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# Yields of the Field Experiments 1898

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## Root-crops; Barn Field

### Rothamsted Research

Rothamsted Research (1899) *Root-crops; Barn Field* ; Yields Of The Field Experiments 1898, pp 50 - 75 - DOI: <https://doi.org/10.23637/ERADOC-1-228>

**EXPERIMENTS ON ROOT-CROPS.—BARN FIELD.**

Experiments with Turnips were commenced in 1843. Eight acres, divided into numerous Plots, were set apart for the purpose, and the crop was grown for ten consecutive years on the same land; "Norfolk Whites" 1843-1846, and "Swedes" 1849-1852; on some Plots without manure, and on others with different descriptions of manure.

Barley was then grown for three consecutive seasons, 1853-1855, without manure, in order to test the comparative corn-growing condition of the different Plots, and also to equalise their condition, as far as possible, by the exhaustion of some of the most active and immediately available constituents supplied by the previous manuring.

A new series of experiments with Swedes was arranged in 1856, having regard to the character of the manures previously applied on the different Plots, and to the

results previously obtained. This second series was continued for fifteen years, namely from 1856 to 1870 inclusive.

The results obtained in the first three years, 1843, 1844, and 1845, were published in the "Journal of the Royal Agricultural Society of England," vol. viii. Part II., 1847. In the upper division of the Table below, there is shown the produce obtained Without Manure, and with Farmyard Manure, in the first 3 years, 1843, '44, and '45; and in the subsequent divisions there are given abstracts of the results obtained Without Manure, and with Different Manures, from 1845 to 1870 inclusive.

During the five years, 1871-1875, the land was devoted to experiments with Sugar-Beet, for particulars of which see pp. 52-55.

In 1876 experiments with Mangel-wurzel were substituted, and are still in progress; see pp. 56-75. (In 1898, small areas were devoted to Sugar-beet—See Plan p. 48; also p. 73.)

(Area under experiment about 8 acres; quantities, average per acre, per annum.)

**NORFOLK WHITE TURNIPS, WITHOUT MANURE, AND WITH FARMYARD MANURE.**

YEAR.	Roots per Acre.		Leaves per Acre.	
	Without Manure.	With Farm-yard Manure.	Without Manure.	With Farm-yard Manure.
	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.
1843	4 4	9 10	not weighed	not weighed
1844	2 4	10 15	not weighed	not weighed
1845	0 14	17 1	0 14	7 8

  

(Area under experiment about 8 acres; quantities, average per acre, per annum.)

**NORFOLK WHITE TURNIPS, WITHOUT MANURE, AND WITH FARMYARD MANURE.**

Plots.	Roots.		Leaves.		SERIES 1. Standard Manures only.	SERIES 2. Standard Manures	SERIES 3. Standard Manures, and Cross-dressed with 160 lbs. Sulphate Ammonia. 75 lbs. Muriate Ammonia.	SERIES 4. Standard Manures, and Cross-dressed with 160 lbs. Sulphate Ammonia. 75 lbs. Muriate Ammonia. 1840 lbs. Rape-cake.	SERIES 5. Standard Manures, and Cross-dressed with 1840 lbs. Rape-cake.
	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.					
	Average Produce, per Acre, per Annum.		Average Produce, per Acre, per Annum.						
3	1 4	0 17	1 7	1 0	5 10	3 19	6 11	3 3	
4	8 1	2 15	9 15	4 3	10 5	6 1	11 2	4 12	
5	8 16	2 19	9 18	4 8	10 1	6 3	10 18	4 15	
6	8 0	2 10	9 16	4 8	10 7	6 6	10 17	4 13	
7									

Gypsum 1845; without Manure 1846 and since (average 1846, 7, 8)  
 Superphosphate, each year; Potash, Soda, and Magnesia, 1847 and '48  
 Superphosphate, each year .. .. .  
 Superphosphate, each year; and Potash 1847 and 1848 .. .. .

SWEDISH TURNIPS; FOUR SEASONS, 1849-1852; Roots and Leaves carted off the Land (excepting 1849, when the Leaves were too small to weigh or remove). Average Produce per acre per annum.

PLOTS.	STANDARD MANURES.	SERIES 1. Standard Manures only.		SERIES 2.		SERIES 3. Standard Manures and Cross-dressed with 200 lbs. Ammonium-salts, and 2000 lbs. Rape-cake.		SERIES 4. Standard Manures and Cross-dressed with 200 lbs. Ammonium-salts, and 2000 lbs. Rape-cake.		SERIES 5. Standard Manures and Cross-dressed with 2000 lbs. Rape-cake.	
		Roots.		Leaves.		Roots.		Leaves.		Roots.	
		Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.
3	Without Manure, 1846 and since .. .. .	2	6	0	6	3	17	0	6	7	14
4	Superphosphate, Sulphates Potash and Magnesia, and Soda-ash .. .. .	7	17	0	10	9	9	0	18	12	7
5	Superphosphate .. .. .	7	9	0	11	8	14	0	13	10	10
6	Superphosphate, and Sulphate Potash .. .. .	6	16	0	9	8	14	0	10	11	14
7	Superphosphate, and Sulphate Potash .. .. .	6	16	0	9	8	14	0	10	11	14

EARLEY, without Manure (after Roots manured as above); THREE SEASONS, 1853-1855. Average Produce per acre per annum.

PLOTS.	SERIES 1.	SERIES 2.		SERIES 3.		SERIES 4.		SERIES 5.	
		Dressed Grain.		Straw.		Dressed Grain.		Straw.	
		Bushels.	Cwts.	Bushels.	Cwts.	Bushels.	Cwts.	Bushels.	Cwts.
3	Without Manure, 1846 and since .. .. .	18½	12½	20½	15½	24½	15½	25½	16
4	Without Manure, 1846, and since .. .. .	20½	12½	22½	13	25	14½	25½	14½
5	Without Manure, 1846, and since .. .. .	21	11½	23	12½	26½	15	27	15½
6	Without Manure, 1846, and since .. .. .	18½	10½	20½	11½	25	14½	25	14½
7	Without Manure, 1846, and since .. .. .	18½	10½	20½	11½	25	14½	25	14½

SWEDISH TURNIPS; FIFTEEN SEASONS, 1856-1870. (1) Roots and Leaves carted off the Land. Average Produce per acre per annum.

PLOTS.	STANDARD MANURES.	SERIES 1. Standard Manures only.		SERIES 2. Standard Manures and Cross-dressed with 5 years, 1856-1860, 3000 lbs. Saw-dust, and 328 lbs. Nitric Acid.		SERIES 3. Standard Manures and Cross-dressed with 5 years, 1856-1860, 200 lbs. Ammonium-salts, and 3000 lbs. Sawdust.		SERIES 4. Standard Manures and Cross-dressed with 5 years, 1856-1860, 200 lbs. Ammonium-salts, and 3000 lbs. Sawdust.		SERIES 5. Standard Manures and Cross-dressed with 5 years, 1856-1860, 3000 lbs. Sawdust.	
		Roots.		Leaves.		Roots.		Leaves.		Roots.	
		Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.
1	Farmyard Manure, 14 tons .. .. .	6	4	7	9	8	8	1	4	8	0
2	Farmyard Manure, 14 tons, and Superphosphate .. .. .	6	7	0	16	8	5	1	5	7	16
3	Without Manure, 1846, and since .. .. .	0	11	0	3	0	13	0	3	3	8
4	Superphosph., each year; Sulph. Potash, Soda, and Magnesia, 1856-60 .. .. .	2	16	0	8	4	12	0	14	5	8
5	Superphosphate, each year .. .. .	2	12	0	9	4	13	0	18	5	16
6	Superphosphate, each year; Sulphate Potash, 1856-1860 .. .. .	2	7	0	7	4	11	0	14	5	3
7	Superphosph., each year; Sulph. Potash, and 36½ Amm.-salts, 1856-60 .. .. .	2	12	0	7	4	12	0	14	6	15
8	Ummn. 1853, and since; previously part Ummn.; part Superphosph. .. .. .	1	3	0	4	1	2	0	5	3	19

NOTE.—"Sulphate of Ammonia" is estimated to contain 23 per cent. Ammonia, and "Muriate of Ammonia" 27 per cent. "Ammonium-salts," in each case, equal parts Sulphate and Muriate of Ammonia of commerce; and the mixture is estimated to contain 25 per cent. Ammonia. The 328 lbs. Nitric Acid (Sp. gr. 1.35), mixed with sawdust, and used as a cross-dressing on the Plots of Series 2, from 1856-1860, were estimated to contain Nitrogen = 50 lbs. Ammonia.  
 (1) The crops of 1859 and 1860 failed, and were ploughed in; but, as the manures were applied, and there would be accumulation within the soil for the succeeding crops, the average produce is calculated as for 15 years, that is the produce of the 13 years is, in each case, divided by 15.

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

GROWN YEAR AFTER YEAR ON THE SAME LAND, WITHOUT MANURE, AND WITH DIFFERENT DESCRIPTIONS OF MANURE, 5 YEARS, 1871-'75.

Previous Cropping:—1843-'48 (6 Seasons), experiments on Norfolk White Turnips, with different descriptions of Manure. 1849-'52 (4 Seasons), experiments on Swedish 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 Swedish 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, Ammonium-salts, and Rape-cake were omitted, as will be seen below. In 1871, the seed was dibbled on ridges, in rows 26 inches apart, and 10 inches apart in the rows; in 1872-'75, seed dibbled on the flat; in rows 22 inches apart, and 11 inches apart in the rows; plants moulded up afterwards. Roots all carted off, Leaves weighed, spread on the respective Plots, and ploughed in.

Below are given the Manures and Produce for the 5 Seasons, 1871-'75. Area under experiment, about 8 acres. The experiments are arranged as under, in 5 Series, each of which comprises 8 Plots.

PLOTS.	Manures, per Acre, per Annum.				
	SERIES 1. Standard Manures only.	SERIES 2. Standard Manures, and Cross-dressed with 550 lbs. Nitrate Soda.	SERIES 3. Standard Manures, and Cross-dressed with 400 lbs. "Ammonium-salts."	SERIES 4. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake, and 400 lbs. "Ammonium-salts."	SERIES 5. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake.

FIRST SEASON, 1871. Seed dibbled April 13 and 14; Crop taken up November 30—December 19.

	PRODUCE PER ACRE (Roots trimmed as for feeding, not as for Sugar-making).															
	Leaves.		Roots.		Leaves.		Roots.		Leaves.		Roots.		Leaves.		Roots.	
	Tons.	cwts.	Tons.	cwts.	Tons.	cwts.	Tons.	cwts.	Tons.	cwts.	Tons.	cwts.	Tons.	cwts.	Tons.	cwts.
1	18	3	27	13	6	19	22	1	5	6	26	4	28	18	5	14
2	14	13	2	14	5	15	21	15	4	6	25	2	25	4	5	5
3	7	11	2	0	22	3	15	6	4	16	19	18	20	16	4	12
4	7	11	1	5	22	15	17	10	3	5	22	15	21	7	3	19
5	5	12	1	8	20	19	15	4	3	19	19	18	18	19	4	5
6	5	1	1	4	21	5	17	4	3	4	23	11	21	0	3	11
7	5	18	1	5	20	19	18	8	4	3	21	0	21	7	3	17
8	7	10	1	14	21	13	16	2	4	15	17	19	20	7	4	9

SECOND SEASON, 1872. Seed dibbled May 1-3; Crop taken up November 12-28.

1	15	13	4	2	23	9	22	14	9	0	26	8	22	5	6	1
2	16	0	3	18	24	6	8	16	7	16	25	9	20	15	5	11
3	7	17	1	13	21	7	6	6	4	13	20	8	16	3	3	11
4	6	14	1	10	20	2	5	19	3	7	23	8	17	18	3	15
5	6	17	1	8	19	6	6	4	4	13	18	11	10	4	3	16
6	6	6	1	5	16	16	5	14	3	19	22	16	9	9	3	14
7	6	15	1	8	17	0	6	1	3	19	23	9	9	10	3	15
8	5	4	1	5	15	6	5	19	4	1	19	12	15	0	4	6

THIRD SEASON, 1873. Seed dibbled May 9-11; Crop taken up November 19-December 2.

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 cwts. 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 cwts. Superphosphate, 500 lbs. Sulphate Potash, 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 cwts. Superphosphate .. .. .	5 5	1 11	18 8	5 13	10 19	5 0	14 15	9 8	13 19	4 9
6	3½ cwts. Superphos., 500 lbs. Sulph. Potash .. .. .	4 12	1 5	15 17	4 4	12 18	3 12	20 2	9 5	14 14	3 11
7	3½ cwts. Superphos., 500 lbs. Sulph. Potash, 36½ lbs. Amm.-salts (2)	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 (3). Mineral Manures as in 1872 and 1873; but no Farmyard Manure, or cross-dressings of Nitrate Soda, Ammonium-salts, or Rape-cake. Seed dibbled April 30 and May 1; Crop taken up November 13-19.

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 cwts. 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 cwts. Superphosphate, 500 lbs. Sulphate Potash, 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 cwts. Superphosphate .. .. .	5 19	1 7	7 10	3 6	7 6	2 8	7 15	5 4	5 17	3 6
6	3½ cwts. Superphos., 500 lbs. Sulph. Potash .. .. .	5 11	1 5	8 1	2 14	8 1	1 18	9 10	4 13	7 13	3 2
7	3½ cwts. 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, Ammonium-salts, or Rape-cake. Seed dibbled April 29 and 30; Crop taken up November 23-30.

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 cwts. 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 cwts. Superphosphate, 500 lbs. Sulphate Potash, 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 cwts. Superphosphate .. .. .	5 11	1 2	9 19	1 10	7 16	1 4	13 17	2 8	11 2	1 14
6	3½ cwts. Superphos., 500 lbs. Sulph. Potash .. .. .	5 4	1 0	8 4	1 4	7 1	1 2	12 8	2 3	10 2	1 9
7	3½ cwts. 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) "Ammonium-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.

An abstract of the analytical results obtained illustrating the influence of different manures, and different seasons, on the composition of Sugar-beet, is given below. In interpreting the figures it must be borne in mind that with forty different experiments each year, and in each year four, or five, 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 was determined in the expressed juice, and calculated into its percentage in the roots in accordance with the methods adopted at the time the experiments were made (1871-75), which were founded on the estimate of the percentage of juice in the roots, reckoned from the determined percentage of dry matter in the juice and in the roots. The results showed an average of about 95 per cent. of juice, and this figure was adopted in calculating the amount of sugar in the roots from that determined in the juice. In 1879, however, Scheibler published results obtained by determining the sugar in Sugar-beet, both directly in the roots by extraction with dilute alcohol, and also in the juice in the ordinary way. Whilst the old method indicated an average of about 95 per cent. of juice, the new one showed only about 90 per cent. Scheibler concluded that water equal to the difference (about 5 per cent.) existed in combination with the marc, and this he

termed "colloid water," as distinguished from the water of the juice. In the Rothamsted "Memoranda" for 1881, attention was called to Scheibler's new results and conclusions, and it was pointed out that if they were confirmed the percentages of sugar annually recorded in the Tables of the Rothamsted results should be reduced by about  $\frac{1}{10}$  or  $\frac{1}{20}$ . Subsequently, further evidence, and especially results obtained by Maercker, by the extraction of the sugar in the roots by alcohol, left no doubt that the amount of juice in Sugar-beet averages more nearly 90 than 95 per cent.; and having in 1895 to re-consider the subject for a paper on "Root-crops," the previously annually recorded percentages of sugar in the experimentally grown Sugar-beet, were then corrected on the assumption that the amount of juice will on the average be only 90 per cent., and the results as so corrected are given in the Table below. It is obvious, however, that with roots varying so much in character of growth, size, and ripeness, the percentage of juice would not be the same in all. Nevertheless, it was considered that the results calculated on the assumption of 95 per cent. of juice, approximately and usefully represented the actual and relative amounts of sugar in the various roots; and now that only 90 per cent. of juice is assumed, it may be supposed that the results will be actually nearer the truth than before.

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 per acre.

MANURES, PER ACRE, PER ANNUM, UNLESS OTHERWISE STATED (SEE BELOW).

PLOTS.	SERIES 1. Standard Manures only.			SERIES 2. Standard Manures, and Cross-dressed with 550 lbs. Nitrate Soda.			SERIES 3. Standard Manures, and Cross-dressed with 400 lbs. "Ammonium-salts."			SERIES 4. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake, and 400 lbs. "Ammonium-salts."			SERIES 5. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake.		
	Dry Matter.	Sugar.	Nitro-gen.	Dry Matter.	Sugar.	Nitro-gen.	Dry Matter.	Sugar.	Nitro-gen.	Dry Matter.	Sugar.	Nitro-gen.	Dry Matter.	Sugar.	Nitro-gen.
1	17.04	11.16	0.821	17.07	10.46	0.934	16.07	10.46	0.199	14.73	8.87	1.021	15.44	9.71	0.892
2	17.24	11.29	0.826	15.03	9.25	0.945	15.12	9.43	0.199	14.80	8.75	0.988	16.11	10.24	0.909
3	17.47	11.86	0.711	15.36	9.82	0.861	17.75	10.40	0.901	16.71	9.15	0.915	16.95	11.10	0.758
4	18.07	12.31	0.738	15.72	10.24	0.828	18.68	11.74	0.907	16.87	9.38	1.002	16.61	11.08	0.767
5	17.89	12.53	0.746	15.93	10.49	0.787	16.36	10.83	0.754	14.63	8.79	0.843	16.84	11.22	0.722
6	18.09	12.32	0.778	15.29	9.92	0.856	16.33	10.91	0.843	15.28	9.20	0.956	17.05	11.44	0.812
7	17.97	12.47	0.762	15.86	9.98	0.901	16.71	10.89	0.826	15.99	9.69	0.904	17.57	11.65	0.782
8	18.32	12.33	0.791	15.98	10.48	0.856	16.08	10.30	0.764	14.90	8.84	0.806	16.73	11.29	0.747

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.)

Mean Per Cent. Total Dry Matter, Sugar, Mineral Matter (Crude Ash), and Nitrogen in the Roots.

	Dry Matter.	Sugar.	Nitro-gen.	Dry Matter.	Sugar.	Nitro-gen.	Dry Matter.	Sugar.	Nitro-gen.	Dry Matter.	Sugar.	Nitro-gen.	Dry Matter.	Sugar.	Nitro-gen.
Farmyard Manure	17.04	11.16	0.821	17.07	10.46	0.934	16.07	10.46	0.199	14.73	8.87	1.021	15.44	9.71	0.892
Farmyard Manure, & Super.	17.24	11.29	0.826	15.03	9.25	0.945	15.12	9.43	0.199	14.80	8.75	0.988	16.11	10.24	0.909
Unmanured (1846, & since)	17.47	11.86	0.711	15.36	9.82	0.861	17.75	10.40	0.901	16.71	9.15	0.915	16.95	11.10	0.758
Super., & Pot., Sod., & Mag.	18.07	12.31	0.738	15.72	10.24	0.828	18.68	11.74	0.907	16.87	9.38	1.002	16.61	11.08	0.767
Superphosphate	17.89	12.53	0.746	15.93	10.49	0.787	16.36	10.83	0.754	14.63	8.79	0.843	16.84	11.22	0.722
Super., & Potash	18.09	12.32	0.778	15.29	9.92	0.856	16.33	10.91	0.843	15.28	9.20	0.956	17.05	11.44	0.812
Super., Pot., & 36½ lb. Am.-sfts.	17.97	12.47	0.762	15.86	9.98	0.901	16.71	10.89	0.826	15.99	9.69	0.904	17.57	11.65	0.782
Unmanured (1853, & since)	18.32	12.33	0.791	15.98	10.48	0.856	16.08	10.30	0.764	14.90	8.84	0.806	16.73	11.29	0.747

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

1	Farmyard Manure ..	18-93	12-29	0-874	17-07	11-32	0-962	17-17	11-43	0-930	17-75	11-70	0-925
2	Farmyard Manure, & Super.	18-07	12-36	0-822	16-04	9-88	0-982	17-07	11-29	0-965	17-95	12-14	0-875
3	Unmanured (1846, & since)	19-22	13-26	0-767	17-83	12-11	0-823	17-87	11-93	0-720	19-12	13-21	0-683
4	Super., & Pot., Sod., & Mag.	19-08	13-41	0-778	0-110	16-97	11-55	0-860	0-148	0-128	0-184	18-67	12-67
5	Superphosphate ..	18-67	13-19	0-712	0-101	16-37	10-58	0-866	0-167	0-167	0-250	18-07	12-53
6	Super., & Potash ..	18-83	13-09	0-772	0-098	17-08	11-26	0-891	0-167	0-166	0-173	18-41	12-47
7	Super., Pot., & 36½ lb. Am.-sfts.	19-03	13-20	0-742	16-66	10-63	0-937	17-38	11-51	0-879	19-01	13-32	0-809
8	Unmanured (1853, & since)	18-69	..	0-701	16-84	..	0-911	17-98	12-15	0-797	18-95	..	0-685

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

1	Farmyard Manure ..	17-62	12-06	0-924	16-64	10-61	0-947	16-76	10-74	0-965	16-88	11-03	0-887
2	Farmyard Manure, & Super.	18-49	12-34	0-847	16-35	10-19	0-973	16-54	10-98	0-951	16-33	10-92	0-960
3	Unmanured (1846, & since)	18-96	13-11	0-710	16-97	11-27	0-843	18-76	12-38	0-762	17-94	13-46	0-735
4	Super., & Pot., Sod., & Mag.	18-80	13-09	0-796	0-132	17-97	11-42	0-934	0-181	0-161	0-187	18-30	12-48
5	Superphosphate ..	19-25	13-52	0-679	0-121	16-89	10-90	0-847	0-184	0-186	0-227	18-93	12-77
6	Super., & Potash ..	19-64	13-60	0-757	0-119	17-94	11-84	0-810	0-169	0-140	0-212	18-22	12-29
7	Super., Pot., & 36½ lb. Am.-sfts.	19-63	13-67	0-747	17-42	11-10	0-907	18-81	13-00	0-858	19-00	12-40	0-852
8	Unmanured (1853, & since)	20-22	13-89	0-742	16-50	10-32	0-917	18-47	12-50	0-756	18-06	12-38	0-695

FOURTH SEASON, 1874 (1). Mineral Manures as in 1872 and 1873; but no Farmyard Manure, or cross-dressings of Nitrate Soda, Ammonium-salts, or Rape-cake. (Samples collected in the middle of November.)

1	Farmyard Manure, '71, '72 & '73	14-66	10-57	1-100	14-27	9-62	1-059	14-35	9-27	1-112	13-53	9-70	1-029
2	Farmyd. Manure, & Super. '71-'73	15-00	12-08	1-022	13-84	9-41	1-082	14-24	9-58	1-081	14-59	9-58	0-970
3	Unmanured (1846, & since)	17-45	12-51	0-792	15-60	9-63	0-990	16-05	11-07	0-863	15-54	10-84	0-861
4	Super., & Pot., Sod., & Mag.	18-54	12-41	0-721	14-00	9-22	0-840	16-70	11-75	0-921	17-17	11-01	1-026
5	Superphosphate ..	18-06	12-32	0-668	14-91	9-26	0-898	16-87	11-76	0-833	14-89	10-94	0-746
6	Super., & Potash ..	17-83	12-30	0-752	15-95	9-95	0-839	16-70	12-97	0-865	15-30	11-41	0-938
7	Super., Pot., & 36½ lb. Am.-sfts.	16-88	..	0-730	15-56	..	0-903	17-74	..	0-784	16-08	..	0-907
8	Unmanured (1853, & since)	18-76	..	0-726	15-30	..	0-890	17-35	..	0-771	15-48	..	0-772

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

1	Farmyard Manure, '71, '72 & '73	16-02	11-10	0-749	16-16	11-22	0-751	16-33	10-91	0-814	16-29	11-39	0-840
2	Farmyd. Manure, & Super. '71-'73	16-08	11-11	0-784	15-67	10-63	0-687	15-43	10-21	0-863	15-70	10-32	0-770
3	Unmanured (1846, & since)	17-29	12-11	0-671	15-66	10-92	0-720	17-52	12-12	0-675	15-90	10-85	0-652
4	Super., & Pot., Sod., & Mag.	16-67	11-48	0-773	0-103	16-10	11-42	0-751	0-112	0-755	16-56	11-27	0-758
5	Superphosphate ..	16-94	12-30	0-686	0-107	16-53	11-46	0-722	0-125	0-683	0-122	15-34	10-61
6	Super., & Potash ..	18-04	12-00	0-782	0-127	16-78	11-82	0-762	0-123	0-752	0-136	16-21	10-97
7	Super., Pot., & 36½ lb. Am.-sfts.	17-51	..	0-730	16-50	..	0-874	16-50	..	0-802	15-88	..	0-856
8	Unmanured (1853, & since)	16-81	..	0-770	16-01	..	0-812	16-56	..	0-767	15-96	..	0-768

(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.

EXPERIMENTS ON MANGEL WURZEL.—BARN FIELD (after SUGAR-BEET); commencing 1876.

Below are given the particulars of the Manures and Produce in each of the first 5 Seasons, 1876-1880; also the average Produce of those first 5 Seasons. For continuation, see pp. 60-1, 64-5, 68-9, and 72-73.

The arrangement of the Plots is precisely the same as previously for Sugar-beet, excepting that Plot 9, which was unmanured for Sugar-beet, and also previously for weighed, spread on the respective Plots, and ploughed in.

(Area under experiment about 8 acres.)

PLOTS.	MANURES PER ACRE PER ANNUM.				
	SERIES 1. Standard Manures only.	SERIES 2. Standard Manures, and Cross-dressed with 550 lbs. Nitrate Soda.	SERIES 3. Standard Manures, and Cross-dressed with 400 lbs. "Ammonium-salts."	SERIES 4. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake and 400 lbs. "Ammonium-salts."	SERIES 5. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake.

FIRST SEASON, 1876. Seed dibbled, May 22-26. Crop taken up, Nov. 3-17.

1	2	3	4	5	6	7	8	9	PRODUCE PER ACRE.											
									Leaves.		Roots.		Leaves.		Roots.		Leaves.		Roots.	
									Tons.	cwts.	Tons.	cwts.	Tons.	cwts.	Tons.	cwts.	Tons.	cwts.	Tons.	cwts.
Farmyard Manure (14 tons)	19	12	4	9	25	2	7	5	29	19	7	12	31	9	10	5	24	9	5	19
Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	19	13	4	6	27	13	7	3	29	8	7	10	30	18	9	16	29	19	6	12
Without Manure (1846, and since)	6	10	1	14	20	13	5	12	14	3	4	10	19	19	7	7	17	4	4	15
3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride	8	8	1	15	25	1	6	0	19	19	4	9	30	8	8	13	25	8	5	10
Sodium (common salt), 200 lbs. Sulphate Magnesia	7	10	1	14	21	0	5	14	13	10	5	1	17	2	7	14	17	17	5	17
3½ cwts. Superphosphate	6	16	1	12	21	2	5	8	17	15	4	13	26	8	9	0	20	10	5	4
3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 36½ lbs. Am-salts (2)	8	13	2	3	22	11	5	14	19	2	5	11	27	2	9	9	20	12	5	15
Unmanured, 1853, and since; previously part Unman., part Superphos.	5	9	1	10	15	16	5	3	11	17	4	16	18	2	7	11	15	12	4	18
Farmyard Manure (14 tons), 3½ cwts. Superphosphate (3)	..	..	..	..	..	..	..	..	25	14	7	6	..	..	..	..	..	..	..	..

SECOND SEASON, 1877. Seed dibbled, June 4-6 (Plots 8 and 9, June 11th). Crop taken up, Nov. 14-23.

1	2	3	4	5	6	7	8	9	PRODUCE PER ACRE.											
									Leaves.		Roots.		Leaves.		Roots.		Leaves.		Roots.	
									Tons.	cwts.	Tons.	cwts.	Tons.	cwts.	Tons.	cwts.	Tons.	cwts.	Tons.	cwts.
Farmyard Manure (14 tons)	15	7	2	1	24	13	3	14	27	1	4	4	30	5	5	5	25	18	3	4
Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	16	14	1	19	26	8	3	12	26	18	4	6	28	15	5	9	24	12	2	19
Without Manure (1846, and since)	5	9	1	0	16	17	3	14	8	16	3	0	13	9	3	19	13	17	2	10
3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride	6	16	1	3	21	10	3	10	16	10	2	2	27	9	3	8	21	14	1	17
Sodium (common salt), 200 lbs. Sulphate Magnesia	6	1	0	19	20	5	3	1	12	2	2	10	15	3	3	8	15	3	2	2
3½ cwts. Superphosphate	5	8	0	18	20	19	2	18	15	6	1	16	24	18	3	16	19	3	1	12
3½ cwts. Superphosphate, 500 lbs. Sulphate Potash	7	0	1	3	22	2	3	16	16	13	2	7	25	15	5	0	20	13	2	8
Unmanured, 1853, and since; previously part Unman., part Superphos.	3	19	1	3	9	17	5	4	7	4	3	10	11	9	4	11	10	3	3	3
Farmyard Manure (14 tons), 3½ cwts. Superphosphate (3)	..	..	..	..	..	..	..	..	13	17	4	0	..	..	..	..	..	..	..	..



THIRD SEASON, 1878. Seed dibbled, June 8-9 (Plot 9, June 11th). Crop taken up, Nov. 7-20.

1	Farmyard Manure (14 tons) .. .. .	13	5	2	16	18	15	4	4	20	11	5	6	22	4	6	3	17	1	8	13
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1) .. .	14	16	2	19	21	4	4	15	19	15	5	3	20	18	5	17	18	17	3	15
3	Without Manure (1846, and since) .. .. .	3	10	1	4	10	2	2	16	4	7	2	11	6	11	3	7	6	3	2	17
4	{ 3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride } { Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. .	5	9	1	7	18	10	4	6	14	3	2	12	21	2	4	14	15	19	3	2
5	3½ cwts. Superphosphate .. .. .	4	14	1	8	14	11	3	18	8	2	3	6	8	4	3	3	8	1	3	6
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash .. .. .	3	18	1	3	15	1	3	7	12	0	2	14	15	3	4	11	12	5	3	3
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (?) .. .	5	8	1	9	13	18	3	1	11	18	2	18	14	0	4	5	11	19	3	8
8	Unmanured, 1853, and since; previously part Unman., part Superphos. .. .	2	13	1	4	11	19	4	7	6	13	3	5	6	12	4	10	6	4	3	5
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (?) .. .. .	..	..	..	..	..	..	..	..	15	17	5	9	..	..	..	..	..	..	..	..

FOURTH SEASON, 1879. Seed dibbled, May 13-15. Crop taken up, Nov. 11-20.

1	Farmyard Manure (14 tons) .. .. .	6	3	1	15	9	8	2	9	12	6	3	11	13	16	8	15	10	14	2	12
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1) .. .	6	13	1	16	11	11	2	18	11	12	3	9	14	1	3	17	9	18	2	11
3	Without Manure (1846, and since) .. .. .	1	12	0	12	4	17	1	19	3	12	2	4	7	17	3	3	6	8	1	17
4	{ 3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride } { Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. .	2	2	0	14	8	13	2	8	7	10	1	15	12	10	2	19	7	7	1	14
5	3½ cwts. Superphosphate .. .. .	1	18	0	14	8	5	2	9	5	0	1	16	9	13	3	5	6	11	1	12
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash .. .. .	1	15	0	13	7	16	2	7	6	9	1	12	11	11	3	5	7	17	1	13
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (?) .. .	1	18	0	14	8	2	2	6	6	7	1	14	11	2	3	6	8	4	2	0
8	Unmanured, 1853, and since; previously part Unman., part Superphos. .. .	1	5	0	11	5	16	2	7	3	10	1	16	9	2	3	14	6	9	2	5
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (?) .. .. .	..	..	..	..	..	..	..	..	9	7	2	19	..	..	..	..	..	..	..	..

FIFTH SEASON, 1880. Seed dibbled, April 22-23 (Plot 9, April 24th). Crop taken up, Nov. 2-11.

1	Farmyard Manure (14 tons) .. .. .	18	11	2	14	26	8	3	5	25	4	5	10	27	3	6	1	27	5	4	1
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1) .. .	17	8	2	0	27	16	3	14	25	15	5	10	26	0	5	12	27	9	4	3
3	Without Manure (1846, and since) .. .. .	4	10	0	18	14	0	2	13	9	17	2	11	11	4	3	0	12	6	2	9
4	{ 3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride } { Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. .	5	17	0	19	23	6	3	3	19	14	2	18	30	11	5	12	24	4	3	6
5	3½ cwts. Superphosphate .. .. .	5	3	0	16	18	6	2	4	9	18	2	13	12	9	2	18	14	8	2	13
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash .. .. .	4	15	0	14	21	10	2	11	18	12	3	4	27	4	5	11	21	8	2	7
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (?) .. .	7	0	0	19	21	10	2	6	19	6	2	19	26	0	5	6	23	2	2	11
8	Unmanured, 1853, and since; previously part Unman., part Superphos. .. .	4	0	0	17	11	14	3	5	5	19	2	17	12	4	3	1	12	1	2	15
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (?) .. .. .	..	..	..	..	..	..	..	..	20	19	4	0	..	..	..	..	..	..	..	..

AVERAGE OF 5 SEASONS, 1876, '77, '78, '79, and 1880.

1	Farmyard Manure (14 tons) .. .. .	14	12	2	15	20	17	4	3	23	0	5	5	24	19	6	6	21	1	3	18
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1) .. .	15	1	2	12	22	18	4	8	22	14	5	4	24	2	6	2	22	3	4	0
3	Without Manure (1846, and since) .. .. .	4	6	1	2	13	6	3	7	8	3	2	19	11	16	4	3	11	4	2	18
4	{ 3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride } { Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. .	5	14	1	4	19	8	3	17	15	11	2	15	24	8	5	1	18	18	3	2
5	3½ cwts. Superphosphate .. .. .	5	1	1	2	16	9	3	9	9	14	3	1	12	10	4	2	12	8	3	2
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash .. .. .	4	10	1	0	17	6	3	6	14	0	2	16	21	1	5	5	16	5	2	16
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (?) .. .	6	0	1	6	17	13	3	9	14	13	3	2	20	16	5	9	16	18	3	4
8	Unmanured, 1853, and since; previously part Unman., part Superphos. .. .	3	9	1	1	11	0	4	1	7	1	3	5	12	0	4	13	10	2	3	5
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (?) .. .. .	..	..	..	..	..	..	..	..	17	3	4	15	..	..	..	..	..	..	..	..

(1) "Superphosphate of Lime"—in all cases made from 200 lbs. Bone-ash, 150 lbs. Sulphuric acid, sp. gr. 1.7 (and water). (2) "Ammonium-salts"—in each case equal parts Sulphate and Muriate of Ammonia of Commerce. (3) Plot 9 sown on the flat instead of on ridges; plants ridged up afterwards; rows 22 inches apart, plants 10 inches apart in the rows.

**EXPERIMENTS ON MANGEL WURZEL.—BARN FIELD—continued.—SUMMARY OF THE COMPOSITION OF THE MANGEL ROOTS, in each of the first 5 Seasons, 1876-1880; also the average composition over the first 5 Seasons. For the composition in 1881 and succeeding years, see pp. 62-3, 66-7, 70-1, and 74-5.**

An abstract of the analytical results obtained, illustrating the influence of different manures, and of different seasons, on the composition of Mangel, is given below. The dry matter, ash, and nitrogen, are of course determined in the roots themselves. The amounts of dry matter, ash, and nitrogen, have also, in many cases, been determined in the expressed juice. In many cases also, the amount of the nitrogen existing as albuminoids has been determined (by Church's method); and in some cases the amount of amides and as nitric acid. It may be observed that by far the larger proportion of both the mineral matter and the nitrogen of the roots is found in the juice; and of the nitrogen in the juice a variable proportion, ranging from less than one-fifth to not more than one-third of the total, is found to exist as albuminoids.

The sugar was determined in the expressed juice, and calculated into its percentage in the roots in accordance with the methods adopted at the time the experiments were made (1876-80), which were founded on the estimate of the percentage of juice in the roots, reckoned from the determined percentage of dry matter in the juice and in the roots. The results showed an average of about 96 per cent. of juice, and this figure was adopted in calculating the amount of sugar in the roots from that determined in the juice. In 1879, however, Scheibler published results obtained by determining the sugar in *Sugar-beet*, both directly in the roots by extraction with dilute alcohol, and also in the juice in the ordinary way. Whilst the old method indicated an average of about 95 per cent. of juice, the new one showed only about 90 per cent. Scheibler concluded that water equal to the difference (about 5 per cent.) existed in combination with the marc, and this he termed "colloid water," as distinguished from the water of the juice. In the Rothmanstedt "Memoranda" for 1884, attention was called to Scheibler's new results and conclusions, in regard to *Sugar-beet*, and it was pointed out that if they were confirmed the percentages of sugar annually recorded in the Tables of the Rothmanstedt results should be reduced by about  $\frac{5}{100}$  or  $\frac{1}{20}$ . It was further pointed out, that supposing the same applied to Mangels, and that the amount of true juice in them averaged only

90 instead of 96 per cent., the percentage of sugar in their roots would also be from  $\frac{1}{10}$  or  $\frac{1}{20}$  less than given in the Table. Subsequently, further evidence, and especially results obtained by Maercker, by the extraction of the sugar in the roots by alcohol, left no doubt that the amount of juice in *Sugar-beet* averages more nearly 90 than 96 per cent. We are not aware of any published results of the determinations of sugar in Mangel-roots by extraction with alcohol; but until direct evidence on the point is available, it is assumed that the amount of juice in Mangels, like that in *Sugar-beet*, will probably average about 90 per cent.; and having in 1885 to reconsider the subject for a paper on "Root-crops," the previously annually recorded percentages of sugar in the experimentally grown Mangel-roots, were then corrected on the assumption that the amount of juice will on the average be only 90 per cent., and the results as so corrected are given in the Table below. It is obvious, however, that with roots varying so much in character of growth, size, and ripeness, the percentage of juice would not be the same in all. Nevertheless, it was considered that the results calculated on the assumption of 96 per cent. of juice, approximately and usefully represented the actual and relative amounts of sugar in the various roots; and now that only 90 per cent. of juice is assumed it may be supposed that the results will be actually nearer the truth than before, and relatively as near.

In interpreting the figures, it must be borne in mind, that, with forty different experiments each year, and, in each year, four, five, 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 seeds, was sown on all the Plots at the same time. The sample analysed was in each case a mixture of vertical sections of ten or fifteen roots, and all the samples were as a rule taken within a period of from one to two weeks; as far as practicable beginning with the ripest. It is obvious, however, that the smaller crops would be much riper than the larger ones; but, although the larger crops generally contain a lower percentage of sugar, they yield very much more sugar per acre.

**MANURES, PER ACRE, PER ANNUM.**

PLOTS.	ABBREVIATED DESCRIPTION OF STANDARD MANURES.	SERIES 1.			SERIES 2.			SERIES 3.			SERIES 4.			SERIES 5.		
		Standard Manures only.			Standard Manures, and Cross-dressed with 550 lbs. Nitrate Soda.			Standard Manures, and Cross-dressed with 400 lbs. Ammonium-salts.			Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake and 400 lbs. Am.-salts.			Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake.		

For details, see pp. 56-7.

**FIRST SEASON, 1876.**

1	Farmyard Manure	Dry Matter.	Sugar.	Ash.	Nitro-gen.	Dry Matter.	Sugar.	Ash.	Nitro-gen.	Dry Matter.	Sugar.	Ash.	Nitro-gen.	Dry Matter.	Sugar.	Ash.	Nitro-gen.	Percent.	
																			Percent.
2	Farmyard Manure & Super.	12.14	6.70	0.969	10.54	1.031	10.65	1.080	8.98	1.065	11.30	0.989	11.80	1.005	11.80	0.989	11.80	11.80	Percent.
3	Farmyard Manure, & since)	12.41	6.74	0.943	9.35	1.020	9.64	1.018	8.92	1.034	10.51	1.005	10.51	1.005	10.51	1.005	10.51	10.51	Percent.
4	Unmanured (1846, & since)	15.14	..	0.828	11.94	..	12.16	..	11.60	..	12.42	..	12.42	..	12.42	..	12.42	12.42	Percent.
5	Super., & Pot., Sod., & Mag.	13.99	8.42	0.905	11.36	5.92	12.23	6.71	9.91	5.27	11.28	6.51	11.28	6.51	11.28	6.51	11.28	11.28	Percent.
6	Superphosphate	13.51	8.88	0.818	10.99	5.96	11.73	6.82	10.93	5.67	10.65	6.41	10.65	6.41	10.65	6.41	10.65	10.65	Percent.
7	Super., & Potash	13.67	8.19	0.928	11.23	7.19	11.02	6.95	10.56	5.07	11.55	6.84	11.55	6.84	11.55	6.84	11.55	11.55	Percent.
8	Super., Pot., & 36½ lb. Am.-sfts.	13.63	..	0.882	11.61	..	10.62	..	10.66	..	11.58	..	11.58	..	11.58	..	11.58	11.58	Percent.
9	Unmanured (1853, & since)	13.06	..	0.900	11.23	..	11.43	..	10.20	..	11.61	..	11.61	..	11.61	..	11.61	11.61	Percent.
9	Farmyard Manure, & Super.	..	..	..	..	0.945	..	..	..	..	..	..	..	..	..	..	..	..	Percent.

**SECOND SEASON, 1877.**

1	Farmyard Manure	Dry Matter.	Sugar.	Ash.	Nitro-gen.	Dry Matter.	Sugar.	Ash.	Nitro-gen.	Dry Matter.	Sugar.	Ash.	Nitro-gen.	Dry Matter.	Sugar.	Ash.	Nitro-gen.	Percent.	
																			Percent.
2	Farmyard Manure & Super.	14.48	8.48	0.988	12.01	1.122	12.95	1.097	12.44	1.114	13.84	1.010	13.84	1.010	13.84	1.010	13.84	13.84	Percent.
3	Farmyard Manure, & since)	13.85	9.39	0.961	12.91	1.072	13.24	7.35	7.20	1.126	14.08	7.97	14.08	7.97	14.08	7.97	14.08	14.08	Percent.
4	Unmanured (1846, & since)	16.58	10.49	0.827	14.06	1.072	17.11	9.52	0.888	0.834	16.41	9.58	16.41	9.58	16.41	9.58	16.41	16.41	Percent.
5	Super., & Pot., Sod., & Mag.	15.42	10.24	0.948	12.25	1.121	13.11	8.77	1.085	0.786	12.69	7.04	12.69	7.04	12.69	7.04	12.69	12.69	Percent.
6	Superphosphate	15.84	10.98	0.797	12.90	0.889	15.63	9.38	0.838	0.786	15.35	10.04	15.35	10.04	15.35	10.04	15.35	15.35	Percent.
7	Super., & Potash	16.15	10.60	0.891	12.53	1.135	15.05	8.86	1.095	0.834	14.27	8.34	14.27	8.34	14.27	8.34	14.27	14.27	Percent.
8	Super., Pot., & 36½ lb. Am.-sfts.	15.88	..	0.943	12.74	..	13.96	..	1.098	1.136	12.58	..	12.58	..	12.58	..	12.58	12.58	Percent.
9	Unmanured (1853, & since)	16.23	..	0.933	14.01	..	14.95	..	0.932	0.811	14.51	..	14.51	..	14.51	..	14.51	14.51	Percent.
9	Farmyard Manure, & Super.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	Percent.

THIRD SEASON, 1878.

1	Farmyard Manure .. ..	12.26	6.87	0.995	0.170	11.47	5.97	1.086	0.218	11.17	5.88	1.018	0.206	10.83	5.80	1.046	0.241	11.98	6.47	0.985	0.186
2	Farmyard Manure, & Super. ..	11.51	6.53	0.981	0.182	10.05	4.89	1.072	0.216	11.00	5.70	1.034	0.206	10.50	5.57	0.987	0.217	10.66	5.76	0.948	0.175
3	Unmanured (1846, & since) ..	15.25	9.56	0.824	0.186	12.02	6.64	0.908	0.211	13.47	7.59	0.811	0.261	12.86	7.14	0.802	0.247	14.10	8.27	0.846	0.240
4	Super., & Pot., Sod., & Mag. ..	13.56	8.45	0.928	0.129	11.03	5.85	1.084	0.188	11.90	6.81	0.975	0.144	10.33	5.51	1.027	0.181	11.22	6.12	1.044	0.211
5	Superphosphate .. ..	13.91	8.60	0.810	0.144	11.61	6.47	0.873	0.188	13.00	7.63	0.845	0.187	13.87	7.20	0.739	0.244	13.87	8.12	0.786	0.211
6	Super., & Potash .. ..	14.23	8.55	0.989	0.173	11.04	5.84	0.986	0.193	13.55	8.13	0.988	0.184	12.09	6.53	1.016	0.235	12.18	6.90	0.940	0.197
7	Super., Pot., & 36½ lb. Am.-sfts. ..	13.42	..	0.976	..	11.26	..	0.982	..	11.82	..	0.982	..	12.03	..	0.986	..	12.05	..	0.977	..
8	Unmanured (1853, & since) ..	14.50	..	0.903	..	11.10	..	0.937	..	12.81	..	0.869	..	11.93	..	0.879	..	12.52	..	0.863	..
9	Farmyard Manure, & Super. ..	..	..	..	..	..	..	..	..	10.77	..	0.939	..	..	..	..	..	..	..	..	..

FOURTH SEASON, 1879.

1	Farmyard Manure .. ..	14.91	9.02	1.007	0.175	13.18	7.47	1.010	0.196	13.86	8.13	1.025	0.193	13.34	7.51	1.025	0.186	14.62	8.61	1.022	0.177
2	Farmyard Manure, & Super. ..	14.78	8.90	1.012	0.185	13.43	7.58	1.016	0.184	13.14	7.57	1.051	0.181	13.54	7.80	1.064	0.186	14.40	8.67	0.995	0.219
3	Unmanured (1846, & since) ..	18.81	11.72	0.861	0.205	16.01	9.38	0.955	0.226	17.18	10.39	0.834	0.252	16.27	9.79	0.831	0.260	16.16	9.81	0.843	0.203
4	Super., & Pot., Sod., & Mag. ..	15.56	9.78	0.980	0.131	12.83	7.60	1.010	0.156	14.03	8.70	0.862	0.134	13.67	7.84	1.086	0.171	13.51	8.08	0.938	0.136
5	Superphosphate .. ..	16.53	10.58	0.848	0.159	12.60	7.34	0.951	0.180	15.61	9.77	0.814	0.202	14.84	8.68	0.810	0.220	15.57	9.75	0.840	0.182
6	Super., & Potash .. ..	16.34	10.29	1.008	0.156	13.75	8.21	0.972	0.180	14.50	9.00	0.998	0.162	13.49	7.94	1.038	0.214	14.42	8.77	0.949	0.157
7	Super., Pot., & 36½ lb. Am.-sfts. ..	16.33	..	0.895	..	12.97	..	0.997	..	14.48	..	0.946	..	14.18	..	0.947	..	15.35	..	0.947	..
8	Unmanured (1853, & since) ..	18.46	..	0.903	..	13.78	..	0.963	..	15.44	..	0.812	..	14.13	..	0.853	..	15.58	..	0.852	..
9	Farmyard Manure, & Super. ..	..	..	..	..	..	..	..	..	14.52	..	0.930	..	..	..	..	..	..	..	..	..

FIFTH SEASON, 1880.

1	Farmyard Manure .. ..	12.65	7.79	0.841	0.126	10.72	5.63	0.942	0.186	11.23	6.39	0.871	0.172	11.26	6.35	0.877	0.212	12.08	6.72	0.877	0.176
2	Farmyard Manure, & Super. ..	12.87	7.56	0.850	0.136	10.44	5.52	0.986	0.188	11.68	6.59	0.891	0.189	10.47	5.94	0.948	0.220	11.66	6.69	0.855	0.171
3	Unmanured (1846, & since) ..	17.02	11.04	0.739	0.142	12.18	6.90	0.874	0.217	14.48	8.63	0.746	0.272	11.75	6.65	0.716	0.225	12.95	7.80	0.690	0.203
4	Super., & Pot., Sod., & Mag. ..	14.05	9.25	0.756	0.082	12.36	7.61	0.847	0.186	12.23	7.71	0.849	0.119	10.77	6.12	0.883	0.151	11.18	6.74	0.869	0.123
5	Superphosphate .. ..	13.72	8.85	0.709	0.100	11.50	6.47	0.819	0.173	12.84	7.94	0.709	0.158	10.72	6.20	0.679	0.192	12.27	7.35	0.676	0.165
6	Super., & Potash .. ..	14.04	8.99	0.761	0.097	11.86	7.00	0.807	0.153	12.40	7.46	0.878	0.123	12.16	7.00	0.837	0.188	13.17	8.14	0.742	0.151
7	Super., Pot., & 36½ lb. Am.-sfts. ..	13.63	..	0.798	..	11.64	..	0.862	0.154	12.14	..	0.863	..	11.68	..	0.906	..	12.79	..	0.742	..
8	Unmanured (1853, & since) ..	14.26	..	0.776	..	12.61	..	0.863	..	14.08	..	0.772	..	11.29	..	0.693	..	12.91	..	0.672	..
9	Farmyard Manure, & Super. ..	..	..	..	..	..	..	..	..	11.92	..	0.801	..	..	..	..	..	..	..	..	..

AVERAGE OF 5 (1) SEASONS, 1876, '77, '78, '79, and 1880.

1	Farmyard Manure .. ..	13.29	8.04	0.960	0.157	11.58	6.69	1.028	0.200	11.97	7.20	1.017	0.190	11.37	6.66	1.025	0.213	12.66	7.28	0.977	0.180
2	Farmyard Manure, & Super. ..	13.08	8.10	0.949	0.168	11.24	6.42	1.040	0.196	11.74	6.80	1.017	0.192	11.04	6.63	1.032	0.208	12.26	7.27	0.961	0.188
3	Unmanured (1846, & since) ..	16.56	10.70	0.816	0.178	13.24	7.78	0.942	0.218	14.88	9.03	0.837	0.262	13.38	8.20	0.799	0.244	14.41	8.87	0.790	0.215
4	Super., & Pot., Sod., & Mag. ..	14.52	9.23	0.903	0.121	11.97	6.76	1.015	0.160	12.70	7.74	0.972	0.132	11.47	6.36	1.057	0.168	12.13	7.33	0.980	0.143
5	Superphosphate .. ..	14.70	9.57	0.796	0.134	11.92	6.83	0.890	0.180	13.76	8.31	0.788	0.182	12.71	7.09	0.766	0.219	15.54	8.33	0.766	0.186
6	Super., & Potash .. ..	14.89	9.32	0.915	0.142	12.08	7.35	0.966	0.175	13.30	8.08	0.990	0.156	12.51	6.98	0.998	0.212	13.08	7.99	0.905	0.168
7	Super., Pot., & 36½ lb. Am.-sfts. ..	14.53	..	0.899	..	12.04	..	0.959	..	12.62	..	0.962	..	12.23	..	..	..	13.12	..	0.928	..
8	Unmanured (1853, & since) ..	15.30	..	0.883	..	12.55	..	0.946	..	13.74	..	0.858	..	12.41	..	0.818	..	13.50	..	0.790	..
9	Farmyard Manure, & Super. ..	..	..	..	..	..	..	..	..	12.61	..	0.911	..	..	..	..	..	..	..	..	..

(1) For Plots 1, 2, and 3, the average percentages of Sugar are taken over the last four years only; and in all cases the average percentages of Nitrogen are taken over the last three years only.

EXPERIMENTS ON MANGEL WURZEL.—BARN FIELD (after SUGAR-BEET); commencing 1876—continued.

Below are given the particulars of the Manures and Produce of the Sixth, Seventh, Eighth, Ninth, and Tenth Seasons, 1881, 1882, 1883, 1884, and 1885. For the Manures and Produce of the 5 preceding Seasons, see pp. 56-7, and for those of succeeding seasons, see pp. 64-5, 68-9 and 72-3. The arrangement of the Plots, and of the Manures, is precisely the same as for the five preceding years of Mangels, and also the same as previously for Sugar-beet (see pp. 52-3), excepting that Plot 9, which was unmanured for Sugar-beet, and also (Area under experiment, about 8 acres.)

PLOTS.	MANURES PER ACRE PER ANNUM.											
	SERIES 1. Standard Manures only.		SERIES 2. Standard Manures, and Cross-dressed with 550 lbs. Nitrate Soda.		SERIES 3. Standard Manures, and Cross-dressed with 400 lbs. "Ammonium-salts."		SERIES 4. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake and 400 lbs. "Ammonium-salts."		SERIES 5. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake.			
	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.
	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.
1	13	15	2	8	17	19	3	16	15	14	3	13
2	15	2	2	3	19	12	4	4	16	10	4	8
3	4	8	0	13	11	6	2	12	3	15	1	14
4	6	3	0	16	16	18	3	5	12	17	2	10
5	5	11	0	13	15	13	2	10	7	3	2	18
6	4	19	0	12	16	8	2	9	11	9	2	10
7	6	12	0	16	16	17	2	17	12	12	2	13
8	4	10	0	13	10	16	3	13	4	3	2	1
9	..	..	..	..	..	..	..	..	20	18	5	10
	SIXTH SEASON, 1881. Seed dibbled, April 19. Crop taken up, October 31 to November 10.											
	SEVENTH SEASON, 1882. Drilling the seed commenced on April 23, but, owing to wet weather, it was not completed until May 9. Plot 9 was dibbled May 23. Crop taken up Nov. 8-21.											
1	14	14	2	12	21	19	3	19	23	5	5	13
2	15	18	2	17	25	2	5	4	23	5	6	4
3	4	12	0	19	14	5	2	15	6	3	3	8
4	4	19	1	0	18	3	3	8	17	13	2	13
5	4	14	1	1	15	10	3	15	9	8	3	18
6	4	5	0	18	15	16	3	14	17	2	2	18
7	6	1	1	3	16	8	3	14	23	4	6	3
8	3	10	0	17	11	9	3	12	7	0	3	18
9	..	..	..	..	..	..	..	..	18	3	5	10
	EIGHTH SEASON, 1883. Seed dibbled, April 19. Crop taken up, October 31 to November 10.											
	NINTH SEASON, 1884. Seed dibbled, April 19. Crop taken up, October 31 to November 10.											
	TENTH SEASON, 1885. Seed dibbled, April 19. Crop taken up, October 31 to November 10.											

EIGHTH SEASON, 1883. Seed dibbled April 5. Crop taken up Nov. 2-10. (4)

1	Farmyard Manure (14 tons) .. .. .	22	12	3	16	27	5	4	7	24	6	6	3	33	5	7
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1) .. .. .	18	19	2	16	28	15	5	2	23	5	6	10	32	14	3
3	Without Manure (1846, and since) .. .. .	4	18	1	1	18	14	4	2	8	6	4	0	13	3	19
4	{ 3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. .	5	15	1	1	23	15	3	16	19	18	3	2	33	12	2
5	3½ cwts. Superphosphate .. .. .	5	3	0	18	21	12	3	10	10	15	3	9	14	12	4
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash .. .. .	4	6	0	16	21	1	2	14	19	4	2	17	33	5	13
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (2) .. .. .	6	4	1	1	22	14	2	19	20	12	2	17	33	4	4
8	Unmanured, 1853, and since; previously part Unman., part Superphos. .. .. .	4	6	0	18	17	0	3	19	7	11	3	0	13	1	1
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (3) .. .. .	..	..	..	..	..	..	..	..	20	11	5	9	..	..	..

NINTH SEASON, 1884. Seed drilled April 10-11. Plot 9 dibbled April 12. Crop taken up Oct. 29-31.

1	Farmyard Manure (14 tons) .. .. .	15	19	2	0	26	14	3	12	22	3	4	13	25	2	26
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1) .. .. .	16	8	2	0	26	13	4	3	22	14	4	14	23	3	17
3	Without Manure (1846, and since) .. .. .	5	11	0	19	7	5	2	8	5	15	2	9	7	16	14
4	{ 3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. .	6	7	1	1	12	1	2	19	13	18	3	3	23	19	7
5	3½ cwts. Superphosphate .. .. .	5	19	0	18	5	17	1	15	4	14	2	12	8	7	4
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash .. .. .	5	9	0	15	4	19	1	7	9	15	3	1	21	13	2
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (2) .. .. .	7	9	1	1	3	3	0	15	8	0	2	2	19	18	7
8	Unmanured, 1853, and since; previously part Unman., part Superphos. .. .. .	4	15	0	16	1	8	0	13	3	2	1	7	7	8	2
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (3) .. .. .	..	..	..	..	..	..	..	..	14	8	3	8	..	..	..

TENTH SEASON, 1885. Mineral Manures and Rape-cake sown April 13; seed drilled April 14 and 15; Nitrate Soda and Ammonium-salts not sown (see note 5 below).  
Crop taken up Oct. 26-Nov. 2.

1	Farmyard Manure (14 tons) .. .. .	3	6	0	16	2	15	0	15	3	1	0	18	11	15	2
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1) .. .. .	2	1	0	10	2	1	0	12	2	14	0	14	10	7	2
3	Without Manure (1846, and since) .. .. .	0	1	0	1	0	1	0	1	0	1	0	1	2	5	1
4	{ 3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. .	0	6	0	2	0	6	0	3	0	19	0	6	14	15	1
5	3½ cwts. Superphosphate .. .. .	0	3	0	2	0	4	0	2	0	12	0	8	2	19	1
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash .. .. .	0	10	0	4	0	10	0	5	2	5	0	12	8	16	2
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (2) .. .. .	0	10	0	4	0	14	0	5	1	16	0	10	7	18	2
8	Unmanured, 1853, and since; previously part Unman., part Superphos. .. .. .	0	9	0	4	1	0	0	9	0	4	0	2	0	14	0
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (3) .. .. .	..	..	..	..	..	..	..	..	2	8	0	19	..	..	..

AVERAGE OF 4 SEASONS, 1881, '82, '83 and 1884. (6)

1	Farmyard Manure (14 tons) .. .. .	16	15	2	14	23	9	3	19	21	7	5	0	25	3	16
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1) .. .. .	16	12	2	9	25	1	4	13	21	9	5	9	24	18	6
3	Without Manure (1846, and since) .. .. .	4	17	0	18	12	18	2	19	6	0	2	18	9	19	3
4	{ 3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. .	5	16	1	0	17	14	3	7	16	2	2	17	26	18	5
5	3½ cwts. Superphosphate .. .. .	5	7	0	17	14	13	2	18	8	0	3	4	11	5	4
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash .. .. .	4	15	0	15	14	11	2	8	14	8	2	16	24	2	5
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (2) .. .. .	6	12	1	0	14	16	2	11	14	13	2	14	23	12	5
8	Unmanured, 1853, and since; previously part Unman., part Superphos. .. .. .	4	5	0	16	10	3	2	19	5	9	2	12	9	15	3
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (3) .. .. .	..	..	..	..	..	..	..	..	18	10	4	19	..	..	..

(1) "Superphosphate of Lime"—in all cases made from 200 lbs. Bone ash, 150 lbs. Sulphuric acid, sp. gr. 1.7 (and water).  
 (2) Plot 9 sown on the flat instead of on ridges; plants ridged up afterwards; rows 22 inches apart, plants 10 inches apart in the rows.  
 (3) Owing to dry weather much seed failed, especially on some Ammonia and Nitrate plots, and the blanks were filled up by transplanting.  
 (4) In order to lessen possible loss by drainage, or injury to the seed or young plants, it was decided to top-dress the Nitrate of Soda and Ammonium-salts after the plant was well up, and for greater convenience the seed was sown on the flat; but owing to unfavourable weather, and to the unsatisfactory condition of the land where these manures had been applied without any organic matter for so many years, the plant almost entirely failed, and the Nitrate and Ammonium-salts were therefore not sown at all. On Series 4 and 5, however, where Rape-cake is usually applied, and the soil was more open, the seed germinated, and the plants grew fairly well.  
 (5) Owing to the failure of the plant on many plots, and the irregularity of the crops in 1885, the produce of that year is not brought into the average.  
 (6) "Ammonium-salts"—in each case equal parts Sulphate and Muriate of Ammonia of Commerce.

**EXPERIMENTS ON MANGEL WURZEL.—BARN FIELD—continued.**—SUMMARY OF THE COMPOSITION OF THE MANGEL ROOTS, in the Sixth, Seventh, Eighth, Ninth, and Tenth Seasons, 1881, 1882, 1883, 1884, 1885. For particulars of the composition in the first 5 Years, 1876-1880, see pp. 58-9, and for those in succeeding seasons see pp. 66-7, 70-1, and 74-5.

An abstract of the analytical results obtained, illustrating the influence of different manures, and of different seasons, on the composition of Mangels, is given below. The dry matter, ash, and nitrogen, are of course determined in the roots themselves. The amounts of dry matter, ash, and nitrogen, have also, in many cases, been determined in the expressed juice. In many cases also, the amount of the nitrogen existing as albuminoids has been determined (by Church's method); and in some cases the amount as amides and as nitric acid. It may be observed that by far the larger proportion of both the mineral matter and the nitrogen of the roots is found in the juice; and of the nitrogen in the juice a variable proportion, ranging from less than one-fifth to not more than one-third of the total, is found to exist as albuminoids. When sugar has been estimated, it has been determined in the expressed juice, and calculated into its percentage in the roots, as described in more detail in the letterpress above the Table on p. 58.

In interpreting the figures, it must be borne in mind, that, with forty different experiments each year, and, in each year four, five, 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. The sample analysed was in each case a mixture of vertical sections of ten or fifteen roots, and all the samples were as a rule taken within a period of from one to two weeks; as far as practicable beginning with the ripest. It is obvious, however, that the smaller crops would be much riper than the larger ones; but, although the larger crops generally contain a lower percentage of sugar, they yield very much more sugar per acre.

MANURES, PER ACRE, PER ANNUM.

PLOTS.	ABBREVIATED DESCRIPTION OF STANDARD MANURES. For details, see pp. 60-1.	SERIES 1. Standard Manures only.				SERIES 2. Standard Manures, and Cross-dressed with 550 lbs. Nitrate Soda.				SERIES 3. Standard Manures, and Cross-dressed with 400 lbs. Ammonium-salts.				SERIES 4. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake and 400 lbs. Ammonium-salts.				SERIES 5. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake.			
		Dry Matter.	Sugar.	Ash.	Nitro-gen.	Dry Matter.	Sugar.	Ash.	Nitro-gen.	Dry Matter.	Sugar.	Ash.	Nitro-gen.	Dry Matter.	Sugar.	Ash.	Nitro-gen.	Dry Matter.	Sugar.	Ash.	Nitro-gen.

SIXTH SEASON, 1881.

Mean Per Cent. Total Dry Matter, Mineral Matter (Crude Ash), and Nitrogen, in the Roots.

1	Farmyard Manure .. .. .	12.98	0.946	0.207	0.014	0.257	12.38	0.984	0.243	0.237	0.983	0.257	11.80	0.945	0.217	0.945	0.217
2	Farmyard Manure, & Super. ..	12.35	0.883	0.171	1.014	0.217	11.83	0.995	0.237	0.237	0.963	0.280	12.07	0.929	0.234	0.929	0.234
3	Unmanured (1846, & since) ..	17.88	0.700	0.205	0.864	0.238	17.13	0.801	0.333	0.333	0.722	0.320	15.93	0.675	0.257	0.675	0.257
4	Super., & Pot., Sod., & Mag. ..	15.11	0.839	0.134	1.020	0.217	14.10	0.977	0.192	0.192	1.037	0.255	13.35	0.979	0.190	0.979	0.190
5	Superphosphate .. .. .	15.76	0.724	0.139	0.836	0.205	14.50	0.649	0.238	0.238	0.708	0.237	13.96	0.691	0.222	0.691	0.222
6	Super., & Potash .. .. .	16.10	0.797	0.133	0.910	0.197	13.84	1.007	0.201	0.201	0.985	0.222	13.69	0.978	0.202	0.978	0.202
7	Super., Pot., & 36½ lb. Am.-sfts. Unmanured (1853, & since) ..	15.11	0.870	0.133	0.945	0.197	13.54	1.033	0.201	0.201	0.985	0.222	13.69	0.978	0.202	0.978	0.202
8	Super., Pot., & 36½ lb. Am.-sfts. Unmanured (1853, & since) ..	15.77	0.788	0.133	0.876	0.197	15.28	1.033	0.201	0.201	0.985	0.222	13.69	0.978	0.202	0.978	0.202
9	Farmyard Manure, & Super. ..	..	..	..	..	..	12.42	0.870	0.133	0.133	0.876	0.197	14.78	0.888	0.202	0.888	0.202

SEVENTH SEASON, 1882.

1	Farmyard Manure .. .. .	14.29	0.850	0.153	0.901	0.175	12.73	0.900	0.196	0.196	0.940	0.224	12.51	0.898	0.196	0.898	0.196
2	Farmyard Manure, & Super. ..	13.19	0.871	0.143	0.929	0.200	12.52	0.849	0.226	0.226	0.885	0.231	13.14	0.869	0.178	0.869	0.178
3	Unmanured (1846, & since) ..	17.08	0.746	0.153	0.817	0.192	13.43	0.745	0.282	0.282	0.675	0.293	15.67	0.677	0.250	0.677	0.250
4	Super., & Pot., Sod., & Mag. ..	15.41	0.820	0.144	0.882	0.146	14.26	0.882	0.144	0.144	0.885	0.166	13.32	0.811	0.140	0.811	0.140
5	Superphosphate .. .. .	15.05	0.720	0.127	0.781	0.161	14.69	0.656	0.243	0.243	0.701	0.273	14.98	0.665	0.214	0.665	0.214
6	Super., & Potash .. .. .	15.40	0.794	0.155	0.830	0.164	14.59	0.862	0.163	0.163	0.873	0.216	14.58	0.836	0.156	0.836	0.156
7	Super., Pot., & 36½ lb. Am.-sfts. Unmanured (1853, & since) ..	15.19	0.808	0.155	0.830	0.164	14.59	0.862	0.163	0.163	0.873	0.216	14.58	0.836	0.156	0.836	0.156
8	Super., Pot., & 36½ lb. Am.-sfts. Unmanured (1853, & since) ..	15.42	0.808	0.155	0.830	0.164	14.59	0.862	0.163	0.163	0.873	0.216	14.58	0.836	0.156	0.836	0.156
9	Farmyard Manure, & Super. ..	..	..	..	..	..	12.57	0.858	0.196	0.196	0.896	0.231	13.99	0.862	0.196	0.862	0.196

EIGHTH SEASON, 1883.

1	Farmyard Manure .. ..	13.10	0.820	11.82	0.870	12.23	0.852	12.24	0.812	13.32	0.813
2	Farmyard Manure, & Super.	13.30	0.841	11.40	0.882	11.30	0.843	12.62	0.727	13.72	0.764
3	Unmanured (1846, & since)	17.24	0.707	13.53	0.720	14.56	0.714	12.33	0.668	14.58	0.585
4	Super., & Pot., Sod., & Mag.	15.18	0.764	0.114	0.897	0.152	0.882	13.44	0.930	0.172	0.860
5	Superphosphate .. ..	15.17	0.686	0.124	0.821	0.172	0.691	13.14	0.636	0.234	0.614
6	Super., & Potash .. ..	14.74	0.813	0.129	0.804	0.150	0.820	12.83	0.846	0.163	0.844
7	Super., Pot., & 36½ lb. Am.-sfts.	14.94	0.718	13.04	0.744	13.94	0.653	13.10	0.629	13.68	0.553
8	Unmanured (1853, & since)	15.26	..	11.85	..	14.36	..	13.98	..	..	..
9	Farmyard Manure, & Super.	..	..	..	..	12.74	..	..	..	..	..

NINTH SEASON, 1884.

1	Farmyard Manure .. ..	13.37	0.947	12.37	0.957	11.74	0.887	11.33	0.903	12.23	0.878
2	Farmyard Manure, & Super.	13.72	0.892	10.69	1.018	12.18	0.908	11.28	0.893	12.44	0.891
3	Unmanured (1846, & since)	16.41	0.748	13.89	0.973	16.30	0.794	14.61	0.722	15.58	0.716
4	Super., & Pot., Sod., & Mag.	14.45	0.934	0.125	1.100	0.205	1.123	0.180	1.113	0.244	0.952
5	Superphosphate .. ..	14.99	0.754	0.125	1.055	0.318	0.843	0.255	0.776	0.262	0.746
6	Super., & Potash .. ..	15.83	0.818	0.111	1.059	0.239	1.020	0.203	0.971	0.203	0.963
7	Super., Pot., & 36½ lb. Am.-sfts.	14.56	0.806	12.63	1.010	12.88	1.082	12.58	0.763	12.98	0.757
8	Unmanured (1853, & since)	15.59	..	13.10	..	14.91	0.898	13.70	..	..	..
9	Farmyard Manure, & Super.	..	..	12.74	..	13.27	..	..	..	..	..

TENTH SEASON, 1885.

1	Farmyard Manure .. ..	11.58	0.976	10.68	1.020	12.19	0.904	13.01	0.830	13.21	0.820
2	Farmyard Manure, & Super.	11.41	1.015	11.44	0.983	12.17	0.942	12.92	0.868	11.99	0.880
3	Unmanured (1846, & since)	14.21	1.160	13.97	1.016	15.06	0.963	16.57	0.820	16.84	0.820
4	Super., & Pot., Sod., & Mag.	14.34	1.094	0.261	1.104	0.251	1.047	0.247	0.842	0.162	0.840
5	Superphosphate .. ..	13.44	1.028	0.283	1.062	0.300 (14.22) <sup>(2)</sup>	(0.729)	0.281	0.789	0.314	0.758
6	Super., & Potash .. ..	13.87	1.110	0.256	0.976	0.248	0.997	0.225	0.789	0.212	0.843
7	Super., Pot., & 36½ lb. Am.-sfts.	13.87	1.019	13.20	0.966	13.36	(1.112)	13.40	0.841	14.16	0.915
8	Unmanured (1853, & since)	15.09	..	13.02	..	14.57	1.027	16.81	..	..	..
9	Farmyard Manure, & Super.	..	..	..	..	13.66	..	..	..	..	..

AVERAGE OF 4 (1) SEASONS, 1881, '82, '83, and 1884. (3)

1	Farmyard Manure .. ..	13.41	0.891	12.44	0.936	0.216	0.906	0.220	0.910	0.240	0.884
2	Farmyard Manure, & Super.	13.14	0.872	11.77	0.944	0.208	0.899	0.232	0.867	0.256	0.863
3	Unmanured (1846, & since)	17.15	0.725	0.179	0.844	0.215	0.749	0.308	0.697	0.307	0.663
4	Super., & Pot., Sod., & Mag.	15.04	0.839	0.129	0.975	0.180	0.954	0.161	0.996	0.209	0.901
5	Superphosphate .. ..	15.24	0.721	0.129	0.873	0.214	0.710	0.237	0.705	0.259	0.679
6	Super., & Potash .. ..	14.52	0.806	0.127	0.901	0.188	0.927	0.179	0.919	0.201	0.905
7	Super., Pot., & 36½ lb. Am.-sfts.	14.95	0.780	13.06	0.880	13.65	0.794	13.11	0.690	14.04	0.669
8	Unmanured (1853, & since)	15.51	..	12.39	..	14.65	..	13.77	..	..	..
9	Farmyard Manure, & Super.	..	..	..	..	12.91	..	..	..	..	..

(1) For plots 1, 2, and 3, the average percentages of nitrogen are for two years only, 1881 and 1882, as no determinations were made in these plots in 1883 and 1884.  
 (2) Owing to an accident, the determinations of dry matter were in these cases lost; the means of the percentages of dry matter in the four preceding years are therefore entered in parentheses, and are adopted in the calculation of the percentages of ash and nitrogen, which are also entered in parentheses.

(3) Owing to the failure of the plant on many plots, and the irregularity of the produce for that year is not brought into the average.

EXPERIMENTS ON MANGEL WURZEL.—BARN FIELD (after SUGAR-BEET); commencing 1876—continued.

Below are given the particulars of the Manures and Produce, of the Eleventh, Twelfth, Thirteenth, Fourteenth, and Fifteenth seasons, 1886, 1887, 1888, 1889, and 1890. For the Manures and Produce of the 10 preceding seasons see pp. 56-7 and 60-1, and for those of succeeding seasons, pp. 68-9 and 72-3. The arrangement of the plots, and of the Manures, is precisely the same as it was for the ten preceding years of Mangels (see pp. 56-7 and 60-1), and also the same as previously for all carted off; leaves weighed, spread on the respective plots, and ploughed in.

(Area under experiment, about 8 acres.)

PLOTS.	MANURES PER ACRE PER ANNUM.									
	SERIES 1. Standard Manures only.		SERIES 2. Standard Manures, and Cross-dressed with 550 lbs. Nitrate Soda.		SERIES 3. Standard Manures, and Cross-dressed with 400 lbs. "Ammonium-Salts." (*)		SERIES 4. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake and 400 lbs. "Ammonium-Salts." (*)		SERIES 5. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake.	

ELEVENTH SEASON, 1886. Seed dibbled May 7 and 8. Crop taken up, November 3-9.

	PRODUCE PER ACRE.											
	Leaves.		Roots.		Leaves.		Roots.		Leaves.		Roots.	
	Tons.	cwts.	Tons.	cwts.	Tons.	cwts.	Tons.	cwts.	Tons.	cwts.	Tons.	cwts.
1 Farmyard Manure (14 tons) .. .. .	16	6	23	8	4	4	19	19	5	8	21	0
2 Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1) .. .. .	15	5	22	7	4	11	19	4	5	11	19	3
3 Without Manure (1846, and since) .. .. .	5	11	14	2	4	5	5	4	3	2	8	3
4 { 3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride } { Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. .	5	15	17	6	4	0	12	19	2	12	20	9
5 3½ cwts. Superphosphate .. .. .	6	12	15	3	3	6	7	3	8	8	12	4
6 3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (2) .. .. .	5	15	14	4	2	19	13	0	2	15	20	4
7 3½ cwts. Superphos., 500 lbs. Sulphate Potash, 41 lbs. Sulphate-Am. Unmanured, 1853, and since; previously part Unman., part Superphos. .. .. .	6	17	15	3	3	5	14	16	3	4	19	16
8 Farmyard Manure (14 tons), 3½ cwts. Superphosphate (3) .. .. .	4	17	10	19	3	9	6	2	3	5	8	1
9 .. .. .	..	..	..	..	..	..	14	2	4	18	..	..

TWELFTH SEASON, 1887. Seed dibbled April 25-27. Plants failed on many plots, especially on the plots of Series 2 and 3. Crop taken up, October 25-27.

1 Farmyard Manure (14 tons) .. .. .	10	17	11	17	2	7	11	17	2	17	15	2
2 Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1) .. .. .	9	6	3	2	0	17	6	14	1	16	17	5
3 Without Manure (1846, and since) .. .. .	1	5	0	16	0	2	0	2	0	2	5	5
4 { 3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride } { Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. .	1	15	0	11	0	6	0	14	0	6	13	2
5 3½ cwts. Superphosphate .. .. .	2	3	0	18	0	3	0	2	0	2	3	15
6 3½ cwts. Superphosphate, 500 lbs. Sulphate Potash .. .. .	2	6	0	17	0	3	0	8	0	4	8	0
7 3½ cwts. Superphos., 500 lbs. Sulphate Potash, 41 lbs. Sulphate-Am. Unmanured, 1853, and since; previously part Unman., part Superphos. .. .. .	2	5	0	17	0	5	0	13	0	6	8	10
8 Farmyard Manure (14 tons), 3½ cwts. Superphosphate (3) .. .. .	1	4	0	15	0	1	0	2	0	2	3	1
9 .. .. .	..	..	..	..	..	..	8	10	3	12	..	..



THIRTEENTH SEASON, 1888. Seed dibbled April 16; Plot 9 April 25. Plants to a great extent failed on the dung plots, and the Series 4 and 5 plots; seed resown, June 13. Crop taken up, November 17-20.

1	Farmyard Manure (14 tons)	5	16	3	2	7	8	3	15	6	4	3	10	7	8	4	2	7	2	4	0
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate	6	12	3	15	19	14	4	17	11	4	4	7	7	11	4	8	8	2	4	3
3	Without Manure (1846, and since)	1	7	1	2	20	7	3	15	6	13	3	0	2	16	1	17	4	2	2	1
4	(3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride)	1	16	1	3	23	4	4	16	20	1	3	17	7	19	8	0	8	0	4	3
5	Sodium (common salt), 200 lbs. Sulphate Magnesia	1	15	1	11	22	2	3	14	11	11	3	9	3	10	2	0	3	6	1	15
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash	1	8	1	0	20	12	3	8	17	12	3	8	3	8	9	3	11	5	1	3
7	3½ cwts. Superphosph., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (?)	2	10	1	7	21	10	3	10	17	18	3	1	9	18	4	0	6	12	3	9
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	1	10	0	13	15	19	3	13	4	12	2	4	3	14	2	15	2	19	1	8
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (?)	..	..	..	..	..	..	..	..	12	11	4	6	..	..	..	..	..	..	..	..

FOURTEENTH SEASON, 1889. Seed dibbled May 15 and 16; Plot 9 dibbled May 21 and 22. Crop taken up, November 8-12. (?)

1	Farmyard Manure (14 tons)	22	16	3	8	31	6	5	7	31	10	7	3	32	16	7	5	29	12	5	17
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate	27	0	3	19	33	19	5	16	31	10	6	15	33	5	8	3	29	18	5	15
3	Without Manure (1846, and since)	6	8	1	2	16	15	3	3	10	19	3	14	20	1	5	12	19	6	4	2
4	(3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride)	7	9	1	6	(22 12)	(3 14)	18	13	2	11	37	2	6	16	31	1	4	14	..	..
5	Sodium (common salt), 200 lbs. Sulphate Magnesia	6	13	1	4	(17 15)	(3 2)	12	7	3	8	21	8	6	7	21	9	4	7	4	7
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash	5	18	1	2	(18 0)	(2 13)	17	11	2	12	30	13	7	2	26	4	4	8	4	8
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (?)	6	9	1	5	(19 1)	(3 2)	17	17	2	17	30	16	7	3	25	11	4	18	..	..
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	4	12	1	4	12	7	3	18	9	12	3	17	17	3	6	4	16	6	5	4
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (?)	..	..	..	..	..	..	..	..	19	1	6	2	..	..	..	..	..	..	..	..

FIFTEENTH SEASON, 1890. Seed dibbled April 23 and 24. Crop taken up, October 17-23.

1	Farmyard Manure (14 tons)	22	19	3	3	31	17	4	15	30	18	6	9	30	17	6	4	32	13	5	7
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate	23	9	3	9	33	13	5	11	30	2	6	0	30	13	6	13	33	4	5	5
3	Without Manure (1846, and since)	6	5	1	0	16	16	3	3	8	19	3	1	15	15	2	14	13	19	2	18
4	(3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride)	7	1	1	4	27	1	4	4	21	16	3	7	33	5	5	14	29	0	4	2
5	Sodium (common salt), 200 lbs. Sulphate Magnesia	6	9	1	1	21	18	3	8	10	4	3	4	15	5	4	7	17	13	3	2
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash	5	13	0	18	21	12	2	16	19	11	2	17	30	19	5	6	26	2	3	1
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (?)	7	4	1	2	22	5	2	18	22	7	3	7	33	12	6	7	27	11	3	9
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	5	5	1	0	15	5	3	13	10	9	3	15	13	14	4	7	18	5	3	7
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (?)	..	..	..	..	..	..	..	..	28	11	5	14	..	..	..	..	..	..	..	..

AVERAGE OF 5 SEASONS, 1886, '87, '88, '89, and 1890.

1	Farmyard Manure (14 tons)	15	15	2	18	20	19	4	2	20	2	5	1	21	9	5	6	21	11	4	11
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate	16	7	3	4	22	11	4	6	19	15	4	18	21	11	5	15	21	8	4	12
3	Without Manure (1846, and since)	4	3	1	1	13	13	2	17	6	7	2	12	10	8	3	13	10	15	3	3
4	(3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride)	4	15	1	3	18	8	3	9	14	16	2	11	22	7	4	19	19	7	3	17
5	Sodium (common salt), 200 lbs. Sulphate Magnesia	4	14	1	4	15	12	2	15	8	2	2	14	10	10	3	17	11	10	3	2
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash	4	4	1	0	15	4	2	9	13	13	2	7	19	13	4	14	16	6	3	3
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (?)	5	1	1	4	15	16	2	12	14	14	2	11	20	10	5	1	17	3	3	13
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	3	10	0	19	10	18	2	19	6	3	2	13	9	10	3	17	9	15	3	2
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (?)	..	..	..	..	..	..	..	..	16	11	4	19	..	..	..	..	..	..	..	..

(1) "Superphosphate of Lime," 1886 and 1887, made from 200 lbs. Bone ash, 150 lbs. Sulphuric acid, sp. gr. 1.7 (and water); 1888, and since, made from high percentage mineral phosphates, and containing 37 per cent. or more, of soluble phosphate. (2) "Ammonium-salts," equal parts Sulphate and Nitrate of Ammonia of Commerce. (3) Plot 9 sown on the flat instead of on ridges; plants ridged up afterwards; rows 22 inches apart. Plants 16 inches apart in the rows. (4) 400 lbs. Ammonium-salts, consisting of equal parts of Sulphate and Nitrate of Ammonia of Commerce; excepting that for the crop of 1887, 450 lbs. Sulphate Ammonia containing an equal amount of Nitrogen, were applied instead. (5) Season 1889.—It will be seen that the produce of plots 4, 5, 6, and 7, of Series 2, is entered between parentheses thus ( ), the amounts being those actually obtained, but owing to a heavy rainfall in July, some of the soil, manure, and plants, were washed away. The produce of roots so lost, is estimated at about 1 ton per acre.

**EXPERIMENTS ON MANGEL WURZEL.—BARN FIELD—continued.—SUMMARY OF THE COMPOSITION OF THE MANGEL ROOTS, in the Eleventh, Twelfth, Thirteenth, Fourteenth, and Fifteenth Seasons, 1886, 1887, 1888, 1889, and 1890. For particulars of the composition in the first 10 Years, 1876-1885, see pp. 58-9 and 62-3, and for those in succeeding seasons, see pp. 70-1, and 74-5.**

An abstract of the analytical results obtained, illustrating the influence of different manures, and of different seasons, on the composition of Mangels, is given below. The dry matter, ash, and nitrogen, are of course determined in the roots themselves. The amounts of dry matter, ash, and nitrogen, have also, in many cases, been determined in the expressed juice. In many cases also, the amount of the nitrogen existing as albuminoids has been determined (by Church's method); and in some cases the amount as amides and as nitric acid. It may be observed that by far the larger proportion of both the mineral matter and the nitrogen of the roots is found in the juice; and of the nitrogen in the juice a variable proportion, ranging from less than one-fifth to not more than one-third of the total, is found to exist as albuminoids. When sugar has been estimated, it has been determined in the expressed juice, and calculated into its percentage in the roots, as described in more detail in the letterpress above the Table on p. 58.

PLOTS.	ABBREVIATED DESCRIPTION OF STANDARD MANURES.	MANURES, PER ACRE, PER ANNUM.															
		SERIES 1.			SERIES 2.			SERIES 3.			SERIES 4.			SERIES 5.			
		Dry Matter.	Sugar.	Ash.	Nitro-gen.	Dry Matter.	Sugar.	Ash.	Nitro-gen.	Dry Matter.	Sugar.	Ash.	Nitro-gen.	Dry Matter.	Sugar.	Ash.	Nitro-gen.
		Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.
1	Farmyard Manure .. .. .	13.75	0.851	0.950	0.128	12.85	0.888	0.909	0.154	11.92	0.854	0.900	0.138	12.69	0.845	0.885	0.150
2	Farmyard Manure, & Super. ..	12.96	0.908	0.951	11.80	11.52	0.941	0.933	0.168	11.93	0.900	0.934	0.176	13.18	0.834	0.887	0.168
3	Unmanured (1846, & since) ..	16.07	0.750	0.953	12.67	14.93	0.799	0.966	0.180	13.76	0.734	0.947	0.189	14.08	0.702	0.850	0.168
4	Super., & Pot., Sod., & Mag. ..	14.72	0.878	0.978	12.02	13.77	0.909	0.966	0.180	13.00	0.750	0.950	0.189	12.50	0.885	0.888	0.168
5	Superphosphate .. .. .	14.38	0.745	0.978	12.97	14.29	0.790	0.924	0.171	12.47	0.847	0.937	0.189	13.59	0.850	0.888	0.168
6	Super., & Potash .. .. .	14.52	0.813	0.978	12.02	14.18	0.878	0.920	0.180	12.77	0.886	0.920	0.189	13.52	0.850	0.888	0.168
7	Super., Pot., & 36½ lb. Am.-sfts. Unmanured (1853, & since) ..	14.45	0.847	0.920	12.74	13.82	0.886	0.920	0.180	12.77	0.886	0.920	0.189	14.52	0.850	0.888	0.168
8	Super., Pot., & 36½ lb. Am.-sfts. Unmanured (1853, & since) ..	15.44	0.817	0.921	11.26	14.29	0.788	0.930	0.180	13.58	0.734	0.886	0.189	14.22	0.669	0.888	0.168
9	Farmyard Manure, & Super. ..	15.44	0.817	0.921	11.26	14.29	0.788	0.930	0.180	13.58	0.734	0.886	0.189	14.22	0.669	0.888	0.168
ELEVENTH SEASON, 1886.																	
Mean Per Cent. Total Dry Matter, Mineral Matter (Crude Ash), and Nitrogen in the Roots.																	
		Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.
1	Farmyard Manure .. .. .	15.21	1.042	1.066	13.66	14.56	1.040	1.066	0.283	14.95	0.953	1.040	0.283	15.00	0.981	1.040	0.283
2	Farmyard Manure, & Super. ..	14.47	1.044	1.118	13.39	14.82	1.051	1.118	0.283	15.48	0.944	1.051	0.283	14.79	0.943	1.051	0.283
3	Unmanured (1846, & since) ..	18.94	1.119	1.078	17.03	20.26	1.087	1.078	0.329	17.41	0.917	1.087	0.329	17.14	0.822	1.087	0.329
4	Super., & Pot., Sod., & Mag. ..	17.11	1.219	1.201	16.41	15.11	1.217	1.201	0.359	14.56	0.868	1.217	0.359	14.60	0.810	1.217	0.359
5	Superphosphate .. .. .	16.81	0.946	0.946	15.60	19.00	0.952	0.946	0.286	17.44	0.868	0.952	0.286	17.34	0.810	0.952	0.286
6	Super., & Potash .. .. .	16.92	1.093	1.093	17.89	15.69	1.230	1.093	0.286	15.50	0.868	1.230	0.286	14.77	0.810	1.230	0.286
7	Super., Pot., & 36½ lb. Am.-sfts. Unmanured (1853, & since) ..	16.76	1.143	1.167	15.98	15.64	1.281	1.143	0.286	15.86	0.861	1.281	0.286	15.31	0.810	1.281	0.286
8	Super., Pot., & 36½ lb. Am.-sfts. Unmanured (1853, & since) ..	17.74	1.077	1.134	18.13	19.24	1.004	1.134	0.286	17.88	0.861	1.004	0.286	18.32	0.823	1.004	0.286
9	Farmyard Manure, & Super. ..	17.74	1.077	1.134	18.13	19.24	1.004	1.134	0.286	17.88	0.861	1.004	0.286	18.32	0.823	1.004	0.286
TWELFTH SEASON, 1887.																	
		Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.
1	Farmyard Manure .. .. .	15.21	1.042	1.066	13.66	14.56	1.040	1.066	0.283	14.95	0.953	1.040	0.283	15.00	0.981	1.040	0.283
2	Farmyard Manure, & Super. ..	14.47	1.044	1.118	13.39	14.82	1.051	1.118	0.283	15.48	0.944	1.051	0.283	14.79	0.943	1.051	0.283
3	Unmanured (1846, & since) ..	18.94	1.119	1.078	17.03	20.26	1.087	1.078	0.329	17.41	0.917	1.087	0.329	17.14	0.822	1.087	0.329
4	Super., & Pot., Sod., & Mag. ..	17.11	1.219	1.201	16.41	15.11	1.217	1.201	0.359	14.56	0.868	1.217	0.359	14.60	0.810	1.217	0.359
5	Superphosphate .. .. .	16.81	0.946	0.946	15.60	19.00	0.952	0.946	0.286	17.44	0.868	0.952	0.286	17.34	0.810	0.952	0.286
6	Super., & Potash .. .. .	16.92	1.093	1.093	17.89	15.64	1.230	1.093	0.286	15.50	0.868	1.230	0.286	14.77	0.810	1.230	0.286
7	Super., Pot., & 36½ lb. Am.-sfts. Unmanured (1853, & since) ..	16.76	1.143	1.167	15.98	15.64	1.281	1.143	0.286	15.86	0.861	1.281	0.286	15.31	0.810	1.281	0.286
8	Super., Pot., & 36½ lb. Am.-sfts. Unmanured (1853, & since) ..	17.74	1.077	1.134	18.13	19.24	1.004	1.134	0.286	17.88	0.861	1.004	0.286	18.32	0.823	1.004	0.286
9	Farmyard Manure, & Super. ..	17.74	1.077	1.134	18.13	19.24	1.004	1.134	0.286	17.88	0.861	1.004	0.286	18.32	0.823	1.004	0.286

THIRTEENTH SEASON, 1888.

1	Farmyard Manure .. ..	13.54	1.104	11.67	1.095	13.30	1.126	14.27	1.116	13.55	1.066
2	Farmyard Manure, & Super.	13.29	1.114	12.36	1.062	13.77	0.950	13.11	1.110	13.59	1.091
3	Unmanured (1846, & since)	15.62	0.849	13.87	0.907	16.25	0.782	14.49	0.823	14.93	0.830
4	Super., & Pot., Sod., & Mag.	15.66	1.028	0.218	1.005	14.05	0.915	0.172	1.184	0.314	0.285
5	Superphosphate .. ..	15.72	0.883	0.254	0.885	14.48	0.705	0.231	0.890	0.279	0.900
6	Super., & Potash .. ..	15.28	1.006	0.277	0.904	14.78	0.848	0.142	1.010	0.269	0.978
7	Super., Pot., & 36½ lb. Am.-sfts.	16.04	0.933	13.81	0.897	14.53	0.751	14.32	0.960	14.45	1.019
8	Unmanured (1853, & since)	17.17	0.876	13.49	0.904	15.60	0.859	15.81	0.751	15.46	0.731
9	Farmyard Manure, & Super.	.. ..	.. ..	.. ..	.. ..	15.55	0.878	.. ..	.. ..	.. ..	.. ..

FOURTEENTH SEASON, 1889.

1	Farmyard Manure .. ..	13.87	0.863	14.20	0.866	12.89	0.852	12.83	0.840	13.76	0.834
2	Farmyard Manure, & Super.	14.51	0.786	12.93	0.934	13.27	0.840	13.07	0.876	14.16	0.835
3	Unmanured (1846, & since)	16.12	0.719	14.52	0.772	16.50	0.640	14.17	0.679	15.39	0.599
4	Super., & Pot., Sod., & Mag.	15.56	0.795	0.102	0.818	14.47	0.796	0.094	0.836	0.122	0.846
5	Superphosphate .. ..	15.04	0.666	0.090	0.739	14.97	0.584	0.133	0.687	0.200	0.641
6	Super., & Potash .. ..	15.40	0.762	0.084	0.739	14.72	0.778	0.082	0.809	0.171	0.808
7	Super., Pot., & 36½ lb. Am.-sfts.	15.51	0.787	13.51	0.877	15.23	0.759	14.94	0.834	13.63	0.804
8	Unmanured (1853, & since)	16.19	0.742	12.70	0.778	15.06	0.690	13.30	0.689	14.87	0.640
9	Farmyard Manure, & Super.	.. ..	.. ..	.. ..	.. ..	13.64	0.860	.. ..	.. ..	.. ..	.. ..

FIFTEENTH SEASON, 1890.

1	Farmyard Manure .. ..	14.34	0.725	13.86	0.836	13.42	0.734	13.12	0.751	13.63	0.794
2	Farmyard Manure, & Super.	14.27	0.794	13.29	0.831	13.81	0.789	14.58	0.833	13.65	0.763
3	Unmanured (1846, & since)	16.12	0.635	14.47	0.679	15.39	0.596	13.06	0.624	14.96	0.523
4	Super., & Pot., Sod., & Mag.	15.45	0.767	0.086	0.827	14.18	0.845	0.093	0.868	0.117	0.826
5	Superphosphate .. ..	15.28	0.632	0.084	0.695	14.31	0.570	0.157	0.641	0.200	0.534
6	Super., & Potash .. ..	15.44	0.752	0.094	0.751	14.79	0.779	0.112	0.755	0.115	0.702
7	Super., Pot., & 36½ lb. Am.-sfts.	15.45	0.711	13.99	0.767	14.89	0.765	13.87	0.768	13.91	0.759
8	Unmanured (1853, & since)	15.34	0.700	12.34	0.774	14.82	0.652	13.48	0.834	14.04	0.513
9	Farmyard Manure, & Super.	.. ..	.. ..	.. ..	.. ..	14.09	0.729	.. ..	.. ..	.. ..	.. ..

AVERAGE OF FIVE SEASONS, 1886, '87, '88, '89, AND 1890.

1	Farmyard Manure .. ..	14.14	0.917	13.13	0.963	13.41	0.928	13.42	0.903	13.69	0.904
2	Farmyard Manure, & Super.	13.90	0.929	13.19	0.933	13.44	0.914	13.63	0.933	13.87	0.893
3	Unmanured (1846, & since)	16.57	0.814	14.51	0.878	16.67	0.781	14.58	0.755	15.30	0.692
4	Super., & Pot., Sod., & Mag.	15.70	0.937	0.165	0.963	14.32	0.936	0.168	0.936	0.202	0.987
5	Superphosphate .. ..	15.45	0.764	0.161	0.833	15.40	0.702	0.231	0.751	0.261	0.717
6	Super., & Potash .. ..	15.51	0.885	0.165	0.935	14.83	0.912	0.159	0.905	0.212	0.886
7	Super., Pot., & 36½ lb. Am.-sfts.	15.64	0.894	14.12	0.926	14.80	0.904	14.07	0.941	14.11	0.912
8	Unmanured (1853, & since)	16.38	0.841	13.58	0.902	15.79	0.778	14.60	0.733	15.36	0.675
9	Farmyard Manure, & Super.	.. ..	.. ..	.. ..	.. ..	14.10	0.876	.. ..	.. ..	.. ..	.. ..

(1) 400 lbs. Ammonium-salts, consisting of equal parts of Sulphate and Muriate of Ammonia of Commerce; excepting that for the crop of 1887, 450 lbs. Sulphate Ammonia, containing an equal amount of Nitrogen, were applied instead.

EXPERIMENTS ON MANGEL WURZEL.—BARN FIELD (after SUGAR-BEET) ; commencing 1876—continued.

Below are given the particulars of the Manures and Produce, of the Sixteenth, Seventeenth, Eighteenth, Nineteenth, and Twentieth Seasons, 1891, 1892, 1893, 1894, and 1895. For the Manures and Produce of the 15 preceding seasons, see pp. 56-7, 60-1, and 64-5, and for those of succeeding seasons, see pp. 72-3.

The arrangement of the plots, and of the manures, is precisely the same as it was for the fifteen preceding years of Mangels (see pp. 56-7, 60-1, and 64-5), and also the same as previously for Sugar-beet (see pp. 52-3) ; excepting that Plot 9, which was unmanured for

Sugar-beet, and also previously for Swedes, was brought in as a manured plot for Mangels. With this exception the manures are also substantially the same as previously for Sugar-beet ; in fact, precisely the same as for the Sugar-beet in 1872 and 1873. Seed, Yellow Globe; dibbled on ridges; rows 26 inches apart; plants 11 inches apart in the rows. (c) Roots all carted off; leaves weighed, spread on the respective plots, and ploughed in. In the spring of 1894 permanent division paths were laid out between plot and plot.

(Area under experiment, about 8 acres.)

MANURES PER ACRE PER ANNUM.

PLOTS.	SERIES 1. Standard Manures only.		SERIES 2. Standard Manures, and Cross-dressed with 550 lbs. Nitrate Soda. (*)		SERIES 3. Standard Manures, and Cross-dressed with 400 lbs. "Ammonium- Salts." (*)		SERIES 4. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake and 400 lbs. "Am- monium-Salts." (*)		SERIES 5. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake.	
	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.

SIXTEENTH SEASON, 1891. Seed dibbled April 16 and 17. Crop taken up, November 2-7.

PLOTS.	SERIES 1. Standard Manures only.		SERIES 2. Standard Manures, and Cross-dressed with 550 lbs. Nitrate Soda. (*)		SERIES 3. Standard Manures, and Cross-dressed with 400 lbs. "Ammonium- Salts." (*)		SERIES 4. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake and 400 lbs. "Am- monium-Salts." (*)		SERIES 5. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake.	
	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.
1	19	3	24	5	31	8	31	9	29	17
2	19	3	20	13	27	3	27	8	26	7
3	5	0	10	18	4	13	8	4	11	13
4	5	6	13	15	13	12	30	7	25	4
5	4	18	12	8	6	8	12	4	13	2
6	4	10	10	15	12	12	26	0	21	6
7	5	19	9	15	14	11	26	2	21	10
8	4	1	4	3	5	1	10	11	11	8
9	..	..	..	..	23	16	..	..	..	..

SEVENTEENTH SEASON, 1892. Seed dibbled April 7 and 8. Crop taken up, October 26 to November 14.

PLOTS.	SERIES 1. Standard Manures only.		SERIES 2. Standard Manures, and Cross-dressed with 550 lbs. Nitrate Soda. (*)		SERIES 3. Standard Manures, and Cross-dressed with 400 lbs. "Ammonium- Salts." (*)		SERIES 4. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake and 400 lbs. "Am- monium-Salts." (*)		SERIES 5. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake.	
	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.
1	22	2	33	0	28	6	28	11	30	0
2	21	10	30	13	22	8	22	8	27	1
3	4	18	16	12	6	0	9	8	11	12
4	5	9	21	15	18	3	27	3	25	13
5	5	1	19	10	8	12	9	10	11	10
6	4	11	20	17	18	2	24	17	21	19
7	6	1	20	6	18	7	23	17	22	5
8	3	16	10	13	4	2	8	7	10	9
9	..	..	..	..	23	19	..	..	..	..

EIGHTEENTH SEASON, 1893. Seed dibbled April 13 and 14. Crop taken up, October 30 to November 4.

1	Farmyard Manure (14 tons) .. .. .	15	13	3	12	18	10	6	1	13	13	4	10	16	14	5	3	20	7	5	12
2	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (¹)	14	5	3	10	17	14	5	18	11	5	4	6	13	16	4	16	18	8	5	9
3	Without Manure (1846, and since)	6	2	2	5	11	18	4	6	1	16	1	6	6	3	2	18	7	13	3	5
4	3½ cwt. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride	4	7	1	2	6	0	3	4	5	16	2	13	16	5	4	12	19	15	3	10
5	Sodium (common salt), 200 lbs. Sulphate Magnesia	4	11	1	3	13	6	3	19	2	7	1	18	4	14	2	17	7	7	3	5
6	3½ cwt. Superphosphate, 500 lbs. Sulphate Potash	3	12	0	19	6	15	2	16	8	4	2	15	16	11	4	7	15	17	3	3
7	3½ cwt. Superphosph., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (²)	4	14	1	2	7	5	3	6	7	10	2	19	14	0	4	0	16	2	3	11
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	3	12	1	2	5	3	2	10	1	7	1	1	4	18	2	17	7	5	3	0
9	Farmyard Manure (14 tons), 3½ cwt. Superphosphate (³)	..	..	..	..	..	..	..	..	16	4	4	18	..	..	..	..	..	..	..	..

NINETEENTH SEASON, 1894. Seed dibbled April 6 and 7. Crop taken up, October 23 to November 9.

1	Farmyard Manure (14 tons) .. .. .	25	15	3	7	38	11	6	13	29	17	7	4	31	13	7	5	31	10	7	3
2	Farmyard Manure (14 tons), and 3½ cwt. Superphosphate (¹)	26	11	4	4	39	8	7	6	30	14	7	16	30	19	7	11	32	1	7	2
3	Without Manure (1846, and since)	6	18	1	7	22	19	4	17	10	13	4	19	13	3	4	15	11	19	3	13
4	3½ cwt. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride	5	7	1	4	29	7	5	5	25	7	3	16	35	12	6	15	28	7	3	19
5	Sodium (common salt), 200 lbs. Sulphate Magnesia	5	13	1	5	19	7	4	2	11	0	4	10	14	6	4	15	14	0	4	4
6	3½ cwt. Superphosphate, 500 lbs. Sulphate Potash	5	3	1	1	21	16	3	14	23	10	3	11	31	4	7	6	25	1	3	14
7	3½ cwt. Superphosph., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (²)	7	7	1	6	23	10	3	17	25	0	4	2	30	3	7	11	26	12	4	5
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	4	19	1	4	14	5	5	7	9	18	4	19	13	9	4	19	13	15	4	8
9	Farmyard Manure (14 tons), 3½ cwt. Superphosphate (³)	..	..	..	..	..	..	..	..	26	0	6	19	..	..	..	..	..	..	..	..

TWENTIETH SEASON, 1895. Seed dibbled April 17 and 18. Crop taken up, October 25-30.

1	Farmyard Manure (14 tons) .. .. .	27	14	2	0	33	8	2	15	28	1	2	8	34	6	2	12	37	4	3	0
2	Farmyard Manure (14 tons), 3½ cwt. Super. (¹) and 500 lbs. Sul. Pot.	25	18	2	1	30	7	2	10	26	9	2	13	37	1	3	1	37	6	3	0
3	Without Manure (1846, and since)	(8 18)	9	0	18	(1 11	0	17	1	1	11	0	13	12	3	1	13	12	9	1	13
4	3½ cwt. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride	5	1	0	16	0	5	0	11	1	0	1	2	34	6	3	5	31	13	2	14
5	Sodium (common salt), 200 lbs. Sulphate Magnesia	7	16	0	17	(²)	0	3	0	0	5	0	6	10	18	1	13	13	1	1	17
6	3½ cwt. Superphosphate, 500 lbs. Sulphate Potash	6	7	0	13	0	4	0	6	1	12	1	2	30	7	2	14	27	7	1	19
7	3½ cwt. Superphosph., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (²)	5	17	0	15	0	4	0	6	0	15	0	13	27	4	2	16	26	18	2	5
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	5	13	0	17	(0 9	0	5	0	1	0	0	9	11	13	1	14	14	5	1	15
9	Farmyard Manure (14 tons), 3½ cwt. Superphosphate (³)	..	..	..	..	..	..	..	..	19	11	2	6	..	..	..	..	..	..	..	..

AVERAGE OF 5 SEASONS, 1891, '92, '93, '94, and 1895.

1	Farmyard Manure (14 tons) .. .. .	22	4	3	2	29	13	5	8	25	0	5	13	28	11	6	4	29	16	5	10
2	Farmyard Manure (14 tons), 3½ cwt. Super. (¹) and 500 lbs. Sul. Pot. (²)	21	16	3	9	25	16	5	15	22	12	5	9	26	5	5	17	28	5	5	3
3	Without Manure (1846, and since)	6	7	1	6	(12 16	3	15	4	4	19	2	14	9	17	4	4	11	1	3	0
4	3½ cwt. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride	5	2	1	2	14	4	3	18	12	16	3	2	28	13	5	16	26	3	3	15
5	Sodium (common salt), 200 lbs. Sulphate Magnesia	5	12	1	1	(*) 12 18	3	10	3	5	14	2	16	10	7	3	9	11	16	3	2
6	3½ cwt. Superphosphate, 500 lbs. Sulphate Potash	4	17	0	18	12	1	3	0	12	16	3	2	25	16	5	13	22	6	3	3
7	3½ cwt. Superphosph., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (²)	6	0	1	2	(12 4	3	4	3	13	5	3	6	24	5	5	15	22	13	3	10
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	4	8	1	1	(6 18	3	1	3	4	6	2	8	9	15	3	8	11	9	3	4
9	Farmyard Manure (14 tons), 3½ cwt. Superphosphate (³)	..	..	..	..	..	..	..	..	21	18	5	11	..	..	..	..	..	..	..	..

(¹) "Superphosphate of Lime," made from high percentage mineral phosphates, and containing 37 per cent., or more, of soluble phosphate.  
 (²) Plot 9 sown on the flat, instead of on ridges; plants ridged up afterwards; rows 22 inches apart, plants 10 inches apart in the rows.  
 (³) 1892, Series 2, one-half the Nitrate of Soda = 275 lbs. only, applied at the time of sowing the seed, the other half sown broadcast, July 10.  
 (⁴) Applied for the first time in 1895.  
 (⁵) Owing to very heavy rains in November, 1894, flooding the lower parts of the Experimental Mangel Field, and washing soil from the dung plots, especially on to Plot 3, Series 1, there is no doubt that this result is too high, and possibly also those given for Plots 5 and 6.  
 (⁶) The plant failed on these plots owing to drought.  
 (⁷) In the case of these plots the averages are given for the five years, though as the details show, there was failure of plant from drought, and scarcely any crop, in 1895.

EXPERIMENTS ON MANGEL WURZEL.—BARN FIELD—continued.—SUMMARY OF THE COMPOSITION OF THE MANGEL ROOTS IN THE SIXTEENTH, SEVENTEENTH, EIGHTEENTH, NINETEENTH, AND TWENTIETH SEASONS, 1891, 1892, 1893, 1894, AND 1895.

For particulars of the composition in the first 15 Years, 1876-1890, see pp. 58-9, 62-3, and 66-7, and for those in succeeding seasons, see pp. 74-5.

An abstract of the analytical results obtained, illustrating the influence of different manures, and of different seasons, on the composition of Mangels, is given below. The dry matter, ash, and nitrogen, are of course determined in the roots themselves. The amounts of dry matter, ash, and nitrogen, have also, in many cases, been determined in the expressed juice. In many cases also, the amount of the nitrogen existing as albuminoids has been determined (by Church's method); and in some cases the amount as amides and nitric acid. It may be observed that by far the larger proportion of both the mineral matter and the nitrogen of the roots is found in the juice; and of the nitrogen in the juice a variable proportion, ranging from less than one-fifth to not more than one-third of the total, is found to exist as albuminoids. In former years when sugar has been estimated, it has been determined by polariscope in the expressed juice, and calculated into its percentage in the roots, as described in more detail in the letterpress above the Table on p. 58. In selected cases of the crops of the twentieth season, 1895, sugar was again determined; not, however, in the expressed juice as formerly, but in both an aqueous, and in an alcoholic extract of the pulp, and the results given in the Table are the means calculated into their percentage in the aqueous, and in the alcoholic extracts, which agreed very closely, the determinations in the original root.

In interpreting the figures, it must be borne in mind, that, with forty different experiments each year, and in each year four, five, 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. The sample analysed was in each case a mixture of vertical sections of ten or fifteen roots, and all the samples were as a rule taken within a period of from one to two weeks; as far as practicable beginning with the ripest. It is obvious, however, that the smaller crops would be much riper than the larger ones; but, although the larger crops generally contain a lower percentage of sugar, they yield very much more sugar per acre.

MANURES, PER ACRE, PER ANNUM.

PLOTS.	ABBREVIATED DESCRIPTION OF STANDARD MANURES.	SERIES 1.		SERIES 2.		SERIES 3.		SERIES 4.		SERIES 5.	
		Standard Manures only.		Standard Manures, and Cross-dressed with 550 lbs. Nitrate Soda.		Standard Manures, and Cross-dressed with 400 lbs. Ammonium-salts.		Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake and 400 lbs. Ammonium-salts.		Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake.	

For details, see pp. 68-9.

SIXTEENTH SEASON, 1891.

1	2	3	4	5	6	7	8	9	Mean Per Cent. Total Dry Matter (Sugar 1895), Mineral Matter (Crude Ash), and Nitrogen in the Roots.															
									Dry Matter.		Nitro-gen.		Sugar.		Ash.		Nitro-gen.		Sugar.		Ash.		Nitro-gen.	
									Percent.	Per cent.	Percent.	Per cent.	Percent.	Per cent.	Percent.	Per cent.	Percent.	Per cent.	Percent.	Per cent.	Percent.	Per cent.	Percent.	Per cent.
Farmyard Manure	13.82	0.792	0.845	12.99	0.845	13.04	0.788	11.97	0.823	13.24	0.807	13.24	0.807	13.24	0.807	13.24	0.807							
Farmyard Manure, & Super.	13.80	0.801	0.919	12.41	0.919	12.39	0.936	11.95	0.775	13.52	0.807	13.52	0.807	13.52	0.807	13.52	0.807							
Unmanured (1846, & since)	16.84	0.699	0.821	14.21	0.821	14.78	0.730	13.73	0.650	14.79	0.591	14.79	0.591	14.79	0.591	14.79	0.591							
Super., & Pot., Sod., & Mag.	15.39	0.764	0.908	11.75	0.908	13.48	0.852	12.03	0.901	13.78	0.784	13.78	0.784	13.78	0.784	13.78	0.784							
Superphosphate	14.73	0.615	0.852	12.51	0.852	13.51	0.649	13.31	0.615	14.53	0.560	14.53	0.560	14.53	0.560	14.53	0.560							
Super., & Potash	14.96	0.754	0.902	12.55	0.902	14.31	0.806	13.52	0.787	13.97	0.705	13.97	0.705	13.97	0.705	13.97	0.705							
Super., Pot., & 36½ lb. Am.-slts.	15.15	0.745	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..							
Unmanured (1853, & since)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..							
Farmyard Manure, & Super.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..							

SEVENTEENTH SEASON, 1892.

1	Farmyard Manure	14.07	0.774	0.831	13.25	0.831	12.49	0.886	13.13	0.778	14.19	0.821	14.19	0.821	14.19	0.821	14.19	0.821
2	Farmyard Manure, & Super.	13.53	0.758	0.855	12.77	0.855	12.77	0.815	12.94	0.872	13.25	0.829	13.25	0.829	13.25	0.829	13.25	0.829
3	Unmanured (1846, & since)	15.80	0.666	0.841	13.25	0.841	14.70	0.678	12.89	0.708	14.48	0.658	14.48	0.658	14.48	0.658	14.48	0.658
4	Super., & Pot., Sod., & Mag.	15.22	0.793	0.904	13.99	0.904	14.06	0.843	13.37	0.997	13.03	0.854	13.03	0.854	13.03	0.854	13.03	0.854
5	Superphosphate	15.03	0.625	0.741	12.13	0.741	14.31	0.639	11.48	0.633	13.43	0.620	13.43	0.620	13.43	0.620	13.43	0.620
6	Super., & Potash	14.70	0.757	0.866	13.78	0.866	14.35	0.819	13.55	0.905	13.85	0.784	13.85	0.784	13.85	0.784	13.85	0.784
7	Super., Pot., & 36½ lb. Am.-slts.	14.94	0.779	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
8	Unmanured (1855, & since)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	
9	Farmyard Manure, & Super.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	

EIGHTEENTH SEASON, 1893.

1	Farmyard Manure .. ..	12.88	0.871	11.50	1.004	12.18	0.852	11.64	0.865	12.82	0.914
2	Farmyard Manure, & Super. ..	12.41	0.949	11.08	1.073	12.20	0.936	12.75	0.911	12.73	0.886
3	Unmanured (1846, & since) ..	14.88	0.685	11.20	0.935	14.03	0.679	13.74	0.756	13.97	0.649
4	Super., & Pot., Sod., & Mag. ..	14.04	0.899	0.184	1.128	0.266	1.135	0.287	1.186	0.287	0.201
5	Superphosphate .. ..	15.10	0.647	0.134	0.769	0.218	0.743	0.276	0.766	0.316	0.237
6	Super., & Potash .. ..	14.90	0.787	0.168	1.003	0.240	1.122	0.256	1.046	0.269	0.236
7	Super., Pot., & 36½ lb. Am.-sfts. ..	14.78	0.877	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
8	Unmanured (1853, & since) ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
9	Farmyard Manure, & Super. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..

NINETEENTH SEASON, 1894.

1	Farmyard Manure .. ..	13.46	0.809	11.73	0.870	12.42	0.765	11.47	0.843	12.56	0.779
2	Farmyard Manure, & Super. ..	13.62	0.756	11.21	0.942	12.21	0.788	11.47	0.839	12.10	0.768
3	Unmanured (1846, & since) ..	15.82	0.607	12.00	0.745	13.75	0.586	13.23	0.575	13.93	0.589
4	Super., & Pot., Sod., & Mag. ..	15.28	0.781	0.092	0.939	0.146	0.918	0.177	0.946	0.177	0.134
5	Superphosphate .. ..	15.62	0.581	0.113	0.770	0.157	0.595	0.208	0.631	0.230	0.205
6	Super., & Potash .. ..	15.64	0.691	0.093	0.881	0.144	0.851	0.147	0.858	0.201	0.139
7	Super., Pot., & 36½ lb. Am.-sfts. ..	15.40	0.724	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
8	Unmanured (1853, & since) ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
9	Farmyard Manure, & Super. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..

TWENTIETH SEASON, 1895.

1	Farmyard Manure .. ..	11.68	0.834	10.21	5.81	9.69	5.28	10.01	5.24	10.76	6.27
2	Farmyard Manure, Super., & Pot. ..	10.85	0.902	8.82	3.83	9.88	5.36	10.02	4.98	10.48	6.22
3	Unmanured (1846, & since) ..	12.18	0.738	.. ..	.. ..	.. ..	.. ..	10.86	5.88	11.60	6.29
4	Super., & Pot., Sod., & Mag. ..	11.66	0.970	0.117	0.970	0.117	0.666	9.66	4.87	10.49	5.43
5	Superphosphate .. ..	13.76	0.666	0.097	0.666	0.097	0.666	10.10	5.22	11.71	6.80
6	Super., & Potash .. ..	13.69	0.791	0.096	0.791	0.096	0.791	10.93	6.14	11.23	6.90
7	Super., Pot., & 36½ lb. Am.-sfts. ..	13.18	0.841	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
8	Unmanured (1853, & since) ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
9	Farmyard Manure, & Super. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..

AVERAGE OF FIVE SEASONS, 1891, '92, '93, '94, and 1895.

1	Farmyard Manure .. ..	13.08	0.816	11.94	0.891	11.96	0.836	11.64	0.827	12.71	0.818
2	Farmyard Manure, Super., & Pot. ..	12.84	0.832	11.26	0.957	11.89	0.861	11.83	0.850	12.42	0.819
3	Unmanured (1846, & since) ..	15.00	0.679	12.67	0.836	14.32	0.668	12.89	0.676	13.75	0.637
4	Super., & Pot., Sod., & Mag. ..	14.32	0.841	0.125	0.969	0.186	0.937	0.169	1.002	0.194	0.145
5	Superphosphate .. ..	14.85	0.627	0.112	0.783	0.186	0.657	0.209	0.664	0.231	0.221
6	Super., & Potash .. ..	14.78	0.756	0.117	0.913	0.180	0.900	0.168	0.894	0.207	0.160
7	Super., Pot., & 36½ lb. Am.-sfts. ..	14.69	0.793	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
8	Unmanured (1853, & since) ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..
9	Farmyard Manure, & Super. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..	.. ..

(1) The plant failed on these plots, owing to drought, and hence no particulars of composition are given.  
 (2) In the case of these plots the averages are for only four years, owing to the failure of the plant from drought in 1895.

EXPERIMENTS ON MANGEL WURZEL.—BARN FIELD (after SUGAR-BEET); commencing 1876—continued.

Below are given the particulars of the Manures for the Twenty-first, Twenty-second, and Twenty-third Seasons, 1896, 1897, and 1898; and of the Produce of the Twenty-first and Twenty-second Seasons, 1896 and 1897. For the Manures and Produce of the 20 preceding seasons, see pp. 56-7, 60-1, 64-5, and 68-9.

The arrangement of the plots, and of the manures, is substantially the same as it was for the 20 preceding years of Mangels (see pp. 56-7, 60-1, 64-5, and 68-9), and also practically the same as previously for Sugar-beet (see pp. 52-3); excepting that

Plot 9, which was unmanured for Sugar-beet, and also previously for Svedes, was brought in as a manured plot for Mangels. In 1896 and since, however, Basic Slag was substituted for Superphosphate of Lime. Seed, Yellow Globe; dibbled or drilled on ridges; rows 26 inches apart; plants 11 inches apart in the rows (?). Roots all carted off; leaves weighed, spread on the respective plots, and ploughed in.

In the spring of 1894 permanent division paths were laid out between plot and plot.

(Area under experiment, about 8 acres.)

MANURES PER ACRE PER ANNUM.

PLOTS.	SERIES 1. Standard Manures only.		SERIES 2. Standard Manures, and Cross-dressed with 550 lbs. Nitrate Soda.		SERIES 3. Standard Manures, and Cross-dressed with 400 lbs. "Ammonium- Salts."		SERIES 4. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake and 400 lbs. "Am- monium-Salts."		SERIES 5. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake.	
	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.

TWENTY-FIRST SEASON, 1896. Seed drilled May 6 and 7; Plot 9, dibbled May 8. Crop taken up, November 3-10.

	SERIES 1.		SERIES 2.		SERIES 3.		SERIES 4.		SERIES 5.	
	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.
1	18	11	27	18	19	3	19	13	5	4
2	21	7	31	0	24	4	23	18	6	5
3	(7 12 <sup>s</sup> )	1	20	11	6	3	6	17	2	13
4	7	2	22	1	16	19	23	12	3	14
5	5	9	19	1	5	2	5	6	2	8
6	5	8	19	5	15	17	20	17	4	19
7	6	8	17	19	16	13	21	13	4	18
8	3	12	11	9	5	0	6	19	2	14
9	..	..	..	..	17	19	..	..	..	..

TWENTY-SECOND SEASON, 1897. Seed drilled May 4 and 5; Plot 9, dibbled May 5 and 6. Crop taken up, October 11-23.

	SERIES 1.		SERIES 2.		SERIES 3.		SERIES 4.		SERIES 5.	
	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.
1	15	16	25	6	19	5	20	4	8	7
2	17	5	27	1	23	3	25	4	8	14
3	(5 8 <sup>s</sup> )	1	17	4	7	8	8	17	5	9
4	4	5	17	8	11	14	24	13	7	5
5	4	0	16	3	8	7	7	18	4	19
6	3	2	14	4	11	4	18	6	18	16
7	3	17	14	4	10	17	19	7	6	15
8	1	13	7	10	3	12	5	16	4	10
9	..	..	..	..	13	14	..	..	..	..







