

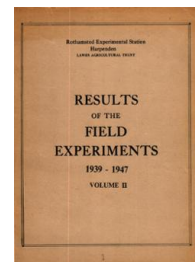
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H Effects of Three Organic Manures

Rothamsted Research

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H/1

DIRECT AND RESIDUAL EFFECTS OF THREE ORGANIC MANURES

Great Harpenden, 1940 - 1947

and

Woburn, Butt Furlong, 1940 - 1941

These two experiments were identical in design. They tested the effects of fermented town refuse and screened dust (each applied before or after ploughing) and of dung, and also of sulphate of ammonia and muriate of potash.

Design; 4 randomized blocks of 12 plots each. Plots split for application of artificials and for the early and late applications of town refuse and screened dust. Certain interactions confounded with differences between whole plots. Area of each sub-plot; Rothamsted, 0.01 acre; Woburn, 0.007 acre.

Treatments

Whole plots Organic manures; Dung, fermented town refuse and screened dust applied as follows (1) None (2) 8 tons per acre every year except 1947 (3) 16 tons per acre in even years only (4) 16 tons per acre in odd years only except 1947, except that at Woburn the rates were 10 and 20 tons per acre

Sub-plots Time of application; Town refuse and screened dust applied before and after ploughing. (Town refuse in 1940 and 1941 only). Sulphate of ammonia; None, 0.6 cwt. N per acre every year except 1947 Muriate of potash; None, and as follows (amounts in cwt. K₂O per acre), 1.0 in 1940, 0.5 every year from 1942 to 1946. Each treatment was always applied to the same plot. In 1947 none of the above treatments were applied, but muriate of potash was applied as a whole-plot treatment at these rates; None, and 1.2 cwt. K₂O per acre.

Basal Manuring; 1940, 0.6 cwt. P₂O₅ per acre as superphosphate 1941-44 and 1946, 0.4 cwt. P₂O₅ per acre as superphosphate 1947, 0.6 cwt. N per acre as sulphate of ammonia 0.5 cwt P₂O₅ per acre as superphosphate

H/2

Effects of Three Organics

Crop Notes

Year (Rothamsted)	Crop	Variety	Sown	Harvested
1940	Sugar Beet	Kleinwanzleben E	May 20	Dec. 2 Previous Crop, Wheat
1941	Mangolds	Yellow Globe	Apr. 24	Oct. 18
1942	Mangolds	Yellow Globe	May 2	Nov. 16
1943	Barley	Plumage Archer	March 2	Aug. 5
1944	Beans	Garton's Giant	29/10/43	Aug. 2
1945	Wheat	Jubilagem	25/10/44	Aug. 3
1946	Sugar Beet	Klein	March 15	Nov. 19
1947	Potatoes	Majestic	May 7	Sept. 30
(Woburn)				
1940	Sugar Beet	Kleinwanzleben	April 25	Oct. 29 Previous crop barley
1941	Mangolds	Yellow Globe	May 7	Nov. 12

H/3

Organic manures tons per acre	Sugar Beet - Rothamsted, 1940				Screened		Mean
	None	Dung		Town refuse		Dust	
		8	16	8	16	8	16

Roots washed: tons per acre

Mean yield	11.49	12.26	12.67	11.64	11.21	12.22	11.57	11.71
Early-late applicn. of organics				0.02	-0.08	-0.01	0.51	0.11
Response to N	1.25	1.60	2.18	1.23	1.31	1.69	2.57	1.51
Response to K	-0.15	-0.70	0.06	-0.51	0.37	-1.24	0.16	-0.23

Sugar Percentage

Mean yield	17.92	17.84	17.59	18.19	18.04	17.92	17.96	17.92
Early-late applicn. of organics				-0.40	0.08	-0.06	-0.25	-0.16
Response to N	-0.32	-0.40	-0.10	0.07	-0.29	-0.40	0.02	-0.25
Response to K	0.17	0.50	0.08	0.25	0.09	-0.06	0.26	0.18

Total sugar: cwt. per acre

Mean yield ± 1.70	41.2 ^a	43.7	44.6	42.3	40.4	43.8	41.6	42.0
Early-late applicn. of organics ± 1.92				-0.8	-0.2	-0.2	1.3	0.0 ^c
Response to N ± 1.92	3.8 ^b	4.8	7.4	4.7	4.1	5.1	9.3	4.8 ^d
Response to K ± 1.92	-0.1 ^b	-1.3	0.3	-1.3	1.5	-4.6	1.0	0.4 ^d

Tops: tons per acre

Mean yield ± 0.360	8.31 ^e	8.92	10.50	8.58	7.55	8.69	8.39	8.54
Early-late applicn. of organics ± 0.500				0.17	-0.08	-0.11	0.35	0.08 ^g
Response to N ± 0.500	2.63 ^f	2.54	3.12	2.38	1.91	3.24	3.16	2.68 ^h
Response to K ± 0.500	0.23 ^f	0.33	0.25	0.23	0.61	-0.16	-0.30	0.20 ^h

Plant number: thousands per acre

Mean yield	28.5	29.2	29.4	29.7	30.1	29.5	29.8	29.1
Early-late applicn. of organics				-1.1	-0.6	0.1	-0.1	-0.4
Response to N	0.1	0.1	0.1	0.2	0.2	-1.0	-0.3	0.0
Response to K	0.9	-0.2	0.4	-0.2	0.1	-0.2	0.0	0.5

Standard errors: (a) 0.692, (b) 0.782, (c) 0.958, (d) 0.553,
(e) 0.147, (f) 0.204, (g) 0.250, (h) 0.144

Per whole plot

Sub-plot

Total sugar, cwt. per acre 3.39 or 8.1%, 38 d.f. 2.71 or 6.5%, 30 d.f.
Tops, tons per acre 0.719 or 8.4%, 38 d.f. 0.707 or 8.3%, 30 d.f.

H/4

Effects of Three Organics

Mangolds - Rothamsted, 1941

Tons per acre 1941	Dung			Town refuse			Screened Dust			Mean
	0	8	16	0	8	16	0	8	16	
Mean yield ± 1.78 Early-late applicn. of organics ± 1.93 Response to N ± 1.93 Response to residual K ± 1.93	None 20.26 ^a 5.15 ^b -1.17 ^b	8 22.70 7.94 4.82	16 26.40 8.87 -1.57	0 23.35 2.26 -0.47	8 26.89 4.68 1.50	16 28.90 5.80 1.29	0 24.43 5.62 -2.34	8 21.99 7.79 -2.25	16 23.70 -0.56 3.55 -2.54	23.81 -1.74 ^c 5.71 ^d -0.20 ^d

Plant number; thousands per acre

Mean ± 1.93 Early-late applicn. of organics ± 1.53 Response to N ± 1.53 Response to residual K ± 1.53	13.3 ^e 1.0 ^f -1.1 ^f	13.9 1.4 3.0	18.9 1.6 0.2	15.2 -0.8 0.5	18.2 -3.4 2.0	19.3 -1.2 1.0	15.7 0.6 -1.5	15.6 -1.2 1.3	15.9 -0.8 -1.1	15.8 -7.7 ^g 0.4 ^h 0.1 ^h
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Standard errors: (a) 1.03 (b) 1.12 (c) 0.97 (d) 0.56 (e) 1.11 (f) 0.88
(g) 0.76 (h) 0.43

Per whole plot

Sub-plot

Roots, tons per acre 3.56 or 14.9%, 35 d.f. 2.73 or 11.5%, 34 d.f.
Plant no., thous. per acre 3.86 or 24.5%, 35 d.f. 2.11 or 13.4%, 34 d.f.

Direct organic treatments were confounded with residual organic treatments; see treatment details.

Mangolds - Rothamsted, 1942

Tons per acre 1942	None		Dung		Town refuse		Screened dust		Mean
	0	16	8	16	0	8	0	16	
Mean yield ± 1.35	23.34	27.91	31.23	26.78	26.74	22.30	24.40	25.06	24.33
Early-late applicn. of dust ± 1.86	4.14	4.66	6.35	-0.99	4.90	2.62	0.45	2.08	1.26 ^c
Response to N ± 1.86	3.75	2.31	3.40	6.50	0.61	-1.40	6.99	3.20	3.70 ^d
Response to K ± 1.86					2.70		3.37	2.60	2.41 ^d
Mean ± 1.00	18.5	19.1	16.1	18.0	17.8	19.0	19.5	17.1	18.5
Early-late applicn. of dust ± 1.41	-0.2	0.0	0.1	0.2	0.1	-0.1	-0.1	0.3	0.1 ^g
Response to N ± 1.41	2.0	-0.8	-1.4	-1.4	-0.1	1.9	-2.3	-3.2	-0.7 ^h
Response to K ± 1.86							-1.2	1.8	-0.2 ^h
Standard errors;	(a) 0.779	(b) 1.07	(c) 0.930	(d) 0.537	(e) 0.58	(f) 0.81	(g) 0.70		
	(h) 0.41								

Plant number; thousands per acre

Per whole plot Sub-plot

Roots, tons per acre 2.70 or 11.1%, 35 d.f. 2.63 or 10.8%, 25 d.f.
 Plant no., thous. per acre 2.16 or 11.7%, 35 d.f. 1.99 or 10.8%, 25 d.f.

Direct organic treatments were confounded with residual organic treatments; see treatment details.

H/6
Effect of Three Organics

Barley - Rothamsted, 1943

Tons per acre 1943	Dung			Town refuse			Screened dust			Mean
	None	0 8 16	0 8 16	0 8 16	0 8 16	0 8 16	0 8 16	0 8 16		
Mean yield \pm 1.16	31.2 ^a	36.4	38.9	33.6	34.7	36.4	33.9	32.3	31.2	34.1
Early-late applicn. of dust \pm 1.54	5.8	6.6	6.3	10.4	9.3	4.0	1.4	1.4	1.4	1.4 ^c
Resp. to N \pm 1.54	0.0	0.1	3.4	0.6	-1.1	-1.3	10.6	10.0	9.2	8.7 ^d
Resp. to K \pm 1.54	-0.4						0.2	0.5	-0.8	0.1 ^d
Straw, cwt. per acre										
Mean yield	37.0	45.6	45.2	38.7	39.6	41.6	38.2	38.0	40.4	40.4
Early-late applicn. of dust	14.1	9.9	11.5	13.7	13.1	10.8	15.6	15.0	12.6	-1.6
Response to N	1.6	1.1	1.4	0.5	-1.7	-1.6	0.2	0.1	1.4	13.2
Response to K										0.7

Standard errors (a) 0.67 (b) 0.89 (c) 0.77 (d) 0.44

Per whole plot Sub-plot

Grain cwt. per acre 2.32 or 6.8%, 35 d.f. 2.18 or 6.4%, 25 d.f.

Direct organic treatments were confounded with residual organic treatments; see treatment details.

Beans - Rothamsted, 1944

Tons per acre 1944	Ncrc	Dung		Town refuse		Screened dust		Mean
		0	16	0	16	0	16	
Mean yield ± 1.18	11.0 ^a	23.3	25.4	26.3	14.2	13.2	14.2	16.2
Early-late applicn. of dust ± 1.61	-0.6 ^b	2.5	-0.2	1.5	-1.6	2.7	1.4	0.5 ^c
Response to N ± 1.61	8.7 ^b	2.8	0.2	0.6	7.4	7.8	7.5	0.6 ^d
Response to K ± 1.61								6.2 ^d
Mean yield ± 0.82	12.7 ^c	19.4	20.4	21.2	14.4	13.3	15.5	15.8
Early-late applicn. of dust ± 1.75	-0.5 ^f	1.1	-0.6	-0.1	-1.3	-0.8	0.6	0.2 ^g
Response to N ± 1.75	6.3 ^f	2.1	-0.8	-0.8	3.2	5.9	3.4	-0.3 ^h
Response to K ± 1.75								3.5 ^h

Standard errors; (a) 0.68 (b) 0.93 (c) 0.80 (d) 0.47 (e) 0.48 (f) 1.01 (g) 0.88 (h) 0.51

Per whole plot Sub-plot
 Grain, cwt. per acre 2.36 or 14.6%, 35 d.f. 2.28 or 14.1%, 25 d.f.
 Straw, cwt. per acre 1.65 or 10.5%, 35 d.f. 2.48 or 15.7%, 25 d.f.

Direct organic treatments were confounded with residual organic treatments; see treatment details.

H/8
Effects of Three Organics

Wheat - Rothamsted 1945

Tons per acre 1945	None	Dung			Town refuse			Screened dust			Mean
		0	8	16	0	8	16	0	8	16	
Mean yield ± 1.14 Early-late applicn. of dust ± 1.40	31.1 ^a	37.1	36.5	37.5	30.8	33.5	35.0	34.3	33.7	32.9	33.7
Response to N ± 1.40 Response to K ± 1.40	11.1 ^b 0.3 ^b	6.7 -2.0	9.0 0.3	7.4 0.6	7.6 2.8	6.3 0.1	5.2 0.9	10.4 2.4	9.2 0.5	9.0 -0.5	-0.2 ^c 8.7 ^d 0.5 ^d
Mean yield ± 1.94 Early-late applicn. of dust ± 1.83	45.8 ^e	57.2	55.2	57.2	48.2	50.3	50.8	51.3	50.0	48.4	50.5
Response to N ± 1.83 Response to K ± 1.83	15.6 ^f -0.4 ^f	13.0 -2.0	14.7 0.3	13.4 -0.6	14.4 1.1	14.4 -0.8	10.4 0.6	17.2 1.6	15.3 -0.5	16.1 1.4	0.2 ^g 14.6 ^h 0.0 ^h

Grain, cwt. per acre

Straw, cwt. per acre

Standard errors (a) 0.66 (b) 0.81 (c) 0.70 (d) 0.41 (e) 1.12 (f) 1.06 (g) 0.92
(h) 0.53

	Per whole plot	Sub-plot
Grain, cwt. per acre	2.29 or 6.8%, 34 d.f.	1.99 or 5.9%, 25 d.f.
Straw, cwt. per acre	3.89 or 7.7%, 34 d.f.	2.59 or 5.1%, 25 d.f.

Direct organic treatments were confounded with residual organic treatments; see treatment details.

Sugar Beet - Rothamsted, 1946

Tons per acre	1946		None			Dung			Town refuse			Screened dust			Mean
	0	8	16	0	8	16	0	8	16	0	8	16			
Mean yield ± 0.49 early-late applicn. of dust ± 0.76	12.07a	16.23	15.36	15.68	14.78	14.22	15.09	15.12	15.16	15.50	14.44				
Response to N ± 0.76	2.93 ^b	4.66	5.88	3.33	2.13	3.85	4.02	-0.09	-1.84	1.70	-0.08 ^b				
Response to K ± 0.76	0.90b	-0.44	0.98	1.15	0.47	-0.13	2.30	3.68	4.06	3.46	3.66 ^c				
								-0.27	-2.63	-0.88	0.27 ^c				
Roots (washed) - tons per acre															
Total Sugar - cwt. per acre ^{###}															
Mean yield	39.3	55.0	50.2	54.2	49.0	47.6	51.4	52.1	52.8	52.8	48.6				
Response to N	9.6	13.4	16.9	6.9	6.1	10.3	12.5	11.8	14.4	12.9	11.2				
Sugar Percentage ^{###}															
Mean	16.48	17.05	16.43	17.05	16.86	16.90	17.26	16.90	17.18	17.00	16.84				
Response to N	-0.49	-0.58	0.26	-0.64	-0.32	-0.55	-0.19	0.35	0.03	-0.23	-0.36				

Standard errors (a) 0.28 (b) 0.43 (c) 0.22

Direct organic treatments were confounded with residual organic treatments; see treatment details

The samples taken from each plot for analysis were bulked so that only the above comparisons were possible.

H/10

Effects of Three Organics

	Sugar Beet - Rothamsted 1946				Town refuse				Screened Dust				Mean										
	Dung		None		0		8		16		0			8		16							
Tons per acre 1946	None		0		8		16		0		8		16										
Mean yield ± 0.82	9.00d		9.78		11.56		11.72		11.57		11.51		10.64		9.59		11.75		9.39		10.38		
Early-late applicn. of dust ± 1.29	4.87e		4.55		5.45		4.24		3.18		6.23		5.11		2.17		2.27		-1.76		0.90 ^e		
Response to N ± 1.29	-0.33e		-0.31		2.10		-0.22		-0.13		-1.18		0.38		-0.29		-1.69		-1.45		3.97f		
Response to K ± 1.29																					-0.31f		
	Tops - tons per acre																						
	Plant number - thousands per acre																						
Mean yield ± 0.68	32.0 g		31.2		31.1		30.5		31.4		31.4		30.8		31.2		32.4		31.4		31.5		
Early-late applicn. of dust ± 0.61	-1.0h		-1.9		-0.6		-1.4		-1.3		0.0		-0.6		1.2		-0.1		0.8		0.6 ^h		
Response to N ± 0.61	0.5h		0.5		-0.8		0.7		0.5		0.5		-1.0		-1.4		-0.9		-1.6		-1.1j		
Response to K ± 0.61																					-0.1j		
Standard errors (d) 0.47 (e) 0.75 (f) 0.37 (g) 0.39 (h) 0.35 (j) 0.18																							
	Standard errors per whole plot											Sub-plot											
Roots (washed) tons per acre	0.99 or 6.8 _v , 34 d.f.											1.07 or 7.4 _v , 25 d.f.											
Tops tons per acre	1.64 or 15.8 _v , 32 d.f.											1.82 or 17.6 _v , 23 d.f.											
Plant number thousands per acre	1.36 or 4.3 _v , 34 d.f.											0.86 or 2.7 _v , 25 d.f.											

Direct organic treatments were confounded with residual organic treatments; see treatment details.

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Potatoes - Rothamsted 1947

Tons per acre 1946	Dung			Town Refuse			Screened Dust			Mean
	0	8	16	0	8	16	0	8	16	
Mean yield ± 0.230	9.23	9.27	9.32	7.90	7.20	7.86	7.91	7.74	8.28	8.01
Response to residual N ± 0.376	0.49	0.00	0.29	-0.57	-0.10	-0.45	0.84	-0.17	-0.75	-0.15 ^d
Response to residual K ± 0.376	0.05	0.64	-0.16	0.52	0.58	-0.85	0.58	1.14	0.89	0.60 ^d
Response to direct K ± 0.476	0.09	0.22	0.66	2.07	2.40	0.77	1.30	1.83	0.45	1.27 ^a

Total tubers, tons per acre

Standard errors; (a) 0.133 (b) 0.217 (c) 0.266 (d) 0.108

Per whole plot

0.459 or 5.7%, 24 d.f.

Sub-plot

0.532 or 6.6%, 25 d.f.

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All treatments were residual this year, except for the direct application of potash.

H/12

Effects of Three Organics

Sugar Beet - Woburn, 1940

Tons per acre 1940	None	Dung		Town refuse		Screened dust		Mean
		10	20	10	20	10	20	
Roots washed: tons per acre								
Mean yield	12.54	14.97	16.24	11.75	11.83	13.27	12.84	13.01
Early-late application of organics				0.48	1.43	1.29	0.77	0.99
Response to N	3.97	3.21	2.23	5.64	6.62	5.16	4.54	4.27
Response to K	0.24	-0.44	0.60	-0.11	1.52	0.13	0.42	0.30
Sugar percentage								
Mean yield	18.50	18.58	18.41	18.77	18.62	18.47	18.55	18.53
Early-late application of organics				0.39	-0.48	-0.30	0.38	0.00
Response to N	-0.15	-0.13	-0.53	0.48	-0.49	-0.48	-0.10	-0.18
Response to K	0.15	0.20	0.00	0.32	-0.17	0.10	0.06	0.12
Total sugar: cwt. per acre								
Mean yield ± 2.57	46.4a	55.6	59.8	44.2	43.7	48.7	47.6	48.2
Early-late application of organics ± 3.12				2.3	4.3	3.8	3.6	3.5c
Response to N ± 3.12	14.4 ^b	11.6	6.5	22.3	23.3	17.9	16.6	15.4d
Response to K ± 3.12	1.2 ^b	-0.8	2.1	0.4	5.2	1.1	1.9	1.4d
Tops: tons per acre								
Mean yield ± 0.494	7.02e	9.01	10.19	6.88	7.42	7.18	7.32	7.51
Early-late application of organics ± 0.653				-0.55	1.48	1.18	0.33	0.61g
Response to N ± 0.653	2.60f	3.33	2.47	3.51	4.31	2.34	3.41	2.91h
Response to K ± 0.653	0.38f	0.72	1.40	0.11	1.63	0.55	-0.11	0.55h

Standard errors: (a) 1.05, (b) 1.28, (c) 1.56, (d) 0.902, (e) 0.202
(f) 0.266 (g) 0.326 (h) 0.188

Per whole plot

Sub-plot

Total sugar, cwt. per acre 5.14 or 10.7%, 38 d.f. 4.42 or 9.2%, 30 d.f.
Tops, tons per acre 0.989 or 13.2%, 38 d.f. 0.923 or 12.3%, 30 d.f.

There was a very even stand, and so the plants were not counted.

Mangolds - Woburn 1941

Tons per acre 1941	None			Dung			Town refuse			Screened Dust			Mean
	0	10	20	0	10	20	0	10	20	0	10	20	
Mean yield \pm 1.22	9.56a	9.93	13.08	14.60	11.40	10.18	13.18	8.69	9.42	9.27	10.70		
Early-late applicn. organics \pm 0.954					-0.12	-2.80		0.96	-0.94		-0.73 ^c		
Response to N \pm 0.954	5.16 ^b	6.64	6.16	4.28	6.60	5.44	7.22	6.22	5.36	4.72	5.68 ^d		
Response to residual K \pm 0.954	0.12 ^b	-0.68	-1.16	0.04	1.68	-0.12	-1.46	0.08	0.56	0.32	-0.03 ^d		

Roots, tons per acre

Standard errors; (a) 0.704 (b) 0.551 (c) 0.477 (d) 0.276

Per whole plot Sub-plot

2.44 or 22.8%, 35 d.f. 1.35 or 12.6%, 25 d.f.

Direct organic treatments were confounded with residual organic treatments; see treatment details.