

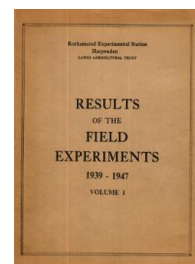
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BA/2 Three-course Rotation

Rothamsted Research

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Ba/2.1

THREE COURSE ROTATION EXPERIMENT

Long Hoos (begun in 1933)

The effects of straw compost, of straw ploughed in with fertilizers, and of magnesium sulphate

There are three series each of 24 plots, and the three crops of the rotation, potatoes, barley and sugar beet rotate on each series. The plots receive the same dressings every other year so that the direct and residual effects of manures can be measured. Area of each plot, 0.02 acre.

Treatments and rates of dressing (per acre)

	Straw	Compost	Sulphate of Ammonia	Super-phosphate	Muriate of potash
	tons	tons	cwt.	cwt.	cwt.
No organic manure (Art.)	-	-	2.0	2.2	0.8
Compost in Autumn (Adco)	-	5.0	-	-	0.8
Straw, ploughed in in autumn, artificials in spring (St ₁)	2.5	-	2.0	2.2	0.8
Straw, ploughed in in autumn, artificials half in autumn, half in spring (St ₂)	2.5	-	2.0 ¹	2.2	0.8 ²

1. For sugar beet the half-dressing applied in spring is 1.3 cwt. Nitrate of Soda;
2. Until 1946 the spring half-dressing to potatoes was 0.4 cwt. Sulphate of potash.

These four treatments are applied to three plots of each crop each year.

Magnesium Sulphate: 2.5 cwt. per acre applied to one of three replicate plots of each treatment in each crop section.

In addition to the above dressings, the potatoes receive a basal dressing of 2 cwt. sulphate of ammonia, 2.2 cwt. superphosphate and 0.8 cwt. muriate of potash. The sugar beet receive 1.3 cwt. nitrate of soda, 1.1 cwt. superphosphate and 0.4 cwt. muriate of potash.

Details of the experiment are as given in the 1933 Station Report, pp.118-119 except that no comparisons of winter green manuring crops are now made and that commencing in 1943, a yearly dressing of magnesium sulphate has been applied as detailed above. Results for 18 years are discussed in the Station Report for 1951, p.135.

Crop Notes

Potatoes (after Sugar beet). Barley (after Potatoes). Sugar beet (after Barley)

	Variety Planted Lifted			Variety Sown Harvested			Variety Sown Lifted		
1939	Ally	Apr. 17	Sept. 18	Plumage	Mar. 7	Aug. 18	Kuhn	Apr. 24	Oct. 25
				Archer					
1940	"	Apr. 26	Sept. 24	"	Mar. 9	Aug. 5	"	May 3	Oct. 17
1941	"	Apr. 28	Oct. 3	"	Mar. 25	Sept. 2	"	Apr. 30	Oct. 25
1942	Majestic	" 21	Oct. 3	"	Mar. 25	Aug. 17	Klein E	Apr. 24	Oct. 26
1943	"	Apr. 8	Sept. 17	"	Mar. 3	Aug. 7	"	Apr. 14	Oct. 14
1944	"	Mar. 28	Sept. 28	"	Mar. 7	Aug. 12	"	Apr. 22	Oct. 24
1945	"	Mar. 30	Sept. 24	"	Mar. 26	Aug. 11	"	Apr. 12	Oct. 19
1946	"	Apr. 1	Oct. 3	"	Mar. 21	Aug. 21	"	Apr. 15	Oct. 22
1947	"	Apr. 30	Sept. 27	"	Apr. 11	Aug. 11	"	Apr. 26	Oct. 17

Three-course Rotation Experiment

Ba/2.3

Potatoes. Total tubers: tons per acre

	Treatments applied same year					Treatments applied previous year				
	Art	Adco	St ₁	St ₂	Mean	Art	Adco	St ₁	St ₂	Mean
Mean Yields										
1939	11.02	10.14	12.41	11.03	11.15	8.87	8.55	10.32	10.51	9.56
		±0.439			±0.219		±0.439			±0.219
1940	8.05	7.32	8.37	8.23	7.99	6.14	6.91	6.96	6.92	6.73
		±0.183			±0.092		±0.183			±0.092
1941	11.08	9.16	12.33	11.16	10.93	8.68	10.31	9.48	10.50	9.74
		±0.652			±0.326		±0.652			±0.326
1942	9.66	8.48	10.21	9.71	9.52	6.79	7.20	8.80	8.52	7.83
		±0.324			±0.162		±0.324			±0.162
1943	8.20	7.05	8.53	8.93	8.18	5.56	5.79	6.93	6.80	6.27
		±0.188			±0.094		±0.188			±0.094
1944	10.10	9.92	10.74	10.55	10.33	8.68	9.15	9.62	9.81	9.32
		±0.502			±0.251		±0.502			±0.251
1945	11.21	10.05	11.67	11.69	11.16	9.14	8.91	10.83	10.24	9.78
		±0.467			±0.234		±0.467			±0.234
1946	10.88	10.10	12.43	12.27	11.42	8.45	8.65	9.95	9.64	9.17
		±0.367			±0.183		±0.367			±0.183
1947	7.56	6.07	7.33	7.07	7.01	5.51	6.45	5.78	6.29	6.01
		±0.562			±0.281		±0.562			±0.281

Responses to Magnesium Sulphate

1943	-0.04	0.42	-1.31	0.17	-0.19	0.22	-1.03	-1.09	-0.34	-0.56
		±0.399			±0.200		±0.399			±0.200
1944	1.70	-0.62	-0.22	0.68	0.38	-0.66	-1.28	1.20	1.00	0.06
		±1.06			±0.532		±1.06			±0.532
1945	0.31	1.33	-0.06	0.51	0.52	-1.32	1.21	-0.38	0.13	0.09
		±0.992			±0.496		±0.992			±0.496
1946	-0.65	-0.98	2.18	-0.19	0.09	0.11	0.44	-0.55	-0.22	-0.06
		±0.778			±0.389		±0.778			±0.389
1947	0.20	0.34	0.38	-0.18	0.19	0.04	-0.23	-0.62	0.20	-0.15
		±1.19			±0.596		±1.19			±0.596

Standard errors per plot

		d. f.
1939	0.760 tons per acre or 7.3%	16
1940	0.318 tons per acre or 4.3%	16
1941	1.13 tons per acre or 10.9%	16
1942	0.561 tons per acre or 6.5%	16
1943	0.326 tons per acre or 4.5%	8
1944	0.869 tons per acre or 8.8%	8
1945	0.810 tons per acre or 7.7%	8
1946	0.635 tons per acre or 6.2%	8
1947	0.974 tons per acre or 15.0%	8

σ^2 between plots
 σ_e^2 plots x years

Ba/2.4

Barley Grain: cwt. per acre

	Treatments applied same year					Treatments applied previous year				
	Art	Adco	St ₁	St ₂	Mean	Art	Adco	St ₁	St ₂	Mean
Mean Yields										
1939	39.9	30.8	35.4	32.2	34.6	33.9	29.1	29.2	32.7	31.2
		±2.00			±1.00		±2.00			±1.00
1940	29.0	29.4	28.5	29.5	29.1	28.3	24.6	26.5	29.0	27.1
		±1.28			±0.640		±1.28			±0.640
1941	28.9	21.8	27.9	25.1	25.9	22.2	19.7	24.2	23.0	22.3
		±0.771			±0.385		±0.771			±0.385
1942	32.1	26.0	27.4	28.6	28.5	26.9	26.2	27.3	24.3	26.2
		±1.82			±0.909		±1.92			±0.909
1943	32.3	25.8	30.5	29.8	29.6	25.2	24.3	24.8	26.1	25.1
		±0.867			±0.434		±0.867			±0.434
1944	35.5	31.4	33.0	34.7	33.6	31.3	32.2	29.9	31.0	31.1
		±1.54			±0.769		±1.54			±0.769
1945	33.2	27.3	32.1	32.8	31.4	25.0	25.3	27.6	28.7	26.6
		±2.07			±1.03		±2.07			±1.03
1946	34.6	33.5	29.7	32.2	32.5	29.2	28.8	27.9	29.9	29.0
		±1.54			±0.768		±1.54			±0.768
1947	27.4	20.6	26.7	23.7	24.6	19.7	16.9	18.6	20.0	18.8
		±1.09			±0.546		±1.09			±0.546

Responses to Magnesium Sulphate

1943	1.1	4.8	0.1	0.2	1.6	-4.3	0.2	1.9	-2.5	-1.2
		±1.84			±0.920		±1.84			±0.920
1944	0.6	1.2	-0.6	1.9	0.8	-3.3	-2.9	0.8	2.2	-0.8
		±3.26			±1.63		±3.26			±1.63
1945	-2.2	-1.5	2.2	-2.2	-0.9	-0.5	-7.9	-0.8	-0.9	-2.5
		±4.39			±2.19		±4.39			±2.19
1946	0.9	-0.4	1.2	-2.1	0.3	2.3	4.9	-1.2	-2.1	1.0
		±3.26			±1.63		±3.26			±1.63
1947	-4.4	-2.3	-0.1	1.7	-1.3	2.4	1.4	-5.9	1.1	-0.3
		±2.31			±1.16		±2.31			±1.16

Standard errors per plot

d. f.

1939	3.47 cwt. per acre or 10.6%	16
1940	2.22 cwt. per acre or 7.9%	15*
1941	1.34 cwt. per acre or 5.5%	16
1942	3.15 cwt. per acre or 11.5%	16
1943	1.50 cwt. per acre or 5.5%	8
1944	2.66 cwt. per acre or 8.2%	8
1945	3.58 cwt. per acre or 12.4%	8
1946	2.66 cwt. per acre or 8.7%	8
1947	1.89 cwt. per acre or 8.7%	8

*One missing plot.

Three Course Rotation Experiment

Ba/2.5

Barley. Straw: cwt. per acre

	Treatments applied same year					Treatments applied previous year				
	Art	Adco	St ₁	St ₂	Mean	Art	Adco	St ₁	St ₂	Mean
Mean Yields										
1939	50.4	36.5	44.4	40.1	42.8	37.5	35.2	33.9	37.2	36.0
1940	38.4	31.8	33.4	31.6	33.8	30.3	26.5	27.4	30.0	28.6
1941	37.3	26.0	34.9	29.2	31.8	27.4	24.4	27.6	28.5	27.0
1942	35.7	26.0	29.9	30.0	30.4	26.5	26.8	27.0	25.0	26.3
1943	34.4	24.4	31.9	29.7	30.1	24.2	24.7	24.8	26.6	25.1
1944	33.5	29.0	29.7	31.6	31.0	29.8	30.1	28.8	29.7	29.6
1945	37.4	27.2	36.1	34.1	33.7	26.5	29.0	29.3	30.5	28.8
1946	40.4	37.5	38.0	36.9	38.2	29.4	30.7	31.7	32.8	31.2
1947	26.5	22.3	27.2	22.8	24.7	20.0	18.5	20.0	21.0	19.9

Responses to Magnesium Sulphate

1943	-0.1	3.6	3.5	0.3	1.8	-4.3	2.1	1.1	-4.8	-1.5
1944	0.5	0.8	-7.5	2.4	-1.0	-4.3	-2.5	-0.7	-0.7	-2.0
1945	-2.0	0.0	2.0	-2.9	-0.7	-1.3	-9.1	-2.7	1.3	-3.0
1946	0.8	0.5	1.7	-5.4	-0.6	-2.6	3.3	5.2	0.4	1.6
1947	-4.4	-4.5	-1.0	-0.1	-2.5	-0.2	2.7	-3.2	0.5	-0.1

Ba/2.6

Sugar Beet. Roots (washed): tons per acre

	Treatments applied same year					Treatments applied previous year				
	Art	Adco	St ₁	St ₂	Mean	Art	Adco	St ₁	St ₂	Mean
Mean Yields										
1939	14.00	12.21	13.01	13.63	13.21	12.11	11.36	11.93	13.07	12.12
1940	10.47	9.45	9.95	11.41	10.32	10.14	9.43	9.59	9.49	9.66
1941	11.53	10.43	10.86	11.61	11.11	10.09	10.36	10.24	10.63	10.33
1942	14.24	10.02	13.52	13.08	12.72	11.87	10.49	11.37	11.09	11.20
			±0.714		±0.357			±0.714		±0.357
1943	14.32	11.50	13.00	12.30	12.78	12.10	11.17	10.43	12.40	11.52
			±0.806		±0.403			±0.806		±0.403
1944	8.87	8.43	7.48	7.90	8.17	7.73	7.81	7.91	8.36	7.95
			±1.05		±0.525			±1.05		±0.525
1945	13.99	12.04	12.77	12.86	12.92	12.37	11.26	13.01	11.47	12.03
			±0.897		±0.448			±0.897		±0.448
1946	14.50	12.16	12.51	13.36	13.13	12.33	11.50	12.17	12.42	12.10
			±0.311		±0.156			±0.311		±0.156
1947	10.89	7.99	10.02	9.63	9.63	9.09	8.97	9.29	8.94	9.07
			±0.741		±0.370			±0.741		±0.370

Responses to Magnesium Sulphate

1943	-0.74	0.60	0.06	-1.14	-0.30	-0.17	0.26	-2.66	0.12	-0.61
			±1.71		±0.855			±1.71		±0.855
1944	3.00	-3.07	0.10	0.38	0.10	1.91	-1.06	1.02	-1.60	0.06
			±2.23		±1.11			±2.23		±1.11
1945	-0.46	-0.38	-0.23	-0.10	-0.29	-0.07	0.85	-0.22	2.11	0.24
			±1.90		±0.951			±1.90		±0.951
1946	-0.93	0.68	-0.11	0.85	0.11	0.39	0.47	0.17	-0.68	0.09
			±0.661		±0.330			±0.661		±0.330
1947	3.55	-2.61	-0.44	1.86	0.60	1.09	-0.97	-0.33	-0.48	-0.17
			±1.57		±0.786			±1.57		±0.786

Standard errors per plot

		d. f.
1942	1.24 tons per acre or 10.3%	16
1943	1.40 tons per acre or 11.5%	8
1944	1.82 tons per acre or 22.6%	8
1945	1.55 tons per acre or 12.5%	8
1946	0.539 tons per acre or 4.3%	8
1947	1.28 tons per acre or 13.7%	8

Three Course Rotation Experiment

Ba/2.7

Sugar Beet. Total Sugar: cwt. per acre

	Treatments applied same year					Treatments applied previous year				
	Art	Adco	St ₁	St ₂	Mean	Art	Adco	St ₁	St ₂	Mean
Mean Yields										
1939	51.4	45.7	48.9	50.2	49.0	44.2	42.8	43.3	47.7	44.5
		±1.97			±0.987			±1.97		±0.987
1940	44.2	40.1	41.9	48.9	43.8	42.6	39.9	41.3	40.1	41.0
		±2.47			±1.23			±2.47		±1.23
1941	46.3	42.7	43.7	47.2	45.0	40.5	41.4	41.0	42.4	41.3
		±2.26			±1.13			±2.26		±1.13
1942	51.5	36.4	49.2	48.0	46.3	42.1	38.1	42.0	40.7	40.7
		±2.54			±1.27			±2.54		±1.27
1943	52.8	41.8	48.1	44.9	46.9	44.9	40.8	38.5	46.1	42.6
		±2.75			±1.38			±2.75		±1.38
1944	29.6	28.0	24.2	26.1	27.0	26.0	26.5	26.7	27.9	26.3
		±3.57			±1.79			±3.57		±1.79
1945	56.5	48.4	52.9	52.4	52.6	50.6	45.2	51.8	46.8	48.6
		±3.66			±1.83			±3.66		±1.83
1946	52.5	45.0	46.3	49.1	48.2	45.3	42.2	44.0	46.4	44.5
		±1.13			±0.566			±1.13		±0.566
1947	45.7	33.3	43.0	40.2	40.5	38.7	37.1	38.8	37.2	37.9
		±3.29			±1.64			±3.29		±1.64

2

Responses to Magnesium Sulphate

1943	-2.5	3.0	-0.9	-3.5	-1.0	-2.7	0.6	-9.4	0.5	-2.8
		±5.84			±2.92			±5.84		±2.92
1944	10.6	-11.8	-0.3	2.3	0.02	6.3	-4.6	2.7	2.3	0.17
		±7.57			±3.79			±7.57		±3.79
1945	-1.0	-0.1	-0.9	0.0	-0.5	1.0	6.7	-2.1	8.4	3.5
		±7.77			±3.88			±7.77		±3.88
1946	-3.2	2.8	-0.9	4.1	0.7	1.7	3.5	0.4	-2.2	0.8
		±2.40			±1.20			±2.40		±1.20
1947	14.9	-10.4	-1.8	7.8	2.6	6.0	-5.1	-3.7	-1.9	-1.2
		±6.97			±3.48			±6.97		±3.48

Standard errors per plot d. f.

1939	3.42 cwt. per acre or 7.3%	16
1940	4.27 cwt. per acre or 10.1%	16
1941	3.91 cwt. per acre or 9.0%	16
1942	4.40 cwt. per acre or 10.1%	16
1943	4.77 cwt. per acre or 10.7%	8
1944	6.18 cwt. per acre or 23.0%	8
1945	6.34 cwt. per acre or 12.5%	8
1946	1.96 cwt. per acre or 4.2%	8
1947	5.69 cwt. per acre or 14.5%	8



Sugar Beet. Sugar Percentage

	Treatments applied same year					Treatments applied previous year				
	Art	Adco	St ₁	St ₂	Mean	Art	Adco	St ₁	St ₂	Mean
Mean Yields										
1939	18.35	18.71	18.78	18.38	18.56	18.27	18.83	18.12	18.25	18.37
1940	21.10	21.25	21.03	21.46	21.21	20.98	21.19	21.53	21.10	21.20
		±0.325			±0.162		±0.325			±0.162
1941	20.10	20.48	20.11	20.32	20.25	20.08	19.96	20.00	19.99	20.01
		±0.227			±0.113		±0.227			±0.113
1942	18.08	18.17	18.22	18.35	18.20	17.75	18.19	18.48	18.38	18.20
		±0.192			±0.096		±0.192			±0.096
1943	18.43	18.18	18.52	18.28	18.35	18.52	18.30	18.47	18.60	18.47
		±0.171			±0.086		±0.171			±0.086
1944	16.67	16.48	16.13	16.40	16.43	16.85	16.93	16.86	16.68	16.83
		±0.126			±0.063		±0.126			±0.063
1945	20.21	20.11	20.74	20.39	20.36	20.47	20.05	19.91	20.38	20.20
		±0.174			±0.087		±0.174			±0.087
1946	18.13	18.52	18.51	18.38	18.38	18.36	18.37	18.10	18.68	18.38
		±0.165			±0.082		±0.165			±0.082
1947	20.97	20.91	21.44	20.86	21.04	21.26	20.63	20.88	20.76	20.88

Responses to Magnesium Sulphate

1943	0.09	0.30	-0.43	0.27	0.06	-0.83	-0.23	0.21	0.01	-0.21
		±0.364			±0.182		±0.364			±0.182
1944	0.28	-1.14	-0.40	0.79	-0.12	-0.08	-0.70	-0.44	0.37	-0.21
		±0.268			±0.134		±0.268			±0.134
1945	0.25	0.60	-0.01	0.14	0.24	0.51	1.42	-0.46	-0.06	0.35
		±0.368			±0.184		±0.368			±0.184
1946	0.11	0.08	-0.20	0.39	0.10	0.12	0.80	-0.10	0.10	0.23
		±0.349			±0.175		±0.349			±0.175
1947	0.00	0.36	0.04	0.05	0.11	0.69	-0.61	-1.24	0.14	-0.25

Standard errors per plot

		d. f.
1940	0.562	16
1941	0.393	16
1942	0.333	16
1943	0.297	8
1944	0.219	8
1945	0.301	8
1946	0.285	8

Three Course Rotation Experiment

Ba/2.9

Sugar Beet. Tops: tons per acre

	Treatments applied same year					Treatments applied previous year				
	Art	Adco	St ₁	St ₂	Mean	Art	Adco	St ₁	St ₂	Mean
Mean Yields										
1939	15.09	11.40	12.83	12.52	12.96	12.33	10.24	12.08	12.22	11.72
1940	8.16	6.46	7.35	8.06	7.51	6.80	6.74	6.32	6.42	6.57
		±0.491			±0.245		±0.491			±0.245
1941	11.91	8.64	9.32	10.87	10.18	8.26	9.57	8.47	9.15	8.86
		±0.675			±0.337		±0.675			±0.337
1942	11.39	7.32	10.14	9.79	9.66	8.87	7.93	8.35	7.80	8.24
		±0.663			±0.332		±0.663			±0.332
1943	11.52	8.43	8.74	8.74	9.36	7.72	8.27	6.25	8.15	7.60
		±1.02			±0.512		±1.02			±0.512
1944	10.35	9.08	8.57	9.17	9.29	8.09	7.77	7.20	9.07	8.03
		±0.693			±0.346		±0.693			±0.346
1945	9.42	6.47	7.70	6.64	7.56	6.31	6.13	7.30	6.98	6.68
		±0.315			±0.158		±0.315			±0.158
1946	13.84	10.54	11.39	11.96	11.93	10.80	11.03	9.16	10.49	10.37
		±1.17			±0.585		±1.17			±0.585
1947	6.12	4.38	5.56	5.83	5.47	4.44	4.96	4.87	5.05	4.83
		±0.280			±0.140		±0.280			±0.140

Responses to Magnesium Sulphate

1943	-1.40	0.68	-0.83	-0.32	-0.47	-0.06	-0.15	-0.31	-0.07	-0.27
		±2.17			±1.09		±2.17			±1.09
1944	1.22	-1.36	1.98	-1.44	0.10	2.05	0.16	0.16	-0.54	0.46
		±1.47			±0.735		±1.47			±0.735
1945	-2.07	-0.93	-1.17	-0.18	-1.09	-0.49	-0.02	2.51	0.65	0.66
		±0.668			±0.334		±0.668			±0.334
1946	-0.87	-1.00	-1.41	1.40	-0.47	-0.35	-0.47	-0.38	-0.60	-0.58
		±2.48			±1.24		±2.48			±1.24
1947	1.14	-0.71	-0.47	-0.31	-0.09	0.10	0.54	0.49	-0.95	0.04
		±0.594			±0.297		±0.594			±0.297

Standard errors per plot

		d. f.
1939	1.13 tons per acre or 9.2%	16
1940	0.850 tons per acre or 12.1%	16
1941	1.17 tons per acre or 12.3%	16
1942	1.15 tons per acre or 12.8%	16
1943	1.77 tons per acre or 20.9%	8
1944	1.20 tons per acre or 13.8%	8
1945	0.546 tons per acre or 7.7%	8
1946	2.03 tons per acre or 18.2%	8
1947	0.435 tons per acre or 9.4%	8

