R H	O 801	1,081	N 792	1,264
S Dp——	O 741	1,097	N 907	1,152
S Sh R H	O 709	1,098	N 729	1,005
S DpR H	N 784	1,026	O 816	1,009
P Sh R —	N 732	1,166	O 826	1,058
S Dp——	O 682	940	N 658	896
P Sh—H	N 586	943	O 614	712
S Sh——	N 436	646	O 669	983
P DpR —	O 606	861	N 642	950
P Dp—H	N 700	979	O 716	978

N ↑

1 — 25 — 49 — 73

Treatment.	Grain.	Straw.	Grain.	Straw.
S Sh ——	N 804	1,419	O	869 1,202
S DpR —	N 881	1,366	O	798 1,088
P Dp——	O 840	1,120	N	854 1,082
S Sh R H	O 667	918	N	843 1,256
P Sh —H	O 778	1,092	N	918 1,349
P Sh R —	N 781	1,218	O	787 1,112
S Dp—H	O 714	975	N	898 1,327
P DpR H	N 824	1,275	O	869 1,150
S Sh —H	O 734	1,186	N	890 1,348
P DpR H	O 970	1,380	N	1,044 1,572
S Sh R —	N 808	1,363	O	741 940
S DpR —	N 916	1,335	O	802 1,103
P Sh R H	N 859	1,269	O	739 680
S Dp—H	N 716	1,030	O	671 890
P Dp——	O 758	1,043	N	724 1,045
P Sh——	O 655	1,058	N	728 1,029
S Sh —H	O 704	936	N	662 943
S DpR H	O 889	1,064	N	582 782
S Dp——	O 703	999	N	588 911
P Sh—H	N 650	976	O	665 887
P DpR H	N 634	905	O	606 703
S Sh R —	N 494	880	O	524 778
P Dp——	N 616	1,081	O	773 1,114
P Sh R —	O 615	820	N	888 1,290

SYSTEM OF REPLICATION : 6 randomised blocks of 8 plots each, the plots being split for sulphate of ammonia. The following interactions (using symbols as above) are partially confounded : (P—S) × R × H, (Dp—Sh) × R × H, (P—S) × (Dp—Sh) × R × H.

AREA OF EACH SUB-PLOT : 1/80 acre (62.5 links × 20 links).

TREATMENTS : All combinations of :

(a) Seed-bed prepared by ploughing (P), or rotary cultivation with simar rototiller (S).
(b) Deep cultivation (7-8 ins.) (Dp), and shallow cultivation (3½-4 ins.) (Sh).
(c) Not rolled (—), and rolled (R).
(d) Not harrowed (—), and harrowed (H).
(e) No sulphate of ammonia (O), and sulphate of ammonia (N) at the rate of 0.2 cwt. N. per acre.

CULTIVATIONS, ETC. : Ploughed : October 5th and 6th. Harrowed : October 6th, 7th, and March 15th. Rolled : March 15th. Manures applied : March 11th. Seed sown : October 7th. Harvested : July 31st. Plots harvested by sampling method (16 metre lengths per sub-plot, drills set 6 ins. apart). Variety : Victor. Previous crop : Beans.

STANDARD ERRORS : Grain : Per whole plot : 2.72 cwt. or 11.7%. Per sub-plot : 2.79 cwt. or 12.0%. Straw : Per whole plot : 5.14 cwt. or 15.1%. Per sub-plot : 4.54 cwt. or 13.4%.

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YIELDS OF SEPARATE TREATMENTS (BLOCK EFFECTS ELIMINATED)

		Ploughed				Simared			
		Shallow		Deep		Shallow		Deep	
		No Nitrogen	Nitrogen	No Nitrogen	Nitrogen	No Nitrogen	Nitrogen	No Nitrogen	Nitrogen
		GRAIN—cwt. per acre							
Not Harrowed	Not Rolled	20.0	21.4	24.3	22.4	23.9	21.1	24.5	24.8
	Rolled	24.3	26.2	22.8	22.5	21.5	22.4	21.2	24.1
Harrowed	Not Rolled	22.5	23.5	23.7	26.5	22.8	22.1	21.5	22.3
	Rolled	22.2	26.4	25.1	25.8	20.3	22.6	28.2	22.7
		STRAW—cwt. per acre							
Not Harrowed	Not Rolled	31.4	33.7	33.9	33.1	33.2	34.8	35.8	35.0
	Rolled	33.3	40.8	34.9	41.6	30.3	39.6	28.7	36.1
Harrowed	Not Rolled	30.1	36.4	33.3	38.0	33.7	31.6	30.1	32.3
	Rolled	25.8	38.6	33.4	39.0	28.6	33.1	35.9	31.5

For standard errors see next table.

RESPONSES TO TREATMENTS

	Mean response	Differential Responses									
		Plough	Simar	Cultivating Shallow	Cultivating Deep	Harrowing Absent	Harrowing Present	Rolling Absent	Rolling Present	Sulph. Amm. Absent	Sulph. Amm. Present
		GRAIN—cwt. per acre									
Simar *minus* plough	-0.8^{1}	—	—	-1.2^{3}	-0.4^{3}	-0.1^{3}	-1.6^{3}	-0.2^{3}	-1.5^{3}	-0.0^{4}	-1.6^{4}
Deep *minus* shallow	$+1.2^{1}$	$+0.8^{3}$	$+1.6^{3}$	—	—	$+0.7^{3}$	$+1.6^{3}$	$+1.6^{3}$	$+0.8^{3}$	$+1.8^{4}$	$+0.7^{4}$
Harrowing	$+0.6^{1}$	$+1.4^{3}$	-0.1^{3}	$+0.2^{3}$	$+1.1^{3}$	—	—	$+0.3^{3}$	$+1.0^{3}$	$+0.5^{4}$	$+0.8^{4}$
Rolling	$+0.8^{1}$	$+1.5^{3}$	$+0.0^{3}$	$+1.2^{3}$	$+0.3^{3}$	$+0.4^{3}$	$+1.1^{3}$	—	—	$+0.3^{4}$	$+1.0^{4}$
Sulphate of Ammonia	$+0.5^{2}$	$+1.2^{4}$	-0.3^{4}	$+1.0^{4}$	0.0^{4}	$+0.4^{4}$	$+0.7^{4}$	$+0.1^{4}$	$+1.0^{4}$	—	—
		STRAW—cwt. per acre									
Simar *minus* plough	-1.7^{5}	—	—	-0.7^{7}	-2.7^{7}	-1.2^{7}	-2.2^{7}	-0.4^{7}	-3.0^{7}	0.0^{8}	-3.4^{8}
Deep *minus* shallow	$+1.1^{5}$	$+2.1^{7}$	$+0.1^{7}$	—	—	$+0.2^{7}$	$+2.0^{7}$	$+0.8^{7}$	$+1.4^{7}$	$+2.4^{8}$	-0.2^{8}
Harrowing	-1.5^{5}	-1.0^{7}	-2.0^{7}	-2.4^{7}	-0.7^{7}	—	—	-0.7^{7}	-2.4^{7}	-1.3^{8}	-1.8^{8}
Rolling	$+0.9^{5}$	$+2.2^{7}$	-0.3^{7}	$+0.7^{7}$	$+1.2^{7}$	$+1.8^{7}$	$+0.1^{7}$	—	—	-1.3^{8}	$+3.2^{8}$
Sulphate of Ammonia	$+3.9^{6}$	$+5.6^{8}$	$+2.2^{8}$	$+5.3^{8}$	$+2.6^{8}$	$+4.2^{8}$	$+3.7^{8}$	$+1.7^{8}$	$+6.2^{8}$	—	—

STANDARD ERRORS: (1) ±0.785, (2) ±0.569, (3) ±1.11, (4) ±0.805, (5) ±1.48, (6) ±0.926, (7) ±2.10, (8) ±1.31.

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INTERACTION BETWEEN CULTIVATIONS AND NITROGEN

	Ploughed		Simared		*Mean*
	Not harrowed	Harrowed	Not harrowed	Harrowed	
GRAIN—cwt. per acre					
No Sulph. Amm. ..	22.9	23.4	22.8	23.2	*23.1*
Sulph. Amm. ..	23.1	25.5	23.1	22.4	*23.5*
Diff. (±*1.14*)	+*0.2*	+*2.1*	+*0.3*	−*0.8*	+*0.4* (±*.570*)
STRAW—cwt. per acre					
No Sulph. Amm. ..	33.4	30.7	32.0	32.1	*32.0*
Sulph. Amm. ..	37.3	38.0	36.4	32.1	*36.0*
Diff. (±*1.85*)	+*3.9*	+*7.3*	+*4.4*	*0.0*	+*4.0* (±*0.925*)

CONCLUSIONS

There are no significant effects of any of the treatments on the grain. Nor are there any significant effects of the cultivations on the straw. The application of nitrogen, on the other hand, has significantly increased the yield of straw, this increase being significantly greater in the presence of rolling. The average difference in response to nitrogen by the straw for the ploughed and simared plots is barely significant but there is a significant interaction between this effect and harrowing, the response to nitrogen being considerably greater on the ploughed than on the simared plots which are harrowed, but somewhat less on the ploughed than on the simared plots which are not harrowed.

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FORAGE MIXTURE

Variation in proportion of oats and vetches.
Effect of nitrogen on yield and composition of different mixtures.

RF—PASTURES—1933

Plan and yields in lb.—Green weights.

N ↑

1										10
C O 31.6	C N 36.2	D N 55.7	D O 56.2	E O 53.7	E N 60.6	B N 33.3	B O 34.5	A O 33.0	A N 28.2	
A O 36.8	A N 35.6	B N 41.6	B O 40.2	C N 53.7	C O 42.6	E N 48.6	E O 66.0	D N 61.8	D O 57.4	
E O 8.9	E N 31.5	A O 39.8	A N 44.6	D N 59.0	D O 51.2	C N 61.5	C O 60.1	B O 52.6	B N 52.8	
D N 56.5	D O 48.5	E O 49.2	E N 76.0	B O 52.3	B N 54.2	A O 47.8	A N 49.2	C O 51.8	C N 58.6	
B O 43.4	B N 42.6	C N 47.1	C O 44.1	A N 47.3	A O 42.8	D O 62.9	D N 63.7	E O 61.7	E N 71.7	
41										50

SYSTEM OF REPLICATION : 5 × 5 Latin square. Each plot divided for nitrogen comparison.
AREA OF EACH SUB-PLOT : 0.0113 acre (40 links × 28.25 links).
TREATMENTS : All combinations of :

(a) Seedings (1 unit = 50 lb. per acre)

	A	B	C	D	E
Oats (units)	4	3	2	1	0
Vetches (units)	0	1	2	3	4

(b) No nitrogen **(O)**. 0.3 cwt. N. per acre as sulphate of ammonia **(N)**.

BASAL MANURING : Muriate of potash at the rate of 0.5 cwt. K_2O per acre, and superphosphate at the rate of 0.5 cwt. P_2O_5 per acre.
CULTIVATIONS, ETC. : Ploughed : March 25th. Manures applied : March 25th. Seed sown : March 25th. Harrowed : March 25th. Rolled : April 1st. The first crop failed and the seed was resown. Ploughed : May 16th. Seed sown : May 17th and 18th. Harrowed : May 17th and 18th. Rolled : May 17th and 18th. Top-dressed : May 22nd. Harvested : August 16th. Previous crop : Beans.
STANDARD ERRORS PER WHOLE PLOT : (Total dry matter) ±2.53 cwt. per acre or ±15.6 per cent. PER SUB-PLOT : ±1.54 cwt. per acre or ±9.5 per cent.
SAMPLING : Two grab samples, comprising from ten to fifteen handfuls, taken when the crop was in swathes. Weighed and separated, after sampling, into oats and vetches. Components weighed when air dry.
DRY MATTER : Each plot chaffed separately and equal volumes of chaffed material from replicates bulked. Whole thoroughly mixed and duplicate samples taken for dry matter.
SAMPLING ERRORS (per single sample) : Of air dry weight as percentage of green weight : ±1.75 of percentage of oats in air dry material : ±2.16.

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SUMMARY OF RESULTS

GREEN MATERIAL

Cwt. per acre	4 Oats 0 Vetches	3 Oats 1 Vetches	2 Oats 2 Vetches	1 Oats 3 Vetches	0 Oats 4 Vetches	*Mean*
Without Nitrogen ..	31.6	35.2	36.4	43.6	37.8	*36.9*
With Nitrogen ..	32.4	35.5	40.6	46.9	45.6	*40.2*
Mean	*32.0*	*35.4*	*38.5*	*45.2*	*41.7*	*38.6*
Difference	*+0.8*	*+0.3*	*+4.2*	*+3.3*	*+7.8*	*+3.3*

TOTAL DRY MATTER

Determined on duplicate samples from each plot, oats and vetches being separated in the sample.

Cwt. per acre		4 Oats 0 Vetches	3 Oats 1 Vetches	2 Oats 2 Vetches	1 Oats 3 Vetches	0 Oats 4 Vetches	*Mean*
Oats	Without Nitrogen	17.9	16.2	10.5	5.2	—	*12.4*
	With Nitrogen	18.1	15.9	11.5	6.2	—	*12.9*
Vetches	Without Nitrogen	—	2.0	5.6	10.1	11.0	*7.2*
	With Nitrogen	—	2.4	6.3	10.8	13.0	*8.1*
Total Dry Matter	Without Nitrogen	17.9	18.2	16.1	15.3	11.0	*15.7*
	With Nitrogen	18.1	18.3	17.8	17.0	13.0	*16.8*
	Mean (±1.14)	*18.0*	*18.2*	*17.0*	*16.2*	*12.0*	*16.2*
	Diff. (±0.980)	*+0.2*	*+0.1*	*+1.7*	*+1.7*	*+2.0*	*+1.1*

CONCLUSIONS

The yields of dry matter are significantly different for the different mixtures, the optimum yield being that of 3 of oats to 1 of vetches. The response in dry matter yields to nitrogen is significant, but not significantly different for the different mixtures.

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POTATOES

The fertiliser value of poultry manure in terms of equivalent sulphate of ammonia and superphosphate.

The fertiliser values of ammonium bicarbonate and sulphate of ammonia.

RP—PASTURES, 1933

Plan and yields in lb.

W ↑ (1 … 6)

B 172	P 161	SP 231	O 166	MP 208	MBP 144
M 192	S 145	BP 204	MP 253	MS 190	B 104
MBP 227	MSP 232	MS 231	MB 214	O 113	SP 131
S 176	MB 186	MS 238	M 198	S 158	MSP 171
O 132	MSP 242	P 180	B 175	M 171	BP 135
MP 196	BP 178	MBP 230	SP 216	MB 146	P 103

Bouts. ↑ (31 … 36)

SYSTEM OF REPLICATION : 6 randomised blocks of 6 plots each. Certain interactions partially confounded with block differences.

AREA OF EACH PLOT : 1/65 acre (45.5 links × 33.8 links).

TREATMENTS : All combinations of :

(a) No poultry manure. M, poultry manure at the rate of 0.6 cwt. N per acre, with additional superphosphate (0.005 cwt. P_2O_5 per acre) to give with the P_2O_5 of the poultry manure 0.6 cwt. P_2O_5 per acre.

(b) No sulphate or bicarbonate of ammonia.
S, Sulphate of ammonia
B, Ammonium bicarbonate
} At the rate of 0.6 cwt. N per acre.

(c) No superphosphate. P, superphosphate at the rate of 0.6 cwt. P_2O_5 per acre.

CULTIVATIONS, ETC. : Ploughed : April 20th. Harrowed April 26th. Ridged : April 28th. Manures applied : April 28th. Potatoes planted : May 1st and 2nd. Grubbed : May 24th and June 26th. Earthed up : July 1st. Potatoes lifted : Oct. 3rd. Variety : Ally. Previous crop : Beans.

STANDARD ERROR PER PLOT : ± 0.531 tons per acre or ± 10.1%.

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YIELDS OF SEPARATE TREATMENTS (BLOCK EFFECTS ELIMINATED)

Tons per acre	Neither	Super.	Poultry Manure	Both	*Mean*
Neither	4.01	4.26	5.40	6.38	*5.01*
Sulph. Amm.	4.83	5.39	6.17	6.44	*5.71*
Bicarb. Amm.	4.38	4.99	5.27	5.82	*5.12*
Mean	*4.41*	*4.88*	*5.61*	*6.21*	*5.28*

Standard error (of a single yield) applicable to second order interactions (which are partially confounded) ±0.412 tons. For other standard errors see below.

DIFFERENTIAL RESPONSES

Tons per acre	*Mean response*	Poultry Manure		Superphosphate		Ammonium		
		Absent	Present	Absent	Present	None	Sulphate	Bicarb.
Poultry manure..	*+1.26*[1]	—	—	+1.20[3]	+1.33[3]	+1.76[4]	+1.20[4]	+0.86[4]
Superphosphate..	*+0.54*[1]	+0.47[3]	+0.60[3]	—	—	+0.62[4]	+0.42[4]	+0.58[4]
Sulph. Amm. ..	*+0.70*[2]	+0.98[4]	+0.42[4]	+0.80[4]	+0.60[4]	—	—	—
Bicarb. Amm. ..	*+0.11*[2]	+0.55[4]	−0.34[4]	+0.12[4]	+0.08[4]	—	—	—

STANDARD ERRORS : ([1]) ±0.177, ([2]) ±0.217, ([3]) ±0.266, ([4]) ±0.307.

MEAN OF NO SUPERPHOSPHATE AND SUPERPHOSPHATE

T.p.a. (±0.217)	Neither	Sulph. Amm.	Bicarb. Amm.	*Mean (±0.125)*
No P.M. ..	4.14	5.11	4.68	*4.64*
Poultry manure	5.89	6.31	5.55	*5.92*
Mean (±0.154)	*5.01*	*5.71*	*5.12*	*5.28*

CONCLUSIONS

The responses to poultry manure, to superphosphate, and to sulphate of ammonia are all significant. The response to ammonium bicarbonate is small and not significant and is significantly less than the response to sulphate of ammonia. The extra response to poultry manure in the absence of the nitrogenous fertilisers over that in their presence is not large enough to be significant.

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SUGAR BEET

Effect of dung and mineral fertilisers, applied in the surface soil and in the subsoil.

RS—PASTURES, 1933

Plan and yields in lb., roots (dirty) above, tops centre, sugar percentage below.

73	NA0 35.5 30.0 15.17	OA3 55.9 50.0 16.58	OA2 51.0 39.5 15.86	OD0 32.2 28.5 15.28	OA2 39.0 36.0 15.83	NA1 46.4 72.4 15.68	OD1 66.4 74.5 15.88	NA3 52.6 65.0 15.94	ND1 53.1 51.0 15.48	NA3 52.0 53.5 15.97	OA3 61.9 44.5 16.43	OA1 50.6 41.0 16.20	117
S ↑	NA2 55.9 51.0 15.68	ND0 30.9 30.5 14.93	OA0 37.3 31.5 15.31	ND1 58.0 62.0 14.84	ND1 57.5 63.5 15.54	OD0 32.7 35.5 15.39	ND0 30.9 40.5 15.02	OD2 56.1 50.5 15.57	OD3 73.3 73.0 15.90	ND3 70.8 71.0 15.13	NA2 47.0 44.0 15.9 1	NA1 40.9 43.5 15.86	
	ND3 71.5 77.5 15.45	OD2 55.9 62.5 16.20	OD1 46.4 54.0 15.91	NA1 35.0 36.5 15.77	OA0 27.5 28.5 15.05	NA0 36.1 42.0 15.08	OD3 69.5 86.0 15.25	NA2 46.0 46.5 16.06	OD2 62.3 53.0 16.09	ND0 36.3 39.0 15.77	ND2 57.7 54.5 15.16	OD0 42.9 35.5 16.26	
76	NA3 45.4 44.0 16.86	ND2 42.4 49.0 16.32	OD3 38.3 53.5 15.34	OA1 24.6 25.5 16.17	OA3 27.9 24.0 16.29	OA1 36.7 33.0 15.94	ND3 59.8 77.5 15.45	ND2 63.6 64.0 15.54	OD1 64.3 63.0 15.68	OA2 52.7 39.5 16.86	OA0 44.3 37.0 15.88	NA0 44.2 42.0 15.84	120

SYSTEM OF REPLICATION : 3 Randomised blocks of 16 plots each.
AREA OF EACH PLOT : 0.0029 acre (10 ft. × 12½ ft. rows).
TREATMENTS : All combinations of :

(a) O=No nitrogen.
N=0.6 cwt. N per acre as sulphate of ammonia.

(b) A=0.5 cwt. P_2O_5 per acre as superphosphate and 1.0 cwt. K_2O per acre as 30% potash salt.
D=20 tons dung per acre, and potash salt and superphosphate as in (A).

(c) 0=No minerals or dung and minerals.
1=Minerals or dung and minerals applied in the surface soil.
2=Minerals or dung and minerals applied in the sub-soil.
3=Minerals or dung and minerals applied in both surface and subsoil (double dressing).

The whole area was hand dug two spits deep. Manures applied in the surface were incorporated with the first spit, those in the subsoil with the second spit.

CULTIVATIONS, ETC. : Dug : May 2nd-8th. Manures applied : May 2nd-9th. Seed sown : May 19th. Harrowed : May 16th and 19th. Rolled : May 16th, 18th and 19th. Hoed : July 20th and 21st. Singled June 27th-29th. Rows 15 ins. apart. Plants 10 ins. apart. Lifted : November 9th and 10th. Variety : Kuhn. Previous crop : Beans.

STANDARD ERRORS PER PLOT : Roots (washed) : ±1.13 tons per acre or 17.5%. Tops : ±1.34 tons per acre or 17.5%. Sugar percentage : ±0.355. Mean dirt tare : 0.1415.

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SUMMARY OF RESULTS

	No Super., Potash or Dung	Super. and Potash only			Super, Potash & Dung			*Mean*	Standard Errors
		Shallow	Deep	Shallow and Deep	Shallow	Deep	Shallow and Deep		
				ROOTS (washed)—tons per acre					
No Sulph.Amm.	4.82[2]	4.99[1]	6.37[1]	6.50[1]	7.88[1]	7.74[1]	8.06[1]	*6.40*	[1] ±0.653
Sulph. Amm. . .	4.76[2]	5.43[1]	6.64[1]	6.68[1]	7.52[1]	7.30[1]	9.00[1]	*6.51*	[2] ±0.462
Mean . .	*4.79*[3]	*5.21*[2]	*6.51*[2]	*6.59*[2]	*7.70*[2]	*7.52*[2]	*8.53*[2]	*6.46*	[3] ±0.325 [4] ±0.923 [5] ±0.336
Diff. . .	*−0.06*[1]	*+0.44*[4]	*+0.27*[4]	*+0.18*[4]	*−0.36*[4]	*−0.44*[4]	*+0.94*[4]	*+0.11*[5]	
				TOPS—tons per acre					
No Sulph.Amm.	5.10[2]	5.16[1]	5.96[1]	6.14[1]	9.93[1]	8.60[1]	11.02[1]	*7.13*	[1] ±0.772
Sulph. Amm.	5.80[2]	7.90[1]	7.34[1]	8.43[1]	9.15[1]	8.69[1]	11.72[1]	*8.10*	[2] ±0.546
Mean . .	*5.45*[3]	*6.53*[2]	*6.65*[2]	*7.28*[2]	*9.54*[2]	*8.64*[2]	*11.37*[2]	*7.61*	[3] ±0.386 [4] ±1.092 [5] ±0.398
Diff.	*+0.70*[1]	*+2.74*[4]	*+1.38*[4]	*+2.29*[4]	*−0.78*[4]	*+0.09*[4]	*+0.70*[4]	*+0.97*[5]	
				SUGAR PERCENTAGE					
No Sulph. Amm.	15.53[2]	16.10[1]	16.18[1]	16.43[1]	15.82[1]	15.95[1]	15.50[1]	*15.88*	[1] ±0.205
Sulph. Amm.	15.30[2]	15.77[1]	15.88[1]	16.26[1]	15.29[1]	15.67[1]	15.34[1]	*15.60*	[2] ±0.145
Mean . .	*15.42*[3]	*15.94*[2]	*16.03*[2]	*16.34*[2]	*15.56*[2]	*15.81*[2]	*15.42*[2]	*15.74*	[3] ±0.102 [4] ±0.290 [5] ±0.106
Diff.	*−0.23*[1]	*−0.33*[4]	*−0.30*[4]	*−0.17*[4]	*−0.53*[4]	*−0.28*[4]	*−0.16*[4]	*−0.28*[5]	
				TOTAL SUGAR—cwt. per acre					
No Sulph. Amm.	15.0	16.1	20.6	21.4	24.9	24.7	25.0	*20.3*	—
Sulph. Amm.	14.6	17.1	21.1	21.7	23.0	22.9	27.6	*20.3*	—
Mean . .	*14.8*	*16.6*	*20.8*	*21.6*	*24.0*	*23.8*	*26.3*	*20.3*	—
Diff.	*−0.4*	*+1.0*	*+0.5*	*+0.3*	*−1.9*	*−1.8*	*+2.6*	*0*	—

CONCLUSIONS

The roots show a significant response to dung and to minerals applied deep, but not to minerals applied shallow. On the other hand the difference between minerals applied deep and applied shallow, though suggestive, is not significant. The tops while responding significantly to dung and minerals show no difference between minerals applied deep and applied shallow.

The response to sulphate of ammonia is significant for the tops but not the roots.

The sugar percentage is significantly greater on the plots receiving minerals only, than on the plots with no minerals and the plots with minerals and dung. The depression with sulphate of ammonia is also significant.

The experiment as a whole is marred by low yields and very high standard errors.

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SUGAR BEET

Effect of varying spacing of rows, of sulphate of ammonia and of ploughing or harrowing in mineral fertilisers.

RS—Pastures—1933

Plan and yields in lb.

	Roots (dirty)	Tops	Sugar Percentage		Roots (dirty)	Tops	Sugar Percentage	
1	$N_2S_{20}B_P$	148.7	169.9	15.05	$N_1S_{10}B_H$	278.2	300.0	16.12	37
	— $S_{15}B_H$	168.6	199.8	15.13	$N_2S_{15}B_P$	254.8	261.5	16.29	
	— $S_{10}B_P$	302.4	276.5	16.06	$N_2S_{20}B_H$	143.2	155.0	15.71	
	$N_1S_{20}B_H$	146.7	177.0	15.86	$N_1S_{20}B_P$	179.4	169.5	16.29	
	$N_1S_{15}B_P$	216.9	208.5	16.12	— $S_{10}B_P$	318.0	253.5	17.07	
	$N_2S_{10}B_H$	227.5	258.5	15.53	— $S_{15}B_H$	200.9	178.5	16.03	
	$N_2S_{15}B_H$	175.7	211.1	15.39	$N_1S_{10}B_P$	329.6	297.5	16.40	
	$N_1S_{10}B_H$	266.3	253.2	15.77	$N_2S_{10}B_H$	302.9	322.5	16.37	
	— $S_{15}B_P$	247.3	201.0	16.37	— $S_{15}B_P$	247.6	200.5	16.26	
	$N_2S_{10}B_P$	323.7	323.7	16.89	$N_1S_{15}B_H$	211.7	210.5	15.86	
	$N_1S_{20}B_P$	191.6	204.7	15.59	— $S_{20}B_H$	132.1	125.0	15.77	
	— $S_{20}B_H$	159.4	194.0	15.71	$N_2S_{20}B_P$	163.2	151.0	16.17	
	— $S_{20}B_P$	182.6	173.9	15.94	— $S_{10}B_H$	281.8	254.0	16.72	
	$N_1S_{10}B_P$	311.9	279.5	16.92	— $S_{20}B_P$	173.3	153.0	16.49	
	$N_2S_{15}B_P$	226.4	230.5	16.37	$N_1S_{15}B_P$	252.8	251.0	16.00	
	— $S_{10}B_H$	230.8	224.0	16.98	$N_1S_{20}B_H$	165.6	166.0	16.61	
	$N_2S_{20}B_H$	136.3	166.0	16.17	$N_2S_{15}B_H$	239.3	264.5	15.91	
	$N_1S_{15}B_H$	196.2	210.0	16.29	$N_2S_{10}B_P$	321.2	346.0	16.12	
	$N_1S_{10}B_H$	268.5	251.5	16.92	— $S_{10}B_P$	310.6	279.5	16.58	
	— $S_{20}B_H$	154.4	165.5	16.37	$N_2S_{10}B_H$	299.3	338.5	15.68	
	$N_2S_{20}B_P$	185.2	191.5	15.91	— $S_{20}B_H$	165.0	156.0	16.55	
	$N_1S_{15}B_P$	263.3	241.5	16.63	$N_1S_{20}B_P$	197.9	183.5	16.63	
	$N_2S_{15}B_H$	244.6	265.0	16.00	$N_1S_{15}B_H$	258.0	288.0	16.64	
	— $S_{10}B_P$	288.7	226.0	17.18	$N_2S_{15}B_P$	285.0	233.5	15.71	
	$N_2S_{10}B_P$	304.9	279.0	16.66	— $S_{15}B_P$	279.8	263.0	16.84	
	$N_1S_{15}B_H$	210.2	213.5	16.08	$N_1S_{20}B_H$	184.5	190.5	16.43	
	— $S_{10}B_H$	328.4	266.5	17.12	$N_2S_{15}B_H$	248.4	295.0	15.83	
	$N_1S_{20}B_P$	174.9	200.5	16.52	$N_1S_{10}B_P$	327.1	324.0	16.26	
	$N_2S_{20}B_H$	151.1	195.0	15.45	— $S_{10}B_H$	307.1	283.5	16.23	
	— $S_{15}B_P$	219.2	230.0	15.83	$N_2S_{20}B_P$	186.9	188.0	16.26	
	— $S_{20}B_P$	176.0	198.5	15.80	$N_2S_{10}B_P$	307.2	330.5	15.80	
	$N_1S_{20}B_H$	148.7	186.0	15.60	$N_2S_{20}B_H$	150.6	181.0	15.42	
	$N_1S_{10}B_P$	292.9	333.5	16.35	$N_1S_{15}B_P$	226.5	255.5	16.00	
	— $S_{15}B_H$	186.0	209.0	15.48	— $S_{20}B_P$	164.7	156.5	16.17	
	$N_2S_{10}B_H$	256.6	319.0	15.65	$N_1S_{10}B_H$	275.5	337.5	15.60	
36	$N_2S_{15}B_P$	200.4	242.0	16.00	— $S_{15}B_H$	170.3	183.0	15.42	72

N ↑

SYSTEM OF REPLICATION : 12 randomised blocks of 6 plots each. Certain degrees of freedom representing interactions are partially confounded with block differences.

AREA OF EACH PLOT : (After rejecting edge-rows). 10 inch spacing : 0.01515 acres ; 15 inch spacing : 0.01363 acres ; 20 inch spacing : 0.01212 acres. Plots actually 120 links rows × 15.15 links.

TREATMENTS : All combinations of :

(a) Rows spaced 10 inches (S_{10}), 15 inches (S_{15}) and 20 inches (S_{20}) apart.

(b) No sulphate of ammonia (—), sulphate of ammonia at the rate of 0.3 cwt. N per acre (N_1) and 0.6 cwt. N per acre (N_2).

(c) Basal mineral fertilisers (superphosphate at the rate of 0.5 cwt. P_2O_5 per acre and 30% potash salt at the rate of 1.0 cwt. K_2O per acre) ploughed in (BP) and harrowed in (BH).

CULTIVATIONS, ETC. : Ploughed : April 20th. Early manures applied : April 6th. Late manures applied : May 11th. Seed sown : May 9th and 10th. Harrowed : April 26th. May 8th, 9th and 10th. Rolled : May 9th, 10th and 12th. Hoed : June 14th, 15th, 27th and 30th, July 12th and 13th. Singled : June 29th-July 5th. Lifted : October 31st-November 9th. Plants 10 inches apart. Variety : Kuhn. Previous crop : Beans.

STANDARD ERRORS PER PLOT : Roots : ±0.500 tons per acre or ±7.65%. Tops : ±0.781 tons per acre or ±10.39%. Sugar percentage : ±0.346. Mean dirt tare : 10 inch spacing : 0.1291, 15 inch spacing : 0.1228, 20 inch spacing : 0.0947.

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SUMMARY OF RESULTS

Yields of Separate Treatments (Block effects eliminated)

	Basal minerals ploughed under			Basal minerals harrowed in		
	Spacing of 10 ins.	Spacing of 15 ins.	Spacing of 20 ins.	Spacing of 10 ins.	Spacing of 15 ins.	Spacing of 20 ins.
ROOTS (washed)—tons per acre (±0.316)*						
No Nitrogen	7.67	6.96	6.15	7.32	5.55	4.78
0.3 cwt. Nitrogen ..	8.18	7.02	5.97	6.95	6.22	5.50
0.6 cwt. Nitrogen ..	8.13	6.97	5.59	7.05	6.26	5.03
TOPS—tons per acre (±0.498)*						
No Nitrogen	7.70	7.38	6.12	7.49	6.19	6.13
0.3 cwt. Nitrogen ..	9.05	7.85	7.04	8.50	7.76	6.26
0.6 cwt. Nitrogen ..	9.40	7.85	6.56	9.10	8.36	6.55
SUGAR PERCENTAGE (±0.219)*						
No Nitrogen	16.66	16.32	16.17	16.64	15.74	15.99
0.3 cwt. Nitrogen ..	16.45	16.27	16.20	16.07	16.09	16.28
0.6 cwt. Nitrogen ..	16.46	16.01	15.83	15.96	15.68	15.64
TOTAL SUGAR—cwt. per acre						
No Nitrogen	25.6	22.7	19.9	24.4	17.5	15.3
0.3 cwt. Nitrogen ..	26.9	22.8	19.3	22.3	20.0	17.9
0.6 cwt. Nitrogen ..	26.8	22.3	17.7	22.5	19.6	15.7

*For second order interactions only.

MAIN EFFECTS

MEAN YIELDS: Roots, 6.52 tons; Tops, 7.52 tons; Sugar percentage, 16.14; Total Sugar, 21.0 cwt.

Spacing

	Roots (washed) tons p.a.	*Diff.*	Tops tons p.a.	*Diff.*	Sugar Percentage Actual	*Diff.*	Total Sugar cwt. p.a.	*Diff.*
10 in. Spacing ..	7.55		8.54		16.37		24.7	
15 in. Spacing ..	6.50	*−1.05*	7.56	*−0.98*	16.02	*−0.35*	20.8	*−3.9*
20 in. Spacing ..	5.50	*−1.00*	6.44	*−1.12*	16.02	*0*	17.6	*−3.2*
Standard Error	±0.102	*±0.144*	±0.161	*±0.228*	±0.071	*±0.100*	—	—

Basals

	Roots (washed) tons p.a.	*Diff.*	Tops tons p.a.	*Diff.*	Sugar Percentage Actual	*Diff.*	Total Sugar cwt. p.a.	*Diff.*
Basals ploughed under ..	6.96		7.66		16.26		22.6	
Basals harrowed in	6.08	*−0.88*	7.37	*−0.29*	16.01	*−0.25*	19.5	*−3.1*
Standard Error	±0.083	*±0.117*	±0.131	*±0.185*	±0.058	*±0.082*	—	—

Nitrogen

	Roots (washed) tons p.a.	*Diff.*	Tops tons p.a.	*Diff.*	Sugar Percentage Actual	*Diff.*	Total Sugar cwt. p.a.	*Diff.*
No Nitrogen ..	6.40		6.83		16.26		20.8	
0.3 cwt. Nitrogen	6.64	*+0.24*	7.75	*+0.92*	16.23	*−0.03*	21.5	*+0.70*
0.6 cwt. Nitrogen	6.51	*−0.13*	7.96	*+0.21*	15.93	*−0.30*	20.7	*−0.80*
Standard Error	±0.102	*±0.144*	±0.161	*±0.228*	±0.071	*±0.100*	—	—

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INTERACTION OF SPACING AND SULPHATE OF AMMONIA. MEAN OF BOTH BASALS

	Roots (washed) tons per acre (±0.188)			Tops tons per acre (±0.298)			Sugar Percentage (±0.130)			Total Sugar cwt. per acre		
	Nitrogen			Nitrogen			Nitrogen			Nitrogen		
	None	0.3cwt	0.6cwt	None	0.3cwt	0.6cwt	None	0.3cwt	0.6cwt	None	0.3cwt	0.6cwt
Spacing												
10 ins.	7.50	7.56	7.59	7.60	8.78	9.25	16.65	16.26	16.21	25.0	24.6	24.6
15 ins.	6.26	6.62	6.62	6.78	7.80	8.10	16.03	16.18	15.84	20.1	21.4	21.0
20 ins.	5.46	5.74	5.31	6.12	6.65	6.56	16.08	16.24	15.74	17.6	18.6	16·7

INTERACTION OF SPACINGS AND BASALS. MEAN OF ALL LEVELS OF NITROGEN

	Roots (washed) tons per acre (± 0.144)		Tops tons per acre (± 0.228)		Sugar Percentage (± 0.100)		Total Sugar cwt. per acre	
	Basal minerals		Basal minerals		Basal minerals		Basal minerals	
	ploughed under	harrowed in	ploughed under	harrowed in	ploughed under	harrowed in	ploughed under	harrowed in
10 in. Spacing . .	8.00	7.11	8.72	8.37	16.52	16.22	26.4	23.1
15 in. Spacing . .	6.99	6.02	7.69	7.44	16.20	15.84	22.6	19.0
20 in. Spacing . .	5.90	5.11	6.57	6.31	16.07	15.97	19.0	16.3

INTERACTION OF NITROGEN AND BASALS. MEAN OF ALL SPACINGS.

	Roots (washed) tons per acre (± 0.144)		Tops tons per acre (± 0.228)		Sugar Percentage (± 0.100)		Total Sugar cwt. per acre	
	Basal minerals		Basal minerals		Basal minerals		Basal minerals	
	ploughed under	harrowed in	ploughed under	harrowed in	ploughed under	harrowed in	ploughed under	harrowed in
No Nitrogen . .	6.92	5.89	7.07	6.59	16.38	16.13	22.7	19.1
0.3 cwt. Nitrogen	7.06	6.22	7.97	7.53	16.31	16.15	23.0	20.1
0.6 cwt. Nitrogen	6.90	6.12	7.93	8.00	16.10	15.76	22.3	19.3

CONCLUSIONS

The effect of varying the spacing of the rows is very marked, the 10 inch spacing giving 31 per cent. greater yield than the 20 inch spacing. The sugar percentage of the 10 inch spacing is also significantly higher than that of the 20 inch spacing, so that the yield of sugar for the narrowest spacing is no less than 35 per cent. greater than that of the widest spacing. The yield of tops is also considerably greater for the narrowest spacing. The spacing effects do not show any significant departure from proportionality to differences between the row widths except for the sugar percentage which (perhaps somewhat surprisingly) shows no increase from 20 inch to 15 inch spacing but a considerable increase from 15 inch to 10 inch, the difference of the increases being significant.

The sulphate of ammonia produces no significant effects on the yield of roots but significantly lowers the sugar percentage, particularly in the higher dressing, and significantly increases the yield of tops.

Basals ploughed under produce significantly greater yields of roots and tops and significantly higher sugar percentage than basals harrowed in.

There are no significant interactions.

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KALE

Comparison of Marrow-stem and Thousand-head. Effect of thinning, and of heavy nitrogen dressings.

RK—GREAT KNOTT, 1933.
Plan and yields in lb.—Green material (Total of all Harvestings)

N ↑

1								8
M T N_3 306.0	H U N_0 180.0	M T N_2 387.4	H T N_1 391.7	H T N_1 345.2	H T N_0 317.5	M T N_2 421.9	H U N_1 494.5*	
M U N_0 395.5	H T N_2 350.2	M T N_1 449.6	M T N_0 406.1	H U N_0 325.6	M U N_0 435.3	H U N_2 507.3	M T N_1 429.2	
H T N_3 385.7	H U N_1 495.9	M U N_3 583.9	M U N_1 585.5	M T N_0 331.4	H T N_2 411.7	M T N_3 402.7	M U N_1 503.1	
H U N_2 468.7	H U N_3 510.2	M U N_2 576.8	H T N_0 364.3	M U N_2 597.7	M U N_3 547.0	H T N_3 356.2	H U N_3 488.7	
M U N_1 497.2	H U N_1 507.7	M U N_3 572.9	H T N_2 465.3	H T N_1 409.4	M U N_1 535.5	H U N_0 318.1	M T N_2 427.3	
M T N_0 340.1	H U N_0 396.3	M T N_3 500.5	H T N_0 370.1	H U N_1 506.3	M U N_0 438.0	H T N_0 289.1	M T N_3 424.3	
H U N_3 460.3	M T N_1 415.6	M T N_2 476.5	M U N_0 481.4	M T N_0 383.4	M U N_2 559.1	H T N_3 387.1	M U N_3 522.1	
H U N_2 428.7	M U N_2 506.2	H T N_3 427.6	H T N_1 420.7	H U N_3 524.1	H U N_2 509.3	M T N_1 398.6	H T N_2 368.6	
57								64

* Fourth harvesting of this plot estimated.

SYSTEM OF REPLICATION : 4 randomised blocks of 16 plots each.

AREA OF EACH PLOT : .0178 acre. (36.3 links × 49.1 links.)

TREATMENTS : All combinations of :
(*a*) Marrow-stem (M) and Thousand-head (H).
(*b*) Unthinned (U) and Thinned to 18 ins. apart in the rows (T).
(*c*) No nitrochalk (N_0), and nitrochalk at the rate of 1 cwt. N. per acre (N_1), 2 cwt. N per acre (N_2) and 3 cwt. N. per acre (N_3) (all applied in three equal dessings).

BASAL MANURING : Superphosphate at the rate of 0.5 cwt. P_2O_5 per acre and muriate of potash at the rate of 0.8 cwt. K_2O per acre (applied with seed).

CULTIVATIONS, ETC. : Tractor cultivate : May 15th. Harrowed : June 7th, 8th, 9th and 23rd. Rolled : May 16th, June 8th, 9th, 12th, 23rd and July 7th. Hoed : July 31st—August 2nd, August 21st, 22nd and 25th. Thinned : August 21st and 22nd. Manures applied : May 19th, 20th, July 25th, 26th, August 23rd and 24th. Seed sown : May 16th. Re-sown : June 26th. Harvested : December 3rd, 11th, 18th, January 1st, 8th, 15th, 22nd, 29th, February 5th, 12th, 19th and 26th. (One twelfth of each plot was harvested on each date.) Rows spaced 2 ft. apart. Previous crop : Wheat.

STANDARD ERRORS PER PLOT : Total of all harvestings : Green material : 1.10 tons or 10.0 per cent. Dry matter : 1.70 cwt. or 5.52 per cent.

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https://doi.org/10.23637/ERADOC-1-3

SUMMARY OF RESULTS

Yield of individual Harvestings.

Harvesting.	Marrow Stem.								Thousand Head.							
	Unthinned.				Thinned.				Unthinned.				Thinned.			
	No N	1 cwt. N	2 cwt. N	3 cwt. N	No N	1 cwt. N	2 cwt. N	3 cwt. N	No N	1 cwt. N	2 cwt. N	3 cwt. N	No N	1 cwt. N	2 cwt. N	3 cwt. N
Green weights—tons per acre.																
1	11.93	15.43	17.85	17.69	9.44	11.16	12.96	11.69	7.31	14.28	13.84	15.15	9.26	11.65	12.62	11.53
2	11.96	13.87	15.01	15.89	9.72	10.71	10.92	10.20	7.59	13.43	11.54	13.20	8.18	9.84	10.04	10.35
3	10.52	14.24	14.40	14.10	8.48	10.14	11.00	10.98	8.00	13.25	13.54	12.16	8.32	9.52	9.54	9.74
4	12.38	15.22	16.11	16.21	10.69	12.23	12.59	11.79	9.61	14.33	15.33	14.43	8.91	12.20	11.98	11.95
5	10.50	15.07	15.94	14.94	10.12	12.02	12.45	12.64	7.87	14.04	13.32	13.77	8.44	10.74	11.22	10.25
6	11.56	14.23	14.23	14.34	8.67	11.65	11.59	9.08	8.69	13.17	11.14	12.83	8.32	9.76	11.09	9.90
7	10.60	13.49	13.56	12.29	9.38	10.36	9.24	9.90	7.96	12.01	11.91	12.50	8.18	9.06	9.46	10.29
8	10.41	12.26	11.88	12.56	8.68	10.41	10.03	10.63	7.27	11.90	10.55	11.56	8.90	8.66	8.30	8.38
9	11.00	11.74	12.44	12.19	9.26	8.91	9.52	10.07	7.56	11.58	10.95	11.03	7.78	9.25	8.87	8.00
10	11.24	12.10	14.56	14.27	9.32	10.32	10.40	9.68	7.34	10.96	10.68	11.57	9.90	10.14	9.52	10.29
11	10.30	12.41	11.54	12.25	8.62	9.66	9.56	8.85	6.90	11.07	11.44	11.12	7.71	8.60	9.78	8.17
12	9.12	9.33	10.78	10.53	7.40	9.65	8.46	7.24	5.58	10.60	9.60	9.70	6.86	8.32	7.48	8.13
Mean ..	*10.96*	*13.28*	*14.02*	*13.94*	*9.15*	*10.60*	*10.73*	*10.23*	*7.64*	*12.55*	*11.99*	*12.42*	*8.40*	*9.81*	*9.99*	*9.75*
Dry Matter—cwt. per acre.																
1	34.9	40.0	45.4	44.6	27.0	29.0	34.7	29.9	23.0	40.6	38.5	42.4	28.8	33.1	34.3	32.0
2	36.4	38.3	41.2	43.0	30.0	30.4	31.4	29.6	25.7	42.4	34.9	39.4	26.1	30.6	31.1	31.9
3	31.1	41.0	41.2	39.2	25.5	28.4	30.0	31.1	26.8	40.7	40.3	36.7	26.4	29.3	30.4	29.6
4	31.7	35.9	39.4	38.9	26.9	29.9	30.5	29.0	26.1	36.7	39.8	36.1	23.4	31.7	31.4	30.4
5	26.4	39.8	39.2	37.6	27.5	31.0	32.6	33.1	22.5	36.5	37.0	37.7	23.6	28.6	30.5	28.1
6	31.0	35.6	35.9	35.3	23.7	30.0	30.4	23.0	25.4	36.4	29.8	34.9	23.3	26.1	30.4	26.8
7	31.0	35.6	36.8	33.4	27.2	28.8	24.2	27.0	24.8	34.9	35.0	36.5	24.0	26.6	27.6	29.8
8	30.6	33.5	32.3	34.1	25.7	28.7	27.4	30.6	23.7	36.7	32.0	34.3	28.1	26.1	25.5	26.0
9	31.0	30.8	32.6	31.7	27.0	24.0	25.1	27.0	23.6	34.6	31.7	33.5	22.7	27.2	26.1	22.7
10	31.7	32.5	39.1	36.5	27.0	26.9	27.2	26.4	22.5	32.6	32.2	33.5	31.2	28.7	28.4	30.0
11	29.2	34.7	31.6	33.8	24.9	25.8	26.9	25.1	22.5	33.2	35.2	32.5	23.7	25.7	29.3	24.8
12	27.2	26.1	30.6	30.0	22.7	27.8	24.3	20.6	18.8	34.6	29.8	31.6	21.6	26.0	23.1	25.5
Mean ..	*31.0*	*35.3*	*37.1*	*36.5*	*26.3*	*28.4*	*28.7*	*27.7*	*23.8*	*36.7*	*34.7*	*35.8*	*25.2*	*28.3*	*29.0*	*28.1*

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RATIO OF LEAVES TO STEMS—INDIVIDUAL HARVESTINGS

Harvesting	Marrow Stem								Thousand Head							
	Unthinned				Thinned				Unthinned				Thinned			
	No N	1 cwt. N	2 cwt. N	3 cwt. N	No N	1 cwt. N	2 cwt. N	3 cwt. N	No N	1 cwt. N	2 cwt N	3 cwt. N	No N	1 cwt. N	2 cwt. N	3 cwt. N
							Green weights									
1	1.87	1.42	1.47	1.23	2.06	2.09	1.71	2.13	3.58	2.88	2.59	2.34	4.14	3.92	3.79	3.73
2	1.50	1.14	1.22	1.24	1.80	1.63	1.76	1.81	3.05	2.50	2.20	2.51	3.74	3.21	3.12	3.34
3	1.41	1.41	1.14	1.20	1.72	1.93	1.81	1.70	3.26	2.42	2.15	2.40	4.09	3.23	3.57	3.22
4	1.60	1.34	1.46	1.34	2.13	1.71	1.83	1.98	3.46	2.60	2.74	2.70	3.81	3.82	3.64	3.68
5	1.76	1.43	1.42	1.33	1.90	2.10	1.73	1.71	4.22	2.37	2.78	2.20	4.65	3.74	3.66	3.97
6	1.54	1.35	1.36	1.38	2.03	2.21	1.80	2.09	3.65	2.27	2.87	2.66	4.62	4.18	3.65	4.02
7	1.42	1.00	1.00	1.11	1.77	1.75	1.61	1.78	3.07	2.20	2.39	1.98	3.23	3.26	3.09	3.06
8	1.28	1.07	0.99	1.07	1.56	1.33	1.56	1.53	2.83	2.14	2.23	2.23	3.16	3.28	2.97	3.66
9	1.11	1.02	0.93	0.97	1.44	1.59	1.62	1.34	3.13	1.88	2.25	2.14	3.46	2.83	3.35	2.93
10	1.28	1.11	1.04	0.98	1.47	1.51	1.30	1.50	2.97	2.17	2.24	2.07	3.70	3.36	3.35	2.95
11	1.15	1.02	0.99	1.02	1.53	1.41	1.48	1.51	3.02	1.88	2.34	1.82	3.18	3.28	2.96	3.54
12	1.08	0.99	0.82	0.92	1.17	1.38	1.11	1.28	2.81	2.00	1.88	1.86	2.88	2.72	2.52	2.59
Mean .. .	*1.42*	*1.19*	*1.15*	*1.15*	*1.72*	*1.72*	*1.61*	*1.70*	*3.25*	*2.28*	*2.39*	*2.24*	*3.72*	*3.40*	*3.31*	*3.39*
							Dry Matter									
1	1.94	1.50	1.62	1.29	2.03	2.26	1.79	2.29	3.27	2.63	2.51	2.29	3.59	3.64	3.54	3.38
2	1.66	1.41	1.51	1.52	1.97	1.92	2.13	1.98	2.76	2.50	2.53	2.62	3.54	3.12	3.28	3.33
3	1.50	1.70	1.41	1.46	1.89	2.21	1.99	1.99	3.01	2.37	2.16	2.40	3.78	3.21	3.48	3.17
4	1.51	1.37	1.57	1.43	1.85	1.64	1.79	1.97	2.72	2.20	2.41	2.34	3.07	3.04	2.98	3.09
5	1.43	1.57	1.52	1.50	1.75	2.13	1.75	1.66	3.48	2.14	2.67	2.05	3.97	3.28	3.33	3.55
6	1.52	1.42	1.44	1.53	2.03	2.23	1.84	2.19	3.10	2.01	2.70	2.54	3.77	3.72	3.24	3.66
7	1.47	1.20	1.18	1.37	1.77	1.99	2.32	1.90	2.74	2.14	2.40	2.03	2.91	3.08	2.97	2.94
8	1.39	1.22	1.28	1.29	1.70	1.56	1.75	1.64	2.56	2.06	2.22	2.26	2.87	3.15	2.88	3.50
9	1.22	1.29	1.21	1.22	1.56	1.84	1.76	1.50	2.89	1.91	2.30	2.37	3.08	2.66	3.23	3.16
10	1.34	1.39	1.24	1.20	1.72	1.69	1.42	1.69	2.70	2.12	2.27	2.13	3.58	3.04	3.25	2.87
11	1.26	1.16	1.20	1.32	1.62	1.54	1.71	1.74	2.78	1.88	2.36	1.95	2.96	3.09	2.91	3.38
12	1.25	1.24	1.04	1.18	1.37	1.58	1.34	1.53	2.67	2.12	2.07	2.08	2.68	2.78	2.60	2.74
Mean .. .	*1.46*	*1.37*	*1.35*	*1.36*	*1.77*	*1.88*	*1.80*	*1.84*	*2.89*	*2.17*	*2.38*	*2.26*	*3.32*	*3.15*	*3.14*	*3.23*

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TOTAL YIELDS

Varieties and Thinning

	Green Material (tons per acre) (±0.275, Means ± 0.195)			Dry Matter (cwt. per acre) (±0.424, Means ± 0.300)		
	Marrow Stem	Thousand Head.	*Mean.*	Marrow Stem.	Thousand Head.	*Mean.*
Thinned ..	10.18	9.49	*9.84*	27.8	27.7	*27.8*
Unthinned ..	13.05	11.15	*12.10*	35.0	32.7	*33.8*
Mean ..	*11.62*	*10.32*	*10.97*	*31.4*	*30.2*	*30.8*

Nitrogen and Thinning

	Green Material (tons per acre) (±0.389, Means ±0.275)				Dry Matter (cwt. per acre) (±0.601, Means ±0.424)			
	No N	1 cwt. N	2 cwt. N	3 cwt. N	No N	1 cwt. N	2 cwt. N	3 cwt. N
Thinned ..	8.77	10.21	10.36	9.99	25.8	28.4	28.9	27.9
Unthinned ..	9.30	12.91	13.00	13.18	27.4	36.0	35.9	36.1
Mean	*9.04*	*11.56*	*11.68*	*11.58*	*26.6*	*32.2*	*32.4*	*32.0*

CHANGES OF YIELD WITH TIME

Decrease per week

Varieties and Thinning

	Green Material (tons per acre) (±0.0284, Means ±0.0201)			Dry Matter (cwt. per acre) (±0.0472, Means ±0.0334)		
	Marrow Stem	Thousand Head	*Mean*	Marrow Stem	Thousand Head	*Mean*
Thinned	0.20	0.20	*0.20*	0.47	0.46	*0.46*
Unthinned	0.36	0.27	*0.32*	0.83	0.60	*0.72*
Mean	*0.28*	*0.24*	*0.26*	*0.65*	*0.53*	*0.59*

Nitrogen and Thinning

	Green Material (tons per acre) (±0.0402, Means ±0.0284)				Dry Matter (cwt. per acre) (±0.0668, Means ±0.0472)			
	No. N	1 cwt. N	2 cwt. N	3 cwt N	No N	1 cwt. N	2 cwt N	3 cwt N
Thinned	0.10	0.18	0.28	0.26	0.22	0.41	0.66	0.57
Unthinned ..	0.14	0.35	0.37	0.39	0.39	0.80	0.82	0.85
Mean	*0.12*	*0.26*	*0.32*	*0.32*	*0.30*	*0.60*	*0.74*	*0.71*

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MEAN RATIO OF LEAVES TO STEMS

Varieties and Thinning

	Green Material (±0.0307) (Means ±0.0217)			Dry Matter (±0.0350) (Means ±0.0247)		
	Marrow Stem	Thousand Head	*Mean*	Marrow Stem	Thousand Head	*Mean*
Thinned	1.69	3.46	*2.58*	1.82	3.21	*2.52*
Unthinned	1.23	2.54	*1.88*	1.38	2.42	*1.90*
Mean	*1.46*	*3.00*	*2.23*	*1.60*	*2.82*	*2.21*

Nitrogen and Thinning, Nitrogen and Varieties

	Green Material (±0.0433) (Means ±0.0307)				Dry Matter (±0.0494) (Means ±0.0350)			
	No N.	1 cwt. N.	2 cwt. N.	3 cwt. N.	No N.	1 cwt. N.	2 cwt. N.	3 cwt. N.
	Nitrogen and Thinning							
Thinned	2.72	2.56	2.46	2.54	2.54	2.52	2.47	2.54
Unthinned ..	2.34	1.74	1.77	1.70	2.18	1.77	1.86	1.81
	Nitrogen and Varieties							
Marrow Stem ..	1.56	1.46	1.38	1.42	1.61	1.63	1.58	1.60
Thousand Head	3.49	2.84	2.85	2.82	3.10	2.66	2.76	2.74
Mean	*2.53*	*2.15*	*2.12*	*2.12*	*2.36*	*2.14*	*2.16*	*2.18*

RATIO OF LEAVES TO STEMS—CHANGES WITH TIME

Varieties and Thinning. Decrease per week.

	Green Material (±0.00552) (Means ±0.00390)			Dry Matter (±0.00482) (Means ±0.00341)		
	Marrow Stem	Thousand Head	*Mean*	Marrow Stem	Thousand Head	*Mean*
Thinned	0.0528	0.0692	*0.0610*	0.0449	0.0471	*0.0460*
Unthinned	0.0410	0.0524	*0.0467*	0.0338	0.0341	*0.0340*
Mean	*0.0469*	*0.0608*	*0.0538*	*0.0394*	*0.0406*	*0.0400*

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RATIO OF LEAVES TO STEMS—CHANGES WITH TIME

Nitrogen and Thinning. Decrease per week.

	Green material (±0.00781) (Means ±0.00552)				Dry matter (± 0.00681) (Means ±0.00482)			
	No N.	1 cwt. N.	2 cwt. N.	3 cwt. N.	No N.	1 cwt. N.	2 cwt. N.	3 cwt. N.
Thinned	0.0759	0.0554	0.0562	0.0566	0.0542	0.0465	0.0444	0.0388
Unthinned ..	0.0537	0.0511	0.0391	0.0427	0.0392	0.0371	0.0332	0.0263
Mean	*0.0648*	*0.0532*	*0.0476*	*0.0496*	*0.0467*	*0.0418*	*0.0388*	*0.0326*

CONCLUSIONS

There is a significant response in yield of green material to the first dressing of nitrogen, this response being significantly greater on the unthinned plots. The further dressings of nitrogen produce no further increase in yield. The effect on the dry matter is substantially the same.

The thinned plots give significantly less yield than the unthinned plots, this difference being significantly greater where nitrogen was applied.

Marrow-stem gives significantly greater yield than Thousand-head, this difference being significantly greater on the unthinned plots.

The plots receiving nitrogen show a significantly greater decrease in yield with time than the plots without nitrogen. The unthinned plots show a significantly greater decrease than the thinned plots. Marrow-stem shows a significantly greater decrease of dry matter than Thousand-head, but not of green material.

The ratio of leaves to stems is significantly greater on the thinned than the unthinned plots. Thousand-head gives a significantly greater ratio than Marrow-stem, both for green material and dry matter, the varietal differences being significantly greater on the thinned plots, and on the plots without nitrogen. The ratios are significantly reduced by the application of nitrogen, there being no differences between the various levels of nitrogen. For dry matter this reduction only occurs on the unthinned plots and for green material the reduction is small (though significant) on the thinned plots.

The only significant changes of the ratio of leaves to stems with time are (1) a significantly greater decrease on the thinned plots for both green material and dry matter; (2) a significantly greater decrease with Thousand-head for green material only.

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BRUSSELS SPROUTS

Effect of poultry manure compared with that of sulphate of ammonia and superphosphate.

RD—Great Harpenden, 1933

Plan and yields in lb. Saleable Sprouts (Total of all pickings)

1 — 8

N ↑

MN_2 63.8	PN_1 70.1	P 68.5	MP 76.0	MPN_1 93.8	MPN_2 87.3	O 69.7	MN_2 72.4
MPN_1 83.7	PN_2 78.9	MN_1 82.0	O 82.6	PN_1 93.8	P 106.5	N_2 89.7	MN_1 82.5
M 70.2	MPN_2 77.4	N_1 64.3	N_2 71.0	M 68.3	MP 90.9	PN_2 63.2	N_1 64.3
PN_1 89.5	PN_2 77.1	MP 90.8	MPN_2 88.8	N_2 96.1*	P 105.8*	MP 90.9*	N_1 77.4*
P 77.7	N_1 81.3	M 84.9	MPN_1 89.6	MPN_1 77.2*	MN_1 74.7*	M 78.3*	O 73.1*
O 99.1	MN_2 96.2	MN_1 81.5	N_2 72.3	PN_2 56.9*	MN_2 60.3*	PN_1 55.4*	MPN_2 28.4*

41 — 48

*The results of this block were rejected owing to evidence of serious tree competition.

SYSTEM OF REPLICATION : 4 randomised blocks of 12 plots each.

AREA OF EACH PLOT : 0.02417 acre (9 yards × 13 yards).

TREATMENTS : All combinations of :

(a) No poultry manure and poultry manure at the rate of 0.6 cwt. N per acre, with the addition of superphosphate at the rate of 0.005 cwt. per acre, to give a total of 0.6 cwt. P_2O_5 per acre (M).

(b) No sulphate of ammonia, sulphate of ammonia at the rate of 0.3 cwt. N per acre (N_1), and 0.6 cwt. N per acre (N_2).

(c) No superphosphate, and superphosphate at the rate of 0.6 cwt. P_2O_5 per acre (P).

CULTIVATIONS, ETC. : Spring ploughed. Rolled : May 22nd. Hoed : June 20th, July 7th, 11th and August 26th-28th. Manures applied : May 26th, 27th, 30th, 31st and June 8th. Planted : May 26th and 27th. Harvested : November 13th and 14th. December 11th and 12th, January 10th and February 6th and 7th. Previous crop : Kale.

STANDARD ERROR PER PLOT : Total of all pickings (saleable sprouts) : 3.73 cwt. or 12.55%.

INDIVIDUAL TREATMENTS

Saleable Sprouts—cwt. per acre.

Mean yield: 29.75 cwt.

Pickings	O	M	P	MP	N_1	MN_1	PN_1	MPN_1	N_2	MN_2	PN_2	MPN_2
1st ..	13.64	12.25	13.86	16.95	11.67	13.63	13.81	14.55	12.58	11.63	12.48	15.44
2nd ..	8.56	7.63	8.49	6.45	6.68	8.69	8.52	8.58	7.71	9.52	6.86	7.37
3rd ..	3.51	2.26	2.90	2.34	2.06	2.72	3.40	4.32	2.87	2.61	2.49	2.23
4th ..	5.24	5.36	5.85	5.98	5.43	5.24	5.47	5.43	5.53	4.85	5.16	6.17
Total	*30.95*	*27.50*	*31.10*	*31.72*	*25.84*	*30.28*	*31.20*	*32.88*	*28.69*	*28.61*	*26.99*	*31.21*

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INDIVIDUAL TREATMENTS—PERCENTAGE BLOWN TO TOTAL

Pickings	O	M	P	MP	N_1	MN_1	PN_1	MPN_1	N_2	MN_2	PN_2	MPN_2
1st ..	20.9	24.8	22.4	23.6	21.2	24.0	24.2	21.9	23.4	24.4	25.1	26.5
2nd ..	8.8	8.2	9.5	10.6	9.4	10.7	9.4	10.6	11.1	10.0	10.7	11.8
3rd ..	20.8	25.7	21.3	27.2	23.7	27.2	21.9	23.8	23.7	23.6	28.6	28.7
4th ..	No blown sprouts.											

INDIVIDUAL TREATMENTS—PERCENTAGE FIRSTS TO SECONDS

Firsts denote sprouts too large to pass through a $1\frac{1}{4}$ in. riddle (blown sprouts excluded).

Pickings.	O	M	P	MP	N_1	MN_1	PN_1	MPN_1	N_2	MN_2	PN_2	MPN_2
1st ..	224.4	233.8	275.3	221.0	207.2	212.6	312.1	266.7	244.4	223.1	175.9	212.9
2nd ..	50.3	71.6	48.0	52.8	45.6	56.3	68.8	68.8	79.8	50.2	85.3	59.3
3rd ..	21.9	34.5	47.0	40.8	33.1	31.8	28.6	42.6	37.7	31.5	33.6	37.3
4th ..	12.3	14.9	10.1	12.2	12.9	12.3	9.9	12.4	12.7	10.0	15.2	12.5

RESPONSES TO TREATMENTS

Saleable Sprouts—total of all pickings.

cwt. per acre	*Mean Response*	Differential Responses						
		Superphosphate		Poultry Manure		Sulphate of Ammonia		
		Absent	Present	Absent	Present	None	Single	Double
Superphosphate..	*+2.20*[1]	—	—	+1.27[3]	+3.14[3]	+2.18[4]	+3.98[4]	+0.45[4]
Poultry Manure..	*+1.24*[1]	+0.30[3]	+2.17[3]	—	—	−1.41[4]	+3.06[4]	+2.07[4]
Single sulph. Amm.	*−0.27*[2]	−1.16[4]	+0.63[4]	−2.50[4]	+1.97[4]	—	—	—
Double sulph. amm.	*−1.44*[2]	−0.58[4]	−2.31[4]	−3.18[4]	+0.30[4]	—	—	—

STANDARD ERRORS: (1) ±1.24, (2) ±1.53, (3) ±1.76, (4) ±2.16.

POULTRY MANURE, SULPHATE OF AMMONIA AND SUPERPHOSPHATE

SALEABLE SPROUTS—TOTAL OF ALL PICKINGS

cwt. per acre	Mean of Super and No Super (± 1.52)			Mean of all levels of N (±1.24)		*Mean*
	No N	0.3 cwt. N	0.6 cwt. N	No Super	Super.	
No Poultry Manure ..	31.03	28.52	27.83	28.49	29.76	*29.12*
Poultry Manure ..	29.61	31.58	29.91	28.80	31.94	*30.37*
Mean	*30.32*	*30.05*	*28.87*	*28.64*	*30.85*	*29.75*

CONCLUSIONS

There are no significant effects on the total of saleable sprouts for all pickings though there is some indication of a response to superphosphate, which becomes significant when the first picking only is considered; the effect of superphosphate, in fact, appears to be confined to the first picking.

The fertilisers produced no significant effects on the ratio of blown to saleable sprouts, or in the ratio of firsts to seconds.

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BARLEY

WOBURN

Residual effect of dung applied to Kale in 1932.

WB, LANSOME—1933

Plan and yields in lb., green weights

1	**D2** 43.0	**O3** 32.0	**O2S** 44.0	**D0S** 45.5	**O0** 33.0	**D1** 48.0	**D3S** 49.0	**O1S** 41.0	8
	D0 42.5	**D1S** 52.0	**D3** 46.0	**O2** 34.0	**D2S** 54.5	**O1** 39.5	**O3S** 47.5	**O0S** 44.5	
	O3 41.5	**O2S** 49.5	**D2** 47.0	**O0** 32.5	**D1** 42.5	**D0S** 58.5	**O1S** 46.5	**D3S** 53.5	NW ↑
	D1S 55.0	**D0** 40.5	**O1** 36.5	**D2S** 44.5	**O3S** 51.5	**D3** 48.0	**O0S** 43.0	**O2** 34.5	
	O2S 49.0	**D2** 42.5	**D0S** 51.5	**D3S** 49.0	**O1S** 43.5	**O0** 40.5	**D1** 43.0	**O3** 37.5	
	O0S 50.5	**O1** 38.0	**O3S** 49.0	**D1S** 48.0	**D3** 39.0	**O2** 42.0	**D2S** 50.0	**D0** 43.0	
	O1S 48.0	**D3S** 56.0	**O0** 36.0	**O3** 29.5	**D0S** 53.0	**D2** 44.0	**O2S** 43.0	**D1** 36.5	
57	**D3** 51.5	**O0S** 56.0	**D1S** 63.0	**O1** 39.5	**O2** 44.0	**O3S** 54.0	**D0** 49.0	**D2S** 47.5	64

SYSTEM OF REPLICATION : 1932. 8 × 8 Latin Square. 1933, Half the plots treated with sulphate of ammonia, the one degree of freedom for the interaction OvS × OvD × (0+3) v (1+2) being confounded with row differences between rows 1 and 2, 3 and 4, 5 and 6, 7 and 8. Columns are not orthogonal with the 1933 sulphate of ammonia and its interactions. (The continuation of the experiment in 1933 was not contemplated when it was originally designed.)

AREA OF EACH PLOT : 0.004591 acre (20 ft. × 10 ft.). Area harvested : 0.004238 acres.

TREATMENTS: 1932, Sulphate of ammonia at the rate of 0(0), 0.2(1), 0.4(2) and 0.8 cwt.(3) N per acre with and without dung (D and O) at the rate of 15 tons per acre. Basal (plots receiving no dung) : Superphosphate at the rate of 0.5 cwt. P_2O_5 per acre, and 30 per cent. potash manure salt at the rate of 1.0 cwt. K_2O per acre.

1933, No sulphate of ammonia and sulphate of ammonia at the rate of 0.2 cwt. N per acre (S).

CULTIVATIONS, ETC. : Dug : March 20th -27th. Harrowed : March 30th. Rolled : March 30th. Manures applied : March 31st. Seed sown : March 30th. Harvested : July 19th. Variety : Plumage Archer. Previous crop : Kale.

STANDARD ERROR PER PLOT : Green material : ±5.47 cwt. per acre or 5.75%.

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GREEN MATERIAL
YIELDS OF INDIVIDUAL TREATMENTS

Cwt. per acre (±2.73)	No Nitrogen, 1933				Nitrogen, 1933			
	No N. 1932	0.2 cwt. N. 1932	0.4 cwt. N. 1932	0.8 cwt. N. 1932	No N. 1932	0.2 cwt. N. 1932	0.4 cwt. N. 1932	0.8 cwt. N. 1932
No Dung	74.8	80.8	81.4	74.0	102.2	94.3	97.7	106.4
Dung	92.2	89.5	93.0	97.2	109.8	114.8	103.5	109.3

MEAN OF NITROGEN AND NO NITROGEN, 1933

Cwt. per acre (±1.93)	No N., 1932	0.2 cwt. N., 1932	0.4 cwt. N., 1932	0.8 cwt. N., 1932	*Mean (±0.967)*	*Difference (±1.37)*
No Dung	88.5	87.6	89.5	90.2	*89.0*	
Dung	101.0	102.2	98.2	103.2	*101.2*	*+12.2*
Mean (±1.37) ..	*94.8*	*94.9*	*93.8*	*96.7*	*95.1*	
Increase (±1.93) ..		*+0.1*	*−1.1*	*+2.9*		

MEAN OF ALL 1932 TREATMENTS ADJUSTED FOR COLUMN DIFFERENCES

No N., 1933	84.7
N., 1933 ..	105.4
Difference ..	*+20.7*

PERCENTAGE DRY MATTER (BULKED REPLICATES)

	No Dung 1932	Dung 1932
No N., 1933	43.1	41.5
N., 1933	41.2	44.8

CONCLUSIONS

There is a significant residual effect of the dung applied in 1932, and a significant effect of the sulphate of ammonia applied in 1933, the increases in green material being :

15 tons dung applied in 1932 : 12.2 cwt. per acre.
0.2 cwt. N. applied in 1933 : 20.7 cwt. per acre.

These results indicate that the dung supplied produced the same increase in yield of green material as 0.118 cwt. N. per acre as sulphate of ammonia. The equivalence would be substantially the same if worked on the dry matter figures : in any case the accuracy of the dry matter determinations is undeterminable since bulked replicates were used.

There is no evidence of any residual effect of the sulphate of ammonia applied in 1932, nor of any interactions between the dung and the 1933 nitrogen.

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SUGAR BEET

WOBURN

Effect of varying spacing of rows, of sulphate of ammonia and of ploughing or harrowing in mineral fertilisers.

W.S.—Lansome—1933
Plan and yields in lb,

N ↑

	Treatment.	Roots (dirty).	Tops	Sugar per cent.		Treatment.	Roots (dirty).	Tops	Sugar per cent.		Treatment.	Roots (dirty).	Tops	Sugar per cent.
1	$-S_{15}Bh$	319	165	17.15	19	$N_2S_{20}Bp$	360	235	17.04	37	$-S_{10}Bp$	370	239	16.78
	$N_1S_{15}Bp$	432	222	17.32		$-S_{10}Bp$	400	227	18.37		$N_1S_{20}Bp$	309	218	16.75
	$N_2S_{20}Bp$	371	223	16.89		$N_1S_{15}Bp$	434	244	17.79		$N_2S_{20}Bh$	314	250	16.06
	$-S_{10}Bp$	394	236	17.47		$N_1S_{10}Bh$	486	299	18.11		$-S_{15}Bh$	333	208	17.38
	$N_1S_{20}Bh$	393	212	17.04		$-S_{20}Bh$	340	222	17.12		$N_1S_{10}Bh$	437	303	17.79
	$N_2S_{10}Bh$	564	323	17.62		$N_2S_{15}Bh$	467	267	17.30		$N_2S_{15}Bp$	370	286	16.78
	$N_1S_{20}Bp$	391	216	17.24		$N_2S_{10}Bp$	511	310	17.93		$-S_{15}Bp$	214	191	17.30
	$N_2S_{15}Bh$	508	255	17.36		$-S_{15}Bp$	337	192	18.48		$N_2S_{10}Bh$	401	317	17.53
	$-S_{15}Bp$	341	177	17.33		$N_2S_{20}Bh$	395	258	17.41		$N_2S_{20}Bp$	309	222	16.84
	$N_1S_{10}Bh$	570	262	17.36		$-S_{10}Bh$	466	232	17.96		$N_1S_{10}Bp$	440	268	17.80
	$N_2S_{10}Bp$	572	345	17.67		$N_1S_{20}Bp$	373	240	17.50		$-S_{20}Bh$	272	173	17.59
	$-S_{20}Bh$	377	195	17.36		$N_1S_{15}Bh$	444	236	17.44		$N_1S_{15}Bh$	318	237	17.73
	$N_2S_{15}Bp$	512	267	17.30		$N_2S_{10}Bh$	496	285	17.40		$N_1S_{15}Bp$	340	231	17.70
	$-S_{10}Bh$	469	248	18.02		$N_1S_{20}Bh$	340	203	17.53		$N_2S_{15}Bh$	410	273	17.56
	$N_1S_{15}Bh$	416	241	17.88		$N_1S_{10}Bp$	456	218	17.82		$-S_{10}Bh$	330	222	17.88
	$N_1S_{10}Bp$	521	233	17.88		$-S_{20}Bp$	310	187	18.25		$-S_{20}Bp$	263	170	17.73
18	$-S_{20}Bp$	305	149	17.79		$N_2S_{15}Bp$	429	291	17.64		$N_1S_{20}Bh$	327	211	17.24
	$N_2S_{20}Bh$	335	196	16.52	36	$-S_{15}Bh$	307	151	17.56	54	$N_2S_{10}Bp$	535	326	17.62

55 72

N_1 S_{15} Bh	N_1 S_{20} Bp	N_2 S_{10} Bh	N_2 S_{15} Bp	— S_{10} Bp	— S_{20} Bh	N_2 S_{15} Bh	— S_{10} Bh	— S_{15} Bp	N_1 S_{10} Bp	N_2 S_{20} Bp	N_1 S_{20} Bh	N_1 S_{10} Bh	N_2 S_{20} Bh	N_2 S_{10} Bp	— S_{20} Bp	— S_{15} Bh	N_1 S_{15} Bp
435	354	623	452	342	346	475	431	363	408	368	415	597	466	619	407	424	443
200	200	264	246	185	172	301	220	168	232	291	242	262	296	339	215	249	264
17.88	17.74	18.05	17.62	17.82	17.44	17.44	17.82	18.05	17.99	17.47	17.82	18.37	17.47	17.62	18.05	17.85	17.36

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SYSTEM OF REPLICATION : 12 randomised blocks of 6 plots each. Certain degrees of freedom for interactions are partially confounded with blocks.

AREA OF EACH PLOT (after rejecting edge rows) : 10 inch spacing : 0.01666 acre. 15 inch spacing : 0.01591 acre. 20 inch spacing : 0.01516 acres. Plots actually 15.15 links × 120 links rows.

TREATMENTS : All combinations of :

(a) Rows spaced 10 inches (S_{10}), 15 inches (S_{15}), and 20 inches (S_{20}) apart.
(b) No sulphate of ammonia (−), sulphate of ammonia at the rate of 0.3 cwt. N per acre (N_1) and 0.6 cwt. N per acre (N_2).
(c) Basal mineral fertilisers (superphosphate at the rate of 0.5 cwt. P_2O_5 per acre and 30% potash salt at the rate of 1.0 cwt. K_2O per acre) ploughed in (B_P) and harrowed in (B_H).

CULTIVATIONS, ETC. : Ploughed : May 1st-5th. Manures applied : May 10th. Seed sown : May 9th. Tractor cultivation : April 19th, 21st and May 8th. Harrowed : May 8th and 10th. Rolled : May 11th. Singled : June 9th. Plants 9 inches apart. Hoed : May 29th, June 15th and 20th, and September 1st-20th. Harvested : November 21st. Variety : Kuhn. Previous crop : Brussels sprouts.

STANDARD ERRORS PER PLOT : Roots : ±0.753 tons per acre or ±8.17%. Tops : ±0.570 tons per acre or ±8.54%. Sugar percentage : ±0.284. Mean dirt tare : 10 inch spacing : 0.1981, 15 inch spacing : 0.1954, 20 inch spacing : 0.1821.

SUMMARY OF RESULTS

Yields of Separate Treatments. (Block effects eliminated)

	Basal minerals ploughed under			Basal minerals harrowed in		
	Spacing of 10 ins.	Spacing of 15 ins.	Spacing of 20 ins.	Spacing of 10 ins.	Spacing of 15 ins.	Spacing of 20 ins.
	ROOTS (washed)—tons per acre (± 0.478)*					
No Nitrogen	8.14	7.17	7.60	9.15	7.65	8.16
0.3 cwt. Nitrogen	10.28	9.04	8.34	10.71	9.25	9.30
0.6 cwt. Nitrogen	11.49	10.13	8.87	11.67	10.51	8.55
	TOPS—tons per acre (± 0.360)*					
No Nitrogen	6.07	4.98	5.30	6.16	5.25	5.80
0.3 cwt. Nitrogen	6.48	6.50	6.57	7.18	6.72	6.47
0.6 cwt. Nitrogen	8.61	8.02	7.01	8.34	7.55	7.09
	SUGAR PERCENTAGE (± 0.180)*					
No Nitrogen	17.74	17.73	17.89	17.79	17.63	17.36
0.3 cwt. Nitrogen	17.81	17.53	17.38	18.03	17.63	17.39
0.6 cwt. Nitrogen	17.64	17.41	17.05	17.66	17.37	16.90
	TOTAL SUGAR—cwt. per acre.					
No Nitrogen	28.9	25.4	27.2	32.6	27.0	28.3
0.3 cwt. Nitrogen	36.6	31.7	29.0	38.6	30.8	32.3
0.6 cwt. Nitrogen	40.5	35.3	30.2	41.2	36.5	28.9

* For second order interactions only.

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MAIN EFFECTS

Mean yields. Roots : 9.22 tons ; Tops : 6.67 tons ; Sugar Percentage : 17.55 ; Total Sugar : 32.4 cwt.

Spacing

	Roots (washed) Tons p.a.	*Diff.*	Tops Tons p.a.	*Diff.*	Sugar percentage Actual	*Diff.*	Total Sugar Cwt. p.a.	*Diff.*
10in. between rows	10.24	—	7.14	—	17.78	—	36.4	—
15 ,, ,, ,,	8.96	*−1.28*	6.50	*−0.64*	17.55	*−0.23*	31.4	*−5.0*
20 ,, ,, ,,	8.47	*−0.49*	6.38	*−0.12*	17.33	*−0.22*	29.3	*−2.1*
Standard Error	±0.154	*±0.218*	±0.117	*±0.165*	±0.058	*±0.082*	—	—

Basals

	Roots (washed) Tons p.a.	*Diff.*	Tops Tons p.a.	*Diff.*	Sugar percentage Actual	*Diff.*	Total Sugar Cwt. p.a.	*Diff.*
Basals ploughed in	9.01	—	6.61	—	17.58	—	31.7	—
,, harrowed in	9.44	*+0.43*	6.73	*+1.2*	17.53	*−0.05*	33.1	*+1.4*
Standard Error	±0.126	*±0.178*	±0.095	*±0.134*	±0.047	*±0.066*	—	—

Nitrogen

	Roots (washed) Tons p.a.	*Diff.*	Tops Tons p.a.	*Diff.*	Sugar Percentage Actual	*Diff.*	Total Sugar Cwt. p.a.	*Diff.*
No Nitrogen ..	7.98	—	5.60	—	17.69	—	28.2	—
0.3 cwt. Nitrogen	9.49	*+1.51*	6.64	*+1.04*	17.62	*−0.07*	33.4	*+5.2*
0.6 cwt. Nitrogen	10.20	*+0.71*	7.78	*+1.14*	17.34	*−0.28*	35.4	*+2.0*
Standard Error	±0.154	*±0.218*	±0.117	*±0.165*	±0.058	*±0.082*	—	—

INTERACTION OF SPACINGS AND SULPHATE OF AMMONIA. MEAN OF BOTH BASALS

	Roots (washed) Tons per acre (±0.285)			Tops Tons per acre (±0.216)			Sugar Percentage (±0.107)			Total Sugar Cwt. per acre		
	Nitrogen			Nitrogen			Nitrogen			Nitrogen		
	None	0.3 cwt.	0.6 cwt.	None	0.3 cwt.	0.6 cwt.	None	0.3 cwt.	0.6 cwt.	None	0.3 cwt.	0.6 cwt.
10 in. Spacing	8.64	10.50	11.58	6.12	6.83	8.48	17.76	17.92	17.65	30.8	37.6	40.8
15 in. Spacing	7.41	9.15	10.32	5.12	6.61	7.78	17.68	17.58	17.39	26.2	32.1	35.9
20 in. Spacing	7.88	8.82	8.71	5.55	6.52	7.05	17.62	17.38	16.98	27.8	30.6	29.6

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INTERACTION OF SPACINGS AND BASALS. MEAN OF ALL LEVELS OF NITROGEN

	Roots (washed) Tons per acre (±0.218)		Tops Tons per acre (±0.165)		Sugar Percentage (±0.082)		Total Sugar Cwt. per acre	
	Basal minerals ploughed under	harrowed in	Basal minerals ploughed under	harrowed in	Basal minerals ploughed under	harrowed in	Basal minerals ploughed under	harrowed in
10 in. Spacing ..	9.97	10.51	7.05	7.23	17.73	17.83	35.3	37.5
15 in. Spacing ..	8.78	9.15	6.50	6.51	17.56	17.54	30.8	32.1
20 in. Spacing ..	8.27	8.67	6.30	6.45	17.44	17.22	28.8	29.8

INTERACTION OF NITROGEN AND BASALS. MEAN OF ALL SPACINGS

	Roots (washed) Tons per acre (±0.218)		Tops Tons per acre (±0.165)		Sugar Percentage (±0.082)		Total Sugar Cwt. per acre.	
	Basal minerals ploughed under	harrowed in	Basal minerals ploughed under	harrowed in	Basal minerals ploughed under	harrowed in	Basal minerals ploughed under	harrowed in
No Nitrogen ..	7.64	8.32	5.45	5.74	17.79	17.59	27.2	29.3
0.3 cwt. Nitrogen	9.24	9.74	6.51	6.78	17.57	17.68	32.4	34.4
0.6 cwt. Nitrogen	10.14	10.27	7.88	7.67	17.37	17.31	35.3	35.5

CONCLUSIONS

The 10 inch spacing gives the greatest yields of both roots and tops and the highest sugar percentage, the yield of total sugar being 7.1 cwt. or 22 per cent greater on the 10 inch than on the 20 inch spacing.

Sulphate of ammonia significantly increases the yields of roots and tops, the response to the second dressing being significantly less in the case of the roots. The sugar percentage is significantly decreased, particularly by the second dressing, but the total sugar is increased by 5.2 cwt. or 16.0 per cent. by the single dressing and by 7.2 cwt. or 22 per cent. by the double dressing.

The nitrogen shows a significant interaction with spacing in the case of the roots, there being a considerably smaller response to nitrogen at the wider spacings.

Basals harrowed in give a significantly greater yield of roots than basals ploughed under. This is the opposite of the effect at Rothamsted.

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BRUSSELS SPROUTS

WOBURN

Comparison of the effect of poultry manure with that of equivalent sulphate of ammonia and superphosphate.

WD—Lansome, 1933

Plan and yields in lb. Saleable Sprouts. (Total of all pickings).

1		NP 48.81	NM 58.88	NM 50.43	O 40.26	N 47.37	P 37.25	6
SW ↑		PM 46.11	O 38.62	PM 52.31	NP 49.62	NPM 46.87	M 46.94	
		M 40.49	NPM 61.55	P 32.36	NPM 48.49	PM 39.30	NM 49.93	
19		P 32.75	N 55.07	M 51.94	N 53.86	O 39.23	NP 51.43	24

SYSTEM OF REPLICATION : 6 randomised blocks of 4 plots each. Second order interaction confounded with block differences.

AREA OF EACH PLOT : 0.01033 acre. (5 yds. × 10 yds.)

TREATMENTS : All combinations of :

(*a*) No poultry manure, and poultry manure at the rate of 0.6 cwt. N per acre with addition of superphosphate at the rate of 0.116 cwt. P_2O_5 per acre, to give a total of 0.6 cwt. P_2O_5 per acre (M).

(*b*) No sulphate of ammonia, and sulphate of ammonia at the rate of 0.6 cwt. N per acre (N).

(*c*) No superphosphate, and superphosphate at the rate of 0.6 cwt. P_2O_5 per acre (P).

BASAL MANURING : Muriate of potash at the rate of 1.0 cwt. K_2O per acre.

CULTIVATIONS, ETC. : Cultivated : May 29th. Hoed : August 2nd. Manures applied : June 27th. Planted : June 27th. Harvested : November 30th, January 3rd, and January 30th. Previous crop : Brussels sprouts.

STANDARD ERROR PER PLOT : Total of all pickings : 4.61 cwt. or 11.4 per cent.

INDIVIDUAL TREATMENTS

Saleable Sprouts—cwt. per acre.

Mean yield : 40.45 cwt.

Pickings	Sub-Blocks A				Sub-Blocks B			
	O	NM	NP	MP	N	P	M	NMP
1st	17.32	26.74	23.62	22.55	27.04	14.28	21.90	26.51
2nd	7.22	8.85	8.56	6.70	7.71	5.69	8.60	7.64
3rd	9.58	10.42	11.12	10.54	10.41	9.61	9.77	11.19
Total	*34.12*	*46.01*	*43.30*	*39.79*	*45.16*	*29.58*	*40.27*	*45.34*

INDIVIDUAL TREATMENTS—PERCENTAGE BLOWN TO TOTAL

Pickings	Sub-Blocks A				Sub-Blocks B			
	O	NM	NP	MP	N	P	M	NMP
1st ..	16.2	20.4	16.7	16.5	17.9	17.2	16.4	16.4
2nd ..	5.1	5.9	5.9	6.2	5.5	5.6	4.6	6.1
3rd ..	5.2	5.3	7.4	6.5	6.5	5.9	6.1	6.6

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INDIVIDUAL TREATMENTS—PERCENTAGE FIRSTS TO SECONDS

Firsts denote sprouts too large to pass through a 1¼ in. riddle (blown sprouts excluded).

Pickings	Sub-blocks A				Sub-blocks B			
	O	NM	NP	MP	N	P	M	NMP
1st	57.5	90.2	118.3	64.2	122.3	39.1	102.3	94.3
2nd	No Firsts in 2nd. and 3rd. pickings.							
3rd								

RESPONSES TO TREATMENTS

Saleable Sprouts—total of all pickings

Cwt. per acre	*Mean Response*	Differential Responses					
		Sulphate of Ammonia		Poultry Manure		Superphosphate	
		Absent	Present	Absent	Present	Absent	Present
Sulphate of Amm.	*+9.01*[1]	—	—	+12.38[2]	+5.64[2]	+8.39[2]	+9.64[2]
Poultry Manure ..	*+4.81*[1]	+8.18[2]	+1.44[2]	—	—	+3.50[2]	+6.12[2]
Superphosphate ..	*−1.89*[1]	−2.51[2]	−1.26[2]	−3.20[2]	−0.58[2]	—	—

Standard Errors: (1) ±1.89, (2) ±2.67.

POULTRY MANURE, SULPHATE OF AMMONIA AND SUPERPHOSPHATE

Saleable Sprouts—total of all pickings

Cwt. per acre	Mean of P and no P (±1.89)		Mean of N and no N (±1.89)		
	No N	N	No P	P	*Mean*
No M. ..	31.85	44.23	39.64	36.44	*38.04*
M. ..	40.03	45.68	43.14	42.57	*42.86*
Mean . .	*35.94*	*44.96*	*41.39*	*39.50*	*40.45*

CONCLUSIONS

The total saleable sprouts show a significant response to poultry manure and to sulphate of ammonia, the responses to these two fertilisers not being significantly different. The percentage of firsts to seconds was significantly increased by sulphate of ammonia and by poultry manure, the increase due to sulphate of ammonia being significantly the greater, but there is no further increase when the two were applied together.

The superphosphate shows no significant effects on the total saleable sprouts, but significantly decreases the percentage of firsts to seconds in the first picking.

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PIG EXPERIMENT

The Value of Green Food.
Comparison of Wet and Dry Feeding.
Effects of differing numbers of pigs per pen (with equal floor space per pig).

ARRANGEMENT

Three randomised blocks of 4 litters of 6 pigs each, sex and litter being equalised as far as possible over the different treatments (the interaction of the feeding treatments is partially confounded with litters, and in blocks II and III sex is also partially confounded with litters). Each block contains one pen of 8 pigs (13 ft. × 6 ft. 3 ins.), two pens of 4 pigs (6 ft. 6 ins. × 6 ft. 3 ins.) and 4 pens of 2 pigs (3 ft. 3 ins. × 6 ft. 3 ins.). Each of these sets of pens contains two pigs on each of the four feeding treatments, namely wet or dry feeding with or without green food. Pigs were fed individually in small pens (1 ft. 8 ins. × 3 ft. 7 ins.) opening off the main pens. Food consumption and live weights were recorded weekly.

DETAILS OF ARRANGEMENT

Block and Duration.	Block I (21 weeks)								Block II (22 weeks)								Block III (20 weeks)							
Litter No.	9		12		19		21		17		20		29		48		27		28		35		58	
Age at start (wks.) ..	7.9		10.9		13.6		12.0		9.7		11.7		11.3		12.1		8.1		10.4		10.7		12.6	
Sex	H	G	H	G	H	G	H	G	H	G	H	G	H	G	H	G	H	G	All H		All G		H	G
Dry and Green Food	8	2	2	8	–	4	4	–	8	–	4	2	–	8	2	4	–	2	8	4	8	4	2	–
Wet and Green Food	–	4	4	–	2	8	8	2	2	4	–	8	4	2	8	–	4	8	2		2		8	4
Dry Food	4	–	–	4	2	8	8	2	2	4	–	8	4	2	8	–	4	8	2		2		8	4
Wet Food	8	2	2	8	4	–	–	4	–	8	4	2	8	–	2	4	–	2	8	4	8	4	2	–

The number 2, 4 or 8 indicates that the pig was one of a pen of 2, 4 or 8 respectively.
H denotes hog (*i.e.* castrated male); G denotes gilt (*i.e.* female).

FEEDING RATIONS

		Percentage Rations.			
Weeks of Experiment	Blocks I	1—3	4	5—18	19—21
	Blocks II ..	1—3	4	5—14	15—22
	Blocks III	1—3	4	5—9	10—20
Middlings		60	50	40	28
Bran		—	—	—	14
Hominy chop		—	15	20	18
Barley meal		20	25	30	30
Flaked maize		10	—	—	—
Fish meal		10	10	—	—
Meat meal		—	—	10	10

Two per cent. minerals (3 parts lime, 1 part salt) added to each ration.
Green food (kale, wheat, oats and vetches) fed twice daily at the rate of about ½ lb. per head per day.

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INITIAL AND FINAL WEIGHTS AND FOOD CONSUMPTION

Pigs receiving Green Food

Block.		I				II				III			
Litter.		9	12	19	21	17	20	29	48	27	28	35	58
Initial Weights (lb.)													
Dry	Hogs	21	37	—	40	38	35	—	42	—	56	35†	42
	Gilts	24	25	45	—	—	47	44	36	41	50*	38	—
Wet	Hogs	—	29	47	30	37	—	41	43	58	50	—	63
	Gilts	28	—	50	37	40	47	57	—	49	—	43	43
Final Weights (lb.)													
Dry	Hogs	**	218	—	205	172	**	—	133	—	196	124†	145
	Gilts	151	142	191	—	—	163	170	153	**	168*	136	—
Wet	Hogs	—	190	229	205	182	—	190	176	149	220	—	Sold
	Gilts	194	—	232	212	185	214	224	—	226	—	186	206
Total Food Consumption (lb.)													
Dry	Hogs	**	719	—	688	629	**	—	565	—	739	356†	542
	Gilts	516	502	598	—	—	607	521	548	**	556*	413	—
Wet	Hogs	—	637	873	781	685	—	685	718	489	785	—	861
	Gilts	649	—	908	844	707	844	844	—	819	—	690	688

* Hog. † Gilt. ** Pig died.

DETAILS

Block	I	II	III	Mean or Total
Commenced	April 11th	May 10th	June 15th	—
Time (weeks)	21	22	20	21
Average age at start (weeks)	11.1	11.2	10.5	10.9
Average wt. (lb.) At start	35.6	32.9	41.2	36.6
Average wt. (lb.) At end	197.2	178.4	180.1	185.2
Number of pigs receiving green food rejected	1	1	3	5
Regression of final on initial wt.	4.51	3.52	2.81	3.68

STANDARD ERRORS OF TOTAL LIVE-WEIGHT INCREASE

(Per Pig—lb. and per cent. of Increase)

Without elimination of differences of initial weight	16.1 lb. or 10.8%
With elimination of differences of initial weight	11.3 lb. or 7.60%
With elimination of initial weight and food consumption	9.3 lb. or 6.29%
Means of two initial and two final weights (initial weight eliminated)	9.9 lb. or 7.02%

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SUMMARY OF RESULTS

EFFECT OF LACK OF GREEN FOOD

	Doing badly and removed from experiment	Lost weight during two or more weeks (excluding those removed)	Remained till end of experiment.
Without Green Food ..	13	15	8
With Green Food ..	3	4	29

WET AND DRY FEEDING

Block	I	II	III	Total or Mean
Increase per pig per week (lbs.)				
Mean of Wet and Dry	7.70	6.61	6.94	7.08
Difference (W—D)	+1.18	+1.23	+2.47	+1.63
Standard Error of difference	±0.339	±0.324	±0.398	±0.205
Food per 1 lb. increase (lbs.)				
Mean of Wet and Dry	4.306	4.596	4.504	4.469
Difference (W—D)	+0.334	+0.196	−0.159	+0.124
Standard Error of difference	±0.234	±0.234	±0.262	±0.141

EFFECTS OF NUMBERS IN PEN

Mean Final Weights adjusted for differences of initial weight

Block	I	II	III	Mean
Two in a pen ..	196.1	173.4	185.7	185.1
Four in a pen ..	191.3	179.0	175.4	181.9
Eight in a pen ..	190.6	179.9	179.2	183.2

CONCLUSIONS

Green food appears essential to the health of young pigs kept under the conditions of the experiment. Pigs on wet food had a significantly greater live weight increase than those on dry food, owing to the greater amount of wet food consumed ; there was no significant difference in efficiency of food utilisation for the two types of feeding. Variation of numbers in a pen (with equal floor space per pig) appears to have no effect.

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REPLICATED EXPERIMENTS ON MALTING BARLEY, 1927-1933.

Summary of Average Responses and Interactions

Grain : cwt. per acre

Place.	Year.	*Mean Yield.*	Average Responses.					1st order Interactions.				2nd order Interaction	
			N	St. Error for N	P	K	St. Error for P & K	N×P	N×K	K×P	Standard Error.	N×P×K	Standard Error.
Rothamsted	1927	*16.6*	**+5.2**	±1.21	+1.6	—	±1.21	+0.4	—	—	±2.42	—	—
Rothamsted	1928	*16.6*	**+3.4**	±0.84	+0.8	—	±0.84	+1.1	—	—	±1.68	—	—
Woburn	1928	*18.2*	+1.0	±1.45	−1.2	+2.2	±1.45	−4.1	**−6.6**	−3.8	±2.90	+7.2	±5.79
Woburn	1929	*28.8*	+1.2	±0.98	−1.4	**+2.8**	±0.98	−1.6	**−6.0**	−0.6	±1.96	−3.9	±3.92
Wellingore	1929	*20.2*	**+3.3**	±0.63	+0.7	+1.2	±0.63	**+6.0**	+1.4	−0.6	±1.26	+4.5	±2.52
Rothamsted	1929	*22.9*	**+3.5**	±1.08	+0.7	−0.5	±0.86	+0.8	−1.6	−1.4	±1.71	+4.0	±3.42
Wellingore	1930	*14.7*	**+6.1**	±0.71	+0.4	+0.5	±0.70	+1.5	+2.7	+1.4	±1.40	+1.6	±2.79
Sparsholt	1930	*13.9*	+1.5	±0.74	**+1.4**	+0.2	±0.56	−0.3	−1.2	+0.3	±1.12	+0.2	±2.25
Wellingore	1931	*29.8*	−0.3	±0.65	−0.6	+0.3	±0.88	−0.3	−1.0	+1.3	±1.75	**−8.2**	±3.50
Wye	1931	*22.6*	**+3.6**	±0.61	+0.9	+0.5	±0.46	+0.3	**−1.9**	**−1.9**	±0.92	+3.2	±1.85
Sparsholt	1931	*17.2*	+1.0	±0.62	+0.2	+0.6	±0.43	0.0	−1.0	−0.3	±0.86	+1.0	±1.72
Wellingore	1932	*30.1*	+1.8	±1.18	−1.5	0.0	±0.98	+2.3	+0.5	+0.3	±1.96	+2.0	±3.92
Wye..	1932	*28.7*	+2.8	±1.64	+1.4	**−3.0**	±1.34	−2.6	+0.6	+0.2	±2.69	+3.5	±5.38
Sparsholt	1932	*24.9*	+3.8	±1.64	+0.6	−0.4	±1.38	−0.4	−0.9	+1.1	±2.77	+2.4	±5.54
Wellingore	1933	*23.6*	**+3.2**	±0.76	**+1.8**	—	±0.76	+0.5	—	—	±1.53	—	—
Wye..	1933	*26.4*	**+5.0**	±1.46	+2.2	—	±1.46	+1.1	—	—	±2.92	—	—
Weighted Mean*	..	—	—	—	**+0.64**	+0.25	—	+0.28	−0.78	−0.29	—	+1.21	—
		—	—	—	±0.21	±0.22	—	±0.42	±0.45	±0.45	—	±0.89	—
Unweighted Mean* ..	..	*23.16*	+2.91	—	+0.68	−0.20	—	+0.26	−0.42	+0.11	—	+1.08	—

* 1930-33 and Rothamsted 1929.

The responses to nitrogen are either those to sulphate of ammonia or the mean responses to sulphate of ammonia and nitrate of soda.

The dressings per acre in cwt. were as follows :
1927-28 and Wellingore 1929 : 0.2N, 0.486 P_2O_5, 0.75K_2O.
1930-33 and Rothamsted and Woburn 1929 : 0.2N, 0.4 P_2O_5, 0.6K_2O.

Other particulars are given in this and previous reports under the reports of the separate experiments.

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CONCLUSIONS

Woburn differs signficantly from the other centres in response to phosphate and potash and in the strong negative interaction between nitrogen and potash. The other first order interactions are also negative (though the differences are not significant).

Excluding Woburn and the early experiments having different levels of manuring, the remaining experiments show a significant response to nitrogen, significantly different for the different experiments (though showing no correlation with year or place). They also show a small but definitely significant general response to phosphate, not significantly different in the different experiments. The general response to potash and the interactions are not significant. The significant depression of yield with potash at Wye in 1932, therefore, and the significant interactions at Wellingore and Wye in 1931 appear to be due to chance and may be ignored.

An earlier series of single plot experiments was carried out in the years 1922-26. There were 51 experiments in which the yields were recorded, carried out at 18 centres. All experiments (with one or two minor exceptions) contained the treatments O, NPK, NP, NK, PK, the levels of manuring being the same as in the replicated experiments 1927-28. The experiments are reported in detail in (1). The mean responses were as follows :

	Grain cwt. per acre.*	Standard Error.†
To Complete Fertiliser (NPK—O)	+2.66	±0.385
To Nitrogen (NPK—PK)	+1.82	±0.424
To Phosphate (NPK—NK)	+0.19	±0.344
To Potash (NPK—NP)	—0.11	±0.316

* Dressed grain converted from bushels per acre.

† Computed from the variation in the response under consideration from experiment to experiment.

The average responses to nitrogen and the complete fertiliser are significant. There are indications of a significant variation in response to nitrogen and complete fertiliser from experiment to experiment. The difference in response between the complete fertiliser and the sum of its components does not approach significance (the standard errors shown are not appropriate for testing this difference).

[1] E. J. Russell and L. R. Bishop, " Investigations on Barley. Report on the Ten Years of Experiments under the Institute of Brewing Research scheme, 1922-1931." Supplement to the *Journal of the Institute of Brewing*, Vol. XXXIX., No. 7 (Vol. XXX., new series), 1933.

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EXPERIMENTS ON POULTRY MANURE AND AMMONIUM BICARBONATE

Centres	Type of Expt.	No. of Plots
Rothamsted (See pp. 146–7 for details)	1a	48
Woburn (See pp. 154–5 for details)	1	24
Lady Manner's School, Bakewell (A)	2	16
Lady Manner's School, Bakewell (B)	2	16
Grammar School, Burford	2	16
Dartington Hall, Totnes, Devon (A)	1b	36
Dartington Hall, Totnes, Devon (B)	1b	36
Fakenham School, Norfolk	2	16
County School, Godalming, Surrey	2	16
Messrs. Spencer Thomas, Honeydon, Beds. J. W. Dallas, Esq., County Organiser	1	32
The High School, Newcastle, Staffs.	2	16
Sailors' Orphan Homes School, Newlands, Hull	2	16
Hertfordshire Farm Institute, Oaklands, St. Albans	1	32
T. H. Ream, Esq., Portobello Farm, nr. Potton	1	32
Church of England School, Staindrop, Co. Durham	2	16
The Horticultural College, Swanley (A)	2b	25
The Horticultural College, Swanley (B)	1	16
County School, Welshpool, Montgomeryshire (A)	2	16
County School, Welshpool, Montgomeryshire (B)	2	16
South-Eastern Agricultural College, Wye, Kent (A)	2a	16
South-Eastern Agricultural College, Wye, Kent (B)	1	32
Oundle School, Peterborough	2	16

Experimental Arrangements

(1) All combinations of $\left\{\begin{matrix}\text{O}\\\text{P.M}\end{matrix}\right\} \times \left\{\begin{matrix}\text{O}\\\text{S/A}\end{matrix}\right\} \times \left\{\begin{matrix}\text{O}\\\text{Super.}\end{matrix}\right\}$

Randomised blocks, second order interaction confounded.

(1a) All combinations of $\left\{\begin{matrix}\text{O}\\\text{P.M}\end{matrix}\right\} \times \left\{\begin{matrix}\text{O}\\\frac{1}{2}\text{S/A}\\\text{S/A}\end{matrix}\right\} \times \left\{\begin{matrix}\text{O}\\\text{Super.}\end{matrix}\right\}$

Randomised blocks.

(1b) All combinations of $\left\{\begin{matrix}\text{O}\\\text{Wet P.M}\\\text{Dry P.M}\end{matrix}\right\} \times \left\{\begin{matrix}\text{O}\\\text{S/A}\end{matrix}\right\} \times \left\{\begin{matrix}\text{O}\\\text{Super.}\end{matrix}\right\}$

Randomised blocks, one interaction degree of freedom confounded.

(2) No N, S/A, B/A, P.M.
(2a) O, S/A, wet and dry P.M.
(2b) O, ½ S/A, S/A, P.M., Guano.
} Latin Squares.

Rates of Manuring

Sulphate of ammonia at the rate of 0.6 cwt. N except for Rothamsted (0.6 and 0.3 cwt. N), Dartington Hall (0.57 cwt. N), Oaklands (0.3 cwt. N), Potton (0.4 cwt. N), Swanley (A) (0.6 and 0.229 cwt. N). Superphosphate at the rate of approximately 0.5 cwt. P_2O_5 in types 1, 1a, 1b, except for Oaklands (0.25 cwt.), i.e., the equivalents of the P_2O_5 in the poultry manure. In types 2, 2a, 2b a basal dressing was given, at the rate of 0.6 cwt. P_2O_5 except for Oundle (0.64 cwt.), Swanley (2.0 cwt.) and Wye (0.44 cwt.).

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Place.	Area Acres.	Soil.	Variety.	Manures Applied.	Seed Sown.	Harvested.	Previous Crop.	Basal Manuring (per acre).
Bakewell (A)	1/102	Limestone	Garton's yellow globe	April 10th	May 9th	Oct. 20th-27th	Potatoes	2½ cwt. Sulph. Pot. 4 cwt. Salt
Bakewell (B)	1/102	Limestone	Scotch King Edward	May 16th-19th	May 16th-19th	Sept. 20th Oct. 4th	Swedes	2½ cwt. Sulph. Pot.
Burford	1/200	Brashy Loam	King George	April 28th	April 27th	Sept. 19th-21st	Perm. Grass	2½ cwt. Sulph. Pot.
Dartington Hall (A) ..	1/109	Shale loam	Roskoff	July 14th	July 14th	April 12th-30th	Seeds	Nil
Dartington Hall (B) ..	1/99	Shale loam	Marrow stem	May 16th	May 30th	Nov. 13th, 20th & 27th	Seeds	Nil
Fakenham	1/302	Sandy loam	Majestic	April 4th	April 5th	Oct. 10th	Potatoes	2½ cwt. Sulph. Pot.
Godalming	1/290	Sandy	Field Marshal	April 24th	April 24th	Sept. 1st	Potatoes	2½ cwt. Sulph. Pot.
Honeydon	1/50	Boulder clay	—	April 5th July 5th & 17th	May 7th	Nov. 2nd Dec. 14th Feb. 2nd March 16th	Brussel sprouts	Nil
Newcastle	1/455	Heavy	Majestic	April 8th	April 10th	Oct. 10th	Waste land	2½ cwt. Sulph. Pot.
Newlands	1/223	Heavy alluvium	Arran banner	April 11th-12th	April 11th	Sept. 5th	Vegetables	2½ cwt. Sulph. Pot.
Oaklands	1/56	Gravel loam	King Edward	April 9th	April 11th	Sept. 27th	Silage	2 cwt. Sulph. Pot. 15 tons F.Y.M.
Oundle	1/60	Heavy loam	Garton's Incomparable	July 3rd	June 8th	Nov. 28th	Wheat	Nil
Potton	1/50	Poor light sand	—	April 27th May 18th July 27th	April 27th	Sept. 25th Nov. 3rd Dec. 29th Feb. 15th	Runner beans	2 cwt. Sulph. Pot.
Staindrop	1/162	Loam	Great Scott	April 28th June 22nd	April 28th	Sept. 11th	Potatoes	2½ cwt. Sulph. Pot.
Swanley (A)	1/90	Light calcareous loam	Boswells R L	May 11th	May 18th	Oct. 5th-Jan. 25th	Brussel sprouts	2 cwt. Sulph. Pot.
Swanley (B)	1/50	Gravelly over chalk	King Edward	April 10th	April 20th	Oct. 16th	Strawberries	10 tons dung 2 cwt. Sulph. Pot.
Welshpool (A) ..	1/200	Medium loam on Wenlock shale	Great Scott	April 9th	April 9th	Sept. 21st	Mangolds	2½ cwt. Sulph. Pot.
Welshpool (B).. ..	1/160	Medium loam on Wenlock shale	Lord Derby	May 16th	May 20th	Nov. 8th	Potatoes	2½ cwt. Sulph. Pot.
Wye (A)	1/50	Silt loam	Golden Tankard	April 12th	April 22nd	Oct. 9th	Spring wheat	2 cwt. Mur. Pot.
Wye (B)	1/100	Loam	Ronsham park Hero	April 7th	April 12th	Sept. 5th	Cauliflowers	3 cwt. Sulph. Pot.

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Yields of Separate Treatments. Type 1

Place.	Crop.	Sub-blocks A				Sub-blocks B				*Mean.*	Standard Error.
		None.	Sulph. Amm., Super.	Poul. Man., Super.	Poul. Man., Sulph. Amm.	Poul. Man.	Sulph. Amm.	Super.	Poul. Man., Super., Sulph. Amm.		
Oaklands	Potatoes : tons	5.16	4.86	4.93	5.00	5.07	4.88	5.28	5.13	*5.04*	±0.360
Swanley (B)	,, ,,	8.94	8.74	8.36	8.52	8.15	9.32	8.19	7.72	*8.49*	±0.816
Wye (B)	Onions : tons	7.16	6.42	8.09	7.79	7.64	7.76	7.50	8.77	*7.64*	±0.470
Potton	Sprouts : cwt.*										
	1st harvesting	1.06	2.06	2.57	3.46	2.84	1.78	2.06	2.73	*2.32*	
	2nd ,,	4.69	5.47	4.02	5.02	5.69	3.68	4.35	4.35	*4.66*	
	3rd ,,	9.26	11.83	10.94	11.16	11.05	11.83	10.82	10.16	*10.88*	
	4th ,,	6.70	7.92	6.36	6.58	6.47	7.03	7.70	6.25	*6.88*	
	Total saleable	21.71	27.28	23.89	26.22	26.05	24.32	24.93	23.49	*24.74*	±2.03
	Total weight including blown	26.78	35.44	30.69	34.82	32.09	31.53	30.24	30.92	*31.56*	
Honeydon	Sprouts : cwt.										
	1st harvesting	3.94	8.66	9.34	7.31	5.29	4.16	8.78	9.90	*7.17*	
	2nd ,,	10.13	15.98	18.12	14.52	12.38	10.02	12.04	14.74	*13.49*	
	3rd ,,	7.76	9.68	10.92	10.46	7.43	7.09	7.65	12.72	*9.21*	
	4th ,,	7.65	9.45	9.45	10.35	13.28	8.89	12.94	11.37	*10.42*	
	Total saleable	29.48	43.77	47.83	42.64	38.38	30.16	41.41	48.73	*40.29*	±1.54
	Total weight including blown	35.22	52.55	56.27	50.87	44.90	37.59	49.40	57.84	*48.08*	

* Nitrate of soda used instead of sulphate of ammonia.

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Average Effects and Interactions. Type 1

Place.	Crop.	*Mean yield.*	N	P	P.M.	St. Error.	N×P	N×PM	P×PM	St. Error.
Oaklands	Potatoes : tons per acre	*5.04*	−0.14	+0.02	−0.01	±0.254	+0.06	+0.42	−0.06	±0.509
Swanley (B)	,, ,, ,, ,,	*8.49*	+0.16	−0.48	−0.61	±0.577	−0.42	−0.60	+0.37	±1.154
Wye (B)	Onions : tons per acre	*7.64*	+0.09	+0.11	**+0.86**	±0.332	−0.58	+0.66	+1.22	±0.664
Potton	Sprouts : Total saleable— cwt. per acre	*24.74*	+1.18	+0.32	+0.35	±1.436	−0.42	−2.60	−5.54	±2.870
Honeydon	,, ,, ,, ,,	*40.29*	+2.05	**+10.27**	**+8.19**	±1.089	−0.84	+1.06	**−5.00**	±2.178

Yields of Separate Treatments. Type 1*b*

Place.	Crop.	Sub-blocks A						Sub-blocks B						*Mean.*	Standard Error.
		O	N, P	Dry PM, P	Wet PM, P	Dry PM, N	Wet PM, N	Dry PM	Wet PM	N	P	Dry PM, N, P	Wet PM, N, P		
Dartington Hall (A)	Broccoli—														
	Centres : tons per acre	1.50	1.65	1.97	1.35	1.90	1.68	1.26	1.42	1.69	1.21	1.55	1.53	*1.56*	±0.168
	Outsides : ,, ,,	7.04	7.38	8.29	6.46	7.43	7.93	6.75	6.78	7.74	6.34	7.93	7.36	*7.28*	±0.758
	No. of plants per acre	5813	5922	5850	5268	6068	5886	5741	5741	5922	5704	6104	6031	*5838*	±230
	Change of yield with time*	+0.071	+0.050	−0.011	+0.050	+0.019	+0.042	+0.028	+0.025	−0.025	−0.006	+0.022	−0.004	*+0.022*	±0.032
Dartington Hall (B)	Kale—tons per acre	21.31	25.15	23.75	21.03	26.44	26.60	23.74	20.94	25.12	21.44	26.31	26.62	*24.04*	±0.619

*Increase of centres in tons per week ; pickings on April 12, 16, 19, 25, 30.

Main Effects. Type 1*b*

Place.	Crop.	N	P	St. Error.	Dry PM	Wet PM	St. Error
Dartington Hall (A)	Broccoli : Centres—tons per acre	**+0.22**	−0.03	±0.097	+0.16	−0.02	±0.119
,, ,, (B)	Kale—Tons per acre	**+4.00**	+0.02	±0.357	**+1.80**	+0.54	±0.438

Interactions. Type 1*b*

Place.	Crop	N×P	N×Dry PM	P×Dry PM	N×Wet PM	P×Wet PM	St. Error.
Dartington Hall (A)	Broccoli : Centres—tons per acre	−*	−0.20	+0.34	−0.10	+0.06	±0.238
,, ,, (B)	Kale—Tons per acre	−*	−1.13	−0.14	**+1.86**	−0.02	±0.876

*Partially confounded.

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Comparison of Poultry Manure with Equivalent Artificials. Types 1, 1*a and* 1*b*

Place	Crop	No Manure	Poultry Manure	S/A and Super.	P.M.—(N+P)			
					Actual	Per cent. of yield		Per cent. of mean response
Oaklands	Potatoes : tons	5.21	5.02	4.91	+0.11	+2.2	±8.8	—
Swanley	,, ,,	8.80	8.29	8.60	−0.31	−3.7	±11.8	—
Wye	Onions : tons	7.44	7.36	6.70	+0.66	+8.7	±7.4	—
Potton	Sprouts : Total saleable : cwt.	21.67	26.09	27.24	−1.15	−4.7	±10.1	23.0
Honeydon	,, ,, ,, ,,	28.85	39.01	43.14	−4.13	**−10.3**	±4.7	33.8
Dartington Hall	Broccoli–Centres tons	1.39	1.37	1.54	−0.17	−10.9	±13.2	—
,, ,,	Kale : tons	21.30	23.75	25.14	−1.39	−5.8	±3.1	44.3
Rotham-sted	Sprouts—Total saleable : cwt.	30.95	27.50	31.20	−3.70	−12.5	±10.3	—
Woburn	,, ,, ,,	33.76	40.63	42.94	−2.31	−5.7	±8.1	28.8

In constructing this table the second order interactions are assumed to be negligible except at Rothamsted where there was no confounding.

Conclusions

Sulphate of ammonia and superphosphate give significantly greater yields on the average than poultry manure, there being no significant differences in response (considered as a percentage of mean yield) at the four stations where there was clear response to fertilisers.

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Summary

Types 2, 2a and 2b

Place	Crop	No Nitrogen	½ Sulph. Amm.	Sulph. Amm.	Amm. Bicarb.	Poultry Manure	*Mean*	Standard Error
Godalming	Potatoes : tons per acre	7.83		10.15	9.45	9.44	*9.22*	0.323
Staindrop	,, ,, ,, ,,	10.62		11.90	11.63	11.56	*11.43*	0.507
Welshpool (A)	,, ,, ,, ,,	7.63		8.95	8.86	8.70	*8.53*	0.250
Burford	,, ,, ,, ,,	6.81		7.25	6.67	7.59	*7.08*	0.155
Newcastle	,, ,, ,, ,,	12.15		12.36	12.28	12.18	*12.24*	0.925
Fakenham	,, ,, ,, ,,	8.61		9.27	9.32	9.50	*9.17*	0.304
Bakewell (B)	,, ,, ,, ,,	6.65		8.29	7.77	7.70	*7.60*	0.287
Newlands	,, ,, ,, ,,	11.57		12.09	11.67	12.23	*11.89*	0.633
Mean of Potato Experiments		*8.98*		*10.03*	*9.71*	*9.86*	*9.64*	0.172
Welshpool (B)	Swedes : Roots : tons per acre	8.50		10.32	10.64	9.68	*9.78*	0.612
	Tops : ,, ,,	2.39		3.43	3.64	4.09	*3.39*	0.263
Oundle	Swedes : Roots ,,	7.41		10.03	8.53	6.84	*8.20*	0.491
Bakewell (A)	Mangolds : Roots tons per acre	24.91		28.19	27.35	26.46	*26.73*	0.557
Wye (A)	,, ,, ,, ,,	24.29		28.54	Wet P.M. 23.62	26.27	*25.68*	0.542
Swanley (A)	Brussel Sprouts : cwt. per acre 1st and 2nd pickings*†	3.11	2.58	2.17	Guano 2.87	3.91	*2.93*	0.665
	Total of all pickings†	25.16	22.19	19.50	21.95	23.43	*22.45*	1.299
	Total of blown sprouts	8.88	7.38	7.90	9.06	9.34	*8.51*	

*First picking October 5th, second picking October 18th. After this eleven more pickings were made, but most of the individual pickings did not cover the whole experiment and are not worth considering separately.

†Saleable sprouts.

Conclusions

Most of the experiments show a significant response to nitrogen. The yields of potatoes with poultry manure and ammonium bicarbonate are less, but not significantly so, than with sulphate of ammonia. Swedes and mangolds give significantly smaller yields with poultry manure than with sulphate of ammonia ; the difference with ammonium bicarbonate is not significant. Wet poultry manure at Wye produced no response. Sulphate of ammonia depressed the yields of sprouts at Swanley significantly whereas the depression with poultry manure was small and not significant, being significantly less than the depression with sulphate of ammonia ; guano occupied an intermediate position.

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SUGAR BEET FERTILISER EXPERIMENTS

FACTORY SERIES

Treatments : All combinations of sulphate of ammonia at the rate of 0.4 cwt. N, superphosphate at the rate of 0.4 cwt. P_2O_5, and muriate of potash at the rate of 0.5 cwt. K_2O per acre.
System of replication : 6 randomised blocks of 4 plots each (the second order interaction being confounded) at each of 14 centres.
Area of each plot : 1/10 acre. (Ipswich : 0.0684. Newark : 0.0975. Felstead : 0.0485. Poppleton : 0.0905. Wissington : 0.0875. King's Lynn : 0.0981. Ely : 0.0833. Cantley : 0.0978.)
Varieties : Ely and Peterborough, Kuhn P. ; King's Lynn, Marsters ; Poppleton, Dobrovice ; remainder, Kleinwanzleben E.
Mechanical and chemical analyses of soil samples from each experiment have been carried out.

Factory	Soil	Previous Crop	Date of Sowing	Date of Harvesting	Farming notes
1. Balderton (Newark)	Sandy loam	—	—	—	Very acid, crop failed.
2. Ipswich	Sandy loam	Beet	April 25th	Oct. 16-23rd	Dung for 1932 beet, tops folded by sheep in autumn.
3. Colwick	Sandy loam	Oats	May 10th	Nov. 16-21st	10 cwt. lime per acre a few days before sowing.
4. Newark	Sandy loam	Wheat (dunged)	April 24th & May 1st	Nov. 2-6th	Not highly farmed recently.
5. Felstead	Heavy loam on clay.	Beet	May 5th	Nov. 1st	6 tons chalk per acre for beet.
6. Brigg	Sandy loam	Wheat	April 25th	Oct. 16-17th	Held out well against drought but not up to standard of district.
7. Poppleton	Sandy loam	Kale	April 28-29th	Sept. 30th-Oct. 3rd.	Poorish land very highly farmed. Previous crop kale sheeped with cake.
8. Bardney	Sandy loam	Barley	May 9th	Nov. 14-16th	Dunged in Dec., 1932, at 10 loads per acre. Wireworm damage.
9. Allscott	Sandy loam	Clover Hay	May 8th.	Nov. 9th.	Field naturally poor but highly farmed.
10. Wissington	Sandy loam	Barley	May 11th	Nov. 15-20th	Poor land well cultivated.
11. Peterboro'	Heavy fen	Peas (dunged)	May 12th	Dec. 1-14th	
12. King's Lynn	Fine sandy Loam	Early potatoes	April 14th	Oct. 20-21st	Rich soil, with fairly high water table. ½ cwt. Nitrate of soda given in June.
13. Ely	Rich clay fen	Beet	April 11th	Nov. 25-28th	After 2 beet crops.
14. Cantley	Sandy loam	Potatoes	April 27th	Dec. 18-19th	5 tons waste lime in Jan., 1933. Poor soil very well farmed. Crop so damaged by wireworm that in June it was proposed by the grower to abandon the experiment as a failure. The soil is on a terrace which may receive water and nutrients by seepage from higher ground.

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Plant Density (Mean Values)

Centre	Yield in tons per acre.	Plants in thousands per acre.	Distance in inches between rows	Weight of roots in lbs. per plant.	Increase in yield for one additional beet	S.E. per plot t.p.a. Before Adjusting for plant number	S.E. per plot t.p.a. After Adjusting for plant number
3. Colwick	7.2	32	19¼	0.5	—	±1.12	—
5. Felstead	9.1	22	23	0.9	1.918	±0.70	±0.62
6. Brigg	10.7	25	18	1.0	1.942	±0.93	±0.91
8. Bardney	12.3	19	21	1.4	−0.748	±1.73	±1.81
9. Allscott	12.4	22	20	1.3	−0.008	±0.68	±0.71
12. King's Lynn	14.4	37	18	0.9	—	±0.81	—
14. Cantley	16.4	25	17	1.5	1.850	±1.70	±1.50

Sampling errors in Sampling for Sugar Content

(*10 Roots in Each Sample*)

Centre	No. of samples analysed per plot	Standard Error Per Sample
4. Newark	2	0.37
6. Brigg	2	0.27
9. Allscott	2	0.52*
10. Wissington ..	4	0.36
13. Ely	4	0.48
14. Cantley	2	0.32

* Estimate of S.E. between plots is lower (but not significantly so) than 0.52 and probably 0.46 is the best estimate of sampling error.

Summary Tables

See following pages.

Conclusions

The responses of roots to sulphate of ammonia and potash are significantly different at the different centres, and there is a significant negative interaction between them, though this interaction does not differ significantly from centre to centre.

The sugar percentages are significantly decreased by sulphate of ammonia, and increased by potash, the variations in these effects from centre to centre not being significant.

The tops on those experiments where they were weighed show significantly different responses to sulphate of ammonia at the different centres, but show no potash effects.

The responses to superphosphate are not significant when considered as a whole, nor are there any significant interactions involving superphosphate.

It is difficult to offer any explanation of the complex significant effects on plant number at Allscott.

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Yields of Individual Treatments

Centre.	*Mean of all Treatments.*	Sub-blocks A.				Sub-blocks B.				Standard Error	S.E. Per Plot
		O	NP	NK	PK	N	P	K	NPK		
Roots (washed) tons per acre :											
2. Ipswich ..	*5.17*	5.5	5.4	5.1	5.0	5.2	4.9	5.2	5.0	±0.25	±0.43
3. Colwick ..	*7.17*	5.7	8.2	7.4	6.6	7.9	6.5	6.9	8.2	±0.65	±1.12
4. Newark ..	*8.29*	8.2	8.7	9.0	9.6	7.9	8.0	7.2	7.7	±0.51	±0.88
5. Felstead ..	*9.09*	8.4	8.8	9.3	9.5	9.0	8.9	9.1	9.5	±0.41	±0.70
6. Brigg	*10.74*	10.3	11.3	12.9	10.5	11.9	9.2	9.3	10.4	±0.54	±0.93
7. Poppleton ..	*11.71*	11.8	11.1	11.0	12.0	12.4	11.4	11.6	12.3	±0.53	±0.92
8. Bardney ..	*12.32*	11.5	12.9	13.8	11.3	12.1	12.2	11.8	12.9	±1.00	±1.73
9. Allscott ..	*12.38*	11.7	12.9	12.8	13.3	12.1	10.5	13.3	12.5	±0.39	±0.68
10. Wissington ..	*13.82*	14.9	14.9	14.0	14.2	13.3	12.9	12.8	13.4	±0.40	±0.69
11. Peterborough ..	*14.06*	13.9	14.4	14.3	15.2	14.2	13.8	13.9	12.8	±0.37	±0.63
12. King's Lynn ..	*14.36*	14.9	14.3	13.8	14.1	14.9	14.6	14.6	13.7	±0.47	±0.81
13. Ely	*14.74*	13.9	15.5	14.6	15.3	14.6	14.7	14.6	14.7	±0.52	±0.90
14. Cantley ..	*16.36*	16.7	16.7	15.5	16.9	14.9	16.4	17.1	16.7	±0.98	±1.70
Mean ..	*11.53*	*11.32*	*11.92*	*11.78*	*11.78*	*11.55*	*11.06*	*11.32*	*11.50*		
Sugar Percentage											
2. Ipswich ..	*15.92*	16.4	15.0	15.9	16.4	15.6	16.0	16.6	15.5	±0.45	±0.78
3. Colwick ..	*15.10*	14.8	14.8	15.0	15.0	15.2	15.2	15.7	15.2	±0.46	±0.79
4. Newark ..	*16.23*	16.4	15.8	16.2	16.5	16.3	16.3	16.5	15.9	±0.17	±0.29
5. Felstead ..	*16.72*	16.9	16.4	16.5	17.4	16.2	17.1	16.8	16.4	±0.18	±0.32
6. Brigg	*17.74*	18.0	17.6	17.7	17.8	17.5	17.8	18.1	17.5	±0.14	±0.23
7. Poppleton ..	*17.94*	17.9	17.7	18.3	18.1	17.6	18.0	18.1	17.8	±0.37	±0.64
8. Bardney ..	*16.15*	16.3	16.0	16.1	16.3	15.4	16.5	16.7	15.9	±0.40	±0.70
9. Allscott ..	*15.93*	15.8	15.8	16.2	16.3	15.5	15.8	16.2	15.8	±0.16	±0.28
10. Wissington ..	*16.40*	16.6	16.2	16.5	17.0	15.7	16.7	16.6	16.0	±0.23	±0.41
11. Peterborough ..	*14.84*	14.8	14.6	14.8	15.5	14.8	14.8	14.6	14.9	±0.31	±0.54
12. King's Lynn	*16.69*	16.5	17.3	16.8	17.0	16.3	17.1	15.8	16.6	±0.42	±0.72
13. Ely	*15.89*	15.9	15.8	15.9	15.7	15.9	16.2	15.9	15.8	±0.27	±0.46
14. Cantley ..	*15.70*	16.0	15.3	15.7	15.8	15.3	16.0	15.7	15.8	±0.30	±0.52
Mean ..	*16.25*	*16.33*	*16.02*	*16.28*	*16.52*	*15.95*	*16.42*	*16.41*	*16.08*		

https://doi.org/10.23637/ERADOC-1-3 pp 74

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Centre.	*Mean of all Treatments*	Sub-blocks A.				Sub-blocks B.					
		O	NP	NK	PK	N	P	K	NPK	Standard Error.	S.E. Per Plot
Plant Number : thousands per acre											
5. Felstead ..	*22.4*	20.9	21.9	22.7	23.0	21.9	23.9	21.5	23.8	±0.71	±1.22
6. Brigg	*24.7*	23.5	25.2	24.3	24.9	24.3	25.6	24.2	25.6	±1.11	±1.92
8. Bardney ..	*18.8*	17.1	19.0	19.2	19.1	19.0	19.2	18.9	19.0	±0.62	±1.07
9. Allscott ..	*22.4*	20.3	25.4	22.1	20.5	21.8	21.4	26.7	21.4	±1.08	±1.88
14. Cantley ..	*25.4*	25.8	25.7	25.4	24.8	24.9	25.1	26.2	25.6	±0.63	±1.09
Mean ..	*22.77*	*21.53*	*23.44*	*22.74*	*22.46*	*22.37*	*23.05*	*23.51*	*23.08*		
Tops : tons per acre											
4. Newark ..	*6.05*	6.3	6.4	6.7	6.7	5.9	5.4	4.7	6.2	±0.43	±0.74
6. Brigg	*6.56*	5.1	7.8	8.2	5.7	8.2	5.3	5.1	7.0	±0.42	±0.73
7. Poppleton ..	*9.59*	8.6	10.1	9.6	8.0	11.0	8.1	10.3	11.1	±0.87	±1.52
9. Allscott ..	*10.99*	9.9	10.5	11.5	10.2	11.9	11.8	10.6	11.4	±1.08	±1.88
13. Ely	*21.96*	21.4	22.6	21.1	23.6	21.3	21.1	22.0	22.7	±0.83	±1.44
Mean ..	*11.03*	*10.26*	*11.48*	*11.42*	*10.84*	*11.66*	*10.34*	*10.54*	*11.68*		
Percentage Purity											
12. King's Lynn ..	90.4	90.3	90.6	89.8	90.8	90.0	90.7	90.3	90.5	±0.10	±0.18

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https://doi.org/10.23637/ERADOC-1-3 pp 75

Mean responses and interactions

* 5 per cent Significance. ** 1 per cent. Significance.

Centre.	*Mean Yield.*	Mean response to			Standard Error.	Interactions			Standard Error.
		N	P	K		N × P	N × K	P × K	
Roots (washed) : tons per acre									
2. Ipswich ..	*5.17*	+0.02	−0.17	−0.15	±0.17	+0.44	−0.12	+0.06	±0.35
3. Colwick ..	*7.17*	*+1.53***	+0.36	+0.21	±0.46	+0.28	−0.92	−0.30	±0.93
4. Newark ..	*8.29*	+0.10	+0.39	+0.20	±0.36	−1.28	−0.26	+0.24	±0.72
5. Felstead ..	*9.09*	+0.17	+0.26	+0.56	±0.29	−0.44	−0.16	+0.18	±0.58
6. Brigg	*10.74*	*+1.76***	−0.74	+0.10	±0.38	−1.65	−0.06	+0.19	±0.76
7. Poppleton ..	*11.71*	+0.02	−0.02	+0.04	±0.38	−0.04	−0.27	+1.66*	±0.75
8. Bardney ..	*12.32*	+1.26	+0.01	+0.30	±0.71	−0.14	+1.10	−1.48	±1.42
9. Allscott ..	*12.38*	+0.38	−0.16	*+1.16***	±0.28	+0.84	*−2.08***	0.00	±0.55
10. Wissington ..	*13.82*	+0.20	+0.08	−0.39	±0.28	+0.82	+0.09	+0.61	±0.56
11. Peterborough ..	*14.06*	−0.29	−0.03	−0.03	±0.26	−1.26*	−1.44*	−0.10	±0.52
12. King's Lynn ..	*14.36*	−0.39	−0.33	−0.65	±0.33	+0.06	−0.38	+0.16	±0.66
13. Ely	*14.74*	+0.24	+0.63	+0.12	±0.36	−0.21	−1.00	−0.53	±0.73
14. Cantley ..	*16.36*	−0.83	+0.62	+0.36	±0.69	+1.70	−0.08	−0.26	±1.38
Mean	*11.53*	*+0.32*	*+0.07*	*+0.14*		*−0.07*	*−0.43*	*+0.03*	
Sugar Percentage									
2. Ipswich ..	*15.92*	−0.84*	−0.38	+0.34	±0.320	−0.20	+0.10	+0.14	±0.640
3. Colwick ..	*15.10*	−0.13	−0.12	+0.22	±0.322	+0.10	−0.30	−0.26	±0.643
4. Newark ..	*16.23*	*−0.38***	−0.22	+0.12	±0.119	−0.32	−0.15	+0.14	±0.238
5. Felstead ..	*16.72*	*−0.66***	+0.22	+0.14	±0.129	−0.35	+0.02	−0.01	±0.258
6. Brigg	*17.74*	*−0.36***	−0.14	+0.09	±0.096	+0.18	−0.01	−0.17	±0.191
7. Poppleton ..	*17.94*	−0.15	−0.05	+0.25	±0.263	−0.24	+0.24	−0.30	±0.526
8. Bardney ..	*16.15*	−0.62*	+0.01	+0.21	±0.286	+0.32	+0.18	−0.68	±0.573
9. Allscott ..	*15.93*	−0.19	+0.02	*+0.39***	±0.113	−0.08	−0.08	−0.28	±0.226
10. Wissington ..	*16.40*	*−0.62***	+0.12	+0.24	±0.166	−0.23	+0.22	−0.33	±0.331
11. Peterborough ..	*14.84*	−0.15	+0.22	+0.20	±0.222	−0.53	−0.16	+0.63	±0.444
12. King's Lynn	*16.69*	+0.14	+0.63*	−0.24	±0.294	−0.48	+0.32	−0.32	±0.587
13. Ely	*15.89*	−0.07	−0.04	−0.13	±0.189	−0.14	+0.14	−0.26	±0.378
14. Cantley ..	*15.70*	−0.33	+0.07	+0.14	±0.212	−0.06	+0.68	+0.14	±0.424
*Mean ..	*16.25*	*−0.34*	*+0.03*	*+0.15*		*−0.16*	*+0.09*	*−0.12*	

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https://doi.org/10.23637/ERADOC-1-3 pp 76

Centre	*Mean Yield*	Mean response to			Standard Error.	Interactions			Standard Error.
		N	P	K		N × P	N × K	P × K	
Total Sugar : cwt. per acre									
2. Ipswich ..	*16.46*	−0.80	−0.94	−0.12		+1.20	−0.28	+0.34	
3. Colwick ..	*21.66*	+4.44	+0.92	+0.94		+0.98	−3.20	−1.28	
4. Newark ..	*26.90*	−0.30	+0.90	+0.84		−4.68	−1.10	+1.00	
5. Felstead ..	*29.46*	−0.62	+1.22	+2.06		−2.02	−0.50	+0.56	
6. Brigg	*38.10*	+5.48	−2.92	+0.54		−5.46	−0.24	+0.30	
7. Poppleton ..	*42.02*	−0.28	−0.18	+0.72		−0.70	−0.40	+5.26	
8. Bardney ..	*39.80*	+2.54	+0.06	+1.48		+0.34	+4.00	−6.46	
9. Allscott ..	*39.44*	+0.74	−0.46	+4.66		+2.48	−6.82	−0.70	
10. Wissington ..	*45.32*	−1.06	+0.60	−0.62		+2.06	+0.90	+1.08	
11. Peterborough ..	*41.72*	−1.28	+0.52	+0.48		−5.24	−4.72	+1.48	
12. King's Lynn ..	*47.94*	−0.90	+0.70	−2.86		−1.18	−0.34	−0.38	
13. Ely	*46.84*	+0.56	+1.88	0.00		−1.08	−2.76	−2.44	
14. Cantley ..	*51.36*	−3.68	+2.18	+1.58		+5.14	+1.98	−0.36	
Mean ..	*37.46*	*+0.37*	*+0.34*	*+0.75*		*−0.63*	*−1.04*	*−0.12*	
Plant Number : thousands per acre									
5. Felstead ..	*22.45*	+0.25	+1.40*	+0.60	±0.50	−1.70	+1.50	−0.20	±1.00
6. Brigg	*24.70*	+0.30	+1.25	+0.13	±0.79	−0.22	+0.22	−0.42	±1.57
8. Bardney ..	*18.81*	+0.48	+0.52	+0.48	±0.44	−1.25	−0.75	−1.05	±0.87
9. Allscott ..	*22.45*	+0.45	−0.55	+0.45	±0.77	+4.00*	−4.60*	*−5.80***	±1.53
14. Cantley ..	*25.44*	−0.08	−0.28	+0.12	±0.45	+1.55	+0.15	−0.65	±0.89
Mean ..	*22.77*	*+0.28*	*+0.47*	*+0.36*		*+0.48*	*−0.70*	*−1.62*	
Tops : tons per acre									
4. Newark ..	*6.05*	+0.51	+0.28	+0.05	±0.30	−0.58	+0.46	+0.92	±0.61
6. Brigg	*6.56*	*+2.51***	−0.20	−0.10	±0.30	−1.21	−0.57	−0.18	±0.60
7. Poppleton ..	*9.59*	+1.76*	−0.55	+0.28	±0.62	+1.70	−1.04	+0.28	±1.24
9. Allscott ..	*10.99*	+0.70	−0.03	−0.11	±0.76	−1.44	+0.66	−0.50	±1.53
13. Ely	*21.96*	−0.10	+1.03	+0.78	±0.59	+0.85	−1.59	+1.09	±1.18
Mean ..	*11.03*	*+1.08*	*+0.11*	*+0.18*		*−0.14*	*−0.42*	*+0.32*	
Percentage Purity.									
12. King's Lynn ..	*90.40*	−0.32**	+0.56**	−0.06	±0.07	+0.17	−0.21	+0.04	±0.15

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EXPERIMENTS AT OUTSIDE CENTRES.

Meadow Hay. 4th Season. W. H. Limbrick, Esq., Badminton Farm, Badminton, Glos., 1933.

5 × 5 Latin square with split plots. Sub-plots : 1/20 acre.
Treatments : Phosphatic dressings at the rate of 1 cwt. P_2O_5 per acre, and muriate of potash at the rate of 1 cwt. (0.5 cwt. K_2O) per acre. The phosphates were applied in 1930 and potash in 1931. No further manuring this year.
Soil : Light red loam, 8 ins. deep. Hay cut : June 22nd.
Standard Errors : per whole plot : ±1.84 cwt. per acre or ±7.53% ; per sub-plot : ±1.79 cwt. per acre or ±7.32%.

Dry Matter (cwt per acre)

Muriate of potash	No Phosphate	Mineral Phosphate	Low sol. Slag	High sol. Slag	Super.	*Mean*
None	24.0	23.7	23.4	25.7	26.7	*24.7*
1 cwt.	23.8	22.6	24.3	24.0	26.4	*24.2*
Mean (±0.824)	*23.9*	*23.2*	*23.8*	*24.8*	*26.6*	*24.5*
Diff. (±1.13)	*−0.2*	*+1.1*	*+0.9*	*−1.7*	*−0.3*	*−0.5* (±0.505)

Conclusions

The response to superphosphate applied in 1930 is just significant. There are no effects of potash applied in 1931.

Meadow Hay. 4th Season. W. Eydes, Esq., Walton Lodge Farm, Chesterfield, 1933.

5 × 5 Latin square. Plots 1/15 acre.
Treatments : Phosphates at the rate of 1 cwt. P_2O_5 per acre applied in 1930. No further manuring this year.
Basal Manuring : Nil.
Hay Cut : July 18th.
Standard Error per Plot : ±0.99 cwt. per acre or ±4.7%.

Conclusions

The response to the phosphatic dressings is significant, low soluble slag being significantly below mineral-phosphate and superphosphate.

Dry Matter

Cwt. per acre	Yield	*Increase*
Mean	*20.9*	
No Phosphate	18.6	
Mineral Phosphate	21.8	*+3.2*
Low soluble slag	20.5	*+1.9*
High soluble slag	21.1	*+2.5*
Superphosphate	22.3	*+3.7*
St. Error ..	±0.442	*±0.625*

Barley. G. H. Nevile, Esq., Wellingore Hall, Lincs., 1933.

6 × 6 Latin square. Plots 1/120 acre.
Treatments : Sulphate of ammonia or ammonium bicarbonate at the rate of 0.2 cwt. N. per acre. Superphosphate at the rate of 0.4 cwt. P_2O_5 per acre.
Basal Manuring : Nil.
Soil : Light loam on Lincoln Heath. Variety : Plumage Archer. Manures applied : March 18th. Barley sown : March 16th. Harvested : August 17th. Previous crop : Oats.
Special Notes : Plots harvested by sampling method (5 random samples per sub-plot each consisting of 4 half-metre rows side by side.) Rows spaced 6 ins. apart.
Standard errors per plot : grain : ±1.88 cwt. per acre or ±8.0% ; straw : ±3.04 cwt. per acre or 10.7%.

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Grain : cwt. per acre (±0.768)

Superphosphate	Nitrogen (0.2 cwt. N per acre.) None	Sulph. Amm.	Amm. bicarb.	*Mean (±0.443)*	*Increase (±0.626)*
None	20.6	23.5	25.2	*23.1*	
0.4 cwt. P_2O_5	22.1	25.5	24.4	*24.0*	*+0.9*
Mean (±0.543)	*21.4*	*24.5*	*24.8*	*23.6*	
Increase (±0.768)		*+3.1*	*+3.4*		

Straw : cwt. per acre (±1.24)

Superphosphate	Nitrogen (0.2 cwt. N per acre) None	Sulph. Amm.	Amm. bicarb.	*Mean (±0.716)*	*Increase (±1.01)*
None	24.4	28.3	31.4	*28.0*	
0.4 cwt. P_2O_5	26.4	31.5	28.9	*28.9*	*+0.9*
Mean (±0.877)	*25.4*	*29.9*	*30.2*	*28.4*	
Increase (±1.24)		*+4.5*	*+4.8*		

Conclusions

Significant response to nitrogen both in grain and straw. The average response to superphosphate and the average difference between the two forms of nitrogen are not significant, but there is indication, significant in the case of straw, and almost so in the case of grain, that bicarbonate is less favourable, as compared with sulphate of ammonia, in the presence of superphosphate than in its absence, the average response to superphosphate being significant in both grain and straw when the ammonium bicarbonate plots are omitted.

Barley. South-Eastern Agricultural College, Wye, Kent, 1933.

6×6 Latin square. Plots : 1/120 acre.
Treatments : Nitrogenous manures at the rate of 0.2 cwt. of N per acre. Superphosphate at the rate of 0.4 cwt. P_2O_5 per acre.
Basal manuring : Nil.
Soil : Loam. Coldharbour series. Variety : Plumage Archer. Manures applied : March 23rd. Barley sown : March 15th. Harvested : August 8th. Previous crop : Barley.
Special Notes : Crop slightly damaged by wireworm. Plots harvested by sampling method (5 random samples per plot each consisting of 4 half-metre rows side by side). Rows spaced 7 ins. apart.
Standard errors per plot : grain : ±3.57 cwt. per acre or ±13.5% ; straw : ±3.10 cwt. per acre or 11.0%.

Grain : cwt. per acre (±1.46)

Superphosphate	Nitrogen (0.2 cwt. N per acre) None	Sulph. Amm.	Amm. bicarb.	*Mean (±0.843)*	*Increase (±1.19)*
None	22.6	27.0	26.9	*25.5*	
0.4 cwt. P_2O_5 ..	24.3	29.8	28.1	*27.4*	*+1.9*
Mean (±1.03) ..	*23.4*	*28.4*	*27.5*	*26.4*	
Increase (±1.46)		*+5.0*	*+4.1*		

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Straw : cwt. per acre (±1.27)

Superphosphate	Nitrogen (0.2 cwt. N per acre) None	Sulph. Amm.	Amm. bicarb.	*Mean (±0.733)*	*Increase (±1.04)*
None	24.7	28.9	29.0	*27.5*	
0.4 cwt. P_2O_5 ..	25.9	31.7	29.5	*29.0*	*+1.5*
Mean (±0.898) ..	*25.3*	*30.3*	*29.2*	*28.3*	
Increase (±1.27)		*+5.0*	*+3.9*		

Conclusions

Significant response to nitrogen both for grain and straw without any significant differences between the two forms. The response to superphosphate is not large enough to be significant.

Potatoes. G. Major, Esq., Newton Farm, Tydd, Wisbech, 1933.

3 randomised blocks of 9 plots each. (No replication.) Two degrees of freedom for second order interactions are confounded with blocks and the error is estimated from interactions of deviations from regression effects. Plots : 1/60 acre.

Treatments : Sulphate of ammonia at the rate of 0, 0.4 and 0.8 cwt. N, superphosphate at the rate of 0, 0.7 and 1.4 cwt. P_2O_5 and sulphate of potash at the rate of 0, 1.0 and 2.0 cwt. K_2O per acre in all combinations.

Basal manuring : Nil.

Soil : Deep silt, rather heavy. Variety : King Edward. Manures applied : April 17th. Potatoes planted : April 21st. Lifted : September 1st. Previous crop : Peas.

Standard error per plot : ±0.360 tons per acre or ±2.7%.

Plan and Yields in lb. of Individual Plots

$N_0P_0K_0$ 408	$N_0P_2K_1$ 479	$N_2P_0K_2$ 491	$N_1P_2K_1$ 530	$N_1P_1K_2$ 514	$N_0P_0K_2$ 459	$N_2P_2K_1$ 552	$N_1P_1K_1$ 476	$N_0P_0K_1$ 444
$N_1P_1K_0$ 498	$N_2P_1K_1$ 534	$N_1P_0K_1$ 466	$N_2P_1K_0$ 533	$N_0P_2K_0$ 491	$N_2P_0K_1$ 481	$N_2P_1K_2$ 531	$N_0P_2K_2$ 479	$N_2P_0K_0$ 485
$N_2P_2K_0$ 508	$N_0P_1K_2$ 468	$N_1P_2K_2$ 553	$N_1P_0K_0$ 467	$N_2P_2K_2$ 644	$N_0P_1K_1$ 441	$N_1P_0K_2$ 473	$N_0P_1K_0$ 448	$N_1P_2K_0$ 486

Summary : tons per acre

Mean of all Potash (±0.208)

Superphosphate	Sulphate of Ammonia None	0.4 cwt. N	0.8 cwt. N	*Mean (±0.120)*	*Increase (±0.170)*
None ..	11.70	12.55	13.01	*12.42*	
0.7 cwt. P_2O_5	12.12	13.28	14.27	*13.22*	*+0.80*
1.4 cwt. P_2O_5	12.94	14.01	15.21	*14.05*	*+0.83*
Mean (±0.120)	*12.25*	*13.28*	*14.16*	*13.23*	
Increase (±0.170)		*+1.03*	*+0.88*		

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Mean of all Superphosphate (±0.208)

Sulphate of potash	Sulphate of Ammonia None	0.4 cwt. N	0.8 cwt. N	*Mean* (±0.120)	*Increase* (±0.170)
None ..	12.03	12.96	13.62	*12.87*	
1.0 cwt. K_2O ..	12.18	13.14	13.99	*13.10*	*+0.23*
2.0 cwt. K_2O ..	12.55	13.75	14.87	*13.72*	*+0.62*
Mean (±0.120)	*12.25*	*13.28*	*14.16*	*13.23*	
Incr. (±0.170)		*+1.03*	*+0.88*		

Mean of all Nitrogen (±0.208)

Superphosphate	Sulphate of Potash None	1.0 cwt. K_2O	2.0 cwt. K_2O	*Mean* (±0.120)	*Increase* (±0.170)
None ..	12.14	12.42	12.70	*12.42*	
0.7 cwt. P_2O_5	13.20	12.96	13.51	*13.22*	*+0.80*
1.4 cwt. P_2O_5	13.26	13.94	14.96	*14.05*	*+0.83*
Mean (±0.120)	*12.87*	*13.10*	*13.72*	*13.23*	
Incr. (±0.170)		*+0.23*	*+0.62*		

Conclusions

Significant responses to all three nutrients, with no significant falling off in the responses with the higher dressings. There is a significantly higher response to sulphate of ammonia and superphosphate in the presence of one another, and also to superphosphate and sulphate of potash in the presence of one another. The second order interaction is also significant. The errors are very low, but not exceptionally so for this farm.

Potatoes. R. Starling, Esq., Little Downham, Ely, 1933.

4 randomised blocks of 9 plots each. Plots : 1/60 acre.
Treatments : Sulphate of ammonia at the rate of 0, 2 and 4 cwt. per acre in combination with superphosphate at the rate of 0, 6 and 12 cwt. per acre.
Basal manuring : Nil.
Soil : Good quality black soil with clay. Variety : Majestic (sprouted Scotch).
Manures applied : April 11th. Potatoes planted : April 11th. Lifted : October 8th. Previous crop : Wheat.
Standard error per plot : ±1.88 tons per acre or ±13.18%.

Summary : tons per acre (±0.943)

Sulphate of Ammonia (p.a.)	Superphosphate (cwt. p.a.) None	6	12	*Mean* (±0.544)	*Increase* (±0.770)
None ..	7.67	13.17	13.43	*11.42*	
2 cwt.	13.61	16.20	15.74	*15.18*	*+3.76*
4 cwt.	14.31	17.04	17.31	*16.22*	*+1.04*
Mean (±0.544)	*11.86*	*15.47*	*15.49*	*14.27*	
Incr. (±0.770)		*+3.61*	*+0.02*		

Conclusions

Significant response to both fertilisers with significantly less additional response to the double dressing than to the single, that of superphosphate being negligible.

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Potatoes. J. A. Tribe, Willow Farm, Binnimoor, March, 1933.

8 randomised blocks of 4 plots each. Second order interaction confounded. Plots : 1/60 acre.
Treatments : 2 cwt. sulphate of ammonia, 7 cwt. superphosphate, and 2 cwt. of sulphate of potash per acre in all combinations.
Basal manuring : Nil.
Soil : Deep black Fen on clay. Variety : Scotch King Edward. Manures applied : April 11th. Potatoes planted : April 15th. Lifted : September 22nd. Previous crop : Sugar Beet.
Standard error per plot : ±0.694 tons per acre or ±5.6%.

Individual Treatments : tons per acre (±0.348)

Sub-blocks A				Sub-blocks B				
O	**NK**	**NP**	**PK**	**N**	**P**	**K**	**NPK**	*Mean*
12.03	11.84	13.32	13.27	11.67	12.17	11.47	13.09	*12.36*

Responses to Fertilisers : tons per acre

Fertiliser	*Mean Response*	Sulphate of Ammonia		Superphosphate		Sulphate of potash	
		Absent	Present	Absent	Present	Absent	Present
Sulphate of ammonia ..	*0.24*[1]	—	—	0.00[2]	+0.48[2]	+0.40[2]	+0.10[2]
Superphosphate ..	*1.21*[1]	+0.97[2]	+1.45[2]	—	—	+0.90[2]	+1.52[2]
Sulphate of potash ..	*0.12*[1]	+0.27[2]	−0.03[2]	−0.20[2]	+0.44[2]	—	—

Standard errors : (1) ±0.246, (2) ±0.348.

Conclusions

There is a significant response to superphosphate, greater, but not significantly so, on the plots receiving potash. There is no evidence of any general potash effect or of any nitrogen effects.

Potatoes. T. H. Ream, Esq., Portobello Farm, Sutton, Beds., 1933.

4×4 Latin square with split plots. Sub-plots 1/80 acre.
Treatments : Superphosphate at the rate of 0 and 0.5 cwt. P_2O_5 per acre in combination with sulphate of potash at the rate of 0 and 1.0 cwt. K_2O per acre. Each plot divided, one half receiving Nitrate of Soda at the rate of 0.25 cwt. N per acre.
Basal manuring : No dung, sulphate of ammonia at the rate of 0.4 cwt. of N per acre.
Soil : Sandy. Variety : Ninetyfold. Manures applied : March 29th. Top dressing applied : May 12th. Potatoes planted : March 29th. Lifted : June 30th. Previous crop : Oats.
Standard errors per whole plot : ±0.511 tons per acre or ±16.07% ; per sub-plot : ±0.284 tons per acre or ±8.93%.

Tons p.a.	Neither	Super.	Potash	Both	*Mean* (±0.071)
No N/Soda ..	2.79	2.70	3.50	3.64	*3.16*
N/Soda ..	2.50	3.00	3.57	3.78	*3.21*
Mean (±0.256)	*2.64*	*2.85*	*3.54*	*3.71*	*3.18*
Diff. (±0.201)	*−0.29*	*+0.30*	*+0.07*	*+0.14*	*+0.05*

Mean increase due to Super : 0.19 tons per acre. Mean increase due to potash : 0.88 tons per acre.

Conclusions

There is a significant response to sulphate of potash of 0.88 tons per acre or 27.7 per cent. The small response to superphosphate is not significant, nor is there any sign of a response to nitrate of soda.

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Potatoes. J. Morris, Esq., Honey Farm, Wimblington, Cambs., 1933.

4 randomised blocks of 9 plots each. Plots : 1/60 acre.
Treatments : Sulphate of ammonia at the rate of 0, 1½ and 3 cwt. per acre in combination with sulphate of potash at the rate of 0, 1½ and 3 cwt. per acre.
Basal manuring : 7 cwt. superphosphate per acre. No dung.
Soil : Black Fen, light and peaty, clayed in 1910. Variety : King Edward, once grown. Manures applied : April 21st.
Potatoes planted : April 21st. Lifted : October 4th. Previous crop : Wheat.
Standard error per plot : ±0.762 tons per acre or 8.84%.

Summary : tons per acre (±0.381)

Sulphate of potash	Sulphate of Ammonia None	1½ cwt.	3 cwt.	*Mean (±0.220)*	*Increase (±0.311)*
None ..	5.99	7.49	7.57	*7.02*	
1½ cwt. ..	8.06	9.76	9.72	*9.18*	*+2.16*
3 cwt. ..	8.42	9.42	11.13	*9.66*	*+0.48*
Mean (±0.220)	*7.49*	*8.89*	*9.47*	*8.62*	
Incr. (±0.311)		*+1.40*	*+0.58*		

Conclusions

Significant responses to both sulphate of ammonia and sulphate of potash. In both fertilisers the additional response to the double dressing is less than the response to the single dressing, significantly so in the case of potash. The increased response to either fertiliser in the presence of the other is not large enough to be significant.

Potatoes. W. E. Morton, Esq., Thorney Abbey, Peterborough, 1933.

Experiments on sulphate of ammonia and muriate of potash.
4×4 Latin squares. Bedlam Farm, 4 randomised blocks. Plots : 1/50 acre (Gores Farm, 27 acre field, 0.0194 acre).
Treatments : 2 cwt. of sulphate of ammonia and 1½ cwt. of muriate of potash per acre.
Basal manuring : 7 cwt. of superphosphate per acre in all cases, with beet tops ploughed in or farmyard manure as shown in the table.
Average standard error per plot : ± 0.524 tons per acre or ± 4.92%.

Farm	Field	Variety (Majestic)	Manures Applied	Planted	Lifted	Previous Crop	Basal Manuring
Australia	10 acre	2nd Scotch	Mar. 31	Apr. 5	Sept. 13	Beet	Beet tops
Australia	16 acre	1st Scotch	Apr. 6	Apr. 15	Sept. 13	Wheat	Dung
Bedlam	16 acre	2nd Scotch	Apr. 3	Apr. 7	Sept. 16	Beet	Beet tops Dung
Bedlam	1st Reach	3rd Scotch	Apr. 3	Apr. 4	Sept. 13	Wheat	No dung
Gores	27 acre	1st Scotch	Mar. 31	Apr. 5	Sept. 4	Oats	No dung
Gores	Stone Bridge	2nd Scotch	Mar. 31	Apr. 10	Sept. 4	Wheat	Dung

Average Yields : tons per acre (±0.262)

Farm	Field	Soil (Fenland)	O	N	K	NK	*Mean*
Australia ..	10 Acre ..	Black, rather heavy ..	10.55	12.37	10.62	12.06	*11.40*
Australia ..	16 Acre ..	Silty ..	10.04	12.40	10.62	12.99	*11.51*
Bedlam ..	16 Acre ..	Light ..	11.77	12.60	13.00	13.48	*12.71*
Bedlam ..	First Reach	Light and blowy, on peat ..	7.51	7.61	10.81	10.37	*9.08*
Gores ..	27 Acre ..	Light ..	6.72	7.15	10.21	11.93	*9.00*
Gores ..	Stone Bridge	Light ..	9.23	9.64	9.97	11.83	*10.17*

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Fertiliser Effects

Farm	Field	Average Increase with Nitrogen (±0.262)	Average Increase with Potash (±0.262)	Interaction (±0.524)
Australia ..	10 Acre ..	1.63	−0.12	−0.38
Australia ..	16 Acre ..	2.37	0.58	0.01
Bedlam ..	16 Acre ..	0.65	1.05	−0.36
Bedlam ..	First Reach ..	−0.17	3.03	−0.53
Gores	27 Acre ..	1.08	4.14	1.28
Gores	Stone Bridge ..	1.14	1.46	1.46

Conclusions

Five out of the six experiments show a significant response to nitrogen and an equal number show a significant response to potash. The responses to both manures are significantly different at the different places, even when the experiments showing no response are excluded. The average interaction between the two manures is not significant, but the two experiments on Gores farm show a marked (significant) positive interaction, nitrogen and potash producing greater increases in the presence of one another.

Sugar Beet. Tunstall, Suffolk, 1933.

A. W. Oldershaw, Esq., County Organiser.

4 × 4 Latin square with split plots. Sub-plots : 0.009 acre.

Treatments : Nitrate of soda at the rate of 0, 0.2, 0.4 and 0.6 cwt. of N. per acre. One half of each plot received sulphate of ammonia and the other half equal ammonia nitrogen as ammonium humate in 1932. (See 1932 Report, p. 210.)

Basal manuring : 3 cwt. superphosphate and 3 cwt. muriate of potash per acre.

Soil : Acid sand. Variety : Kleinwanzleben E. Manures applied : April 28th. Beet sown : May 6th. Lifted : December 5th. Previous crop : Sugar beet. Mean dirt tare plots 1-19 : 0.1223 ; plots 20-32 : 0.03.

Standard errors	Per whole plot Tons per acre	Per whole plot Per cent.	Per sub-plot Tons per acre	Per sub-plot Per cent.
Roots (washed) ..	±0.438	±2.92	±0.785	±5.23
Tops	±0.292	±5.65	±0.426	±8.23
Sugar percentage ..	±0.180		±0.224	

Yields of Separate Treatments

Nitrate of Soda (per acre)	ROOTS (washed) tons per acre Humate	ROOTS (washed) tons per acre S/A	TOPS tons per acre Humate	TOPS tons per acre S/A	SUGAR PERCENTAGE Humate	SUGAR PERCENTAGE S/A	TOTAL SUGAR Cwt. per acre Humate	TOTAL SUGAR Cwt. per acre S/A
None ..	13.28	13.06	4.17	4.22	17.75	17.88	47.1	46.7
0.2 cwt. N.	15.55	14.53	5.00	4.51	17.39	17.54	54.1	51.0
0.4 cwt. N.	16.42	15.40	5.88	5.75	17.89	17.43	58.8	53.7
0.6 cwt. N.	15.82	16.03	6.18	5.69	17.11	17.16	54.1	55.0

Effects of Fertiliser (mean of ammonium humate and sulphate of ammonia)

Nitrate of Soda (per acre)	ROOTS (washed) Tons per acre	ROOTS (washed) *Increase*	TOPS Tons per acre	TOPS *Increase*	SUGAR PERCENTAGE	SUGAR PERCENTAGE *Increase*	TOTAL SUGAR Cwt. per acre	TOTAL SUGAR *Increase*
Mean ..	*15.01*		*5.18*		*17.52*		*52.6*	
None ..	13.17		4.20		17.81		46.9	
0.2 cwt. N.	15.04	*+1.87*	4.76	*+0.56*	17.46	*−0.35*	52.6	*+5.7*
0.4 cwt. N.	15.91	*+0.87*	5.82	*+1.06*	17.66	*+0.20*	56.2	*+3.6*
0.6 cwt. N.	15.92	*+0.01*	5.94	*+0.12*	17.14	*−0.52*	54.6	*−1.6*
St. Error ..	±0.219	*±0.310*	±0.146	*±0.206*	±0.090	*±0.127*		

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Differences of 1932 Dressings (Humate minus Sulphate)

Nitrate of Soda per acre	ROOTS (washed) tons per acre	TOPS tons per acre	SUGAR PERCENT-AGE	TOTAL SUGAR Cwt. per acre
Mean ..	*+0.51*	*+0.27*	*+0.04*	*+1.9*
St. Error ..	*±0.278*	*±0.150*	*±0.079*	
None ..	+0.22	−0.05	−0.13	+0.4
0.2 cwt. N. ..	+1.02	+0.49	−0.15	+3.1
0.4 cwt. N. ..	+1.02	+0.13	+0.46	+5.1
0.6 cwt. N. ..	−0.21	+0.49	−0.05	−0.9
St. Error ..	±0.555	±0.301	±0.158	

Conclusions

Both the roots and tops show a significant response to nitrate of soda, with a significantly smaller response per unit dressing at the higher levels.

The sugar percentage is significantly decreased by increasing dressings of nitrate of soda, with the exception of an anomalous (significant) reversal of this effect between the single and double dressing.

The residual effect of ammonium humate above that of sulphate of ammonia is not large enough to be significant.

Sugar Beet. Tunstall, Suffolk, 1933.
A. W. Oldershaw, Esq., County Organiser.

5 × 5 Latin square. Plots; 1/56 acre.
Treatments: Second year, no further chalk applied. (See 1932 Report p.208, for first year's dress ngs.)
Basal manuring: 3 cwt. super, 3 cwt. muriate of potash and 3 cwt. of nitrate of soda per acre.
Soil: Acid sand. Variety: Kleinwanzleben E. Beet sown: May 6th. Lifted: December 1st.
Previous crop: Sugar beet.
Standard errors per plot: Roots: ±0.978 tons per acre or ±8.93 per cent.; tops: ±0.630 tons per acre or ±10.86 per cent.; sugar percentage: ±0.276. Mean dirt tare: 0.0960.

Chalk tons per acre (1932)	ROOTS (washed) Tons per acre	*Increase*	TOPS Tons per acre	*Increase*	SUGAR PERCENTAGE	*Increase*	TOTAL SUGAR Cwt. per acre	*Increase*
Mean	*10.95*		*5.80*		*16.35*		*36.0*	
None	2.94		2.36		15.89		9.3	
1 ..	11.40	*+8.46*	6.00	*+3.64*	16.49	*+0.60*	37.6	*+28.3*
2 ..	13.23	*+1.83*	6.61	*+0.61*	16.32	*−0.17*	43.2	*+5.6*
3 ..	13.26	*+0.03*	6.88	*+0.27*	16.53	*+0.21*	43.8	*+0.6*
4 ..	13.91	*+0.65*	7.16	*+0.28*	16.53	*0.00*	46.0	*+2.2*
St. Error	±0.437	*±0.618*	±0.282	*±0.399*	±0.123	*±0.174*		

Conclusions

A large response to one ton of chalk (applied in 1932). The roots show a significant further response to two tons, but little further response. The similar increase to two tons in the case of tops is not itself significant, but may be considered so in the light of the higher yields with three and four tons.

The sugar percentage is significantly increased by one ton of chalk, but there is no further increase with the heavier dressings.

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Sugar Beet. J. Morris, Esq., Honey Farm, Wimblington, Cambs., 1933.

8 randomised blocks of 4 plots each. Plots : 0.0153 acre.
Treatments : Superphosphate at the rate of 0, and 3 cwt. per acre in combination with muriate of potash at the rate of 0, and 1½ cwt. per acre.
Basal manuring : nil.
Soil : Light fenland resting on peat. Variety : Hilleshog.
Manures applied : May 8th. Beet sown : May 10th. Lifted : December 28th. Previous crop : Wheat.
Standard errors per plot ; roots : 1.402 tons per acre or 12.87%. Sugar percentage : 0.424. Mean dirt tare : 0.0722.

Roots (washed) tons per acre (±0.495)					Sugar Percentage (±0.150)				
Muriate of potash	Superphosphate None	Superphosphate 3 cwt.	*Mean* (±0.350)	*Increase* (±0.495)	Muriate of potash	Superphosphate None	Superphosphate 3 cwt.	*Mean* (±0.106)	*Increase* (±0.150)
None ..	10.46	10.99	*10.72*		None ..	15.04	15.16	*15.10*	
1½ cwt. ..	10.96	11.10	*11.03*	*+0.31*	1½ cwt. ..	15.24	15.12	*15.18*	*+0.08*
Mean (±0.350)	*10.71*	*11.04*	*10.88*		*Mean* (±0.106)	*15.14*	*15.14*	*15.14*	
Incr. (±0.495)	*+0.33*				*Incr.* (±0.150)	*0.00*			

Total Sugar cwt. per acre

Muriate of potash	Superphosphate None	Superphosphate 3 cwt.	*Mean*	*Incr.*
None	31.5	33.3	*32.4*	
1½ cwt.	33.4	33.6	*33.5*	*+1.1*
Mean	*32.4*	*33.4*	*32.9*	
Increase	*+1.0*			

Conclusions

No significant effects.

Peas. H. Inskip, Esq., Stanford, Biggleswade, 1933.

6 randomised blocks of 4 plots each. Second order interaction confounded. Plots : 1/70 acre.
Treatments : 4 cwt. high-soluble basic slag, 2 cwt. nitro-chalk, and 1 cwt. sulphate of potash per acre in all combinations.
Basal manuring : Nil.
Soil : Sandy gravel. Variety : Laxton's Superb. Manures applied : March 9th. Peas sown : March 8th. Picked : June 20th. Previous crop : Potatoes.
Standard errors per plot : 2.46 cwt. per acre or ±7.16%.

Individual Treatments : cwt. per acre (±1.42)

Sub-blocks A				Sub-blocks B				
O	**NP**	**NK**	**PK**	**N**	**P**	**K**	**NPK**	*Mean*
32.1	36.2	34.2	31.6	39.8	34.0	32.5	34.0	*34.3*

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Responses to Fertilisers : cwt. per acre

Fertiliser	*Mean Response*	Basic Slag		Nitro-chalk		Sulphate of potash	
		Absent	Present	Absent	Present	Absent	Present
Basic Slag	*−0.70*[1]	—	—	+0.50[2]	−1.90[2]	−0.85[2]	−0.55[2]
Nitro-chalk	*+3.50*[1]	+4.70[2]	+2.30[2]	—	—	+4.95[2]	+2.05[2]
Sulphate of potash	*−2.45*[1]	−2.60[2]	−2.30[2]	−1.00[2]	−3.90[2]	—	—

Standard errors : (1) 1.00, (2) 1.42.

Conclusions

Significant response to nitrogen and a significant depression in yield by potash, appearing mainly on the plots receiving nitrogen, though the interaction is not significant. No evidence of any phosphate effects.

EXPERIMENTS CARRIED OUT BY LOCAL WORKERS.

Hay. Hertfordshire Farm Institute, St. Albans, 1933.

One strip of each of two seeds mixtures, the double strip being divided transversely into 30 plots, giving 5 randomised blocks of 6 plots each for manurial treatments. Sub-plots : 1/100 acre.
Treatments : No phosphate, basic slag (85% citric solubility, 15% P_2O_5), at the rate of 1 cwt. P_2O_5 per acre, Gafsa rock phosphate (90% through 120 sieve) at the rate of 1 cwt. P_2O_5, alone and with 0.5 cwt. K_2O per acre in the form of 30% potash salt.
Mixture (1) : 6 lb. Italian ryegrass, 20 lb. perennial ryegrass, 6 lb. late flowering red clover, 1 lb. rough stalked meadow grass, 1 lb. wild white clover. Mixture (2) : 20 lb. perennial ryegrass, 1½ lb. wild white clover.
Basal manuring : Nil. Soil : Heavy flinty loam, well supplied with chalk. Manures applied : 7th January. Cut : 6th June. Previous crop : Oats.
Special notes : Grazed till May 5th. The yields are therefore one month's growth in a very dry time
Standard error : per whole plot—1.82 cwt. or 5.89%, per sub-plot—2.23 cwt. or 7.22%.

Dry Hay : cwt. per acre

	None	Basic Slag	Mineral phosphate	Potash	Slag and Potash	Min. Phos. and Potash	*Mean*
Mixture 1	43.7	46.3	43.3	42.8	46.2	47.1	*44.9*
Mixture 2	15.2	17.0	18.2	15.1	16.2	19.6	*16.9*
Diff. (±1.41)	*28.5*	*29.3*	*25.1*	*27.7*	*30.0*	*27.5*	*28.0*

Mean of both Mixtures (±0.814)

Cwt. per acre	No Phosphate	Basic Slag	Mineral Phosphate	Mean (±0.470)
No Potash	29.4	31.6	30.8	30.6
Potash	29.0	31.2	33.4	31.2
Mean (±0.576) ..	29.2	31.4	32.1	30.9

Conclusions

There is a significant response to phosphate, not signficantly different for the two forms. The interactions of the two mixtures with the manurial treatments are not significant. The mixtures appear to give very different yields, though there is no statistical test applicable to this difference.

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Meadow Hay. 3rd Season. Lady Manner's School, Bakewell ,1933.

5×5 Latin square. Plots : 1/198th acre.
Treatments : Low and high soluble slag, rock phosphate and superphosphate at the rate of 1.0 cwt. P_2O_5 per acre.
Basal manuring : Nil.
Soil : Limestone. Manures applied : March 27th. 1931.
Hay cut : July 18th and 19th.
Standard error per plot : ±3.81 cwt. per acre, or ±8.3 %.

	Yield, cwt. per acre.	*Increase over no dressing.*
Mean	*45.8*	
No phosphate	46.0	
Rock phosphate	43.6	*−2.4*
Low soluble slag	45.9	*−0.1*
High soluble slag	46.8	*+0.8*
Superphosphate	46.8	*+0.8*
Standard Error	±1.70	*±2.40*

Conclusions
No significant effects.

Hay. 3rd Season. Lady Manner's School, Bakewell, 1933.

3 randomised blocks of eight plots each. Plots 1/161 acre.
Treatments : Nitrate of soda at the rate of 2 cwt., superphosphate at the rate of 3 cwt., and 30% potash salt at the rate of 1 cwt. per acre in all combinations.
Basal manuring : Nil.
Soil : Limestone. Manures applied : April 3rd and 4th. Hay cut : July 3rd and 4th.
Standard error per plot : ±5.63 cwt. per acre or ±11.6%.

Individual Treatments : cwt. per acre (±3.25)

O	N	P	K	NP	NK	PK	NPK	*Mean*
40.6	52.8	41.0	36.9	52.5	57.4	42.3	64.1	*48.4*

Responses to Fertilisers : cwt. per acre

Fertiliser.	*Mean Response*	Nitrate of Soda Absent	Nitrate of Soda Present	Superphosphate Absent	Superphosphate Present	Potash Salt Absent	Potash Salt Present
Nitrate of Soda	*+16.5*[1]	—	—	+16.4[2]	+16.6[2]	+11.8[2]	+21.2[2]
Superphosphate..	*+3.0*[1]	+2.9[2]	+3.2[2]	—	—	+0.2[2]	+6.0[2]
Potash Salt ..	*+3.4*[1]	−1.2[2]	+8.1[2]	+0.4[2]	+6.4[2]	—	—

Standard errors : (1) ±2.30, (2) ±3.25.

Conclusions
Significant response to nitrogen, but not to superphosphate or potash.

Meadow Hay. 2nd Season. Lady Manner's School, Bakewell, 1933.

3 randomised blocks of 9 plots each. Plots : 1/216 acre.
Treatments : 8 tons of compost, 2 cwt. of nitrate of soda, 3 cwt. of superphosphate, and 1 cwt. of 30% potash salts.
Basal manuring : Nil.
Soil : Limestone. Manures applied : March 29th, 30th and 31st. Hay cut : June 12th.
Standard error per plot : ±7.73 cwt. per acre, or ±19.6%.

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Summary : cwt. per acre (±4.45)

Second year's Treatment	First Year's Treatment			*Mean* (±2.57)	*Increase* (±3.63)
	None	NPK	Compost		
None	27.6	28.3	30.4	*28.8*	
NPK	46.8	54.0	46.6	*49.1*	*+20.3*
Compost ..	44.0	35.2	42.4	*40.5*	*+11.7*
Mean (±2.57)	*39.5*	*39.2*	*39.8*	*39.5*	
Incr. (±3.63)		*—0.3*	*+0.3*		

Conclusions

The yields with artificials are significantly greater than those with compost, and both are significantly greater than the yields without manure. The manures applied in the previous year, on the other hand, show no apparent residual effects.

Meadow Hay. Haileybury College Farm, 1933.
H. W. Gardner, Esq., Hertfordshire Farm Institute.

6 × 6 Latin Square. Plots 1/50 acre.
Treatments : Basic Slag (15% P_2O_5 85% citric solubility) and ground mineral phosphate (28% P_2O_5, 90% through 120 sieve) at the rate of 1.0 cwt. P_2O_5 per acre in combination with 30% potash salt at 0 and 0.5 cwt. K_2O per acre.
Basal manuring : Nil.
Soil : Clay loam. Manures applied : January 4th. Hay cut : July 4th.
Standard error per plot : ±3.02 cwt. per acre or ±10.1%.

Cwt. p.a. (±1.23)	No phosphate	Basic Slag	Mineral Phosphate	*Mean* (±0.710)	*Increase* (±1.00)
No potash ..	26.8	28.5	31.7	*29.0*	
Potash salt ..	30.5	28.3	33.8	*30.9*	*+1.9*
Mean (±0.870)	*28.6*	*28.4*	*32.8*	*29.9*	
Increase (±1.23)		*—0.2*	*+4.2*		

Conclusions

Significant response to mineral phosphate, but no response to basic slag. The response to potash is not significant.

Barley. F. Richardson, Esq., Sansom Wood Farm, Calverton, Notts, 1933.
K. R. Davis, Esq., Notts Education Committee.

4 × 4 Latin square. Yields from 8 plots only obtained. Plots 1/40 acre.
Treatments : applied in 1932 to potato crop : Mineral mixture (2.12 cwt. sulphate of ammonia, 3.98 cwt. superphosphate, 3.28 cwt. 30% potash salt per acre), concentrated fertiliser (I.C.I. No. 1), organic manure (H.O.P. No. 9 fish manure). The fish manure and the mineral mixture on an equal N.P.K. basis.
Basal manuring : applied in 1932 : 12 loads dung per acre.
Soil : Very light sand on Bunter sandstone. Variety : Spratt Archer. Seed sown : March 30th. Harvested : August 15th. Previous crop : Potatoes.
Special notes : Plots harvested by sampling method (16 random samples per plot each consisting of 4 half metre rows). Rows 8 ins. apart.
Standard errors per plot : Grain : 1.59 cwt. per acre or 7.0%. Straw : 3.48 cwt. or 13.7%.

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	GRAIN cwt. per acre	*Increase*	STRAW cwt. per acre	*Increase*
Mean	*22.9*		*25.3*	
No manure ..	22.5		22.8	
Mineral mixture ..	22.8	*+0.3*	24.4	*+1.6*
Concentrated fertiliser	22.9	*+0.4*	28.1	*+5.3*
Organic manure ..	23.4	*+0.9*	25.9	*+3.1*
St. Error ..	±1.12	*±1.58*	±2.46	*±3.48*

Conclusions

No significant effects.

Wheat. A. Hunter, Esq., The Farm, Wilford, Notts, 1933. K. R. Davis, Esq., Notts Education Committee.

4×4 Latin square. Plots : 1/50 acre.
Treatments : applied in 1932 to sugar beet : Mineral mixture, I.C.I. concentrated fertiliser No. 1, at the rate of 3.6 cwt. per acre and Fish manure at the rate of 10 cwt. per acre.
Fish Manure and mineral mixture on an equal N.P.K. basis.
Basal manuring : applied to sugar beet in 1930 : 12 loads of Farmyard manure per acre.
Soil : Sandy loam. Variety : Little Joss. Seed sown : November 1932. Harvested : August 22nd.
Previous crop : Sugar Beet.
Special notes : Plots harvested by sampling method (16 random samples per plot each consisting of 2 half metre rows). Rows 10 ins. apart.
Standard errors per plot : Grain : 1.14 cwt. or 6.4%. Straw : 1.41 cwt. or 6.1%.

	GRAIN cwt. per acre	Increase	STRAW cwt. per acre	Increase
Mean	*17.8*		*23.0*	
No manure	18.2		23.4	
Mineral mixture ..	18.0	*−0.2*	22.3	*−1.1*
Concentrated fertiliser	17.5	*−0.7*	22.6	*−0.8*
Fish manure	17.4	*−0.8*	23.5	*+0.1*
St. Error	±0.572	*±0.809*	±0.705	*±0.997*

Conclusions

No significant effects.

Potatoes. J. E. Arden, Esq., Owmby Cliff, Lincs., 1933. J. A. McVicar, Esq., County Organiser.

4×4 Latin Square. Plots 1/80 acre.
Treatments : 4 levels of sulphate of ammonia as shown.
Basal manuring : 2 cwt. of superphosphate and 2 cwt. of sulphate of potash per acre.
Soil : Limestone. Variety : Dunbar Cavalier.
Manures applied : April 10th. Potatoes planted : April 11th. Lifted : October 20th. Previous crop : Seeds.
Standard error per plot : ±0.425 tons per acre or ±4.02%.

Sulphate of Ammonia (p.a.)	Yield tons p.a.	*Increase for each dressing*
Mean	*10.56*	
None ..	9.50	
1½ cwt. ..	10.29	*+0.79*
3 cwt.	11.12	*+0.83*
4½ cwt. ..	11.33	*+0.21*
St. Error ..	±0.212	*±0.300*

Conclusions

Significant response to increasing dressings of sulphate of ammonia, this response showing no significant departure from proportionality with the amount of the fertiliser.

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Potatoes. Midland Agricultural College, Loughborough, 1933.

4 × 4 Latin Square. Plots 1/60 acre.
Treatments: 4 levels of a mixed fertiliser containing 1 part of sulphate of ammonia, 3 parts superphosphate and 1 part of sulphate of potash.
Basal manuring: 1 ton of lime per acre applied in autumn 1932 and 12 tons of dung per acre.
Soil: Light loam. Variety: Scotch King Edward. Manures applied: April 7th. Potatoes planted: April 11th and 12th. Potatoes lifted: October 17th. Previous Crop: Seeds hay.
Standard errors per plot: ±0.553 tons per acre or ±6.17%.

Artificials	Yield tons p.a.	*Increase for each dressing*
Mean	*8.97*	
None ..	8.34	
4 cwt.	8.89	*+0.55*
8 cwt.	9.16	*+0.27*
12 cwt. ..	9.50	*+0.34*
St. Error ..	±0.276	*±0.390*

Conclusions

The progressive response to artificials is just large enough to be significant, without any significant deviations from proportionality.

Potatoes. Midland Agricultural College, Loughborough, 1933.

4 randomised blocks of 9 plots each. Plots 0.0205 acre.
Treatments: Sulphate of Ammonia at the rate of 0, 1½ and 3 cwt. per acre in combination with sulphate of potash at the rate of 0, 1½ and 3 cwt. per acre.
Basal manuring: 12 tons of dung in the autumn and 3 cwt. of superphosphate in the spring.
Soil: Light loam. Variety: Scotch King Edward.
Manures applied: April 7th.
Potatoes planted: April 11th and 12th. Lifted: October 17th. Previous crop: Seeds.
Standard error per plot: ±1.19 tons per acre or ±11.77%.

Summary: tons per acre (±0.591)

Sulphate of potash	Sulphate of Ammonia: None	1½ cwt.	3 cwt.	*Mean (±0.341)*	*Increase (±0.482)*
None ..	10.03	9.44	10.29	*9.92*	
1½ cwt. ..	9.71	10.00	11.09	*10.27*	*+0.35*
3 cwt. ..	10.07	10.53	9.53	*10.04*	*−0.23*
Mean (±0.341)	*9.94*	*9.99*	*10.30*	*10.08*	
Incr. (±0.482)		*+0.05*	*+0.31*		

Conclusions

No significant effects.

Potatoes. Norton New Council School, Doncaster, 1933.

4 randomised blocks of 4 plots each. Plots 1/306 acre.
Treatments: 3 times of application of a dressing of 3 cwt. of sulphate of potash per acre.
Basal manuring: 4 cwt. of superphosphate and 3 cwt. of sulphate of ammonia per acre.
Soil: Medium Loam.
Variety: Majestic, Scotch.
Potatoes planted: April 10th. Lifted: August 24th.
Previous Crop: Potatoes.
Standard error per plot: ±0.883 tons per acre or 11.29%.

Date of application	Yield Tons p.a.	*Increase over no potash*
Mean ..	*7.82*	
None ..	3.58	
March 7 ..	9.00	*+5.42*
April 10 ..	11.18	*+7.60*
May 22 ..	7.52	*+3.94*
St. Error ..	±0.441	*±0.624*

Conclusions

The response to potash is significant, being significantly greater for the April dressing than for the other two.

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Potatoes. Kinmel School, Abergele, Denbighshire, 1933.

4 randomised blocks of 8 plots each. Plots : 1/67 acre.
Treatments : All combinations of 3 cwt. sulphate of ammonia, 4 cwt. superphosphate and 3 cwt. sulphate of potash per acre.
Basal Manuring : Nil.
Soil : Fairly light, with some clay and stones. Variety : Great Scot. Manures applied : May 4th. Planted : May 11th. Lifted : September 29th. Previous crop : Old grass.
Standard error per plot : ±0.991 tons per acre or ±18.7%.

Individual Treatments : tons per acre (±0.496)

O	N	P	K	NP	NK	PK	NPK	*Mean*
4.62	4.41	5.62	4.80	5.28	5.32	5.80	6.50	*5.29*

Responses to Fertilisers : tons per acre

Fertiliser	*Mean Response*	Sulphate of Ammonia		Superphosphate		Sulphate of potash	
		Absent	Present	Absent	Present	Absent	Present
Sulphate of ammonia ..	*+0.17*[1]	—	—	+0.16[2]	+0.18[2]	−0.28[2]	+0.61[2]
Superphosphate ..	*+1.01*[1]	+1.00[2]	+1.02[2]	—	—	+0.94[2]	+1.09[2]
Sulphate of potash ..	*+0.62*[1]	+0.18[2]	+1.06[2]	+0.54[2]	+0.70[2]	—	—

Standard errors : (1) ±0.351, (2) ±0.496.

Conclusions

There is a significant response to superphosphate, but no apparent response to sulphate of ammonia, nor does the response to potash reach significance.

Sugar Beet. County Farm Institute, Moulton, Northampton, 1933.

4×4 Latin Square. Plots : 1/50 acre.
Treatments : 4 levels of a mixture of fertilisers (containing sulphate of ammonia, steamed bone flour, superphosphate and potash salts) to give the following analysis : N : 5% ; insoluble P_2O_5 : 3.5% ; soluble P_2O_5 : 4% ; K_2O : 11%.
Basal manuring : 12 tons of farmyard manure ploughed in and 14 cwt. burnt lime per acre.
Soil : Sandy loam (Northampton sand formation). Variety : Kleinwanzleben E. Manures applied : April 27th. Beet planted : April 28th. Lifted : November 2nd. Previous crop : Second year seeds.
Standard errors per plot : roots : ±1.12 tons per acre or ±11.24% ; tops : ±1.48 tons per acre or ±13.36% ; sugar percentage : ±0.559. Mean dirt tare : 0.1040 (treatments corrected separately).

Fertiliser cwt. p.a.	ROOTS (washed) tons p.a.	*Increase*	TOPS tons p.a.	*Increase*	Sugar Percentage	*Increase*	Total Sugar cwt. p.a.	*Increase*
Mean	*9.95*		*11.11*		*16.72*		*33.2*	
None	8.26		9.02		16.92		28.0	
5	9.38	*+1.12*	10.52	*+1.50*	16.80	*−0.12*	31.5	*+3.5*
10	11.85	*+2.47*	12.37	*+1.85*	16.42	*−0.38*	38.9	*+7.4*
15	10.30	*−1.55*	12.54	*+0.17*	16.76	*+0.34*	34.5	*−4.4*
St. Error	±0.560	*±0.792*	±0.742	*±1.049*	±0.279	*±0.395*		

Conclusions

Both the roots and the tops show a significant response to artificials. In the case of the roots there is a significant falling off in response per unit fertiliser with the highest dressing. The similar falling off with the tops is much smaller and non-significant. There are no significant differences in sugar percentage.

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Sugar Beet. R. Goodhand, Esq., Redbourne, Kirton-Lindsey, Lincs., 1933.

A. McVicar, Esq., County Organiser.

5×5 Latin square with split columns. Sub-plots : 1/100 acre.
Treatments : 5 levels of a compound fertiliser (containing sulphate of ammonia, nitrate of soda, superphosphate, muriate of potash and steamed bone flour) to give the following analysis : ammonia N : 3.60% ; nitric N : 2.40% ; soluble P_2O_5 : 12.75% ; K_2O : 10.00% and bone P_2O_5 : 3.00% ; half columns harvested early or late.
Basal manuring : Nil.
Soil : Limestone. Variety : Kleinwanzleben E. Manures applied : April 12th. Beet sown : April 18th. Lifted, early : October 4th ; late : November 13th. Previous crop : Oats.
Standard errors : Roots : per half column, ±0.714 tons per acre or ±4.62%. Per whole plot : ±0.537 tons per acre or ±3.48%. Per sub-plot : ±0.550 tons per acre or ±3.57%. Tops : per half column, ±0.830 tons per acre or ±8.57%. Per whole plot : ±0.769 tons per acre or ± 7.91%. Per sub-plot : ±0.969 tons per acre or ±9.98%. Sugar percentage : per half column : ±0.154. Per whole plot : ±0.292. Per sub-plot : ±0.249. Mean dirt tare : 0.0938. (Treatments corrected separately.)

Yields of Separate Treatments

Fertiliser cwt. p.a.	Roots (Washed) tons p.a.		Tops, tons p.a.		Sugar Percentage		Total Sugar. cwt. p. a.	
	Early	Late	Early	Late	Early	Late	Early	Late
None	13.66	15.17	6.90	8.07	16.18	16.38	44.2	49.7
4	14.45	16.17	7.76	9.54	16.36	16.48	47.3	53.3
8	14.78	16.45	8.78	10.70	15.74	16.12	46.5	53.0
12	14.86	17.02	10.28	11.73	15.64	16.34	46.5	55.6
16	14.74	16.78	9.91	13.39	15.34	15.78	45.2	53.0

Effects of Fertiliser (mean of two harvestings)

Fertiliser cwt. p.a.	Roots (Washed) tons p.a.	Increase	Tops tons p.a.	Increase	Sugar Percentage	Increase	Total Sugar cwt. p.a.	Increase
Mean	*15.41*		*9.71*		*16.04*		*49.4*	
None	14.42		7.48		16.28		47.0	
4	15.31	+0.89	8.65	+1.17	16.42	+0.14	50.3	+3.3
8	15.62	+0.31	9.74	+1.09	15.93	−0.49	49.8	−0.5
12	15.94	+0.32	11.00	+1.26	15.99	+0.06	51.0	+1.2
16	15.76	−0.18	11.65	+0.65	15.56	−0.43	49.1	−1.9
St. Error	±0.239	±0.338	±0.344	±0.486	±0.130	±0.184		

Effect of Time of Harvesting (late minus early)

Fertiliser Cwt. p.a.	ROOTS Tons p.a.	TOPS Tons p.a.	SUGAR PERCENTAGE	TOTAL SUGAR Cwt. p.a.
Mean ..	*+1.82*	*+1.96*	*+0.37*	*+7.0*
St. Error..	*±0.452*	*±0.525*	*±0.0973*	
None	+1.51	+1.17	+0.20	+5.5
4	+1.72	+1.78	+0.12	+6.0
8	+1.67	+1.92	+0.38	+6.5
12	+2.16	+1.45	+0.70	+9.1
16	+2.04	+3.48	+0.44	+7.8
St. Error..	±1.01	±1.17	±0.218	

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Conclusions

Both the roots and tops show a significant response to the fertiliser, set off against a significant reduction in sugar percentage. The response per unit dressing is significan'ly less for the higher dressings in the case of the roots but not in the case of the tops. The similar effect in the sugar percentage is not large enough to be significant.

The yields of both roots and tops are significantly greater for the later harvesting. The sugar percentage is also increased significantly. In the case of the tops and sugar percentage (but not of the roots) this difference is significantly greater for increasing dressings of fertiliser, i.e., the fertiliser has been more effective on the late harvested crop.

Sugar Beet. J. A. Cradock, Esq., College Farm, Elsham, 1933. A. McVicar, Esq., County Organiser.

5×5 Latin square with split plots. Sub-plots 1/100 acre.
Treatments : 5 levels of a complete fertiliser (containing nitrate of soda, superphosphate, muriate of potash and steamed bone flour) of the following analysis : nitric N : 3.5% ; soluble P_2O_5 : 7.1% ; insoluble P_2O_5 : 3.1% ; K_2O : 11.1%. Half plots top dressed with 1 cwt. of nitrate of soda.
Basal manuring : 10 loads of farmyard manure per acre.
Soil : Deep Wold. Variety : Dippe. Manures applied : April 24th. Top dressing applied : June 12th. Beet sown : April 28th. Lifted : October 13th. Previous crop : Wheat.
Plant counts taken on whole plots. Mean plant number : 27276 per acre. Mean yield per plant : 1.209 lb. (clean). Mean increase in yield for one additional plant : +0.370 lbs.
Mean dirt tare : 0.125.

Standard Errors	Per Whole Plot per acre	Per Whole Plot per cent.	Per Sub-Plot per acre	Per Sub-Plot per cent.
Plant number	±1047		±1869	
Roots (tons) unadjusted for plant number	±0.433	±2.94	±0.522	±3.54
Roots (tons) adjusted for plant number	±0.403	±2.74	±0.470	±3.20
Tops (tons)	±0.330	±2.84	±0.522	±4.50
Sugar percentage	±0.260		±0.346	

Yields of Separate Treatments

Fertiliser Cwt. p.a.	ROOTS (washed) Tons p.a. None	ROOTS (washed) Tons p.a. N/S	TOPS Tons p.a. None	TOPS Tons p.a. N/S	SUGAR PERCENTAGE None	SUGAR PERCENTAGE N/S	TOTAL SUGAR Cwt. p.a. None	TOTAL SUGAR Cwt. p.a. N/S	PLANT NUMBER p.a. None	PLANT NUMBER p.a. N/S
None	13.65	14.18	9.58	9.89	16.00	15.52	43.7	44.0	25960	24880
4	14.66	14.48	10.66	10.70	15.96	15.92	46.8	46.1	27300	26420
8	14.87	15.01	11.09	12.02	15.68	15.40	46.6	46.2	28140	26840
12	14.81	15.39	12.02	13.04	15.54	15 38	46.0	47.3	28100	28420
16	14.91	15.30	13.46	13.40	15.40	15.00	45.9	45.9	27960	28740

Effects of Fertiliser (mean of top dressing and no top dressing)

Fertiliser Cwt. p.a.	ROOTS (washed) Tons p.a.	ROOTS (washed) *Increase*	TOPS Tons p.a.	TOPS *Increase*	SUGAR PERCENTAGE	SUGAR PERCENTAGE *Increase*	TOTAL SUGAR Cwt. p.a.	TOTAL SUGAR *Increase*	PLANT NUMBER per acre	PLANT NUMBER *Increase*
Mean	*14.72*		*11.59*		*15.58*		*45.8*		*27276*	
None	13.91		9.74		15.76		43.8		25420	
4	14.57	*+0.66*	10.68	*+0.94*	15.94	*+0.18*	46.4	*+2.6*	26860	*+1440*
8	14.94	*+0.37*	11.56	*+0.88*	15.54	*−0.40*	46.4	*0.0*	27490	*+630*
12	15.10	*+0.16*	12.53	*+0.97*	15.46	*−0.08*	46.6	*+0.2*	28260	*+770*
16	15.10	*0.00*	13.43	*+0.90*	15.20	*−0.26*	45.9	*−0.7*	28350	*+90*
St. Error	±0.194	*±0.274*	±0.147	*±0.208*	±0.116	*±0.164*			±468	*±662*

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Effect of Top Dressing

Fertiliser Cwt. p.a.	ROOTS (Washed) Tons p.a.	TOPS Tons p.a.	SUGAR PERCEN-TAGE	TOTAL SUGAR Cwt. p.a.	PLANT NUMBER p.a.
Mean	*+0.29*	*+0.45*	*−0.28*	*+0.1*	*−432*
St. Error	*±0.148*	*±0.148*	*±0.098*		*±529*
None	+0.53	+0.31	−0.48	+0.3	−1080
4	−0.18	+0.04	−0.04	−0.7	−880
8	+0.14	+0.93	−0.28	−0.4	−1300
12	+0.58	+1.02	−0.16	+1.3	+320
16	+0.39	−0.06	−0.40	0.0	+780
St. Error	±0.330	±0.330	±0.219		±1182

Conclusions

The roots show a significant response to the complete fertiliser with a significantly lower response per unit fertiliser in the higher dressings ; dressings above 8 cwt. produce little effect. Part, but not all, of this response is due to the significant increase in the number of roots with increasing applications of fertiliser ; here again dressings above 8 cwt. produce little effect.

The tops also show a significant response to the complete fertiliser without any lower response per unit fertiliser in the higher dressings.

The sugar percentage is significantly decreased by the complete fertiliser, the decrease per unit fertiliser being significantly greater for the higher dressings.

The top dressing of nitrate of soda increases the yield of roots and tops, the latter significantly and the former significantly if allowance is made for plant number, which does not appear to be affected by this treatment. Sugar percentage is significantly decreased.

There are no significant interactions of the top dressing and the complete fertiliser.

Sugar Beet. A. S. Williamson, Es q., Thonock, Gainsborough, 1933. A. McVicar, Esq., County Organiser.

4×4 Latin Square. Plots : 1/50 acre.
Treatments : 4 widths of singling as shown in the summary.
Basal manuring : 3 cwt. of sulphate of ammonia, 4½ cwt. superphosphate, 2¾ cwt. muriate of potash, and 10 loads of farmyard manure per acre.
Soil : Sand. Variety : Kleinwanzleben E. Manures applied : April 10th. Beet sown : April 20th. Lifted : October 23rd. Previous crop : barley.
Standard errors per plot : roots : ±0.776 tons per acre or ±5.68% ; tops : ±1.309 tons per acre or ±16.87% ; Sugar percentage : ±0.538. Analysis of variance performed on clean roots.

Singling Inches	ROOTS (Washed) tons p.a.	*Increase*	TOPS tons p.a.	*Increase*	SUGAR PER-CENTAGE	*Increase*	TOTAL SUGAR cwt. p.a.	*Increase*
Mean	*13.69*		*7.76*		*16.34*		*44.8*	
8	13.48		7.75		16.28		43.9	
10	13.74	*+0.26*	7.20	*−0.55*	16.30	*+0.02*	44.8	*+0.9*
12	13.72	*−0.02*	8.28	*+1.08*	16.42	*+0.12*	45.1	*+0.3*
14	13.81	*+0.09*	7.81	*−0.47*	16.38	*−0.04*	45.2	*+0.1*
St. Error	±0.389	*±0.550*	±0.654	*±0.925*	±0.269	*±0.380*		

Conclusions

No significant effects.

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Sugar Beet. E. Addison, Esq., Riby, Lincs., 1933. J. A. McVicar, Esq., County Organiser.

4×4 Latin square. Plots: 1/50 acre.
Treatments: 4 levels of a compound fertiliser (containing sulphate of ammonia, nitrate of soda, muriate of potash, superphosphate and steamed bone flour) to give the following analysis: ammonia N: 3.5%; nitric N: 1.9%; K_2O: 7.5%; water soluble P_2O_5: 6.2%; insoluble P_2O_5: 0.7%.
Basal manuring: Nil.
Soil: Wold. Variety: Kleinwanzleben E. Manures applied: April 10th. Beet sown; April 13th. Lifted: October 3rd. Previous crop: Wheat.
Plant counts taken on whole plots. Mean plant number: 27859 per acre. Mean yield per plant, 1.372 lb. Mean increase in yield for one additional plant: +0.231 lb.
Standard errors per plot: Plant number: ±1042 per acre; roots, unadjusted for plant number: ±0.448 tons per acre or ±2.62%; roots adjusted for plant number: ±0.478 tons per acre or ±2.80%; tops: ±0.379 tons per acre or 2.57%; sugar percentage: ±0.428. Mean dirt. tare: 0.0804.

Compound fertiliser cwt. p.a.	ROOTS (Washed) tons p.a.	*Increase*	TOPS tons p.a.	*Increase*	SUGAR PERCENTAGE	*Increase*	TOTAL SUGAR cwt. p.a.	*Increase*
Mean	*17.06*		*14.74*		*15.18*		*51.8*	
6	17.06		13.50		15.45		52.7	
9	17.35	*+0.29*	14.64	*+1.14*	15.45	*0.00*	53.6	*+0.9*
12	16.97	*−0.38*	15.25	*+0.61*	14.98	*−0.47*	50.8	*−2.8*
15	16.87	*−0.10*	15.58	*+0.33*	14.82	*−0.16*	50.0	*−0.8*
St. Error	±0.224	*±0.317*	±0.190	*±0.269*	±0.214	*±0.303*		

Conclusions

The roots show no response to fertiliser. The tops responded significantly, but with a not quite significantly smaller response per unit dressing at the higher levels. The sugar percentage is significantly depressed by the fertiliser.

Sugar Beet. Cavendish Lodge, Clipstone, Mansfield. R. N. Dowling, Esq., County Organiser. H. T. Cranfield, Esq., Advisory Chemist.

6 randomised blocks of 9 plots each. Plots: 1/50 acre.
Treatments: Ground limestone at the rate of O, 30 and 60 cwt. per acre in all combinations with muriate of potash at the rate of 0, 1½, and 3 cwt. per acre.
Basal manuring: 2 cwt. of nitro-chalk per acre.
Soil: Sandy gravel from Bunter Drift. Very acid. Variety: Kleinwanzleben.
Manures applied: April 12th. Beet planted: May 12th. Lifted: October 30th.
Previous crop: Kale.
Standard errors per plot: roots: ±0.930 tons per acre or ±32.63%; tops: ±0.691 tons per acre, or ±25.14%; sugar percentage, ±0.475. Analysis of variance performed on clean roots.

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ROOTS (Washed) Tons per acre (±0.379)

Muriate of potash	Limestone (cwt. p.a.) None	30	60	*Mean* (±0.219)	*Incr.* (±0.310)
None	1.12	2.05	3.17	*2.12*	
1½ cwt.	1.66	3.81	3.02	*2.83*	*+0.71*
3 cwt.	2.67	4.08	4.04	*3.60*	*+0.77*
Mean (±0.219)	*1.82*	*3.31*	*3.41*	*2.85*	
Incr. (±0.310)		*+1.49*	*+0.10*		

TOPS Tons per acre (±0.282)

Muriate of potash	Limestone (cwt. p.a.) None	30	60	*Mean* (±0.162)	*Incr.* (±0.229)
None	1.17	2.25	3.30	*2.24*	
1½ cwt.	1.58	3.40	3.03	*2.67*	*+0.43*
3 cwt.	2.67	3.76	3.59	*3.34*	*+0.67*
Mean (±0.162)	*1.81*	*3.14*	*3.31*	*2.75*	
Incr. (±0.229)		*+1.33*	*+0.17*		

SUGAR PERCENTAGE (±0.194)

Muriate of potash	Limestone (cwt. p.a.) None	30	60	*Mean* (±0.112)	*Incr.* (±0.158)
None	16.18	15.50	15.82	*15.83*	
1½ cwt.	16.28	15.75	15.87	*15.97*	*+0.14*
3 cwt.	16.08	16.22	16.42	*16.24*	*+0.27*
Mean (±0.112)	*16.18*	*15.82*	*16.03*	*16.01*	
Incr. (±0.158)		*−0.36*	*+0.21*		

TOTAL SUGAR Cwt. per acre

Muriate of potash	Limestone (cwt. p.a.) None	30	60	*Mean*	*Incr.*
None	3.6	6.4	10.0	*6.7*	
1½ cwt.	5.4	12.0	9.6	*9.0*	*+2.3*
3 cwt.	8.6	13.2	13.3	*11.7*	*+2.7*
Mean	*5.8*	*10.5*	*11.0*	*9.1*	
Incr.		*+4.7*	*+0.5*		

Conclusions

The single dressing of limestone significantly increases the yield of roots and tops, but the additional response to the double dressing is small and insignificant, and is significantly less than that to the single dressing. The dressing of limestone has no effect on sugar percentage.

Muriate of potash significantly increases the roots, tops and sugar percentage, there being no significant differences between the responses to the single dressing and the additional response to the double dressing.

The responses to muriate of potash are not significantly affected by either dressing of limestone.

Sugar Beet. F. Bell, Esq., Markham Moor, Notts, 1933. J. McCloy, Esq., Second Lincolnshire Sugar Co., Brigg, Lincs.

4×4 Latin Square. Plots: 1/50 acre.
Treatments: 4 levels of a complete fertiliser of the following analysis: N, 5%; water soluble P_2O_5, 5.7%; insoluble P_2O_5, 0.7%; K_2O, 10%.
Basal manuring: 12 loads of farmyard manure per acre ploughed in in winter.
Soil: Poor sand on gravel. Variety: Klein N. English. Manures applied: April 5th. Beet sown: April 25th. Lifted: September 18th. Previous crop: Barley.
Standard Errors per plot: roots: ±0.414 tons per acre or ±6.01%; tops: ±0.774 tons per acre or ±20.69%; sugar percentage: ±0.500. Mean dirt tare: 0.0536.

Fertiliser	ROOTS (Washed) Tons p.a.	*Increase*	TOPS Tons p.a.	*Increase*	SUGAR PERCENTAGE	*Increase*	TOTAL SUGAR Cwt. p.a.	*Increase*
Mean	*6.90*		*3.74*		*21.68*		*29.9*	
4 cwt	6.74		3.18		21.80		29.4	
8 cwt	6.98	*+0.24*	3.66	*+0.48*	21.80	*0.00*	30.4	*+1.0*
12 cwt	7.04	*+0.06*	3.78	*+0.12*	22.10	*+0.30*	31.1	*+0.7*
16 cwt	6.86	*−0.18*	4.35	*+0.57*	21.00	*−1.10*	28.8	*−2.3*
St. Error	±0.207	*±0.293*	±0.387	*±0.547*	±0.250	*±0.354*		

Conclusions

The tops, but not the roots, show a significant response to increasing dressings of fertiliser, the sugar percentage a depression, barely significant, with the highest dressing.

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Mangolds. Oakerthorpe, Derbyshire, 1933.

G. Limb, Esq., Derbyshire Education Committee.

4 randomised blocks of 8 plots each. Plots : 1/70th acre. 1/93rd acre harvested.
Treatments : Sulphate of ammonia at the rate of 0 and 3 cwt., 30% potash salt at the rate of 0 and 4 cwt., and dung at the rate of 0 and 15 tons per acre in all combinations.
Basal manuring : 4 cwt. superphosphate per acre.
Soil : Medium-heavy loam on clay sub-soil. Coal measures. Variety : Yellow globe. Manures applied : May 1st, Seed sown : May 2nd, Lifted : November 3rd, and 4th, Previous crop : Wheat.
Standard errors per plot : Roots : ±2.77 tons per acre or ±13.4%. Tops : ±0.410 tons per acre or ±13.1%.

Individual Treatments

Tons per acre	O	N	K	D	NK	ND	KD	NKD	*Mean*
Roots (±1.38)	14.57	17.46	20.08	21.09	21.76	21.82	23.71	24.09	*20.58*
Tops (±0.205)	2.62	2.86	2.82	2.88	3.46	3.46	3.19	3.68	*3.12*

Responses to Fertilisers—Roots : tons per acre

Fertiliser	*Mean Response*	Sulphate of Amm. Absent	Sulphate of Amm. Present	Potash Salt Absent	Potash Salt Present	Dung Absent	Dung Present
Sulphate of ammonia ..	+*1.42*[1]	—	—	+1.81[2]	+1.03[2]	+2.28[2]	+0.56[2]
Potash Salt	+*3.68*[1]	+4.06[2]	+3.28[2]	—	—	+4.90[2]	+2.44[2]
Dung	+*4.21*[1]	+5.08[2]	+3.35[2]	+5.44[2]	+2.98[2]	—	—

Standard errors : ([1]) ±0.976([2]), ±1.38.

Tops : tons per acre

Fertiliser	*Mean Response*	Sulphate of amm. Absent	Sulphate of amm. Present	Potash Salt Absent	Potash Salt Present	Dung Absent	Dung Present
Sulphate of ammonia ..	+*0.49*[1]	—	—	+0.42[2]	+0.56[2]	+0.44[2]	+0.54[2]
Potash Salt	+*0.33*[1]	+0.26[2]	+0.41[2]	—	—	+0.40[2]	+0.26[2]
Dung	+*0.36*[1]	+0.31[2]	+0.41[2]	+0.43[2]	+0.30[2]	—	—

Standard errors : ([1]) ±0.145, ([2]) ±0.205.

Conclusions

Significant responses to dung and to potash both in the roots and the tops, and sulphate of ammonia in the tops only. The response to potash in the presence of dung is less, but not significantly so, than in the absence of dung.

Kale. Midland Agricultural College, Loughborough, 1933.

4 randomised blocks of 6 plots each. Plots : 1/50 acre.
Treatments : Nitro-chalk at the rate of 0, 3 and 6 cwt. per acre in combination with thinning. Plants were 1 in. apart before thinning, 1 ft. apart after thinning.
Basal manuring : 12 tons of dung, 5 cwt. slag (15% P_2O_5) and 2 cwt. potash salt (30% K_2O) per acre.
Soil : Light loam. Variety : Marrow stem. Manures applied : April 25th. Kale drilled : April 10th.
Cut : October 17th-November 9th. Previous crop : Wheat.
Standard Error per plot : 2.21 tons per acre or 6.87%.

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Tons per acre (±1.103)	Nitro-chalk (cwt. p.a.) 0	3	6	*Mean (±0.637)*	*Effect of thinning (±0.901)*
Not thinned ..	29.22	32.89	38.28	*33.46*	
Thinned ..	25.78	32.97	33.75	*30.83*	*−2.63*
Mean (±0.780)	*27.50*	*32.93*	*36.02*	*32.15*	
Incr. (±1.103)		*+5.43*	*+3.09*		

Conclusions

Significant response to nitrogen, the falling off in response per unit fertiliser at the higher level not being significant. Significant reduction in yield by thinning without any significant interactions with nitrogen.

Kale. Farm Institute, Sparsholt, Winchester, 1933.

4 randomised blocks of 6 plots each. Plots 1/60 acre.
Treatments : Sulphate of ammonia at the rate of 0, 2 and 4 cwt. per acre in combination with thinning.
Basal manuring : 3 cwt. superphosphate and 3 cwt. 30% potash salt per acre.
Soil : Light loam with flints, thinly overlying chalk. Variety : Thousand Head.
Manures applied : May 22nd. Seed sown : May 23rd. Kale cut : December 19th-23rd. Previous crop : Sainfoin ley.
Special Notes : It was noted that on one side of the experiment the kale was considerably thinner than on the other and kale had to be planted out to fill up gaps.
Standard error per plot : ±1.28 tons per acre or ±11.0%.

Tons per acre	Sulphate of Ammonia. Cwt. p.a. (±0.640) 0	2	4	*Mean (±0.370)*	*Increase (±0.523)*
Unthinned ..	10.92	12.42	10.36	*11.23*	
Thinned ..	13.26	12.33	10.55	*12.05*	*+0.82*
Mean (±0.453)	*12.09*	*12.38*	*10.46*	*11.64*	
Incr. (±0.640)		*+0.29*	*−1.92*		

Conclusions

The double dressing of sulphate of ammonia significantly depresses the yield. The differences between the thinned and unthinned plots are not large enough to be significant.

Spring Cabbage. R. C. Wood, Esq., Avoncroft College, Evesham, 1933.

5×5 Latin Square. Plots : 1/100 acre.
Treatments : Plots receiving nitrogen had 0.39 cwt. N per acre, those receiving potash 1.32 cwt. K_2O per acre.
Basal manuring : Hoof and horn (14%N) at the rate of 10 cwt. per acre.
Soil : Light loam. Variety : Early Offenham.
Manures applied : March 16th. Cabbages planted : September 28th, 1932. Cut : May 22nd. Previous crop : Runner beans.
Standard error per plot : ±1.11 tons per acre or ±8.19%.

	Yield Tons p.a.	*Increase over no dressing*
Mean ..	*13.55*	
No manure ..	12.70	
Nitrate of soda	13.69	*+0.99*
Sulphate of pot.	12.93	*+0.23*
Both	14.33	*+1.63*
Nitrate of potash	14.08	*+1.38*
St. Error ..	±0.496	*±0.701*

Conclusions

A significant response to nitrogen. No significant response to potash. The response to nitrate of potash is entirely accounted for by its nitrogen content.

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Brussel Sprouts. Bowman's Farm, London Colney, 1933.

H. W. Gardner, Esq., Hertfordshire Farm Institute.

8 randomised blocks of four plots each. Second order interaction confounded. Plots : 1/50 acre.
Treatments : Sulphate of ammonia at the rate of 2½ cwt., superphosphate at the rate of 6 cwt., and sulphate of potash at the rate of 3 cwt. per acre, in all combinations.
Basal Manuring : Nil. Soil : Medium to heavy loam. Manures applied : June 29th. Planted : May. Harvested : October 26th, 27th, December 14th-15th, January 25th, March 8th. Previous crop : Temporary Grass.
Standard Error per plot, total of all pickings, graded sprouts : ±3.62 cwt. per acre or ±9.48%.

Individual Treatments : cwt. per acre

Pickings	Sub-blocks A				Sub-blocks B				
	O	**NP**	**NK**	**PK**	**N**	**P**	**K**	**NPK**	*Mean*
				Graded Sprouts					
1st	6.8	6.9	9.9	10.3	7.4	5.7	7.8	9.7	*8.1*
2nd	9.8	9.6	12.5	15.6	9.1	7.1	12.5	11.4	*10.9*
3rd	8.8	8.5	10.1	11.2	10.1	7.7	10.0	11.6	*9.8*
4th	9.6	8.7	10.4	9.7	9.2	8.7	9.5	10.1	*9.5*
Total (±*1.81*)	*35.0*	*33.7*	*42.9*	*46.8*	*35.8*	*29.2*	*39.8*	*42.8*	*38.3*
				Total Sprouts					
Total	*42.4*	*40.9*	*50.6*	*54.7*	*42.4*	*34.9*	*47.1*	*51.7*	*45.6*

Responses to Fertilisers : cwt. per acre
Graded Sprouts : total of all pickings

Fertiliser	*Mean Response*	Sulphate of Ammonia		Superphosphate		Sulphate of Potash	
		Absent	Present	Absent	Present	Absent	Present
Sulphate of Ammonia ..	+*1.1*[1]	—	—	+2.0[2]	+0.2[2]	+2.6[2]	−0.4[2]
Superphosphate	−*0.2*[1]	+0.6[2]	−1.1[2]	—	—	−4.0[2]	+3.4[2]
Sulphate of Potash ..	+*9.7*[1]	+11.2[2]	+8.1[2]	+6.0[2]	+13.4[2]	—	—

Standard errors : (1) ±1.28, (2) ±1.81.

Increase due to Potash in different pickings
Graded Sprouts : cwt. per acre

	1st	2nd	3rd	4th	*Mean*
Super absent ..	+1.78	+3.12	+0.62	+0.60	+*1.53*
Super present..	+3.68	+5.10	+3.29	+1.20	+*3.32*
Mean	+*2.73*	+*4.11*	+*1.96*	+*0.90*	+*2.43*

Conclusions

In the yields of graded sprouts there is a large and significant response to potash, which shows in all the pickings. This response is significantly greater for the earlier pickings so that potash not only increases the total yield but also gives an earlier crop.

There is no average response to super, but the interaction with potash is significant, a depression without potash being converted into an increase with potash ; equally the response to potash is significantly greater in the presence of superphosphate.

Sulphate of ammonia has produced no effects.

The percentage of graded sprouts to total of all sprouts picked is not affected by treatments with the possible exception (not quite significant) that potash increases this percentage.

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Tomatoes. Hertfordshire Farm Institute, Horticultural Dept., 1933.

Continuation of the 1932 experiment on the same plots (*See* 1932 Report, p.226).
8 randomised blocks of 4 plots each. Plots : 0.00386 acre.
Treatments : Organic manures applied in 11 top dressings ; sulphate of ammonia applied in 22 top dressings (at half rate). Top dressings to provide N at the rate of 4.2 cwt., soluble P_2O_5 at the rate of 5.8 cwt., insoluble P_2O_5 at the rate of 2.2 cwt., and K_2O at the rate of 8.0 cwt. per acre.
Basal manuring : 20 tons dung, ½ ton sulphate of potash, ½ ton lime, 2½ cwt. superphosphate and 2½ cwt. steamed bone flour per acre.
Standard error per plot : 3.44 tons per acre or 6.70%.

	Yield tons p.a. 1933	Mean Yield tons p.a. 1932-33
Mean	*51.44*	*53.25*
Dried blood ..	49.96	52.44
Hoof and horn	52.28	53.68
Sulphate of Am.	52.88	53.51
Fish meal ..	50.65	53.38
St. Error ..	±1.22	—

Conclusions

Any possible differences between the various kinds of nitrogenous top dressings appear to be masked by the basal dressings of dung, etc.

Lettuce. Oaklands Farm Institute, St. Albans, 1933.
H. W. Gardner, Esq.

6 randomised blocks of 9 plots each, some second order interactions being partially confounded with blocks. Plots : 11 square yards.
Treatments : Sulphate of ammonia at the rate of 0, 1½ and 3 cwt., superphosphate at the rate of 0, 3 and 6 cwt., and sulphate of potash at the rate of 0, 1 and 2 cwt. per acre, in all combinations.
Basal manuring : Nil.
Soil : Medium loam. Variety : Lobjoit's Cos. Seed sown : March 9th. Manures applied : March 9th.
Lettuce cut : In succession, finishing June 25th. Previous crop : Market garden crops (greenstuff).
Standard error per plot (number of lettuce cut) : ± 9860 or ± 29.6%.

Number of Lettuce cut per 1/100 acre

Mean of all Levels of Potash (±40.3)

Super-phos-phate	Sulphate of Ammonia 0 cwt.	1½ cwt.	3 cwt.	*Mean*
0 cwt.	410	367	285	*354*
3 cwt.	374	326	292	*331*
6 cwt.	335	248	365	*316*
Mean	*373*	*313*	*314*	*333*

Mean of all Levels of Nitrogen (±40.3)

Sulph. of pot.	Superphosphate 0 cwt.	3 cwt.	6 cwt.	*Mean*
0 cwt.	395	372	285	*351*
1 cwt.	343	305	359	*336*
2 cwt.	324	315	303	*314*
Mean	*354*	*331*	*316*	*333*

Mean of all Levels of Super. (±40.3)

Sulphate of potash	Sulphate of Ammonia 0 cwt.	1½ cwt.	3 cwt.	*Mean*
0 cwt. ..	421	359	272	*351*
1 cwt. ..	370	264	372	*336*
2 cwt. ..	328	316	298	*314*
Mean ..	*373*	*313*	*314*	*333*

Conclusions

The effects of treatments on the number of lettuces cut are not large enough to be significant owing to the high variability. The mean weight per lettuce (of those cut) was also recorded and analysed, but no significant effects were found. This is to be expected since the lettuces tended to be cut on reaching a definite size ; in view of this consideration it was not thought worth while to publish the mean weights.

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