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



[Full Table of Content](#)

Table of Results - the Classical Experiments

Rothamsted Research

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DATES OF SOWING AND HARVESTING (Harvest 1923).

Field.	Crop.	Variety.	Sowing began.	Sowing finished.	Cutting began.	*Carting began.	*Carting finished.	Yield per Acre.
Great Knott, east	Fallow	...	...	...	...	...	...	...
" west	Wheat	Red Standard	Oct. 27, '22	Oct. 30, '22	Aug. 10	Aug. 22	Sept. 3	37.5 bush.
Little Knott	Potatoes	Kerr's Pink	May 11, '23	May 17, '23	...	Oct. 29	Oct. 29	see p.118
Foster's, east	Mangolds*	Prizewinner Yellow Globe	May 2, '23	May 10, '23	...	frosted	...	...
" west	Swedes	Hurst's Monarch	May 15, '23	May 23, '23	...	Oct. 20	Nov. 8	14.3 tons.
West Barnfield	Oats	{ Grey Winters ... White Winters ... }	Oct. 12, '22	Oct. 13, '22	Aug. 2	Aug. 13	Aug. 14	48.0 bush.
Long Hoos, east	Barley	Plumage Archer	Apr. 18, '23	Apr. 18, '23	Aug. 16	Sept. 3	Sept. 6	32.0 bush.
" west	Clover	Red	May 10, '22	May 10, '22	July 2	July 13	July 14	...
New Zealand	Clover	Red	May 2, '22	May 4, '22	June 25	July 3	July 18	1.4 tons.
Stackyard	Clover	Red	May 5, '22	May 16, '22	June 29	July 9	July 19	...
Great Harpenden	Wheat	Red Standard	Nov. 16, '22	Nov. 30, '22	Aug. 13	Aug. 22	Aug. 29	24.0 bush.
Sawpit	Oats	{ Black Winters ... Grey Winters ... }	Oct. 10, '22	Oct. 12, '22	July 27	Aug. 10	Aug. 11	42.5 bush.
Sawyers	{ Barley ... Potatoes	Plumage Archer	Apr. 18, '23	Apr. 19, '23	Aug. 21	Sept. 6	Sept. 7	40.0 bush.
Broadbalk	{ Fallow ... Wheat	Kerr's Pink	May 4, '23	May 5, '23	...	Nov. 1	Nov. 17	see p.121
Little Hoos	Clover	Red	Oct. 31, '22	Nov. 1, '22	Aug. 15	Aug. 27	Aug. 28	see p.108
Hoos	Barley	Plumage Archer	May 8, '22	May 9, '22	June 28	July 6	July 7	112
Barnfield	Mangolds	Prizewinner Yellow Globe	Apr. 20, '23	Apr. 20, '23	Aug. 25	Sept. 5	Sept. 5	112
Agdell	Wheat	Red Standard	Apr. 30, '23	Apr. 30, '23	Aug. 22	Sept. 3	Sept. 6	110
Great Field	Grass	...	Oct. 30, '22	Oct. 30, '22	...	Nov. 17	Dec. 15	103
Park	Grass	{ 1st Crop ... 2nd Crop ... }	...	...	July 17	July 21	July 23	124
			...	...	June 16	June 22	June 23	104
			...	...	Dec. 20	Jan. 15 '24	Jan. 17 '24	104

* In the case of roots, the dates given are those on which lifting began and finished.

DATES OF SOWING AND HARVESTING (Harvest 1924).

Field.	Crop.	Variety.	Sowing began.	Sowing finished.	Cutting began.	*Carting began.	*Carting finished.	†Yield per Acre.
Great Knott, east	Oats	Black Winter	Oct. 16, '23	Oct. 17, '23	Aug. 5	Aug. 23	Aug. 25	16 bush.
" west	Oats	Grey Winter	Nov. 5, '23	Nov. 7, '23	Aug. 8	Aug. 25	Aug. 27	14 "
Little Knott	Barley	Plumage Archer	Mar. 14, '24	Mar. 17, '24	Aug. 20	Sept. 8	Oct. 17	28 "
Foster's, east	Swedes	Hurst's Monarch	May 28, '24	May 30, '24	...	Nov. 5	Nov. 28	25 tons
" west	{ Potatoes	Kerr's Pink	May 6, '24	May 10, '24	...	Oct. 1	Nov. 4	28 "
"	{ Mangolds	Prizewinner Yellow Globe	May 27, '24	May 28, '24	...	Nov. 17	Nov. 21	27 "
West Barnfield	Wheat	Red Standard	Nov. 1, '23	Nov. 3, '23	Sept. 4	Sept. 19	Sept. 22	24 bush.
Long Hoos, east	Clover	Broad Red	Apr. 18, '23	Apr. 19, '23	June 23	July 2	July 4	2.5 tons
" west	Wheat	Red Standard	Oct. 19, '23	Oct. 20, '23	Aug. 22	Sept. 3	Sept. 5	28 bush.
Great Harpenden	Barley	Plumage Archer	Mar. 18, '24	Mar. 21, '24	Aug. 15	Aug. 28	Oct. 15	26 "
New Zealand	Wheat	Red Standard	Nov. 19, '23	Nov. 21, '23	Sept. 3	Sept. 18	Oct. 10	25 "
Stackyard	Wheat	Red Standard	Nov. 12, '23	Nov. 15, '23	Sept. 2	Sept. 16	Oct. 10	20 "
Sawpit	Barley	Plumage Archer	Apr. 4, '24	Apr. 5, '24	Sept. 1	Sept. 19	Oct. 7	26 "
Sawyers	{ Clover	Broad Red	Apr. 24, '23	Apr. 24, '23	June 24	July 5	July 8	1.5 tons
"	{ Barley	Plumage Archer	Mar. 31, '24	Mar. 31, '24	Sept. 1	Sept. 24	Sept. 24	20 bush.
Broadbalk	Wheat	Red Standard	Nov. 9, '23	Nov. 12, '23	Sept. 5	Sept. 25	Oct. 3	see p. 109
Little Hoos	Wheat	Red Standard	Nov. 21, '23	Nov. 22, '23	Sept. 3	Sept. 22	Sept. 24	" 112
Hoos	Barley	Plumage Archer	Mar. 17, '24	Mar. 18, '24	Aug. 26	Oct. 3	Oct. 10	" 110
Barnfield	Mangolds	Prizewinner Yellow Globe	Apr. 25, '24	Apr. 25, '24	...	Oct. 27	Nov. 17	" 103
Agdell	Turnips	Aberdeen Yellow	July 19, '24	July 19, '24	...	Nov. 28	Dec. 5	" 102
Great Field	Hay	...	...	...	June 26	June 30	June 30	" 124
Park	Grass	1st crop	...	...	June 24	June 27	June 28	" 104

* In the case of roots, the dates given are those on which lifting began and finished. † Estimates of standing crops.

METEOROLOGICAL RECORDS, 1923 and 1924.

	Rain.		Drainage through soil.			Bright Sunshine.	Temperature (Mean).				
	Total Fall. $\frac{1}{1000}$ Acre Gauge.	No. of Rainy Days. (0.01 inch or more) $\frac{1}{1000}$ Acre Gauge.	20 ins. deep.	40 ins. deep.	60 ins. deep.		Max.	Min.	1 ft. in ground.	Solar Max.	Grass Min.
1923	Inches.	No.	Inches.	Inches.	Inches.	Hours.	°F.	°F.	°F.	°F.	°F.
Jan. ...	1.500	12	1.269	1.449	1.296	59.8	46.1	34.7	38.4	70.0	29.2
Feb. ...	3.914	23	3.510	3.598	3.346	53.5	46.0	36.8	40.6	77.7	32.4
Mar. ...	2.481	16	1.584	1.754	1.620	75.9	48.4	36.7	41.3	86.9	31.6
April ...	1.480	12	0.371	0.434	0.401	115.3	52.3	38.0	45.1	103.9	32.4
May ...	1.681	14	0.177	0.180	0.179	166.2	56.7	42.0	50.4	115.8	37.8
June ...	0.617	9	0.003	0.045	0.047	116.1	60.7	46.8	53.6	111.3	42.2
July ...	3.871	12	1.380	1.395	1.355	223.8	72.5	55.1	63.1	127.3	50.2
Aug. ...	2.329	11	0.342	0.375	0.295	256.9	68.5	51.1	60.7	124.1	44.8
Sept. ...	2.541	12	1.009	1.023	0.891	189.1	62.9	46.1	54.4	114.1	39.2
Oct. ...	4.974	23	3.691	3.691	3.452	98.3	55.4	43.9	50.0	96.1	39.0
Nov. ...	1.648	14	1.083	1.147	1.068	103.9	42.2	31.0	40.4	77.6	26.3
Dec. ...	2.932	19	2.630	2.592	2.467	42.3	42.6	31.4	37.0	60.5	28.1
Total or Mean	29.968	177	17.049	17.683	16.417	1501.1	54.5	41.1	47.9	97.1	36.1
1924											
Jan. ...	2.898	19	3.024	3.199	3.196	58.1	43.5	34.8	38.1	64.1	31.2
Feb. ...	0.714	12	0.045	0.097	0.087	54.8	40.2	31.5	36.9	67.3	28.4
Mar. ...	1.138	10	0.379	0.390	0.364	174.2	47.1	31.3	37.1	92.4	25.0
April ...	3.182	14	1.358	1.324	1.281	157.5	52.4	37.2	42.6	102.4	31.3
May ...	4.628	21	2.208	2.228	2.201	190.9	61.0	45.3	52.2	117.9	41.9
June ...	1.974	11	0.666	0.823	0.733	199.6	65.2	50.2	59.3	126.1	46.2
July ...	4.533	16	1.763	1.801	1.670	236.1	68.3	51.0	61.1	127.6	45.3
Aug. ...	2.551	22	0.080	0.095	0.056	169.0	64.8	50.5	58.7	121.6	46.6
Sept. ...	3.417	19	1.312	1.265	1.105	118.4	61.4	50.8	56.6	110.9	46.7
Oct. ...	4.279	21	3.549	3.494	3.333	89.9	55.3	45.3	51.3	89.9	40.3
Nov. ...	3.271	12	2.749	2.789	2.651	36.1	48.1	39.6	45.2	70.4	35.9
Dec. ...	3.920	20	3.637	3.742	3.638	42.5	46.4	37.8	42.7	63.3	34.2
Total or Mean	36.505	197	20.770	21.247	20.315	1527.1	54.5	42.1	48.5	96.2	37.8

RAIN AND DRAINAGE.
MONTHLY MEAN FOR 54 HARVEST YEARS, 1870-1—1923-4.

	Rainfall.	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.
September	2.348	0.762	0.727	0.666	32.5	31.0	28.4	1.586	1.621	1.682
October ...	3.143	1.793	1.749	1.624	57.0	55.6	51.7	1.350	1.394	1.519
November	2.724	2.053	2.086	1.965	75.4	76.6	72.1	0.671	0.638	0.759
December	2.851	2.426	2.511	2.397	85.1	88.1	84.1	0.425	0.340	0.454
January ...	2.374	1.922	2.104	2.024	81.0	88.6	85.3	0.452	0.270	0.350
February	1.995	1.468	1.569	1.496	73.6	78.6	75.0	0.527	0.426	0.499
March ...	2.076	1.125	1.257	1.188	54.2	60.5	57.2	0.951	0.819	0.888
April ...	2.043	0.666	0.736	0.703	32.6	36.0	34.4	1.377	1.307	1.340
May ...	2.048	0.488	0.548	0.515	23.8	26.8	25.2	1.560	1.500	1.533
June ...	2.270	0.564	0.586	0.565	24.8	25.8	24.9	1.706	1.684	1.705
July ...	2.713	0.718	0.743	0.691	26.5	27.4	25.5	1.995	1.970	2.022
August ...	2.683	0.706	0.707	0.664	26.3	26.4	24.7	1.977	1.976	2.019
Year ...	29.268	14.691	15.323	14.498	50.2	52.4	49.5	14.577	13.945	14.770

Area of each gauge $\frac{1}{1000}$ acre.

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CROP YIELDS ON THE EXPERIMENTAL PLOTS.

NOTES.—In each case the year refers to the harvest, *e.g.*, Wheat harvested in 1924.
In the tables, total straw includes straw, cavings and chaff.

CONVERSION TABLE.

1 acre =	0·404 Hectare	0·963 Feddan.
1 bushel (Imperial) =	0·346 Hectolitre (36·346 litres) ...	0·184 Ardeb.
1 lb. (pound avoirdupois) =	0·453 Kilogramme	1·009 Rotls.
1 cwt. (hundredweight) =	50·8 Kilogrammes	{ 113·0 Rotls. 1·366 Maunds.
1 metric quintal ... =	{ 100·0 Kilogrammes 220·46 lb.	
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 ... =	125·60 Kilogrammes per Hectare or 1·256 metric Quintals per Hectare	117·4 Rotls per Feddan.

In America the Winchester bushel is used = 35·236 litres. 1 English bushel = 1·032 American bushels.

CROPS GROWN IN ROTATION. AGDELL FIELD. PRODUCE PER ACRE.

Year.	CROP.	O. Unmanured.		M. Mineral Manure.		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 THE FIRST NINETEEN COURSES, 1848-1923.							
	Roots (Swedes) cwt.*	32·7	11·2	175·7	195·9	355·3	302·0
	Barley—						
	Dressed Grain bush.	22·7	20·9	23·8	27·9	32·2	36·8
	Total Straw ... cwt.	13·9	13·7	14·0	16·0	19·5	22·6
	Beans—						
	Dressed Grain bush.	—	13·1	—	18·2	—	22·3
	Total Straw ... cwt.	—	9·2	—	13·2	—	15·3
	Clover Hay ... cwt.	—	28·3	—	54·1	—	55·0
	Wheat—						
	Dressed Grain bush.	24·2	22·8	28·5	31·2	29·5	31·2
	Total Straw ... cwt.	23·7	21·7	29·0	30·3	31·4	30·4
NINETEENTH COURSE, 1920-23.							
1920	Roots (Swedes) ... cwt.	20·5	2·1	163·9	270·0	262·1	56·4†
1921	Barley—						
	Dressed Grain bush.	13·0	2·4†	12·8	26·3	10·9	25·7
	Offal Grain ... lb.	57·0	42·0	45·0	58·0	39·0	65·0
	Straw lb.	891·0	601·0	596·0	1124·0	444·0	1444·0
	Total Straw ... cwt.	10·9	7·8	7·9	14·2	6·3	17·7
	Wt. of Dressed } lb.						
	Grain per bush. }	55·1	51·0	56·5	56·8	56·4	56·7
	Proportion of Total } Grain to 100 of }	63·0	19·0	86·3	97·5	92·2	77·1
	Total Straw }						
1922	Clover Hay ... cwt. (1 crop only)	—	4·4	—	9·7	—	3·5
1923	Wheat—						
	Dressed Grain bush.	18·0	25·2	20·3	28·3	19·7	22·9
	Offal Grain ... lb.	174·0	206·0	190·0	221·0	205·0	220·0
	Straw lb.	2019·0	2575·0	2590·0	2975·0	2363·0	2390·0
	Total Straw ... cwt.	20·6	26·5	26·9	30·7	24·3	24·5
	Wt. of Dressed } lb.						
	Grain per bush. }	63·6	63·4	63·5	64·3	64·3	64·6
	Proportion of Total } Grain to 100 of }	57·0	60·7	49·0	59·4	54·0	61·9
	Total Straw }						
PRESENT COURSE (20th), 1924.							
1924	Roots (Turnips) ... cwt.	2·9	0·7	42·8	31·5	127·4	104·7

* Plots 1, 3 and 5 based upon 18 years. Plots 2, 4 and 6 based upon 17 years.
† Plot 6 was more badly attacked by Gout Fly than the other plots.
‡ The roots on this plot were badly attacked by finger and toe disease in 1920.
In 1920 Rape Cake was omitted from plots 1 and 2.

MANGOLDS, BARN FIELD, 1923 and 1924.

Roots since 1856. Mangolds since 1876.

Produce per Acre.

Strip.	Strip Manures.	Cross Dressings.				
		O.	N.	A.	A.C.	C.
		None.	Nitrate of Soda	Ammon. Salts.	Ammon. Salts and Rape Cake.	Rape Cake.
	1923†.	Tons.	Tons.	Tons.	Tons.	Tons.
1	Dung only	R. 16.55	32.69	23.67	21.63	22.29
		L. 2.20	3.70	3.78	4.15	4.18
2	Dung, Super., Potash ...	R. 18.92	37.38	30.40	29.64	29.96
		L. 2.16	4.48	4.64	5.23	4.11
4	Complete Minerals ...	R. 4.72 ^a	R. 22.04 ^a	19.18	25.28	20.85
		L. 0.92 ^b	L. 3.69			
			R. 19.18	2.82	5.12	2.96
			L. 3.70			
5	Superphosphate only ...	R. 5.22	19.09	8.48	6.16	6.59
		L. 1.23	2.92	3.54	3.15	3.21
6	Super. and Potash ...	R. 4.25	19.73	16.08	18.39	16.48
		L. 1.06	2.56	2.65	4.50	2.72
7	Super., Sulphate of Mag., and Sodium Chloride	R. 4.71	21.92	19.82	17.53	15.44
		L. 1.11	2.86	2.78	4.62	2.69
8	None	R. 3.63	11.05	5.90	4.71	3.47
		L. 1.14	2.72	2.80	2.49	1.92
9	Sodium Chloride, Nit. Soda, Sulph. Potash, and Sulph. Mag. ...	R. 24.73	—	—	—	—
		L. 3.03				
	1924.					
1	Dung only	R. 14.49	23.99	20.75	28.38	24.80
		L. 3.83	6.11	6.43	6.77	5.29
2	Dung, Super., Potash ...	R. 18.61	25.08	23.28	34.17	32.15
		L. 3.86	5.68	5.52	7.20	6.13
4	Complete Minerals ...	R. 3.15 ^a	R. 14.34	14.42	34.16	20.91
		L. 1.06 ^b	L. 4.55			
			R. 11.15	3.50	5.62	3.66
			L. 4.19			
5	Superphosphate only ...	R. 3.31	14.92	11.47	15.81	15.31
		L. 1.03	3.76	3.61	4.83	3.54
6	Super. and Potash ...	R. 3.16	12.58	16.40	29.40	20.55
		L. 1.12	3.52	2.96	5.73	2.73
7	Super., Sulphate of Mag., and Sodium Chloride	R. 3.42	17.28	18.34	28.91	20.18
		L. 1.11	3.94	3.29	5.24	3.05
8	None	R. 2.14	11.70	10.18	13.35	11.55
		L. 1.87	3.62	3.18	4.32	3.49
9	Sodium Chloride, Nit. Soda, Sulph. Potash and Sulph. Mag. ...	R. 20.46	—	—	—	—
		L. 3.51				

R. = roots. L. = leaves.

* From 1904 onwards plot 4 N has been divided, 4a receiving Sulphate of Potash, Sulphate of Magnesia, Sodium Chloride and Nitrate of Soda; 4b receiving Calcium Chloride, Potassium Nitrate and Calcium Nitrate.

† In 1923 plot 4 in series A, N, AC and C were lifted on Nov. 22nd in good condition. The remainder of the plots were lifted Dec. 10th—15th after several severe frosts.

HAY. THE PARK GRASS PLOTS. 1923, 1924.

Plot	Manuring per acre.	1923.						1924.			Plot.
		Yield of Hay per acre.			Dry Matter per acre.			Yield of Hay Matter per acre.	Dry Matter per acre.		
		1st Crop.	2nd Crop.	Total.	1st Crop.	2nd Crop.	Total.				
1	Single dressing Amm. Salts (=43 lb. N.); (with Dung also 8 years 1856-63)	{ not limed ... limed ...	cwt. 23.8 16.2	cwt. 40.0 30.9	lb. 1917 1732	lb. 310 199	cwt. 29.0 28.1	lb. 2667 2551	1		
2	Unmanured; (after Dung 8 years, 1856-63)	{ not limed ... limed ...	cwt. 17.4 18.0	cwt. 30.9 20.6	lb. 1297 1426	lb. 102 48	cwt. 18.1 23.8	lb. 1518 1804	2		
3	Unmanured	{ not limed ... limed ...	cwt. 15.0 14.9	cwt. 20.7 17.8	lb. 1165 1142	lb. 98 66	cwt. 15.8 17.6	lb. 1383 1445	3		
4-1	Superphosphate of Lime	{ not limed ... limed ...	cwt. 20.8 18.7	cwt. 25.2 22.8	lb. 1435 1444	lb. 83 83	cwt. 23.0 20.9	lb. 1944 1818	4-1		
4-2	Superphosphate of Lime and double dressing Amm. Salts (=86 lb. N.)	{ not limed ... limed ...	cwt. 45.5 38.9	cwt. 50.3 60.2	lb. 3210 3135	lb. 77 358	cwt. 27.7 46.4	lb. 2478 4319	4-2		
5-1	(N. half) Unmanured; following double dressing Amm. Salts (=86 lb. N.) 1856-97	not limed	cwt. 20.3	cwt. 30.2	lb. 1405	lb. 191	cwt. 15.2	lb. 1390	5-1		
5-2	(S. half) Super., Sulphate of Potash; following double dressing Amm. Salts (=86 lb. N.) 1856-97	not limed	cwt. 21.3	cwt. 41.7	lb. 1593	lb. 438	cwt. 27.3	lb. 2287	5-2		
6	Complete Mineral Manure as plot 7; following double dressing Amm. Salts (=86 lb. N.) 1856-68	not limed	cwt. 23.0	cwt. 50.3	lb. 1838	lb. 507	cwt. 36.0	lb. 3166	6		
7	Complete Mineral Manure	{ not limed ... limed ...	cwt. 23.0 38.3	cwt. 43.8 59.6	lb. 1806 2838	lb. 402 438	cwt. 36.1 54.0	lb. 3123 4851	7		
8	Mineral Manure without Potash	{ not limed ... limed ...	cwt. 21.3 19.1	cwt. 30.0 27.8	lb. 1505 1513	lb. 151 200	cwt. 21.3 17.4	lb. 1854 1539	8		
9	Complete Mineral Manure and double dressing Amm. Salts (=86 lb. N.)	{ not limed ... limed ...	cwt. 57.5 59.9	cwt. 74.8 82.6	lb. 4009 4488	lb. 287 443	cwt. 32.9 66.2	lb. 2946 5600	9		
10	Mineral Manure (without Potash) and double dressing Amm. Salts (=86 lb. N.)	{ not limed ... limed ...	cwt. 45.2 46.7	cwt. 53.5 75.6	lb. 3210 3197	lb. 132 577	cwt. 31.5 49.1	lb. 2970 4744	10		
11-1	Complete Mineral Manure and treble dressing Amm. Salts (=129 lb. N.)	{ not limed ... limed ...	cwt. 72.0 75.8	cwt. 127.5 109.8	lb. 4559 5184	lb. 779 586	cwt. 39.9 73.4	lb. 3267 6467	11-1		
11-2	As plot 11-1 and Silicate of Soda	{ not limed ... limed ...	cwt. 77.4 75.7	cwt. 132.4 109.4	lb. 5472 5219	lb. 831 666	cwt. 50.5 70.8	lb. 4502 5957	11-2		

The Park Grass Plots.
BOTANICAL COMPOSITION, PER CENT. 1921, 1st Crop.

Plot.	Manuring.	Liming.	Gramineæ.	Leguminosæ.	Other Orders.	"Other Orders" consist largely of	Plot.
3	Unmanured	Limed ...	68.4	10.5	21.1	Plantago lanceolata	3
5-1	Unmanured, following double Amm. Salts, 1856-97	Not limed	73.1	4.7	22.2	Plantago lanceolata	
5-2	Super. and Sulph. Potash following double Amm. Salts, 1856-97	Not limed	86.8	1.1	12.1	Centaurea nigra	5-1
7	Complete Mineral Manure	Not limed	72.5	9.2	18.3	Rumex acetosa	5-2
9	Complete Mineral Manure and double Amm. Salts	Limed ...	66.1	22.0	11.9	Heracleum sphondylium	7
14	Complete Mineral Manure and double Nitrate of Soda	Not limed	68.9	13.5	17.6	Achillea millefolium	
15	As plot 7 following double Nitrate of Soda, 1858-75	Limed ...	96.3	—	3.7	Rumex acetosa; Heracleum sphondylium	9
17	Single Nitrate of Soda	Not limed	99.0	—	1.0	Rumex acetosa	
18	Potash, Sulphate Soda, Magnesia, and double Sulphate of Amm. 1905 and since	Limed ...	95.5	3.0	1.5	Taraxacum vulgare	14
19	Farmyard Dung in 1905 and every 4th year since (omitted in 1917)	Not limed	97.4	0.2	2.4	Taraxacum vulgare	
20	Farmyard Dung in 1905 and every 4th year since (omitted 1917), each intervening year Sulphate Potash, Super., and Nitrate of Soda	Limed ...	70.6	18.2	11.2	Plantago lanceolata	15
		Not limed	76.2	8.8	15.0	Plantago lanceolata	
		Limed ...	74.1	0.9	25.0	Plantago lanceolata	17
		Not limed	65.3	0.2	34.5	Plantago lanceolata	
		limed 6788 lb.	82.6	—	17.4	Rumex acetosa	18
		" 3951 lb.	86.0	—	14.0	Rumex acetosa	
		Not limed	91.2	—	8.8	Rumex acetosa	
		limed 3150 lb.	92.3	4.0	3.7	Conopodium denudatum	19
		" 570 lb.	92.3	2.3	5.4	Rumex acetosa	
		Not limed	88.8	5.1	6.1	Rumex acetosa; Centaurea nigra	
		limed 2772 lb.	20.2	3.8	6.0	Rumex acetosa; Conopodium denudatum; Ranunculus spp.	20
		limed 570 lb.	91.0	4.8	4.2	Rumex acetosa	
		Not limed	90.2	4.0	5.8	Rumex acetosa	

The Park Grass Plots—*contd.*
BOTANICAL COMPOSITION, PER CENT. 1922, 1st CROP.

Plot.	Manuring.	Liming.	Gramineae.	Leguminosae.	Other Orders.	"Other Orders" consist largely of	Plot.
3	Unmanured	Limed ...	51.0	7.6	41.4	Centaurea nigra	3
5-1	Unmanured, following double Ammonium Salts 1856-97	Not limed	60.5	4.6	34.9	Plantago lanceolata	
5-2	Super. and Sulph. Potash following double Ammonium Salts 1856-97	Not limed	57.2	2.1	40.7	Centaurea nigra	5-1
7	Complete Mineral Manure	Not limed	71.8	6.1	22.1	Rumex acetosa	5-2
9	Complete Mineral Manure & double Ammonium Salts	Limed ...	61.3	29.6	9.0	Heracleum sphondylium	7
14	Complete Mineral Manure & double Nitrate of Soda	Not limed	69.7	12.7	17.5	Centaurea nigra	
18	Potash, Sulphate Soda, Magnesia, and double Sulphate of Ammonia, 1905 and since.	Limed ...	99.2	0.3	0.5	_____	9
19	Farmyard Dung in 1905 and every fourth year since (omitted in 1917)	Not limed	99.1	0.1	0.8	Taraxacum vulgare	14
20	Farmyard Dung in 1905 and every fourth year since (omitted in 1917), each intervening year Sulphate Potash, Super. and Nitrate of Soda	Limed ...	92.5	1.1	6.4	Taraxacum vulgare	
		Not limed	96.4	0.2	3.4	Rumex acetosa	18
		limed 6788 lb.	82.3	1.4	16.3	Rumex acetosa	
		" 3951 lb.	87.5	—	12.5	Centaurea nigra	
		Not limed	80.7	—	19.3	Conopodium denudatum	
		limed 3150 lb.	86.2	7.2	6.6	Conopodium denudatum	19
		" 570 lb.	88.1	5.9	5.9	Rumex acetosa; Ranunculus spp.	
		Not limed	85.8	7.5	6.7	Rumex acetosa	
		limed 2772 lb.	85.6	4.6	9.8	Conopodium denudatum	
		" 570 lb.	86.8	7.9	5.3	Conopodium denudatum	20
		Not limed	90.9	1.0	8.1	Conopodium denudatum; Achillea millefolium	

WHEAT. BROADBALK FIELD, 1923.

Plot.	Manurial Treatment.	Top Portion.						Bottom Portion.						71 year Average 1852-1922.	
		Dressed Grain.		Offal Grain per Acre.	Straw per Acre.	Total Straw per Acre.	Proportion of Total Straw.	Dressed Grain.		Offal Grain per Acre.	Straw per Acre.	Total Straw per Acre.	Proportion of Total Straw.	Dressed Grain per Acre.	Total Straw per Acre.
		Yield per Acre.	Weight per Bushel.					Yield per Acre.	Weight per Bushel.						
		bush.	lb.	lb.	lb.	cwt.		bush.	lb.	lb.	cwt.		bush.	cwt.	
2A	Farmyard Manure ...	12.5	63.4	124	1718	20.3	40.4	20.4	63.2	206	2470	29.2	45.7	28.4*	32.8*
2B	Farmyard Manure ...	13.5	63.3	155	2751	32.9	27.4	21.2	63.8	328	3060	37.5	40.0	34.3	34.6
3	Unmanured ...	3.8	62.8	27	332	3.7	65.4	4.2	62.9	37	298	3.7	71.6	12.1	9.9
5	Complete Mineral Manure ...	3.1	61.5	29	264	3.1	63.3	4.4	62.8	56	430	5.3	56.6	13.9	11.7
6	As 5, and Single Amm. Salts ...	6.2	62.0	61	813	9.9	40.0	7.9	63.1	69	828	9.7	52.2	22.3	20.7
7	As 5, and Double Amm. Salts ...	10.2	62.6	109	1824	20.9	31.8	15.8	63.5	300	2808	32.4	35.9	30.9	32.2
8	As 5, and Treble Amm. Salts ...	12.4	62.5	142	2708	30.2	27.1	17.8	63.3	388	3312	38.6	35.0	35.1	40.2
9	As 5, and Single Nitrate of Soda ...	8.3	62.0	81	1302	14.6	36.3	9.3	62.8	150	1924	23.0	28.5	24.5†	24.7†
10	Double Amm. Salts alone ...	7.6	62.0	84	1174	14.1	35.2	7.5	63.5	194	1396	19.8	30.1	19.1	18.0
11	As 10, and Superphosphate ...	6.5	62.2	100	1472	18.5	24.4	8.4	63.3	225	1902	24.1	28.0	21.5	21.7
12	As 10, and Super. and Sulph. Soda ...	7.8	62.4	108	1396	17.6	30.1	11.1	63.6	250	2096	25.3	33.8	27.6	27.2
13	As 10, and Super. and Sulph. Potash ...	12.2	63.3	113	1816	21.8	36.2	12.3	62.6	216	2748	30.3	29.0	29.8	31.0
14	As 10, and Super. and Sulph. Magnesia ...	10.5	63.3	135	1714	20.5	34.7	11.3	63.4	300	2270	27.6	32.9	27.3	27.2
15	Double Amm. Salts in Autumn and Minerals ...	17.4	63.3	126	1896	22.2	49.5	13.3	63.5	168	1972	23.4	38.6	28.4	28.7
16	Double Nitrate and Minerals ...	16.9	63.3	167	2224	26.5	41.7	11.8	61.0	275	2958	33.1	26.8	30.7†	35.8†
17)	Minerals alone, or Double Amm. Salts alone in	2.9	61.5	39	356	4.7	40.9	5.0	62.4	76	698	9.2	37.6	28.6	28.6
18)	alternate years ...	11.7	63.9	201	1620	20.0	42.3	11.8	63.4	192	2232	25.9	32.4	14.3	12.4
19	Rape Cake alone ...	13.6	63.4	232	1664	20.5	47.6	12.2	63.9	229	1918	24.4	36.8	22.0†	22.7†
20	Mineral Manure (without Super.) and Amm. Salts	8.6	63.0	122	1443	17.9	33.0	—	—	—	—	—	—	18.6§	19.8§

* 23 years only, 1900-1922. † 30 years only, 1893-1922. § 15 years only, 1906-1922 (no crop in 1912 and 1914)

WHEAT. BROADBALK FIELD, 1924.

Plot.	Manurial Treatment.	Top Portion.						Bottom Portion.					
		Dressed Grain.		Offal Grain per Acre. lb.	Straw per Acre. lb.	Total Straw per Acre. cwt.	Proportion of Total Grain to 100	Dressed Grain.		Offal Grain per Acre. lb.	Straw per Acre. lb.	Total Straw per Acre. cwt.	Proportion of Total Grain to 100
		Yield per Acre. bush.	Weight per Bushel. lb.					Yield per Acre. bush.	Weight per Bushel. lb.				
2A	Farmyard Manure	10.3	60.3	142	1047	18.6	36.7	16.6	60.5	156	1417	22.2	46.5
2B	Farmyard Manure	10.4	59.5	158	1181	19.3	35.8	14.6	60.5	137	1367	22.4	40.6
3	Unmanured	2.1	58.9	25	188	3.6	36.4	2.2	58.9	23	136	2.8	47.3
5	Complete Mineral Manure	4.4	58.8	29	270	4.0	64.6	3.9	58.3	25	220	3.7	60.0
6	As 5, and Single Amm. Salts	10.2	60.0	52	827	11.2	52.7	9.1	60.5	43	554	7.6	69.9
7	As 5, and Double Amm. Salts	19.3	60.7	160	2182	28.9	41.2	24.1	60.9	136	1898	24.9	57.5
8	As 5, and Treble Amm. Salts	23.2	60.5	174	2826	35.8	39.4	23.7	60.0	148	2578	33.1	42.4
9	As 5, and Single Nitrate of Soda	12.9	59.6	107	1268	18.6	42.0	12.6	59.6	69	1012	13.5	54.1
10	Double Amm. Salts alone	4.9	59.0	72	532	11.4	28.2	5.4	58.9	85	434	8.3	43.1
11	As 10, and Superphosphate	5.5	58.3	111	944	16.6	23.1	4.6	58.0	109	632	12.8	26.3
12	As 10, and Super. and Sulph. Soda	9.1	59.4	128	910	15.7	38.0	9.3	58.5	129	1008	17.0	35.3
13	As 10, and Super. and Sulph. Potash	15.0	60.2	118	1420	21.2	42.9	11.0	60.0	85	1234	17.6	37.7
14	As 10, and Super. and Sulph. Magnesia	9.9	58.8	159	1260	18.0	36.6	8.6	58.8	129	948	14.8	38.3
15	Double Amm. Salts in Autumn and Minerals	7.9	59.0	91	836	14.0	35.7	4.6	58.1	66	532	10.9	27.3
16	Double Nitrate and Minerals	22.1	60.0	146	2168	32.8	40.0	19.3	59.5	156	1648	25.6	45.3
17	Minerals alone, or double Amm. Salts alone in alternate years	7.8	59.8	68	722	11.1	42.8	7.4	58.0	58	556	9.6	45.0
18	Rape Cake alone	7.8	59.5	39	480	6.7	67.4	8.4	59.0	46	560	7.8	61.7
19	Mineral Manure (without Super.) and Amm. Salts	6.2	58.8	90	822	14.0	29.1	4.5	57.8	98	666	12.1	26.4
20	Mineral Manure (without Super.) and Amm. Salts	2.7	56.8	41	510	8.5	20.5	—	—	—	—	—	—

PERMANENT BARLEY PLOTS. Hoos Field, 1923, 1924.
PRODUCE PER ACRE.

Plot.	Manuring.	1923.						1924.						70 years Average Yield 1852-1922.†	
		Yield per Acre.	Weight per Bushel.	Offal Grain per Acre.	Straw per Acre.	Total Straw per Acre.	Proportion of Total Grain to 100 of Total Straw.	Yield per Acre.	Weight per Bushel.	Offal Grain per Acre.	Straw per Acre.	Total Straw per Acre.	Proportion of Total Grain to 100 of Total Straw.	Dressed Grain per Acre.	Total Straw per Acre.
1 O	Unmanured	11.4	53.0	84	690	8.2	74.7	1.7	44.3	72	217	47.8	14.0	8.0	
2 O	Superphosphate only	19.9	54.8	69	927	10.8	96.1	7.5	45.4	107	410	75.6	19.6	9.9	
3 O	Alkali Salts only	13.6	52.1	54	916	11.1	61.5	1.7	44.0	72	195	44.3	15.0	8.8	
4 O	Complete Minerals	17.2	53.6	66	996	11.4	77.0	2.5	44.8	101	289	40.5	19.8	11.1	
5 O	Potash and Superphosphate	10.4	54.4	62	655	8.3	67.0	3.2	47.5	96	347	45.3	16.2	9.6	
1 A	Ammonium Salts only	13.4	53.5	144	858	10.5	73.3	4.1	48.1	196	490	48.8	24.8	14.1	
2 A	Superphosphate and Amm. Salts	23.3	54.3	108	1232	14.1	87.4	33.5	48.9	336	1680	95.0	37.0	20.9	
3 A	Alkali Salts and Amm. Salts	16.5	54.3	149	1213	15.7	59.1	7.0	44.9	153	583	52.1	27.0	16.3	
4 A	Complete Minerals and Amm. Salts	33.0	55.9	98	1598	18.2	95.3	28.4	49.0	343	1744	76.1	40.6	24.0	
5 A	Potash, Super. and Amm. Salts	25.3	56.0	76	1336	15.6	85.7	28.4	49.0	216	1650	77.0	34.9	22.2	
1 AA	Nitrate of Soda only	18.1	53.0	122	1320	15.1	64.0	5.7	48.3	227	699	42.8	25.3*	15.6*	
2 AA	Super. and Nitrate of Soda	32.1	54.9	102	1656	18.4	90.4	32.0	47.8	342	1832	82.1	39.9*	23.5*	
3 AA	Alkali Salts and Nitrate of Soda	17.0	54.3	123	1408	17.0	55.0	6.0	44.6	157	627	41.3	25.9*	16.8*	
4 AA	Complete Minerals and Nitrate of Soda	31.2	56.1	107	1562	18.2	91.3	24.3	46.7	337	1700	61.7	39.2*	23.9*	
1 AAS	As Plot 1 AA and Silicate of Soda	21.4	55.0	133	1397	16.5	71.1	10.0	48.3	221	908	52.9	31.6*	18.7*	
2 AAS	" " 2 AA "	35.3	55.0	100	1711	18.8	96.9	26.3	48.3	278	1518	78.3	41.0*	24.5*	
3 AAS	" " 3 AA "	23.3	54.3	107	1749	19.7	62.2	9.7	49.5	188	858	48.5	32.9*	20.4*	
4 AAS	" " 4 AA "	36.0	55.9	96	1898	21.0	89.5	21.2	46.4	250	1469	61.4	41.5*	26.0*	
1 C	Rape Cake only	28.1	54.9	78	1507	17.3	83.6	22.6	45.2	257	1287	75.7	36.5	20.9	
2 C	Superphosphate and Rape Cake	36.0	55.8	89	1471	16.7	112.2	30.8	44.7	284	1612	80.9	38.8	22.3	
3 C	Alkali Salts and Rape Cake	27.9	55.3	65	1474	17.2	83.6	17.9	45.0	219	1125	67.7	35.0	20.9	
4 C	Complete Minerals and Rape Cake	35.2	54.9	65	1765	19.5	91.4	27.0	47.7	278	1689	71.8	38.5	22.9	
7-1	Unmanured (after dung 20 years, 1852-71)	17.6	54.9	81	1106	12.7	73.5	2.2	46.5	107	297	39.7	24.0†	14.1†	
7-2	Farmyard Manure	30.6	56.1	68	1856	19.3	82.3	28.4	49.9	212	2034	61.1	46.0	28.5	
6-1	Unmanured	8.7	53.1	82	628	8.2	59.2	—	—	42	102	36.8	15.4	8.9	
6-2	Ashes from Laboratory furnace	12.3	54.8	87	704	9.4	72.0	2.0	44.0	91	234	49.8	16.3	9.5	
1 N	Nitrate of Soda only	18.3	54.0	144	1320	15.9	63.6	4.4	44.0	169	479	43.8	30.0§	18.3§	
2 N	" " "	23.1	55.0	119	1463	17.4	71.3	11.7	44.4	215	847	58.1	33.8§§	20.4§§	

† 1912, all plots were fallowed. * 54 years, 1868-1922. † 50 years, 1872-1922. § 69 years, 1853-1922. §§ 63 years, 1859-1922.

RED CLOVER grown year after year on rich Garden Soil,
Rothamsted Garden.

Hay, Dry Matter, and Nitrogen per Acre, 1923 and 1924.

Year.	No. of Cuttings.	As Hay.	Dry Matter.	Nitrogen.	Seed Sown.
1923	2	lb. 1477	lb. 1231	lb. 37	1923 May mended
1924	2	794	663	20	1924 April mended
Averages:					
25 years, 1854—1878		7664	6387	179	
25 years, 1879—1903		3924	3270	101	
20 years, 1904—1923		2640	2200	65	

WHEAT AFTER FALLOW (without Manure 1851,
and since).

Hoos Field, 1923 and 1924.

	1923.	1924.	Average 67 years 1856-1922.
Dressed Grain { Yield per Acre—bushels	2·8	1·6 lb.	15·22
{ Weight per Bushel—lb.	62·0	—	59·6
Offal Grain per Acre—lb.	42·0	1·5	52·0
Straw per Acre—lb.	459·0	18·0	—
Total Straw per Acre—cwt.	5·4	0·9	13·1
Proportion of Total Grain to 100 of Total Straw	35·9	3·1	—

AVERAGE WHEAT YIELDS of VARIOUS COUNTRIES.

Country.	Mean Yield per Acre 1901-10. bushels.	Country.	Mean Yield per Acre 1901-10. bushels.
Great Britain	31·6	Denmark	41·3
England	31·7	Argentina	10·6
Hertfordshire	30·5	Australia	10·1
France	20·2	Canada	19·5
Germany	29·1	United States	14·3
Belgium	35·1	Russia—European	10·0

NOTE.—Figures for Great Britain, England and Hertfordshire are taken from the Board of Agriculture's "Agricultural Statistics," Vol. 46. Other figures from "Annuaire International de Statistique Agricole," 1910-12, and converted at the rate of 60 lb. per bushel.

ROTATION PLOTS.

Little Hoos Field, 1923 and 1924.

Arranged to test the VALUE of VARIOUS MANURES in year of application and their RESIDUAL VALUE one, two, and three years after.

Produce per acre.

Plot.	Manure per Acre from 1919 onwards.	Season of Last Dressing.	1923 (20th Season), Clover.				1924 (21st Season), Wheat.							
			Yield per Acre.		Dry Matter per Acre.		Dressed Grain.		Straw per Acre.	Total Straw per Acre.	Proportion of Total Grain to 100 of Total Straw.			
			1st Crop	2nd Crop	Total	1st Crop	2nd Crop	Total				Yield per Acre.	Weight per Bush.	Ofal Grain per Acre.
A 1	Control	—	cwt. 24.0	cwt. 26.7	lb. 50.1	lb. 2578	lb. 4741	bush. 72.8	lb. 58.9	lb. 146	lb. 676	cwt. 11.0	72.8	
A 2	...	1920	41.2	34.9	76.1	4002	2814	6816	46.2	60.0	190	3008	36.6	72.1
A 3	...	1921	41.3	32.1	73.4	4312	2572	6884	39.0	60.8	197	2772	33.9	67.6
A 4	Ordinary Dung, 16 tons	1922	43.2	30.7	73.9	4564	2495	7059	36.7	60.0	175	2416	28.9	73.3
A 5	...	1924	34.9	28.1	63.0	3605	2371	5976	47.8	60.3	149	3248	37.5	72.2
B 1	Cake fed dung, 16 tons	1920	40.6	34.1	74.7	4068	2702	6770	43.0	60.0	216	3016	36.1	68.9
B 2	Control ...	—	26.4	27.6	54.0	2694	2148	4842	19.9	58.2	177	1180	16.1	73.7
B 3	...	1921	44.4	34.4	78.8	4420	2716	7136	40.4	60.4	201	2728	32.5	72.4
B 4	Cake fed dung, 16 tons	1922	42.1	34.7	76.8	4345	2690	7035	40.7	59.9	189	2720	33.9	69.2
B 5	...	1924	38.4	30.1	68.5	3866	2453	6319	43.6	60.8	215	3260	39.7	64.4
C 1	Shoddy; Superphosphate; Sulphate of Potash ...	1920	26.1	26.4	52.5	2540	2144	4684	14.6	59.0	120	916	13.1	66.6
C 2	...	1921	17.7	28.1	45.8	1788	2258	4046	16.7	59.0	141	1052	15.0	66.7
C 3	Control ...	—	16.6	28.0	44.6	1668	2235	3903	16.9	58.6	125	1004	13.8	72.3
C 4	Shoddy; Superphosphate; Sulphate of Potash ...	1922	28.1	33.3	61.4	2837	2820	5657	20.1	58.5	132	1252	17.0	68.5
C 5	...	1924	20.3	27.1	47.4	1985	2178	4163	33.4	59.7	135	2180	26.0	73.1

D	1	Guano; Sulphate of Ammonia; Sulphate of Potash	1920	27.1	28.1	55.2	2762	2298	5060	20.3	59.8	160	1148	15.5	79.3
	2		1921	21.6	23.0	44.6	2179	1900	4079	16.8	59.3	156	1000	16.0	64.3
	3		1922	25.7	26.9	52.6	2644	2228	4872	18.3	58.3	124	1112	14.9	71.4
	4		—	24.3	27.9	52.2	2303	2278	4581	17.7	59.8	148	1112	16.7	64.6
	5		1924	25.7	27.6	53.3	2600	2247	4847	22.9	60.1	164	1416	20.8	66.2
E	1	Rape Dust; Superphosphate; Sulphate of Potash	1920	25.5	27.1	52.6	2626	2070	4696	16.1	58.5	160	820	12.5	78.8
	2		1921	25.4	27.0	52.4	2598	2158	4756	21.1	59.4	174	1148	17.6	72.3
	3		1922	22.6	25.9	48.5	2298	2131	4429	18.2	59.0	161	1000	15.3	71.9
	4		1924	23.5	27.9	51.4	2397	2213	4610	29.2	60.0	206	1912	27.6	63.3
	5		—	31.4	31.6	63.0	3072	2520	5592	24.0	59.7	168	1408	20.4	70.3
F	1	Control	—	17.6	26.1	43.7	1825	2029	3854	7.8	58.0	129	444	10.2	50.7
	2		1920	20.1	24.1	44.2	1934	1875	3809	17.2	59.0	147	932	13.5	76.9
	3		1921	20.7	25.0	45.7	1945	1840	3785	20.3	59.8	162	1104	14.7	83.4
	4		1922	25.3	29.3	54.6	2454	2286	4740	19.9	60.0	133	1120	15.2	78.0
	5		1924	26.6	26.7	53.3	2667	2144	4811	30.1	60.2	209	2176	28.1	64.4
G	1	Bone Meal; Sulphate of Ammonia; Sulphate of Potash	1920	20.4	24.4	44.8	1982	2060	4042	11.3	60.1	133	648	11.6	62.1
	2		1921	18.1	25.6	43.7	1791	2083	3874	21.7	60.3	130	1296	18.3	70.4
	3		—	20.1	23.0	43.1	1932	1896	3828	20.3	60.2	118	1244	15.8	75.6
	4		1922	25.6	24.4	50.0	2503	1918	4421	21.7	60.5	104	1432	17.1	74.0
	5		1924	18.1	22.3	40.4	1777	1833	3610	20.8	59.9	156	1560	22.0	56.9
H	1	Basic Slag; Sulphate of Ammonia; Sulphate of Potash	1920	31.2	26.9	58.1	3113	2199	5312	29.1	60.8	156	1980	25.4	67.6
	2		1921	25.3	27.6	52.9	2426	2258	4684	32.6	60.6	181	2140	26.2	73.4
	3		1922	32.6	28.9	61.5	3178	2341	5519	32.8	60.2	184	2092	24.4	79.2
	4		1924	31.8	25.0	56.8	3146	2055	5201	34.0	60.1	260	2952	33.4	61.6
	5		—	27.9	22.0	49.9	2725	1778	4503	18.2	60.5	128	1416	17.3	63.2

NOTES.—Since 1919 the manure for each plot (except of series A and B) has been rationed at 40 lb. Nitrogen, 100 lb. Calcium Phosphate and 50 lb. Potash per acre. Each plot has been supplied with as much of its particular manure (shoddy, guano, &c.) as possible without exceeding the receipt in any of the three rationed ingredients. Any deficit in either of these three has then been made good by adding the necessary quantity of Sulphate of Ammonia, Superphosphate, or Sulphate of Potash. No manure was applied for 1923 crop. Figures in italics denote unmanured plots. The yields on the plots to which the manure was applied in a given season are printed in heavy type.