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Other Experiments at Woburn

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SUGAR BEET
WOBURN

Effect of agricultural salt and of muriate of potash, ploughed in in December or broadcast in December, early in March or at sowing, and of dung

WS—Butt Furlong, 1937
Plan and yields in lb.

		Roots	Tops	Sugar	Plant			Roots	Tops	Sugar	Plant
		(dirty)		per	num-			(dirty)		per	num-
				cent.	ber					cent.	ber
1	— — — M ₁	541	332	16.46	460	D Na — M ₃	576	416	16.73	482	33
	— Na — M ₂	531	357	16.85	470	D — — M ₁	557	361	17.14	487	
	D Na — M ₁	609	433	16.68	482	— — — M ₂	513	312	16.93	495	
	— Na K M ₃	599	384	17.31	474	— Na K M ₃	546	305	17.45	509	
	— — K M ₂	621	422	16.01	464	— Na — M ₁	541	268	16.73	504	
	D Na — M ₃	652	489	16.70	450	D — K M ₃	575	304	17.08	488	
	D — K M ₁	642	433	16.68	476	— Na K M ₂	523	259	17.60	483	
	D — — M ₂	590	377	14.92	476	D Na K M ₄	544	331	18.20	495	
	D — K M ₃	607	419	16.79	486	— Na — M ₁	498	238	17.94	497	
	— — K M ₄	585	351	17.51	484	D Na — M ₂	560	276	18.92	485	
	D Na K M ₂	591	361	17.42	494	D — — M ₃	488	243	18.23	478	
	D Na K M ₄	612	393	17.45	495	— — — M ₄	439	238	17.74	506	
	D — — M ₄	530	287	17.74	496	— Na — M ₃	499	296	17.77	478	
	— — — M ₃	476	238	17.25	488	D Na K M ₁	518	318	17.28	498	
	— Na K M ₁	501	214	17.63	489	— Na K M ₂	505	269	18.35	500	
	— Na — M ₄	488	242	17.77	489	D — K M ₂	511	308	17.14	498	
	D — — M ₃	524	257	17.63	498	— — K M ₁	501	394	15.95	493	
	D Na — M ₄	544	279	18.03	482	D — — M ₄	595	432	16.01	480	
	— Na K M ₄	483	230	18.10	467	D Na K M ₁	584	432	16.56	485	
	D — K M ₄	505	271	17.45	497	— Na — M ₄	544	356	16.91	495	
— Na — M ₃	468	267	17.51	495	D Na — M ₂	634	389	16.79	481		
D Na — M ₁	516	297	17.16	481	D — K M ₂	589	345	16.84	467		
D — K M ₁	520	276	17.68	482	— — K M ₄	552	338	17.37	487		
D — — M ₂	539	314	17.22	482	— — — M ₃	553	326	17.51	481		
— — K M ₃	491	245	17.45	455	— — — M ₂	553	320	17.74	503		
D Na K M ₂	510	288	17.86	456	D — K M ₄	570	383	17.34	499		
— Na — M ₂	477	270	17.19	466	D — — M ₁	559	307	17.48	473		
— Na K M ₁	517	236	16.70	464	— — K M ₃	573	327	18.09	493		
D Na K M ₃	468	329	18.95	472	D Na K M ₃	609	479	16.68	487		
— — K M ₂	454	288	18.46	460	D Na — M ₄	616	458	16.47	478		
— — — M ₁	460	299	18.49	474	— Na K M ₄	556	311	17.94	459		
— — — M ₄	471	311	18.20	476	— — K M ₁	579	338	17.88	479		

The positions of the blocks in the field were slightly different from those shown above.

SYSTEM OF REPLICATION : 4 randomised blocks of 16 plots each. Certain interactions partially confounded with block differences.

AREA OF EACH PLOT (after rejecting edge rows) : 3/220 acre. Plots actually 1/55 acre (99.9 lks. × 18.2 lks.).

TREATMENTS : 4 × 2³ factorial design.

Dung : None, 10 tons per acre ploughed in, in November (D).

Agricultural salt : None, 5 cwt. per acre (Na).

Muriate of potash : None, 1.0 cwt. K₂O per acre (K).

Minerals ploughed in, in December (M₁), broadcast immediately after ploughing (M₂), broadcast in early spring (M₃), broadcast at sowing (M₄).

BASAL MANURING : Sulphate of ammonia at the rate of 0.6 cwt. N per acre, superphosphate at the rate of 0.5 cwt. P₂O₅ per acre.

CULTIVATIONS, ETC. : Dung applied : Nov. 30. Minerals (M₁) applied : Dec. 2-4. Ploughed and minerals (M₂) applied : Dec. 4-6. Minerals (M₃) applied : Mar. 12. Harrowed : April 28. Drilled and minerals (M₄) applied : April 30. Harrowed : May 1. Rolled : May 5. Hand hoed : May 17-20. Singled : May 28-June 2. Hand hoed : June 22-24. Lifted : Oct. 29-Nov. 20. Variety : Kleinwanzleben E. Previous crop : Potatoes.

STANDARD ERRORS PER PLOT : Total Sugar : 4.05 cwt. per acre or 7.29%. Tops : 1.65 tons per acre or 15.4%. Mean dirt tare : 0.095.

Effects of mineral manures

	Minerals				Mean	Minerals				Mean
	None	Salt	Mur. of pot.	Both		None	Salt	Mur. of pot.	Both	
TOTAL SUGAR : cwt. per acre (± 2.02)					ROOTS (washed) : tons per acre					
M ₁ ..		53.8	56.5	54.0	54.8 ²	15.46	15.72	16.55	15.86	16.04
M ₂ ..	53.3 ¹	57.2	56.1	56.5	56.6 ²		16.42	16.52	15.88	16.27
M ₃ ..		54.5	58.0	57.4	56.6 ²		15.91	16.72	16.38	16.34
M ₄ ..		56.2	57.4	58.4	57.3 ²		16.30	16.48	16.32	16.37
Mean ..	53.3 ¹	55.4 ¹	57.0 ¹	56.6 ¹	55.6	15.46	16.09	16.57	16.11	16.06
Increase ..		+2.1 ³	+3.7 ³	+3.3 ³			+0.63	+1.11	+0.65	
TOPS : tons per acre (± 0.825)					SUGAR PERCENTAGE					
M ₁ ..		10.12	11.80	9.82	10.58 ⁵	17.29	17.13	17.05	17.04	17.07
M ₂ ..	10.14 ⁴	10.57	11.16	9.63	10.45 ⁵		17.44	17.11	17.81	17.45
M ₃ ..		12.01	10.60	12.26	11.62 ⁵		17.18	17.35	17.60	17.38
M ₄ ..		10.92	11.00	10.36	10.76 ⁵		17.30	17.42	17.92	17.55
Mean ..	10.14 ⁴	10.90 ⁴	11.14 ⁴	10.52 ⁴	10.68	17.29	17.26	17.23	17.59	17.34
Increase ..		+0.76 ⁶	+1.00 ⁶	+0.38 ⁶			-0.03	-0.06	+0.30	

Standard errors : (1) ± 1.01 , (2) ± 1.17 , (3) ± 1.43 , (4) ± 0.413 , (5) ± 0.476 , (6) ± 0.583 .

PLANT NUMBER : thousands per acre

	Minerals				Mean
	None	Salt	Mur. of pot.	Both	
M ₁ ..		36.0	35.4	35.4	35.6
M ₂ ..	35.5	34.8	34.6	35.4	34.9
M ₃ ..		35.0	35.2	35.6	35.3
M ₄ ..		35.6	36.0	35.2	35.6
Mean ..	35.5	35.4	35.3	35.4	35.4
Increase ..		-0.1	-0.2	-0.1	

M₁=Minerals ploughed in, in December; M₂=broadcast immediately after ploughing
M₃=broadcast in early spring; M₄=broadcast at sowing.

Effect of dung and interaction of dung with minerals

	Minerals				Mean Increase	Minerals				Mean Increase
	None	Salt	Mur. of pot.	Both		None	Salt	Mur. of pot.	Both	
TOTAL SUGAR : cwt. per acre (± 1.43)					ROOTS (washed) : tons per acre					
No dung	52.2	51.4	56.7	55.8	54.0 ¹	14.90	14.82	16.38	15.82	15.48
Dung	54.4	59.5	57.3	57.4	57.2 ¹ + 3.2 ²	16.01	17.36	16.75	16.40	16.63 + 1.15
TOPS : tons per acre (± 0.583)					SUGAR PERCENTAGE					
No dung	9.72	9.38	11.06	9.04	9.80 ³	17.54	17.33	17.34	17.64	17.46
Dung	10.55	12.42	11.21	12.00	11.54 ³ + 1.74 ⁴	17.05	17.18	17.12	17.55	17.22 - 0.24

Standard errors : (1) ± 0.715 , (2) ± 1.01 , (3) ± 0.292 , (4) ± 0.413 .

PLANT NUMBER : thousands per acre

	Minerals				Mean Increase
	None	Salt	Mur. of pot.	Both	
No dung	35.6	35.7	35.0	35.2	35.4
Dung	35.5	35.0	35.7	35.6	35.4 0.0

Conclusions

The yields of total sugar were high. The average response to minerals was significant in both total sugar and tops. In both cases the response to muriate of potash was somewhat greater than that to salt, though the differences were not significant. The differences produced by the different methods of applying the minerals were not significant.

Dung produced significant increases of 3.2 cwt. per acre in sugar and 1.7 tons per acre in tops.

KALE
WOBURN

Effect of sulphate of ammonia, poultry manure, soot and rape dust

WK—LANSOME, 1937 (4th year)
Plan and yields in lb.

NW ↑	1	S ₁ 81.4	N ₂ 129.8	R ₁ 88.0	N ₁ 110.0	S ₀ 71.5	R ₁ ^e 83.6	R ₀ 70.4	S ₂ 108.9	8
	R ₀ 71.5	N ₀ 68.2	M ₀ 61.6	S ₀ 59.4	N ₀ 74.8	M ₂ 95.7	S ₁ 78.1	M ₁ 71.5		
	S ₂ 83.6	M ₂ 89.1	R ₂ 75.9	M ₁ 79.2	N ₂ 138.6	R ₂ 103.4	N ₁ 96.8	M ₀ 64.9		
	S ₁ 71.5	M ₀ 62.7	M ₂ 82.5	M ₁ 78.1	N ₂ 157.3	M ₁ 73.7	R ₀ 71.5	S ₀ 58.3		
	R ₀ 58.3	N ₂ 138.6	N ₀ 62.7	S ₀ 61.6	N ₀ 67.1	S ₂ 113.3	M ₂ 90.2	R ₂ 91.3		
41	N ₁ 77.0	R ₂ 79.2	S ₂ 107.8	R ₁ 78.1	S ₁ 77.0	M ₀ 57.2	N ₁ 95.7	R ₁ 85.8	48	

SYSTEM OF REPLICATION : 4 randomised blocks of 12 plots each.
 AREA OF EACH PLOT : 1/160 acre (25 lks. × 25 lks.).
 TREATMENTS, 1937 : No nitrogen (0) and sulphate of ammonia (N) half applied in seed-bed and the remainder as a top dressing, soot (S), poultry manure (M) and rape dust (R), applied in seed-bed at the rate of 0.4 cwt. N per acre (1) or 0.8 cwt. N per acre (2). Plots receiving treatment (0) in 1937 had treatment (2) in 1936 and vice versa. Plots receiving treatment (1) had this in both years. For N₀, S₀, M₀ and R₀ (see plan), the fertilizer symbols refer to the 1936 treatment.
 BASAL MANURING : All plots were made up to 1.0 cwt. P₂O₅ per acre and 1.0 cwt. K₂O per acre, using superphosphate and muriate of potash (an allowance being made for the P₂O₅ and K₂O contained in the organic manures).
 CULTIVATIONS, ETC. : Ploughed : Feb. 12 and 13. Rolled and harrowed : May 7. Manures applied (sulphate of ammonia at half rate) : May 8. Seed sown : May 8. Singled : June 17-21. Second half of sulphate of ammonia applied : July 8. Hoed : June 21 and July 8-10. Harvested : Jan. 24, 26, 28, and 31. Variety : Thousand head. Previous crop : Kale (see 1936 Report p. 229.)
 STANDARD ERROR PER PLOT : 0.562 tons per acre or 9.32%.

Summary of Results: tons per acre (±0.281)

Nitrogen, cwt. per acre		Sulph. amm.	Poultry manure	Soot	Rape dust	Mean (±0.140)
1934 1936	1935 1937					
0.8	0.0	4.87	4.40	4.48	4.85	4.65
0.4	0.4	6.78	5.40	5.50	5.99	5.92
0.0	0.8	10.08	6.38	7.39	6.25	7.52
Mean (±0.162)		7.24	5.39	5.79	5.70	6.03

Conclusions

The crop was a small one and very tough in the stalk. The fertilizers applied in 1937 produced significant increases in yield, sulphate of ammonia giving significantly higher yields than any of the other fertilizers.
 There was no indication of any differences in the residual effects of the 1936 applications.

PYRETHRUM

WOBURN

The effect of lime, fish manure and artificial fertilisers on the yield of flowers and their content of Pyrethrins

ROADPIECE, 1937 (5th year)

Plan and yields—Pyrethrin I content per cent. 1935, total Pyrethrins per cent. 1935, dry stalkless heads 1937 (grammes), Pyrethrin I content per cent. 1937, total Pyrethrins per cent. 1937, in descending order

	1									
		LOA1	LFO2	OFO2	LOO1	OOA1	LOO1	OOA2	OOO2	8
		0.57	0.53	0.48	0.50	0.43	0.45	0.51	0.43	
		1.21	1.21	1.11	1.20	0.99	1.04	1.18	1.00	
		—	—	—	—	—	—	—	—	
		LFO1	OOA2	OOA1	OFA2	OFO1	LOA2	LOA1	LFA1	
		0.50	0.42	0.44	0.53	0.42	0.46	0.54	0.46	
		1.09	0.98	1.03	1.07	0.93	0.99	1.20	0.98	
		1007	948	959	1724	1217	1361	1262	883	
		0.53	0.51	0.48	0.56	0.50	0.62	0.53	0.52	
		1.23	1.14	1.22	1.28	1.23	1.34	1.26	1.16	
		LFA2	OFO1	LFA1	LOA2	LFO1	LOO2	LFO2	OFA2	
		0.47	0.44	0.49	0.42	0.42	0.43	0.44	0.43	
		1.03	1.01	1.14	0.95	0.97	0.92	0.99	0.99	
		1530	1208	1559	1615	1272	1349	1556	1279	
		0.51	0.51	0.51	0.58	0.48	0.57	0.56	0.55	
		1.25	1.14	1.22	1.32	1.23	1.29	1.25	1.28	
		OOO1	LOO2	OOO2	OFA1	OFA1	LFA2	OOO1	OFO2	
		0.42	0.46	0.42	0.45	0.42	0.42	0.57	0.37	
		0.93	0.92	0.93	0.98	1.02	0.98	1.12	0.83	
		—	—	—	—	—	—	—	—	
	25									32

Notes: In 1937 the outside plots on the NW and SE sides were omitted from the experiment, owing to poor yields in previous years. The 1935 pyrethrin analyses were done too late for inclusion in the 1935 Report and are given above for completeness.

SYSTEM OF REPLICATION: 2 randomised blocks of 8 plots each.

AREA OF EACH PLOT (after rejecting edge rows): 0.00560 acre. Plots actually 29.6 lks. × 22.7 lks.

TREATMENTS:

Lime: None (O), 2.88 tons equivalent to 4 tons CaCO₃ applied in first year only (L).

Fish manure: None (O), 5 cwt. per acre (0.4 cwt. N) applied in first year only, half this dressing applied every year (F).

Complete artificals: None (O), sulphate of ammonia (0.4 cwt. N), superphosphate (0.4 cwt. P₂O₅) and muriate of potash (0.5 cwt. K₂O) applied in first year only, half this dressing applied every year (A).

Manures applied: 1st year only 1933(1), every year (2).

CULTIVATIONS, ETC.: Hand hoed: Aug. 9-15, 1936. Weeded: April, 1937. Manures applied: April 14. Harvested: June 28-29. Previous crop: Pyrethrum (see 1936 Report, p. 231).

SPECIAL NOTE: The residual effects of the artificals and fish manure applied in the first year of the experiment were assumed to be negligible.

STANDARD ERRORS PER PLOT: Dry stalkless heads: 0.867 cwt. per acre or 17.8%.
Pyrethrin I content per cent.: 0.0327.

Effect of Lime

	No Lime	Lime	Increase	Standard error
Dry stalkless heads, cwt. ..	4.26	4.86	+ 0.60	±0.450
Pyrethrin I content, per cent. ..	0.520	0.545	+ 0.025	±0.018
Total pyrethrins, per cent. ..	1.23	1.25	+ 0.02	—

Effect of artificials and fish manures, applied every year

	None	Artificials	Fish manure	Artificials and fish manure	Mean of manures	Increase
Dry stalkless heads, cwt.	4.17	4.58	5.25	5.49	5.11	+ 0.94
Pyrethrin I content, per cent	0.51	0.57	0.55	0.55	0.56	+ 0.05
Total pyrethrins, per cent.	1.22	1.27	1.24	1.27	1.26	+ 0.05

No single standard error can be applied to the figures in the same line of this table.

Conclusions

Lime applied in 1933 increased both the yield of heads and the pyrethrin I content, though neither increase was significant. Manures applied every year produced significant increases in both heads and pyrethrin I content. The increase in heads was somewhat greater with fish manure than with artificials, though not significantly so.