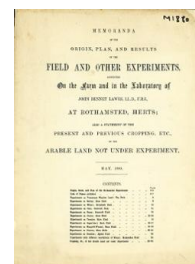


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# Memoranda of the Field Experiments at Rothamsted: May 1880



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## Experiments on Sugar Beet; Barn Field

### Rothamsted Research

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EXPERIMENTS ON SUGAR BEET (VILMORIN'S GREEN-TOP WHITE SILESIAN)—BARN FIELD.

GROWN YEAR AFTER YEAR ON THE SAME LAND, WITHOUT MANURE, AND WITH DIFFERENT DESCRIPTIONS OF MANURE, COMMENCING 1871.

Previous Cropping:—1843-'48 (6 Seasons), experiments on Norfolk White Turnips, with different descriptions of Manure.

1849-'52 (4 Seasons), experiments on Swede Turnips, with different descriptions of Manure.

1853-'55 (3 Seasons), Barley without Manure (with a view as far as possible to equalise the condition of the Plots).

1856-'70 (15 Seasons), experiments on Swede Turnips, with different descriptions of Manure, in which the arrangement of the

Plots was the same, and that of the Manures very similar—in fact, exactly the same during the last 10 years—as in the first year of Sugar Beet, excepting that, during those 10 years, the Alkalies were omitted for the Swedes. For the second and subsequent years of Sugar Beet slight alterations in the Mineral Manures were made, and in the fourth and fifth years the Farmyard Manure, Nitrate of Soda, Ammonia-salts, and Rape-cake were omitted, as will be seen below. Seed dibbled on the flat; in rows 22 inches apart, and 11 inches apart in the rows; plants moulded up afterwards. Roots all carried off, Leaves weighed, spread on the respective Plots, and ploughed in.

Area under experiment about 8 acres. The experiments are arranged as under, in 5 Series, each of which comprises 8 Plots.

PLOTS.	SERIES 1.	Manures, per Acre, per Annum.									
		SERIES 2. Each Plot as Series 1, and Cross-dressed with 550 lbs. Nitrate Soda.		SERIES 3. Each Plot as Series 1, and Cross-dressed with 400 lbs. "Ammonia- salts."		SERIES 4. Each Plot as Series 1, and Cross-dressed with 2000 lbs. Rape-cake, and 400 lbs. "Ammonia- salts."		SERIES 5. Each Plot as Series 1, and Cross-dressed with 2000 lbs. Rape-cake.			
FIRST SEASON, 1871.											
PRODUCE PER ACRE (Roots trimmed as for feeding, not as for Sugar-making).											
		Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.
		Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.
1	Farmyard Manure (14 tons) .. .. .	18 3	3 5	27 13	6 19	22 1	5 6	26 4	6 14	28 18	5 14
2	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (1) .. .	14 13	2 14	25 16	5 15	21 15	4 6	25 2	6 7	25 4	5 5
3	Without Manure (1846, and since) .. .. .	7 11	2 0	22 3	5 12	15 6	4 16	19 18	7 0	20 16	4 12
4	{ 3½ cwt. Superphosphate, 300 lbs. Sulphate Potass, 200 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia .. .. .	7 11	1 5	22 15	4 8	17 10	3 5	22 15	6 3	21 7	3 19
5	{ 3½ cwt. Superphosphate .. .. .	5 12	1 8	20 19	3 14	15 4	3 19	19 18	7 12	18 19	4 5
6	{ 3½ cwt. Superphos., 300 lbs. Sulph. Potass .. .. .	5 1	1 4	21 5	3 13	17 4	3 4	23 11	6 11	21 0	3 11
7	{ 3½ cwt. Superphos., 300 lbs. Sulph. Pot., 36½ lbs. Amm.-salts (?) .. .	5 18	1 5	20 19	3 18	18 8	4 3	21 0	5 0	21 7	3 17
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	7 10	1 14	21 13	3 16	16 2	4 15	17 19	7 11	20 7	4 9
SECOND SEASON, 1872.											
		Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.
1	Farmyard Manure (14 tons) .. .. .	15 13	4 2	23 9	7 19	22 14	9 0	26 8	9 11	22 5	6 1
2	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (1) .. .	16 0	3 18	24 6	8 16	22 0	7 16	25 9	9 14	20 15	5 11
3	Without Manure (1846, and since) .. .. .	7 17	1 13	21 7	6 6	15 3	4 13	20 8	10 1	16 3	3 11
4	{ 3½ cwt. Superphosphate, 500 lbs. Sulphate Potass, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. .	6 14	1 10	20 2	5 19	15 10	3 7	23 8	7 13	17 18	3 15
5	{ 3½ cwt. Superphosphate .. .. .	6 17	1 8	19 6	6 4	14 5	4 13	18 11	10 4	15 18	3 16
6	{ 3½ cwt. Superphos., 500 lbs. Sulph. Potass .. .. .	6 6	1 5	16 16	5 14	14 7	3 19	22 16	9 9	15 17	3 14
7	{ 3½ cwt. Superphos., 500 lbs. Sulph. Potass, 36½ lbs. Amm.-salts (?) .. .	6 15	1 8	17 0	6 1	15 9	3 19	23 9	9 10	15 10	3 15
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	5 4	1 5	15 6	5 19	13 10	4 1	19 12	9 17	15 0	4 6
THIRD SEASON, 1873.											
		Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.
1	Farmyard Manure (14 tons) .. .. .	15 2	5 12	20 5	10 9	22 2	9 18	22 15	12 10	23 10	7 8
2	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (1) .. .	14 6	5 2	21 10	11 0	19 4	8 9	23 7	13 6	21 18	6 18
3	Without Manure (1846, and since) .. .. .	5 1	1 11	14 5	6 11	9 3	3 16	15 12	9 11	14 13	4 1
4	{ 3½ cwt. Superphosphate, 500 lbs. Sulphate Potass, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. .	5 2	1 13	16 9	6 11	12 10	3 10	20 3	8 0	16 1	3 8
5	{ 3½ cwt. Superphosphate .. .. .	5 5	1 11	18 8	5 13	10 19	5 0	14 15	9 8	13 19	4 9
6	{ 3½ cwt. Superphos., 500 lbs. Sulph. Potass .. .. .	4 12	1 5	15 17	4 4	12 18	3 12	20 2	9 5	14 14	3 11
7	{ 3½ cwt. Superphos., 500 lbs. Sulph. Potass, 36½ lbs. Amm.-salts (?) .. .	5 19	1 12	16 14	5 3	13 0	4 15	19 16	9 0	15 17	4 4
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	4 11	1 7	12 9	5 18	8 8	2 19	15 2	9 8	12 2	3 16
FOURTH SEASON, 1874 (?). Mineral Manures as in 1872 and 1873; but no Farmyard Manure, or cross-dressings of Nitrate Soda, Ammonia-salts, or Rape-cake.											
		Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.
1	Without Manure, 1874 and 1875 (Farmyard Manure in '71, '72, '73) .. .	10 16	5 6	11 14	8 9	11 7	8 3	13 7	9 17	14 10	7 8
2	3½ cwt. Superphosphate (with Farmyard Manure, '71, '72, '73) .. .	13 3	5 9	7 9	4 16	9 5	5 17	12 5	7 7	13 1	6 4
3	Without Manure (1846, and since) .. .. .	5 2	1 5	3 2	2 6	3 7	2 2	2 11	2 10	3 19	2 9
4	{ 3½ cwt. Superphosphate, 500 lbs. Sulphate Potass, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. .	6 10	1 8	8 16	3 6	7 10	2 0	10 12	4 16	8 2	3 11
5	{ 3½ cwt. Superphosphate .. .. .	5 19	1 7	7 10	3 6	7 6	2 8	7 15	5 4	5 17	3 6
6	{ 3½ cwt. Superphos., 500 lbs. Sulph. Potass .. .. .	5 11	1 5	8 1	2 14	8 1	1 18	9 10	4 13	7 13	3 2
7	{ 3½ cwt. Superphos., 500 lbs. Sulph. Pot., and Amm.-salts, '71, '72, '73 .. .	6 14	1 3	9 5	2 11	8 15	1 14	11 14	4 11	8 4	3 9
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	5 0	1 2	7 13	2 16	6 10	2 0	7 6	4 7	3 12	2 1
FIFTH SEASON, 1875. Mineral Manures as in 1872, 1873, and 1874; but no Farmyard Manure, or cross-dressings of Nitrate Soda, Ammonia-salts, or Rape-cake.											
		Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.	Tons. cwt.
1	Without Manure, 1874 and 1875 (Farmyard Manure in '71, '72, '73) .. .	17 5	2 11	19 18	2 14	21 0	3 6	22 7	3 12	19 13	2 11
2	3½ cwt. Superphosphate (with Farmyard Manure, '71, '72, '73) .. .	15 11	2 2	19 18	2 18	18 17	2 18	20 9	3 5	18 10	2 1
3	Without Manure (1846, and since) .. .. .	5 9	1 1	9 5	1 12	8 0	1 3	14 1	2 13	11 17	1 10
4	{ 3½ cwt. Superphosphate, 500 lbs. Sulphate Potass, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. .	5 9	1 0	9 8	1 7	7 16	1 1	12 14	1 14	10 3	1 7
5	{ 3½ cwt. Superphosphate .. .. .	5 11	1 2	9 19	1 10	7 16	1 4	13 17	2 8	11 2	1 14
6	{ 3½ cwt. Superphos., 500 lbs. Sulph. Potass .. .. .	5 4	1 0	8 4	1 4	7 1	1 2	12 8	2 3	10 2	1 9
7	{ 3½ cwt. Superphos., 500 lbs. Sulph. Pot. and Amm.-salts '71, '72, '73 .. .	5 11	1 1	8 2	1 6	7 6	1 1	11 17	1 17	10 6	1 11.
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	4 15	1 0	7 4	1 2	6 1	1 4	12 2	2 11	11 12	2 13

(1) "Superphosphate of Lime"—in all cases made from 200 lbs. Bone-ash, 150 lbs. Sulphuric Acid sp. gr. 1.7 (and water).

(2) "Ammonia-salts"—in each case equal parts Sulphate and Muriate of Ammonia of Commerce.

(3) Owing to the deficiency of Rain for some time after sowing a large proportion of the plants failed. Some were transplanted on plots 1, but not on the other plots; and eventually the plant was (excepting on plots 1) upon the whole very deficient and irregular, the remaining plants being larger than usual.

EXPERIMENTS ON SUGAR BEET—BARN FIELD—continued.

SUMMARY OF THE COMPOSITION OF THE SUGAR-BEET ROOTS.

As it will be some time before we shall be able to report fully the results obtained illustrating the influence of different manures, and different seasons, on the composition of Sugar-beet, an abstract of the analytical results obtained is given below. In interpreting the figures it must be borne in mind that with forty different experiments each year, and in each year 4 or 5 or more times as much produce on some plots as on others, it would be impossible to sample each at its best, and all in the same condition of ripeness. Each year the seed was sown on all the Plots at the same time; and the samples (each consisting of the vertical fourths of 10 or 15 roots) were taken from all within a period of about a week, beginning with the ripest. It is obvious, however, that the smaller crops would be much riper than the larger ones. The dry matter, ash, and nitrogen, as given in the table, are determined in the roots themselves; but they have generally been determined in the expressed juice also. The sugar is determined in the juice; and calculated into its percentage in the roots, on the assumption that they contain uniformly 95 per cent. of juice. But, with roots varying so much in character of growth, size, and ripeness, this will not be the case. Nevertheless, the results so calculated, approximately, and usefully, represent both the actual and relative amounts of sugar in the various roots. It need only further be observed that although, in comparable cases, the larger crops generally give a juice containing a lower percentage of sugar and higher percentages of mineral matter and of nitrogen, yet the larger crops yielded very much more sugar over a given area of land.

For Manures and Produce, see facing page.	CROSS-DRESSED MANURES, PER ACRE, PER ANNUM.																			
	SERIES 1. No Cross-dressing.				SERIES 2. As Series 1, and Cross-dressed with 550 lbs. Nitrate Soda.				SERIES 3. As Series 1, and Cross-dressed with 400 lbs. "Ammonia-salts."				SERIES 4. As Series 1, and Cross-dressed with 2000 lbs. Rape-cake, and 400 lbs. "Ammonia-salts."				SERIES 5. As Series 1, and Cross-dressed with 2000 lbs. Rape-cake.			

FIRST SEASON, 1871. (Results in all cases the means of determinations made on two samples, collected at the end of October, and the end of November, respectively.)

PLOTS.	Mean Per Cent. Total Dry Matter, Sugar, Mineral Matter (Crude Ash), and Nitrogen in the Roots.																			
	SERIES 1.				SERIES 2.				SERIES 3.				SERIES 4.				SERIES 5.			
	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.
1	17.04	11.77	0.821	0.142	14.83	9.76	0.945	0.184	16.07	11.05	0.934	0.246	14.73	9.36	1.021	0.244	15.44	10.25	0.892	0.192
2	17.24	11.91	0.826	0.146	15.03	9.80	0.970	0.200	15.12	9.95	0.977	0.213	14.80	9.23	0.988	0.249	16.11	10.80	0.909	
3	17.47	12.31	0.711		15.36	10.37	0.861		17.75	10.98	0.901		16.71	9.66	0.915		16.95	11.72	0.758	
4	18.07	12.99	0.738		15.72	10.81	0.828		18.68	11.87	0.907		16.87	9.90	1.002		16.61	11.69	0.767	
5	17.89	13.23	0.746		15.93	11.07	0.787		16.36	11.44	0.754		14.63	9.28	0.843		16.84	11.85	0.722	
6	18.09	13.00	0.778		15.29	10.47	0.856		16.33	11.51	0.843		15.28	9.71	0.956		17.05	12.08	0.812	
7	17.97	13.17	0.762		15.86	10.49	0.901		16.71	11.50	0.826		15.99	10.23	0.904		17.57	12.30	0.782	
8	18.32	13.02	0.791		15.98	11.07	0.856		16.08	10.88	0.764		14.90	9.33	0.806		16.73	11.93	0.747	

SECOND SEASON, 1872. (Samples collected early in November.)

PLOTS.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	18.23	12.97	0.874		17.07	12.04	0.973		17.07	11.95	0.962		17.17	12.07	0.930		17.75	12.35	0.925	
2	18.07	13.04	0.822		15.97	11.12	1.000		16.04	10.43	0.982		17.07	11.81	0.965		17.95	12.82	0.875	
3	19.22	13.99	0.767		17.83	12.78	0.823		19.62	14.38	0.691		17.87	12.60	0.720		19.12	13.95	0.683	
4	19.08	14.16	0.778	0.110	16.97	12.19	0.860	0.148	18.55	13.32	0.800	0.128	18.49	12.66	0.965	0.184	18.67	13.58	0.795	0.139
5	18.67	13.92	0.712	0.101	16.37	11.16	0.866	0.167	18.40	13.02	0.734	0.167	15.82	10.40	0.918	0.250	18.07	13.22	0.705	0.159
6	18.83	13.81	0.772	0.098	17.08	11.88	0.891	0.167	18.70	13.46	0.837	0.166	17.38	12.15	0.879	0.173	18.41	13.17	0.780	0.162
7	19.03	13.94	0.742		16.66	11.22	0.937		18.71	13.35	0.787		17.98	12.83	0.797		19.01	14.06	0.809	
8	18.69	..	0.701		16.84	..	0.911		..	..	0.790		18.00	..	0.738		18.95	..	0.685	

THIRD SEASON, 1873. (Samples collected from November 10 to November 14.)

PLOTS.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	17.62	12.73	0.924		16.64	11.20	0.947		16.76	11.33	0.965		18.80	10.21	1.267		16.88	11.64	0.887	
2	18.49	13.02	0.847		16.35	10.75	0.973		16.54	11.59	0.951		13.39	10.29	0.905		16.33	11.52	0.960	
3	18.96	13.84	0.710		16.97	11.89	0.843		18.76	13.07	0.762		16.00	11.24	0.755		17.94	14.20	0.735	
4	18.80	13.81	0.796	0.132	17.97	12.06	0.934	0.181	18.31	13.11	0.877	0.161	16.67	11.21	0.974	0.187	18.30	13.18	0.861	0.149
5	19.25	14.27	0.679	0.121	16.89	11.50	0.847	0.184	18.24	13.17	0.604	0.186	16.66	11.65	0.734	0.227	18.93	13.48	0.664	0.160
6	19.64	14.35	0.757	0.119	17.94	12.49	0.810	0.169	18.42	13.21	0.894	0.140	17.56	11.89	0.906	0.212	18.22	12.97	0.845	0.148
7	19.63	14.43	0.747		17.42	11.71	0.907		18.81	13.72	0.858		17.68	12.11	0.870		19.00	13.09	0.852	
8	20.22	14.66	0.742		16.50	10.90	0.917		18.47	13.20	0.756		16.54	10.83	0.782		18.06	13.07	0.695	

FOURTH SEASON, 1874 (°). Mineral Manures as in 1872 and 1873; but no Farmyard Manure, or cross-dressings of Nitrate Soda, Ammonia-salts, or Rape-cake. (Samples collected in the middle of November.)

PLOTS.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	14.66	11.15	1.100		14.27	10.16	1.089		14.35	9.79	1.112		13.53	10.24	1.029		14.39	10.85	0.972	
2	15.00	12.75	1.022		13.84	9.93	1.082		14.24	10.11	1.081		14.59	10.11	0.970		14.34	10.88	0.983	
3	17.45	13.20	0.792		15.60	10.17	0.990		16.05	11.69	0.863		15.54	11.44	0.861		15.04	11.16	0.864	
4	18.54	13.10	0.721		14.00	9.73	0.840		16.70	12.41	0.921		17.17	11.62	1.026		14.98	12.55	1.027	
5	18.06	13.01	0.668		14.91	9.78	0.898		16.87	12.42	0.833		14.89	11.55	0.746		16.26	10.82	0.796	
6	17.83	12.99	0.732		15.95	10.50	0.859		16.70	13.69	0.865		15.30	12.05	0.938		16.29	11.04	0.879	
7	16.88	..	0.730		15.56	..	0.903		17.74	..	0.784		16.08	..	0.907		15.50	..	0.868	
8	18.76	..	0.726		15.50	..	0.890		17.35	..	0.771		15.48	..	0.841		16.51	..	0.772	

FIFTH SEASON, 1875. Mineral Manures as in 1872, 1873, and 1874; but no Farmyard Manure, or cross-dressings of Nitrate Soda, Ammonia-salts, or Rape-cake. (Samples collected in the middle of November.)

PLOTS.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	16.02	11.71	0.749		16.16	11.85	0.751		16.33	11.51	0.814		16.29	12.02	0.840		16.13	11.57	0.780	
2	16.08	11.72	0.784		15.67	11.22	0.687		15.43	10.77	0.863		15.70	10.90	0.770		15.92	11.71	0.793	
3	17.29	12.78	0.671		15.66	11.52	0.720		17.52	12.80	0.675		15.90	11.45	0.652		16.48	12.12	0.641	
4	16.67	12.11	0.773	0.103	16.10	12.06	0.751	0.112	17.07	12.32	0.755		16.56	11.89	0.758	0.125	16.24	11.69	0.775	0.121
5	16.94	12.99	0.686	0.107	16.53	12.09	0.722	0.125	16.55	12.08	0.683	0.122	15.34	11.20	0.682	0.152	15.86	11.81	0.622	0.123
6	18.04	12.66	0.782	0.127	16.78	12.47	0.762	0.123	16.19	12.21	0.752	0.136	16.21	11.58	0.777	0.158	16.53	12.09	0.759	0.141
7	17.51	..	0.730		16.22	..	0.874		16.50	..	0.802		15.83	..	0.856		16.38	..	0.866	
8	16.81	..	0.770		16.01	..	0.812		16.56	..	0.767		15.96	..	0.768		15.86	..	0.658	

(1) Owing to the deficiency of Rain for some time after sowing a large proportion of the plants failed. Some were transplanted on plots 1, but not on the other plots; and eventually the plant was (excepting on plots 1) upon the whole very deficient and irregular, the remaining plants being larger than usual.