

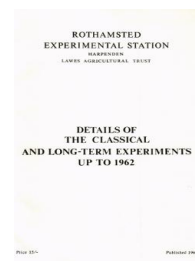
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Market Garden Soil- Woburn

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MARKET GARDEN EXPERIMENT WOBURN, LANSOME FIELD, 1942 ONWARDS

The purpose of the experiment is to study the effects of certain bulky organic manures, dung, sewage sludge, and two types of compost, in building up an agricultural soil for the growth of market garden crops. Certain plots are treated with fertilisers alone to provide controls for the organic treatments.

The crops are grown in a 2-year rotation. The experiment falls into two periods 1942-1950 when 4 crops were grown in the 2 years; 1951 onwards when 3 crops were grown in 2 years. The organic manuring and the basal fertilisers remained practically the same until 1960. The rates of "Nitro-Chalk" on test were raised in the second period. A new scheme of manuring was introduced in 1961.

First Period 1942-1950

The cropping was as follows:-

- 1st Year Globe Beetroot (sown April, lifted July)
Winter Cabbage (transplanted August, cut December
-March)
- 2nd Year Peas (sown March-April, pulled June-July)
Leeks (transplanted July, lifted January-March).

The 2-year rotation occupied two series of plots, one carrying beet followed by cabbage, while the other carried peas followed by leeks. Each series has 40 plots divided into 4 blocks of 10 plots, certain interactions being partially confounded with block differences.

Area of each plot:- 0.0125 acres.

Treatments per acre:

- (i) Organics at 15 and 30 tons:-
Dung
Sewage sludge (West Middlesex)
Sewage sludge and farm waste compost⁽¹⁾ (Cs)
Vegetable compost (farm waste activated by farmyard manure). (Cd)
- (ii) Sulphate of ammonia (total to two crops)
(a) In presence of organics 0 v. 0.6 cwt. N
(b) Without organics 0, 0.6, 1.2, 1.8 cwt. N.
- (1) Composted town refuse in 1942 and 1943.

Basal dressings: 0.4 cwt. P_2O_5 as superphosphate.
0.5 cwt. K_2O as muriate of potash.

Application of manures:

- (i) Organics ploughed in in winter and basal dressing broadcast in early spring before globe beet and again before peas. No organics nor basal dressings were applied to cabbages or leeks.
- (ii) The sulphate of ammonia was divided as follows:-

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	With organics	No organics
Peas and globe beet	0, 0.2	0, 0.2, 0.4, 0.6
Cabbages and leeks	0, 0.4	0, 0.4, 0.8, 1.2

The higher dressings of sulphate of ammonia were applied in divided dressings according to the requirements of the crop.

In the first year, which was preliminary, winter cabbages were grown on both series. They tested dung, sewage sludge, and composted town refuse (vegetable compost and sewage sludge compost were not available). Sulphate of ammonia at 0.6 cwt. N was also tested. In 1943 composted town refuse was again used in place of sludge compost.

Second Period 1951-1960 (including leeks 1960-61).

The experiment was recast as follows:-

Sequence of crops:

1st Year Red Beet, sown April-May, lifted July - August followed by Spring Cabbage, planted September-October, cut April-May.

2nd Year Leeks, planted June-July, lifted March-April.

Organic manures: The same four organics were applied to each of the three crops of the rotation at 10 and 20 tons per acre, i.e. 30 and 60 tons every two years as before.

Basal fertiliser: 0.3 cwt. P_2O_5 and 0.3 cwt. K_2O as 0:13:13 fertiliser applied to every crop.

Nitrogenous dressings: These were applied to every crop on the following scale:-

In presence of organics 0, 0.3, N as "Nitro-Chalk" (N_1).

In absence of organics 0, 0.3, 0.6, 0.9 cwt. N as "Nitro-Chalk" (N_1, N_2, N_3). The heavier dressings were divided; leeks and red beet had N_1 and half N_2 and half N_3 before planting or sowing, the remaining halves later. Spring cabbage had N_1 , half N_2 , half N_3 as a spring application and the remainder later. Leeks 1960 - 61 received vegetable compost at half rate.

1961 (including leeks 1961-62)

Organics applied as before.

Fertiliser treatments per acre:

(a) Plots without organics: All combinations of:

Nitrogen: 0.9, 1.8 cwt. N as "Nitro-Chalk" (N_1, N_2)

Phosphate and potash: 1.5 cwt. P_2O_5 with 1.5 or 3.0 cwt. K_2O as compound fertiliser 0:20:20 or 0:14:28 (P_1K_1, P_1K_2).

Methods of application:

(i) All fertiliser before planting or sowing.

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- (ii) Half PK (for potatoes) or half NPK (for red beet and leeks) ploughed in at time of applying organics, remainder before planting or sowing.

Note: "Before planting" fertiliser for potatoes applied on the flat.

(b) Plots receiving organics:

No fertiliser; $N_1P_1K_1$ (rates as above) applied before planting or sowing. In addition, all plots were split for a test of 0 v. 500 lb. sulphate of magnesia applied before planting or sowing. All treatments cumulative.

1962

Applications of sewage sludge and sewage sludge compost discontinued. Dung at 10, 20 tons per acre replaced vegetable compost at 10, 20 tons per acre except for potatoes.

Plots previously treated with sludge and sludge compost were split for a test of P_1K_1 v. $N_1P_1K_1$ (rates as 1961) all applied before planting or sowing. Leeks on these plots harvested at one time only, other plots two dates of harvest.

For red beet only, the split is across the direction of the rows, no sulphate of magnesia being applied to this crop.

A comparison of sowing depths ($\frac{3}{4}$, $1\frac{1}{2}$ inches) was made on red beet, each strip of 4 plots being split for this test. The crop was lifted early, because of excessive bolting, and resown at uniform depth without further manures.

Cabbages, leeks, and red beet are graded and the numbers and weights in each grade are recorded. Since 1950 leeks have been harvested two rows per plot at a time at several intervals during the season; in 1953 the same procedure was adopted for red beet. Since 1961 red beet has been harvested on two dates only. In 1958 winter cabbages failed. Spring cabbage 1952-53 failed and was replaced by peas, in 1953 also red beet failed and was replaced by white turnips. Spring cabbage 1955-56 failed and early potatoes (Arran Pilot) were grown instead on the same manure. It was decided to continue this change, the organic manures being ploughed in in winter, the fertilisers broadcast on the flat in spring, and the potatoes planted by machine.

Liming: From 1943-45 ground chalk at 29 cwt. per acre was applied before planting cabbages. In 1948 and 1949 an amount of ground chalk was applied for the red beet equal in weight to all the ammonium sulphate previously applied up to date. In 1950 chalk was applied to red beet equal to the amount of ammonium sulphate used on the previous four crops on this block. In 1951 certain plots which were still acid were corrected individually. From 1952 onwards 10 cwt. CaO as 18-20 cwt. of ground chalk was given before every crop of red beet. In 1955 this dressing was applied to spring cabbages also. In 1958 the quantity of ground chalk was raised to 23 cwt. per acre.

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For soil organic matter data see Mann, H.H. and Barnes, T. W. (1956). The permanence of organic matter added to soil. *J. agric. Sci.*, 48, No. 2, 160-163.

For weed growth see Mann, H.H. (1957). Weed herbage of slightly acid arable soils as affected by manuring. *J. Ecol.*, 45, 1949-156.

For bolting of red beet see Mann, H.H. (1951). The effect of manures on the bolting of the beet plant. *Ann. appl. Biol.* 38, No. 2, 435-443.

For a summary of the results see Rep. Rothamst. exp. Sta. for 1962, 186-193.

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Table 54

Total produce, tons per acre - Means 1944-1950

Treatment		Rate of manuring (tons per acre)		First crops after organic manures				Green peas (7)			
				Globe beet (1944-45, 1947-50) (6)				(excluding unmarketable produce)			
				cwt. N per acre		Mean	Diff.	cwt. N per acre		Mean	Diff.
0	0.2	0	0.2								
No organics				(±0.404)	(±0.286)	(±0.571)	(±0.166)	(±0.118)	(±0.235)		
		2.03	2.75	2.39	0.72	1.81	1.84	1.82	0.03		
		3.02*	3.16†	3.09	0.14	1.86*	1.82†	1.84	-0.04		
FYM	15	4.84	4.90	4.87	0.06	2.38	2.23	2.31	-0.15		
	30	6.52	6.64	6.58	0.12	2.27	2.04	2.16	-0.23		
Mean		5.68	5.77	5.72	0.09	2.32	2.14	2.24	-0.18		
		(±0.286)		(±0.202)	(±0.404)	(±0.118)		(±0.083)	(±0.166)		
Sewage sludge	15	4.21	4.64	4.43	0.43	1.84	2.04	1.94	0.20		
	30	5.31	4.94	5.13	-0.37	1.68	1.84	1.76	0.16		
Mean		4.76	4.79	4.78	0.03	1.76	1.94	1.85	0.18		
Compost Cd	15	3.87	4.57	4.22	0.70	2.36	2.22	2.29	-0.14		
	30	5.74	5.98	5.86	0.24	2.06	2.20	2.13	0.14		
Mean		4.80	5.27	5.04	0.47	2.20	2.21	2.21	0.01		
Compost Cs	15	3.76	3.73	3.74	-0.03	2.24	2.10	2.17	-0.14		
	30	4.61	5.24	4.92	0.63	2.27	2.12	2.20	-0.15		
Mean		4.18	4.48	4.33	0.30	2.26	2.11	2.18	-0.15		
				* 0.4 cwt. N per acre.		† 0.6 cwt. N per acre.					
Treatment		Rate of manuring (tons per acre)		Second crops after organic manures				Leeks (7)			
				Winter cabbages (1944-46, 1948-50)* (6)				(1944-50)* (7)			
				cwt. N per acre		Mean	Diff.	cwt. N per acre		Mean	Diff.
0	0.4	0	0.4								
No organics				(±0.246)	(±0.174)	(±0.348)	(±0.160)	(±0.113)	(±0.226)		
		2.63	4.32	3.48	1.69	2.20	2.67	2.44	0.47		
		5.24†	5.67†	5.46	0.43	2.71†	2.90†	2.80	0.19		
FYM	15	4.17	5.41	4.79	1.24	3.16	3.07	3.11	-0.09		
	30	5.12	6.17	5.64	1.05	3.84	3.89	3.86	0.05		
Mean		4.64	5.79	5.22	1.15	3.50	3.48	3.49	-0.02		
		(±0.174)		(±0.123)	(±0.246)	(±0.113)		(±0.080)	(±0.160)		
Sewage sludge	15	5.21	6.56	5.88	1.35	3.11	3.06	3.08	-0.05		
	30	6.97	7.11	7.04	0.14	3.47	3.66	3.56	0.19		
Mean		6.09	6.84	6.46	0.75	3.29	3.36	3.32	0.07		
Compost Cd	15	3.87	5.04	4.46	1.17	2.89	3.25	3.07	0.36		
	30	4.85	5.91	5.38	1.06	3.52	3.50	3.51	-0.02		
Mean		4.36	5.48	4.92	1.12	3.20	3.37	3.29	0.17		
Compost Cs	15	3.87	4.97	4.42	1.10	2.89	3.33	3.11	0.44		
	30	4.40	6.17	5.28	1.77	3.15	3.18	3.16	0.03		
Mean		4.14	5.57	4.85	1.43	3.02	3.25	3.14	0.23		

* Years of sowing and transplanting. † 0.8 cwt. N per acre. ‡ 1.2 cwt N per acre. Number of years given in brackets.

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Table 55

Total produce: tons per acre - Means 1951-60

Treatment	Rate of manuring (tons per acre)	Globe beet (1951-52, 1954-60) (9)				Leeks (saleable produce) (1951-60)* (10)			
		cwt N per acre		Mean	Diff.	cwt N per acre		Mean	Diff.
		0	0.3			0	0.3		
No organics		(±0.784)		(±0.554)	(±1.109)	(±0.190)		(±0.134)	(±0.269)
		4.21	6.19	5.20	1.98	2.56	3.77	3.16	1.21
		8.52†	7.43‡	7.98	-1.09	4.39†	4.07‡	4.23	-0.32
FYM	10	9.25	12.24	10.74	2.99	4.47	5.16	4.81	0.69
	20	15.74	16.89	16.31	1.15	5.77	6.01	5.89	0.24
	Mean	12.49	14.56	13.52	2.07	5.12	5.58	5.35	0.46
		(±0.554)		(±0.392)	(±0.784)	(±0.134)		(±0.095)	(±0.190)
Sewage sludge	10	10.99	11.45	11.22	0.46	5.08	5.02	5.05	-0.06
	20	12.61	14.18	13.39	1.57	5.10	5.39	5.25	0.29
	Mean	11.81	12.82	12.30	1.02	5.09	5.20	5.15	0.11
Compost Cd	10	10.18	12.38	11.28	2.20	4.71	5.21	4.96	0.50
	20	12.35	16.07	14.21	3.72	5.49	5.81	5.65	0.32
	Mean	11.27	14.22	12.74	2.95	5.10	5.51	5.31	0.41
Compost Cs	10	10.00	11.95	10.98	1.95	4.87	5.23	5.05	0.36
	20	13.78	15.29	14.53	1.51	5.20	5.60	5.40	0.40
	Mean	11.89	13.62	12.75	1.73	5.03	5.42	5.22	0.39

Treatment	Rate of manuring (tons per acre)	Spring cabbages (1951, 1953-54)* (3)				Potatoes (tubers) (1956-60) (6)			
		cwt. N per acre		Mean	Diff.	cwt. N per acre		Mean	Diff.
		0	0.3			0	0.3		
No organics		(±0.696)		(±0.492)	(±0.984)	(±0.260)		(±0.184)	(±0.367)
		2.20	4.68	3.44	2.48	4.03	5.38	4.70	1.35
		6.28†	6.31‡	6.30	0.03	6.43†	6.35‡	6.39	-0.08
FYM	10	5.48	6.47	5.98	0.99	6.72	7.54	7.13	0.82
	20	7.44	8.65	8.05	1.21	7.79	8.26	8.03	0.47
	Mean	6.46	7.56	7.02	1.10	7.25	7.90	7.58	0.65
		(±0.492)		(±0.348)	(±0.696)	(±0.184)		(±0.130)	(±0.260)
Sewage sludge	10	7.07	8.19	7.63	1.12	6.44	6.75	6.59	0.31
	20	9.02	10.05	9.54	1.03	7.06	7.37	7.21	0.31
	Mean	8.04	9.12	8.58	1.08	6.75	7.06	6.90	0.31
Compost Cd	10	5.19	6.92	6.05	1.73	6.43	7.45	6.94	1.02
	20	6.32	7.90	7.11	1.58	7.39	7.80	7.59	0.41
	Mean	5.75	7.41	6.58	1.66	6.91	7.62	7.27	0.71
Compost Cs	10	5.73	7.21	6.47	1.48	6.59	6.95	6.77	0.36
	20	7.16	8.37	7.77	1.21	7.55	7.86	7.70	0.31
	Mean	6.44	7.79	7.12	1.35	7.07	7.40	7.24	0.33

* Years of sowing and transplanting. †0.6 cwt. N per acre. ‡0.9 cwt. N per acre
Number of years given in brackets.