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Yields of the Field Experiments 1901

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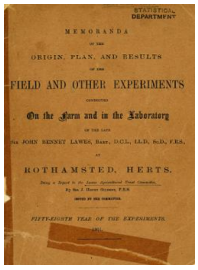

Roots-crops; Barn Field

Rothamsted Research

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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" 1843–1848, 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. 58–61.

In 1876 experiments with Mangel-wurzel were substituted, and are still in progress; see pp. 62–83. (In 1898, and since, small areas have been devoted to new experiments with Sugar-beet—See Plan p. 54; also pp. 84–5.)

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

NORFOLK WHITE TURNIPS; FOUR SEASONS, 1845–1848; Roots and Leaves carted off the Land.

Plots.	Standard Manures.	Series 1. Standard Manures only.		Series 2.	Series 3. Standard Manures, and Cross-dressed with 160 lbs. Sulphate Ammonia, and 75 lbs. Muriate Ammonia.		Series 4. Standard Manures, and Cross-dressed with 160 lbs. Sulphate Ammonia, 75 lbs. Muriate Ammonia, and 1840 lbs. Rape-cake.		Series 5. Standard Manures, and Cross-dressed with 1840 lbs. Rape-cake.	
		Average Produce, per Acre, per Annum.								
		Roots.	Leaves.		Roots.	Leaves.	Roots.	Leaves.	Roots.	Leaves.
		Tons. cwts.	Tons. cwts.		Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.	Tons. cwts.
3	Gypsum 1845; without Manure 1846 and since (average 1846, 7, 8)	1 4	0 17		1 7	1 0	5 10	3 19	6 11	3 3
4	Superphosphate, each year; Potash, Soda, and Magnesia, 1847 and '48	8 1	2 15		9 15	4 3	10 5	6 1	11 2	4 12
5	Superphosphate, each year	8 16	2 19		9 18	4 8	10 1	6 3	10 18	4 15
6, 7	Superphosphate, each year; and Potash 1847 and 1848	8 0	2 10		9 16	4 8	10 7	6 6	10 17	4 13

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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. Roots.	Series 1. Leaves.	Series 2. (Cross-dressed, as under, in 1849 and 1850. No Cross-dressing in 1851 and 1852.)	Series 3. Standard Manures, and Cross-dressed with 200 lbs. Ammonium-salts. Roots.	Series 3. Leaves.	Series 4. Standard Manures, and Cross-dressed with 200 lbs. Ammonium-salts, and 2000 lbs. Rape-cake. Roots.	Series 4. Leaves.	Series 5. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake. Roots.	Series 5. Leaves.
		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 0	0 17	7 14	0 13
4	Superphosphate, Sulphates Potash and Magnesia, and Soda-ash	7 17	0 10		9 9	0 11	13 1	0 18	12 7	0 15
5	Superphosphate	7 9	0 11		8 14	0 13	11 4	1 1	10 10	0 17
6 } 7 }	Superphosphate, and Sulphate Potash	6 16	0 9		8 14	0 10	12 8	0 17	11 14	0 14

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

Plots.	Series 1. Dressed Grain.	Series 1. Straw.	Series 2.	Series 3. Dressed Grain.	Series 3. Straw.	Series 4. Dressed Grain.	Series 4. Straw.	Series 5. Dressed Grain.	Series 5. Straw.
	Bushels.	Cwts.		Bushels.	Cwts.	Bushels.	Cwts.	Bushels.	Cwts.
3	18¾	12½		20½	12⅝	24½	15⅜	25⅞	16
4	20¾	12¼		22½	13	25	14¾	25¼	14⅞
5	21	11⅞		23	12¾	26¾	15	27	15½
6 } 7 }	18¾	10⅞		20½	11⅞	25	14⅜	25	14⅞

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. Roots.	Series 1. Leaves.	Series 2. Standard Manures, and Cross-dressed with— 5 years, 1856–1860, 3000 lbs. Saw-dust, and 328 lbs. Nitric Acid. 10 years, 1861–1870, 550 lbs. Nitrate Soda. Roots.	Series 2. Leaves.	Series 3. Standard Manures, and Cross-dressed with— 5 years, 1856–1860, 200 lbs. Ammonium-salts. 10 years, 1861–1870, 400 lbs. Ammonium-salts. Roots.	Series 3. Leaves.	Series 4. Standard Manures, and Cross-dressed with— 5 years, 1856–1860, 200 lbs. Ammonium-salts, and 3000 lbs. Sawdust. 10 years, 1861–1870, 400 lbs. Ammonium-salts, and 2000 lbs. Rape-cake. Roots.	Series 4. Leaves.	Series 5. Standard Manures, and Cross-dressed with— 5 years, 1856–1860, 3000 lbs. Sawdust. 10 years, 1861–1870, 2000 lbs. Rape-cake. Roots.	Series 5. Leaves.
		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	0 17	7 9	1 2	8 8	1 4	8 16	1 9	8 0	1 4
2	Farmyard Manure, 14 tons, and Superphosphate	6 7	0 16	7 13	1 3	8 5	1 5	8 14	1 9	7 16	1 2
3	Without Manure, 1846, and since	0 11	0 3	0 19	0 4	0 13	0 3	3 6	0 14	3 8	0 13
4	Superphosph., each year; Sulph. Potash, Soda, and Magnesia, 1856–60	2 16	0 8	5 2	0 16	4 12	0 14	6 12	1 5	5 8	0 17
5	Superphosphate, each year	2 12	0 9	4 13	0 18	3 16	0 15	5 16	1 7	5 0	0 19
6	Superphosphate, each year; Sulphate Potash, 1856–1860	2 7	0 7	4 11	0 14	4 5	0 13	6 6	1 2	5 3	0 16
7	Superphosph., each year; Sulph. Potash, and 36½ Amm.-salts, 1856–60	2 12	0 7	4 13	0 14	4 12	0 14	6 15	1 4	5 9	0 17
8	Unman. 1853, and since; previously part Unman.; part Superphosph.	1 3	0 4	1 13	0 5	1 2	0 5	3 19	0 18	3 14	0 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.

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

GROWN YEAR AFTER YEAR ON THE SAME LAND, WITHOUT MANURE, AND WITH DIFFERENT DESCRIPTIONS OF MANURE, 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.	Standard Manures.	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.	
		Manures, per Acre, per Annum.									
		Produce per Acre (Roots trimmed as for feeding, not as for Sugar-making).									
		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.
	First Season, 1871. Seed dibbled April 13 and 14; Crop taken up November 30–December 19.										
1	Farmyard Manure (14 tons)	18 3	3 5	27 13	6 19	22 1	5 6	26 4	6 14	28 18	5 14
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	14 13	2 14	25 16	5 15	21 15	4 6	25 2	6 7	25 4	5 5
3	Without Manure (1846, and since)	7 11	2 0	22 3	5 12	15 6	4 16	19 18	7 0	20 16	4 12
4	3½ cwts. Superphosphate, 300 lbs. Sulphate Potash, 200 lbs. Sulphate Soda, 100 lbs. Sulphate Magnesia	7 11	1 5	22 15	4 8	17 10	3 5	22 15	6 3	21 7	3 19
5	3½ cwts. Superphosphate	5 12	1 8	20 19	3 14	15 4	3 19	19 18	7 12	18 19	4 5
6	3½ cwts. Superphos., 300 lbs. Sulph. Potash	5 1	1 4	21 5	3 13	17 4	3 4	23 11	6 11	21 0	3 11
7	3½ cwts. Superphos., 300 lbs. Sulph. Potash, 36½ lbs. Amm.-salts (2)	5 18	1 5	20 19	3 18	18 8	4 3	21 0	5 0	21 7	3 17
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	7 10	1 14	21 13	3 16	16 2	4 15	17 19	7 11	20 7	4 9
	Second Season, 1872. Seed dibbled May 1–3; Crop taken up November 12–28.										
1	Farmyard Manure (14 tons)	15 13	4 2	23 9	7 19	22 14	9 0	26 8	9 11	22 5	6 1
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	16 0	3 18	24 6	8 16	22 0	7 16	25 9	9 14	20 15	5 11
3	Without Manure (1846, and since)	7 17	1 13	21 7	6 6	15 3	4 13	20 8	10 1	16 3	3 11
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	6 14	1 10	20 2	5 19	15 10	3 7	23 8	7 13	17 18	3 15
5	3½ cwts. Superphosphate	6 17	1 8	19 6	6 4	14 5	4 13	18 11	10 4	15 18	3 16
6	3½ cwts. Superphos., 500 lbs. Sulph. Potash	6 6	1 5	16 16	5 14	14 7	3 19	22 16	9 9	15 17	3 14
7	3½ cwts. Superphos., 500 lbs. Sulph. Potash, 36½ lbs. Amm.-salts (2)	6 15	1 8	17 0	6 1	15 9	3 19	23 9	9 10	15 10	3 15
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	5 4	1 5	15 6	5 19	13 10	4 1	19 12	9 17	15 0	4 6

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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.

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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 $\frac{1}{18}$ 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, and relatively as near.

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.

Plots.	Abbreviated Description of Standard Manures. For details, see pp. 58–9.	Manures, per Acre, per Annum, unless otherwise stated (see below). 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.			
		Mean Per Cent. Total Dry Matter, Sugar, Mineral Matter (Crude Ash), and Nitrogen in the Roots.																			
		Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
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.)																					
1	Farmyard Manure	17·04	11·16	0·821	0·142	14·83	9·25	0·945	0·184	16·07	10·46	0·934	0·199	14·73	8·87	1·021	0·271	15·44	9·71	0·892	0·191
2	Farmyard Manure, & Super. ..	17·24	11·29	0·826	0·146	15·03	9·28	0·970	0·199	15·12	9·43	0·977	0·212	14·80	8·75	0·988	0·249	16·11	10·24	0·909	
3	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	
4	Super., & Pot., Sod., & Mag. ..	18·07	12·31	0·738	0·100	15·72	10·24	0·828	0·157	18·68	11·74	0·907	0·170	16·87	9·38	1·002	0·244	16·61	11·08	0·767	0·138
5	Superphosphate	17·89	12·53	0·746	0·101	15·93	10·49	0·787	0·130	16·36	10·83	0·754	0·176	14·63	8·79	0·843	0·251	16·84	11·22	0·722	0·155
6	Super., & Potash	18·09	12·32	0·778	0·098	15·29	9·92	0·856	0·137	16·33	10·91	0·843	0·148	15·28	9·20	0·956	0·273	17·05	11·44	0·812	0·146
7	Super., Pot., & 36½ lb. Am.-slts.	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	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	

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

1	Farmyard Manure	18·23	12·29	0·874		17 07	11·40	0·973		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		15·97	10·53	1·000		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		19·62	13·63	0·691		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	18·55	12·62	0·800	0·128	18·49	12·00	0·965	0·184	18·67	12·67	0·795	0·139
5	Superphosphate	18·67	13·19	0·712	0·101	16·37	10·58	0·866	0·167	18·40	12·34	0·734	0·167	15·82	9·86	0·918	0·250	18·07	12·53	0·705	0·159
6	Super., & Potash	18·83	13·09	0·772	0·098	17·08	11·26	0·891	0·167	18·70	12·75	0·837	0·166	17·38	11·51	0·879	0·173	18·41	12·47	0·780	0·162
7	Super., Pot., & 36½ lb. Am.-slts.	19·03	13·20	0·742		16·66	10·63	0·937		18·71	12·65	0·787		17·98	12·15	0·797		19·01	13·32	0·809	
8	Unmanured (1853, & since) ..	18·69	..	0·701		16·84	..	0·911		..	..	0·790		18·00	..	0·738		18·95	..	0·685	

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

1	Farmyard Manure	17·62	12·06	0·924		16·64	10·61	0·947		16·76	10·74	0·965		18·80	9·68	1·267		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		13·39	9·75	0·905		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		16·00	10·65	0·755		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	18·31	12·42	0·877	0·161	16·67	10·62	0·974	0·187	18·30	12·48	0·861	0·149
5	Superphosphate	19·25	13·52	0·679	0·121	16·89	10·90	0·847	0·184	18·24	12·47	0·604	0·186	16·66	11·03	0·734	0·227	18·93	12·77	0·664	0·160
6	Super., & Potash	19·64	13·60	0·757	0·119	17·94	11·84	0·810	0·169	18·42	12·52	0·894	0·140	17·56	11·27	0·906	0·212	18·22	12·29	0·845	0·148
7	Super., Pot., & 36½ lb. Am.-slts.	19·63	13·67	0·747		17·42	11·10	0·907		18·81	13·00	0·858		17·68	11·48	0·870		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		16·54	10·26	0·782		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	1·089		14·35	9·27	1·112		13·53	9·70	1·029		14·39	10·28	0·972	
2	Farmyd. Manure, & Super. '71–'3	15·00	12·08	1·022		13·84	9·41	1·082		14·24	9·58	1·081		14·59	9·58	0·970		14·34	10·31	0·933	
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		15·04	10·53	0·864	
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		14·98	11·89	1·027	
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		16·26	10·25	0·796	
6	Super., & Potash	17·83	12·30	0·752		15·95	9·95	0·859		16·70	12·97	0·865		15·30	11·41	0·938		16·29	10·46	0·879	
7	Super., Pot., & 36½ lb. Am.-slts.	16·88	..	0·730		15·56	..	0·903		17·74	..	0·784		16·08	..	0·907		15·50	..	0·868	
8	Unmanured (1853, & since) ..	18·76	..	0·726		15·30	..	0·890		17·35	..	0·771		15·48	..	0·841		16·51	..	0·772	

FIFTH SEASON, 1875. Mineral Manures as in 1872, 1873, and 1874; but no Farmyard Manure, or cross-dressings of Nitrate Soda, 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		16·13	10·96	0·780	
2	Farmyd. Manure, & Super. '71–'3	16·08	11·11	0·784		15·67	10·63	0·687		15·43	10·21	0·863		15·70	10·32	0·770		15·92	11·10	0·793	
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		16·48	11·48	0·641	
4	Super., & Pot., Sod., & Mag. ..	16·67	11·48	0·773	0·103	16·10	11·42	0·751	0·112	17·07	11 67	0·755		16·56	11·27	0·758	0·125	16·24	11·07	0·775	0·121
5	Superphosphate	16·94	12·30	0·686	0·107	16·53	11·46	0·722	0·125	16·55	11·45	0·683	0·122	15·34	10·61	0·682	0·152	15·86	11·19	0·622	0·123
6	Super., & Potash	18·04	12·00	0·782	0·127	16·78	11·82	0·762	0·123	16·19	11·57	0·752	0·136	16·21	10·97	0·777	0·158	16·53	11·46	0·759	0·141
7	Super., Pot., & 36½ lb. Am.-slts.	17·51	..	0·730		16·22	..	0·874		16·50	..	0·802		15·88	..	0·856		16·38	..	0·866	
8	Unmanured (1853, & since) ..	16·81	..	0·770		16·01	..	0·812		16·56	..	0·767		15·96	..	0·768		15·86	..	0·658	

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

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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. 66–7, 70–1, 74–5, 78–9, and 82–3.

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 Swedes, is now added as a manured Plot. 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 (3). Roots all carted off; Leaves weighed, spread on the respective Plots, and ploughed in.

(Area under experiment about 8 acres.)

Plots.	Standard Manures.	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.					
	Produce per Acre.	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.
1	Farmyard Manure (14 tons)	19 12 / 4 9	25 2 / 7 5	29 19 / 7 12	31 9 / 10 5	24 9 / 5 19
2	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
3	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
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	8 8 / 1 15	25 1 / 6 0	19 19 / 4 9	30 8 / 8 13	25 8 / 5 10
5	3½ cwts. Superphosphate	7 10 / 1 14	21 0 / 5 14	13 10 / 5 1	17 2 / 7 14	17 17 / 5 17
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash	6 16 / 1 12	21 2 / 5 8	17 15 / 4 13	26 8 / 9 0	20 10 / 5 4
7	3½ cwts. Superphos., 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
8	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
9	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	Farmyard Manure (14 tons)	15 7 / 2 1	24 13 / 3 14	27 1 / 4 4	30 5 / 5 5	25 18 / 3 4
2	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
3	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
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	6 16 / 1 3	21 10 / 3 10	16 10 / 2 2	27 9 / 3 8	21 14 / 1 17
5	3½ cwts. Superphosphate	6 1 / 0 19	20 5 / 3 1	12 2 / 2 10	15 3 / 3 8	15 3 / 2 2
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash	5 8 / 0 18	20 19 / 2 18	15 6 / 1 16	24 18 / 3 16	19 3 / 1 12
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (2)	7 0 / 1 3	22 2 / 3 16	16 13 / 2 7	25 15 / 5 0	20 13 / 2 8
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
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (3)	.. / ..	.. / ..	13 17 / 4 0	.. / ..	.. / ..

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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	3	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 (2)	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 (3)	..		..		..		..		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	3	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 (2)	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 (3)	..		..		..		..		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 (2)	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 (3)	..		..		..		..		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 (2)	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 (3)	..		..		..		..		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.

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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. 68–9, 72–3, 76–7, and 80–1.

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.

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 Rothamsted "Memoranda" for 1881, 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 Rothamsted results should be reduced by about $\frac{1}{18}$ 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 $\frac{1}{18}$ 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 95 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 1895 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 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.

Plots.	Abbreviated Description of Standard Manures. (For details, see pp. 62–3.)	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.-salts.				Series 5. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake.			
		Manures, per Acre, per Annum.																			
		Mean Per Cent. Total Dry Matter, Sugar, Mineral Matter (Crude Ash), and Nitrogen, in the Roots.																			
		Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
	First Season, 1876.																				
1	Farmyard Manure	12·14	6·70	0·969		10·54	..	1·031		10·65	..	1·080		8·98	..	1·065		11·30	..	0·989	
2	Farmyard Manure, & Super. ..	12·41	6·74	0·943		9·35	4·55	1·020		9·64	5·36	1·018		8·92	..	1·034		10·51	..	1·005	
3	Unmanured (1846, & since) ..	15·14	..	0·828		11·94	..	0·903		12·16	..	0·904		11·60	..	0·811		12·42	..	0·751	
4	Super., & Pot., Sod., & Mag. ..	13·99	8·42	0·905		11·36	5·92	1·013		12·23	6·71	0·989		9·91	5·27	1·067		11·28	6·51	1·003	
5	Superphosphate	13·51	8·88	0·818		10·99	5·96	0·917		11·73	6·82	0·735		10·93	5·67	0·816		10·65	6·41	0·744	
6	Super., & Potash	13·67	8·19	0·928		11·23	7·19	0·929		11·02	6·95	0·993		10·56	5·07	1·036		11·55	6·84	0·911	
7	Super., Pot., & 36½ lb. Am.-slts.	13·63	..	0·882		11·61	..	0·922		10·62	..	0·969		10·66	..	1·015		11·58	..	0·936	
8	Unmanured (1853, & since) ..	13·06	..	0·900		11·23	..	0·945		11·43	..	0·905		10·20	..	0·856		11·61	..	0·757	
9	Farmyard Manure, & Super. ..	..	..	..	..	..	..	..	..	11·59	..	0·876	..	..	..	..	..	..	..	..	..
	Second Season, 1877.																				
1	Farmyard Manure	14·48	8·48	0·988		12·01	7·70	1·122		12·95	8·39	1·097		12·44	7·47	1·114		13·34	7·30	1·010	
2	Farmyard Manure, & Super. ..	13·85	9·39	0·961		12·91	7·70	1·107		13·24	7·35	1·089		11·78	7·20	1·126		14·08	7·97	1·000	
3	Unmanured (1846, & since) ..	16·58	10·49	0·827		14·06	8·21	1·072		17·11	9·52	0·888		14·44	9·19	0·834		16·41	9·58	0·819	
4	Super., & Pot., Sod., & Mag. ..	15·42	10·24	0·948		12·25	6·80	1·121		13·11	8·77	1·085		12·69	7·04	1·221		13·45	9·20	1·046	
5	Superphosphate	15·84	10·93	0·797		12·90	8·01	0·889		15·63	9·38	0·838		14·36	7·72	0·786		15·35	10·04	0·784	
6	Super., & Potash	16·15	10·60	0·891		12·53	8·53	1·135		15·05	8·86	1·095		14·27	8·34	1·061		14·10	9·32	0·978	
7	Super., Pot., & 36½ lb. Am.-slts.	15·88	..	0·943		12·74	..	1·034		13·96	..	1·098		12·58	..	1·136		13·83	..	1·036	
8	Unmanured (1853, & since) ..	16·23	..	0·933		14·01	..	1·023		14·95	..	0·932		14·51	..	0·811		14·87	..	0·807	
9	Farmyard Manure, & Super. ..	..	..	..	..	..	..	..	..	14·84	..	1·011	..	..	..	..	..	..	..	..	..

Third Season, 1878.

1	Farmyard Manure	12·26	6·87	0·995	0·170	11·47	5·97	1·036	0·218	11·17	5·88	1·013	0·206	10·83	5·30	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	0·171
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	12·69	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.-slts.	13·42	..	0·976	..	11·26	..	0·982	..	11·92	..	0·932	..	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	0·842	0·203
4	Super., & Pot., Sod., & Mag. ..	15·56	9·78	0·980	0·151	12·83	7·60	1·010	0·156	14·03	8·70	0·962	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.-slts.	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	6·66	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	0·136	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	0·745	0·151
7	Super., Pot., & 36½ lb. Am.-slts.	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. ..	..	..	..	..	..	..	..	..	11·32	..	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	6·85	0·890	0·180	13·76	8·31	0·788	0·182	12·71	7·09	0·766	0·219	13·54	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.-slts.	14·58	..	0·899	..	12·04	..	0·959	..	12·62	..	0·962	..	12·23	..	0·998	..	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.

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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. 62–3, and for those of succeeding seasons, see pp. 70–1, 74–5, 78–9, and 82–3.

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. 58–9), excepting that Plot 9, which was unmanured for Sugar-beet, and also previously for Swedes, was brought in as a manured Plot. 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; in 1881 and 1883, seed dibbled, in 1882 and 1884 drilled, on ridges, rows 26 inches apart; plants 11 inches apart in the rows (3). In 1885 the seed was drilled on the flat on all the plots; see note 5, below. Roots all carted off; Leaves weighed, spread on the respective Plots, and ploughed in.

(Area under experiment, about 8 acres.)

Plots.	Standard Manures.	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.
	Sixth Season, 1881. Seed dibbled, April 19. Crop taken up, October 31 to November 10.					
		Produce per Acre.				
		Roots. Tons. cwts. / Leaves. Tons. cwts.	Roots. Tons. cwts. / Leaves. Tons. cwts.	Roots. Tons. cwts. / Leaves. Tons. cwts.	Roots. Tons. cwts. / Leaves. Tons. cwts.	Roots. Tons. cwts. / Leaves. Tons. cwts.
1	Farmyard Manure (14 tons)	13 15 / 2 8	17 19 / 3 16	15 14 / 3 13	15 3 / 4 10	15 5 / 3 14
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	15 2 / 2 3	19 12 / 4 4	16 10 / 4 8	18 6 / 5 5	15 5 / 3 16
3	Without Manure (1846, and since)	4 8 / 0 13	11 6 / 2 12	3 15 / 1 14	6 18 / 2 12	7 19 / 2 16
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	6 3 / 0 16	16 18 / 3 5	12 17 / 2 10	21 13 / 5 6	17 8 / 3 1
5	3½ cwts. Superphosphate	5 11 / 0 13	15 13 / 2 10	7 3 / 2 18	10 9 / 3 17	10 17 / 3 4
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash	4 19 / 0 12	16 8 / 2 9	11 9 / 2 10	17 7 / 4 7	16 7 / 2 10
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (2)	6 12 / 0 16	16 17 / 2 17	12 12 / 2 13	17 15 / 4 4	18 1 / 2 13
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	4 10 / 0 13	10 16 / 3 13	4 3 / 2 1	8 18 / 3 9	10 0 / 3 2
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (3)	.. / ..	.. / ..	20 18 / 5 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	Farmyard Manure (14 tons)	14 14 / 2 12	21 19 / 3 19	23 5 / 5 13	27 4 / 6 15	25 3 / 4 4
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	15 18 / 2 17	25 2 / 5 4	23 5 / 6 4	25 10 / 6 18	25 12 / 4 3
3	Without Manure (1846, and since)	4 12 / 0 19	14 5 / 2 15	6 3 / 3 8	12 0 / 4 8	13 1 / 3 1
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	4 19 / 1 0	18 3 / 3 8	17 13 / 2 13	28 6 / 5 3	21 10 / 2 18
5	3½ cwts. Superphosphate	4 14 / 1 1	15 10 / 3 15	9 8 / 3 18	11 12 / 5 6	13 14 / 3 4
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash	4 5 / 0 18	15 16 / 3 2	17 2 / 2 18	24 4 / 6 3	19 19 / 2 13
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (2)	6 1 / 1 3	16 8 / 3 14	17 6 / 3 5	23 12 / 5 19	20 16 / 3 2
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	3 10 / 0 17	11 9 / 3 12	7 0 / 3 18	9 14 / 4 15	10 12 / 4 1
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (3)	.. / ..	.. / ..	18 3 / 5 10	.. / ..	.. / ..

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	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	7	33	5	4	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	7	11	31	2	3	19
3	Without Manure (1846, and since)	4	18	1	1	18	14	4	2	8	6	4	0	13	3	4	18	13	13	2	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	5	15	23	10	3	2
5	3½ cwts. Superphosphate	5	3	0	18	21	12	3	10	10	15	3	9	14	12	5	3	16	4	3	5
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash	4	6	0	16	21	1	2	14	19	4	2	17	33	5	6	9	23	9	2	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	6	8	24	17	3	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	4	15	13	10	4	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	4	3	26	17	3	0
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1) ..	16	8	2	0	26	13	4	3	22	14	4	14	23	3	4	8	25	14	3	6
3	Without Manure (1846, and since)	5	11	0	19	7	5	2	8	5	15	2	9	7	16	2	15	10	0	2	18
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	4	14	19	7	2	6
5	3½ cwts. Superphosphate	5	19	0	18	5	17	1	15	4	14	2	12	8	7	3	5	9	4	3	0
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash	5	9	0	15	4	19	1	7	9	15	3	1	21	13	4	19	17	15	2	7
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	4	6	19	6	2	12
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	12	7	4	2	9
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	9	15	8	2	9
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	7	13	10	2	5
3	Without Manure (1846, and since)	0	1	0	1	0	1	0	1	0	1	0	1	2	5	1	8	3	3	1	10
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	18	13	1	1	7
5	3½ cwts. Superphosphate	0	3	0	2	0	4	0	2	0	12	0	8	2	19	1	19	3	12	1	11
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash	0	10	0	4	0	10	0	5	2	5	0	12	8	16	2	5	7	14	2	4
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	2	6	6	1	12
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	17	0	12	0	13
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	5	14	25	3	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	1	24	8	3	16
3	Without Manure (1846, and since)	4	17	0	18	12	18	2	19	6	0	2	18	9	19	3	13	11	3	2	19
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	4	20	9	2	17
5	3½ cwts. Superphosphate	5	7	0	17	14	13	2	18	8	0	3	4	11	5	4	8	12	10	3	3
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash	4	15	0	15	14	11	2	8	14	8	2	16	24	2	5	10	19	7	2	11
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	4	20	15	2	18
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	18	10	7	3	8
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) "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.
(4) Owing to dry weather much seed failed, especially on some Ammonia and Nitrate plots, and the blanks were filled up by transplanting.
(5) 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.
(6) 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.

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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, and 1885. For particulars of the composition in the first 5 Years, 1876–1880, see pp. 64–5, and for those in succeeding seasons see pp. 72–3, 76–7, and 80–1.

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. 64.

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.

Plots.	Abbreviated Description of Standard Manures. — For details, see pp. 66–7.	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.			
		Mean Per Cent. Total Dry Matter, Mineral Matter (Crude Ash), and Nitrogen, in the Roots.																			
		Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.
		Sixth Season, 1881.																			
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	Farmyard Manure	12·98		0·946	0·207	12·26		1·014	0·257	12·38		0·984	0·243	12·86		0·983	0·257	11·80		0·945	0·217
2	Farmyard Manure, & Super. ..	12·35		0·883	0·171	11·91		0·946	0·217	11·83		0·995	0·237	13·32		0·963	0·280	12·07		0·929	0·234
3	Unmanured (1846, & since) ..	17·88		0·700	0·205	13·98		0·864	0·238	17·13		0·801	0·333	15·94		0·722	0·320	15·93		0·675	0·257
4	Super., & Pot., Sod., & Mag. ..	15·11		0·839	0·134	12·77		1·020	0·217	14·10		0·977	0·192	13·02		1·057	0·255	13·35		0·979	0·190
5	Superphosphate	15·76		0·724	0·139	12·50		0·836	0·205	14·50		0·649	0·238	14·59		0·708	0·237	13·96		0·691	0·222
6	Super., & Potash	16·10		0·797	0·133	14·14		0·910	0·197	13·84		1·007	0·201	13·65		0·985	0·222	13·69		0·978	0·202
7	Super., Pot., & 36½ lb. Am.-slts.	15·11		0·870		12·42		0·945		13·54		1·033		13·33		0·982		13·44		0·888	
8	Unmanured (1853, & since) ..	15·77		0·788		12·40		0·876		15·28		0·766		14·07		0·671		14·78		0·704	
9	Farmyard Manure, & Super. ..	..		..	..	..		..	..	12·73		0·865	..	..		..	..	..		..	..
		Seventh Season, 1882.																			
1	Farmyard Manure	14·29		0·850	0·153	13·32		0·901	0·175	12·73		0·900	0·196	11·60		0·940	0·224	12·51		0·898	0·196
2	Farmyard Manure, & Super. ..	13·19		0·871	0·143	13·08		0·929	0·200	12·52		0·849	0·226	12·75		0·885	0·231	13·14		0·869	0·178
3	Unmanured (1846, & since) ..	17·08		0·746	0·153	14·78		0·817	0·192	15·43		0·745	0·282	14·37		0·675	0·293	15·67		0·677	0·250
4	Super., & Pot., Sod., & Mag. ..	15·41		0·820	0·144	12·45		0·883	0·146	14·26		0·882	0·144	12·81		0·885	0·166	13·32		0·811	0·140
5	Superphosphate	15·05		0·720	0·127	12·58		0·781	0·161	14·69		0·656	0·243	12·96		0·701	0·273	14·98		0·665	0·214
6	Super., & Potash	15·40		0·794	0·135	13·87		0·830	0·164	14·59		0·862	0·163	12·97		0·873	0·216	14·58		0·836	0·156
7	Super., Pot., & 36½ lb. Am.-slts.	15·19				13·67				14·23				13·41		..		14·10		0·833	
8	Unmanured (1853, & since) ..	15·42		0·808		12·57		0·891		14·04		0·858		13·31		0·696		13·99		0·662	
9	Farmyard Manure, & Super. ..	..		..	..	..		..	..	12·89		0·896	..	..		..	..	..		..	..

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9	Farmyard Manure, & Super. ..	..				..				..									

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	12·80		0·897	0·152	13·46		0·832	0·127	13·44		0·930	0·172	13·81		0·860	0·126
5	Superphosphate	15·17		0·686	0·124	12·16		0·821	0·172	13·01		0·691	0·211	13·14		0·636	0·234	15·04		0·614	0·185
6	Super., & Potash	14·74		0·813	0·129	13·52		0·804	0·150	14·06		0·820	0·147	12·83		0·846	0·163	13·98		0·844	0·149
7	Super., Pot., & 36½ lb. Am.-slts.	14·94				13·04				13·94				13·10				13·68			
8	Unmanured (1853, & since) ..	15·26		0·718		11·85		0·744		14·36		0·653		13·98		0·629		13·66		0·553	
9	Farmyard Manure, & Super. ..	..		..	..	..		..	..	12·74		..	..	..		..	..	..		..	..

NINTH SEASON, 1884.

1	Farmyard Manure	13·27		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		0·734		14·61		0·722		15·58		0·716	
4	Super., & Pot., Sod., & Mag. ..	14·45		0·934	0·125	11·83		1·100	0·205	11·83		1·123	0·180	11·16		1·113	0·244	12·79		0·952	0·152
5	Superphosphate	14·99		0·754	0·125	11·84		1·055	0·318	14·67		0·843	0·255	13·64		0·776	0·262	14·70		0·746	0·279
6	Super., & Potash	15·83		0·818	0·111	12·63		1·059	0·239	13·64		1·020	0·203	13·93		0·971	0·203	13·89		0·963	0·184
7	Super., Pot., & 36½ lb. Am.-slts.	14·56				13·10				12·88		1·082		12·58				12·98			
8	Unmanured (1853, & since) ..	15·59		0·806		12·74		1·010		14·91		0·898		13·70		0·763		14·82		0·757	
9	Farmyard Manure, & Super. ..	..		..	..	..		..	..	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	12·53		1·104	0·251	12·38		1·047	0·247	13·07		0·842	0·162	13·70		0·840	0·168
5	Superphosphate	13·44		1·028	0·283	12·72		1·062	0·300	(14·22)(2)		(0·729)	(0·281)	15·39		0·789	0·314	14·79		0·758	0·278
6	Super., & Potash	13·87		1·110	0·256	13·23		0·976	0·248	13·36		0·997	0·225	13·56		0·789	0·212	13·76		0·843	0·214
7	Super., Pot., & 36½ lb. Am.-slts.	13·87				13·20				(13·65)(2)		(1·112)		13·40				14·16			
8	Unmanured (1853, & since) ..	15·09		1·019		13·02		0·966		14·57		1·027		16·81		0·841		16·48		0·915	
9	Farmyard Manure, & Super. ..	..		..	..	..		..	..	13·66		..	..	..		..	..	..		..	..

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

1	Farmyard Manure	13·41		0·891	0·180	12·44		0·936	0·216	12·27		0·906	0·220	12·01		0·910	0·240	12·47		0·884	0·207
2	Farmyard Manure, & Super. ..	13·14		0·872	0·157	11·77		0·944	0·208	11·96		0·899	0·232	12·49		0·867	0·256	12·84		0·863	0·206
3	Unmanured (1846, & since) ..	17·15		0·725	0·179	14·05		0·844	0·215	15·86		0·749	0·308	14·31		0·697	0·307	15·44		0·663	0·254
4	Super., & Pot., Sod., & Mag. ..	15·04		0·839	0·129	12·46		0·975	0·180	13·41		0·954	0·161	12·61		0·996	0·209	13·32		0·901	0·152
5	Superphosphate	15.24		0·721	0·129	12·27		0·873	0·214	14·22		0·710	0·237	13·58		0·705	0·259	14·67		0·679	0·225
6	Super., & Potash	15·52		0·806	0·127	13·54		0·901	0·188	14·03		0·927	0·179	13·35		0·919	0·201	14·04		0·905	0·173
7	Super., Pot., & 36½ lb. Am.-slts.	14·95				13·06				13·65				13·11				13·55			
8	Unmanured (1853, & since) ..	15·51		0·780		12·39		0·880		14·65		0·794		13·77		0·690		14·31		0·669	
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 crops, in 1885, the composition of the produce for that year is not brought into the average.

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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. 62–3 and 66–7, and for those of succeeding seasons, pp. 74–5, 78–9, and 82–3.

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. 62–3 and 66–7), and also the same as previously for Sugar-beet (see pp. 58–9); 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. (3) Roots all carted off; leaves weighed, spread on the respective plots, and ploughed in.

(Area under experiment, about 8 acres.)

PLOTS.	STANDARD MANURES.	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." (4)	Series 4. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake and 400 lbs. "Ammonium-Salts." (4)	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.				
		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.
1	Farmyard Manure (14 tons)	16 6 / 2 19	23 8 / 4 4	19 19 / 5 8	21 0 / 5 8	21 4 / 4 4
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1) ..	15 5 / 2 17	22 7 / 4 11	19 4 / 5 11	19 3 / 5 12	19 1 / 4 5
3	Without Manure (1846, and since)	5 11 / 1 6	14 2 / 4 5	5 4 / 3 2	8 3 / 4 15	8 11 / 3 16
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	5 15 / 1 5	17 6 / 4 0	12 19 / 2 12	20 9 / 4 4	17 4 / 3 15
5	3½ cwts. Superphosphate	6 12 / 1 6	15 3 / 3 6	6 7 / 3 8	8 12 / 4 6	10 9 / 3 19
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash	5 15 / 1 1	14 4 / 2 19	13 0 / 2 15	20 4 / 5 4	15 4 / 3 3
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (2)	6 17 / 1 7	15 3 / 3 5	14 16 / 3 4	19 16 / 5 3	16 13 / 4 0
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	4 17 / 1 3	10 19 / 3 9	6 2 / 3 5	8 1 / 4 3	7 11 / 3 15
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (3)	.. / ..	.. / ..	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 / 1 19	10 18 / 2 7	11 17 / 2 17	15 2 / 3 13	17 5 / 3 8
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	9 6 / 2 1	3 2 / 0 17	6 14 / 1 16	17 5 / 3 18	16 16 / 3 13
3	Without Manure (1846, and since)	1 5 / 0 16	0 2 / 0 1	0 2 / 0 2	5 5 / 3 5	5 15 / 3 0
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	1 15 / 0 16	0 11 / 0 6	0 14 / 0 6	13 2 / 3 3	11 9 / 2 11
5	3½ cwts. Superphosphate	2 3 / 0 18	0 3 / 0 3	0 2 / 0 2	3 15 / 2 6	4 13 / 2 9
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash	2 6 / 0 17	0 6 / 0 3	0 8 / 0 4	8 0 / 2 8	8 16 / 2 6
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 41 lbs. Sulphate-Am.	2 5 / 0 17	0 9 / 0 5	0 13 / 0 6	8 10 / 2 9	9 9 / 2 8
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	1 4 / 0 15	0 1 / 0 1	0 2 / 0 2	3 1 / 1 14	3 13 / 1 18
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (3)	.. / ..	.. / ..	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 Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. ..}	1	16	1	3	23	4	4	16	20	1	3	17	7	19	4	16	8	0	4	3
5	3½ cwts. Superphosphate	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	8	9	3	11	5	1	3	0
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (2)	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	6	5	14	2	15	2	19	1	8
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (2)	..		..		..		..		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. (5)

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 Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. ..}	7	9	1	6	(22	12)	(3	14)	18	13	2	11	37	2	6	16	31	1	4	14
5	3½ cwts. Superphosphate	6	13	1	4	(17	15)	(3	2)	12	7	3	8	21	8	6	7	21	9	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
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (2)	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 (2)	..		..		..		..		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	15	19	2	18
4	{3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. ..}	7	1	1	4	27	1	4	4	21	16	3	7	33	5	5	14	29	0	4	2
5	3½ cwts. Superphosphate	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 (2)	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 (2)	..		..		..		..		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 Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. ..}	4	15	1	3	18	8	3	9	14	16	2	11	22	7	4	19	19	7	3	17
5	3½ cwts. Superphosphate	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 (2)	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 (2)	..		..		..		..		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 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.

(4) 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.

(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.

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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. 64–5 and 68–9, and for those in succeeding seasons, see pp. 76–7, and 80–1.

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. 64.

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.

Plots.	Abbreviated Description of Standard Manures. — For details, see pp. 70–1.	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. (1)				Series 4. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake and 400 lbs. Ammonium-salts. (1)				Series 5. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake.			
		Manures, per Acre, per Annum.																			
		Eleventh Season, 1886.																			
		Mean Per Cent. Total Dry Matter, Mineral Matter (Crude Ash), and Nitrogen in the Roots.																			
		Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	Farmyard Manure	13·75		0·851		12·28		0·950		12·85		0·888		11·92		0·854		12·69		0·845	
2	Farmyard Manure, & Super. ..	12·96		0·908		11·80		0·951		11·52		0·941		11·93		0·900		13·18		0·834	
3	Unmanured (1846, & since) ..	16·07		0·750		12·67		0 953		14·93		0·799		13·76		0·734		14·08		0·687	
4	Super., & Pot., Sod., & Mag. ..	14·72		0·878	0·135	12·02		0·966	0·168	13·77		0·909	0·154	13·00		0·947	0·176	12·50		0·885	0·150
5	Superphosphate	14·38		0·745	0·133	12·27		0·790	0·180	14·29		0·697	0·235	12·47		0·750	0·256	13·59		0·702	0·224
6	Super., & Potash	14·52		0·813	0·132	12·02		0·878	0·180	14·18		0·924	0·171	12·72		0·847	0·189	13·52		0·850	0·168
7	Super., Pot., & 36½ lb. Am.-slts.	14·45		0·847		12·74		0·920		13·82		0·886		12·77		0·997		14·52		0·888	
8	Unmanured (1853, & since) ..	15·44		0·811		11·26		0·921		14·29		0·783		13·58		0·734		14·22		0·669	
9	Farmyard Manure, & Super. ..	..		..	..	..		..	..	11·95		0·930	..	..		..	..	..		..	..
		Twelfth Season, 1887.																			
1	Farmyard Manure	15·21		1·042		13·66		1·066		14·56		1·040		14·95		0·953		15·00		0·981	
2	Farmyard Manure, & Super. ..	14·47		1·044		15·39		1·118		14·82		1·051		15·48		0·944		14·79		0·943	
3	Unmanured (1846, & since) ..	18·94		1·119		17·03		1·078		20·26		1·087		17·41		0·917		17·14		0·822	
4	Super., & Pot., Sod., & Mag. ..	17·11		1·219	0·283	16·41		1·201	0·322	15·11		1·217	0·329	14·56		1·146	0·283	14·60		1·154	0·260
5	Superphosphate	16·81		0·946	0·245	15·60		1·056	0·359	19·00		0·952	0·399	17·44		0·868	0·370	17·34		0·810	0·314
6	Super., & Potash	16·92		1·093	0·236	17·89		1·286	0·350	15·69		1·230	0·286	15·50		1·102	0·315	14·77		1·093	0·263
7	Super., Pot., & 36½ lb. Am.-slts.	16·76		1·143		15·98		1·167		15·64		1·281		15·86		1·144		15·31		1·088	
8	Unmanured (1853, & since) ..	17·74		1·077		18·13		1·134		19·24		1·004		17·88		0·861		18·32		0·823	
9	Farmyard Manure, & Super. ..	..		..	..	..		..	..	15·28		0·982	..	..		..	..	..		..	..

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Thirteenth Season, 1888.

1	Farmyard Manure	13·54		1·104		11·67		1·095		13·30		1·126		14·27		1·116		13·35		1·066	
2	Farmyard Manure, & Super. ..	13·29		1·114		12·56		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	13·94		1·005	0·179	14·05		0·915	0·172	11·29		1·184	0·314	11·70		1·226	0·285
5	Superphosphate	15·72		0·833	0·254	13·61		0·885	0·205	14·43		0·705	0·231	13·77		0·830	0·279	14·96		0·900	0·267
6	Super., & Potash	15·28		1·006	0·277	13·81		0·904	0·198	14·78		0·848	0·142	14·32		1·010	0·269	14·66		0·978	0·271
7	Super., Pot., & 36½ lb. Am.-slts.	16·04		0·983		14·31		0·897		14·44		0·831		14·53		0·960		14·45		1·019	
8	Unmanured (1853, & since) ..	17·17		0·876		13·49		0·904		15·60		0·759		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		0·954		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	13·80		0·818	0·113	14·47		0·796	0·094	12·91		0·836	0·122	14·05		0·846	0·110
5	Superphosphate	15·04		0·666	0·090	13·31		0·739	0·123	14·97		0·584	0·133	12·70		0·667	0·200	14·60		0·641	0·161
6	Super., & Potash	15·40		0·762	0·084	13·51		0·824	0·118	14·72		0·778	0·082	13·94		0·809	0·171	13·81		0·808	0·145
7	Super., Pot., & 36½ lb. Am.-slts.	15·51		0·787		13·69		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		0·669		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	13·58		0·827	0·102	14·18		0·845	0·093	12·96		0·868	0·117	13·25		0·826	0·102
5	Superphosphate	15·28		0·632	0·084	13·95		0·695	0·113	14·31		0·570	0·157	13·27		0·641	0·200	13·94		0·534	0·154
6	Super., & Potash	15·44		0·752	0·094	13·99		0·781	0·106	14·79		0·779	0·112	13·87		0·755	0·115	13·77		0·702	0·108
7	Super., Pot., & 36½ lb. Am.-slts.	15·45		0·711		13·86		0·767		14·89		0·765		13·48		0·768		13·91		0·759	
8	Unmanured (1853, & since) ..	15·34		0·700		12·34		0·774		14·82		0·652		12·41		0·650		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		0·983		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	13·95		0·963	0·177	14·32		0·936	0·168	12·94		0·996	0·202	13·22		0·987	0·181
5	Superphosphate	15·45		0·764	0·161	13·75		0·833	0·196	15·40		0·702	0·231	13·93		0·751	0·261	14·89		0·717	0·224
6	Super., & Potash	15·51		0·885	0·165	14·24		0·935	0·190	14·83		0·912	0·159	14·07		0·905	0·212	14·11		0·886	0·191
7	Super., Pot., & 36½ lb. Am.-slts.	15·64		0·894		14·12		0·926		14·80		0·904		14·32		0·941		14·36		0·912	
8	Unmanured (1853, & since) ..	16·38		0·841		13·58		0·902		15·79		0·778		14·60		0·733		15·38		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.

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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. 62–3, 66–7, and 70–1, and for those of succeeding seasons, see pp. 78–9, and 82–3.

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. 62–3, 66–7, and 70–1), and also the same as previously for Sugar-beet (see pp. 58–9); 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.(3) 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.)

Plots.	Standard Manures.	Series 1. Standard Manures only.	Series 2. Standard Manures, and Cross-dressed with 550 lbs. Nitrate Soda. (4)	Series 3. Standard Manures, and Cross-dressed with 400 lbs. "Ammonium-Salts." (4)	Series 4. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake and 400 lbs. "Ammonium-Salts." (4)	Series 5. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake.
		Manures per Acre per Annum.				
	Sixteenth Season, 1891. Seed dibbled April 16 and 17. Crop taken up, November 2–7.					
		Produce per Acre.				
		Roots. Tons. cwts. / Leaves. Tons. cwts.	Roots. Tons. cwts. / Leaves. Tons. cwts.	Roots. Tons. cwts. / Leaves. Tons. cwts.	Roots. Tons. cwts. / Leaves. Tons. cwts.	Roots. Tons. cwts. / Leaves. Tons. cwts.
1	Farmyard Manure (14 tons)	19 19 / 3 6	24 15 / 5 12	25 4 / 7 7	31 8 / 9 0	29 17 / 6 1
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	20 14 / 3 13	20 17 / 6 16	20 19 / 7 4	27 3 / 8 4	26 7 / 5 0
3	Without Manure (1846, and since)	5 0 / 1 1	10 18 / 4 10	4 13 / 3 10	8 8 / 4 11	11 13 / 3 1
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	5 6 / 1 6	13 15 / 5 13	13 12 / 4 7	30 1 / 7 2	25 4 / 4 3
5	3½ cwts. Superphosphate	4 18 / 1 3	12 8 / 5 5	6 8 / 3 11	12 4 / 4 8	13 2 / 3 0
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash	4 10 / 1 0	10 15 / 4 7	12 12 / 4 6	26 0 / 6 15	21 6 / 3 4
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (2)	5 19 / 1 5	9 15 / 4 6	14 11 / 4 11	26 2 / 7 10	21 10 / 3 14
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	4 1 / 1 2	4 3 / 3 4	5 1 / 3 5	10 11 / 4 4	11 8 / 3 16
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (3)	.. / ..	.. / ..	23 16 / 7 1	.. / ..	.. / ..
	Seventeenth Season, 1892. Seed dibbled April 7 and 8. Crop taken up, October 26 to November 14.					
1	Farmyard Manure (14 tons)	22 2 / 3 5	33 0 / 5 18	28 6 / 6 15	28 11 / 6 18	30 0 / 5 13
2	Farmyard Manure (14 tons), and 3½ cwts. Superphosphate (1)	21 10 / 3 18	30 13 / 6 5	23 15 / 5 4	22 8 / 5 11	27 1 / 5 6
3	Without Manure (1846, and since)	4 18 / 1 0	16 12 / 4 4	6 0 / 3 4	9 8 / 3 5	11 12 / 3 2
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	5 9 / 1 1	21 15 / 4 16	18 3 / 3 11	27 3 / 7 8	25 13 / 4 12
5	3½ cwts. Superphosphate	5 1 / 0 19	19 10 / 4 2	8 12 / 3 14	9 10 / 3 14	11 10 / 3 2
6	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash	4 11 / 0 16	20 17 / 3 18	18 2 / 3 15	24 17 / 7 3	21 19 / 3 11
7	3½ cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (2)	6 1 / 1 1	20 6 / 4 2	18 7 / 4 5	23 17 / 6 17	22 5 / 3 15
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	3 16 / 1 1	10 13 / 3 18	4 2 / 2 7	8 7 / 3 6	10 9 / 3 2
9	Farmyard Manure (14 tons), 3½ cwts. Superphosphate (3)	.. / ..	.. / ..	23 19 / 6 10	.. / ..	.. / ..

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 cwts. 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 cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	4	7	1	2	6	0	3	4	5	16	2	13	16	5	4	12	19	15	3	10
5	3½ cwts. Superphosphate	4	11	1	3	13	6	3	19	2	7	1	18	4	14	2	17	7	7	3	5
6	3½ cwts. 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 cwts. Superphos., 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 cwts. 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 cwts. 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	18
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	5	7	1	4	29	7	5	5	25	7	3	16	35	12	6	15	28	7	3	19
5	3½ cwts. Superphosphate	5	13	1	5	19	7	4	2	11	0	4	10	14	6	4	15	14	0	4	4
6	3½ cwts. 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 cwts. Superphos., 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 cwts. 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 cwts. Super. (1) and 500 lbs. Sul. Pot.	25	18	2	1	20	7	2	10	26	9	2	13	37	1	3	1	37	6	3	0
3	Without Manure (1846, and since)	(8	18 (6))	0	18	1	11	0	17	1	11	0	13	12	3	1	13	12	9	1	13
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	5	1	0	16	0	5	0	11	1	0	1	2	34	6	3	5	31	13	2	14
5	3½ cwts. Superphosphate	7	16	0	17	(7) 0	3	0	2	0	5	0	6 (7)	10	18	1	13	13	1	1	17
6	3½ cwts. 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 cwts. Superphos., 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	1	0	0	9	11	13	1	14	14	5	1	15
9	Farmyard Manure (14 tons), 3½ cwts. 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 cwts. Super. (1) and 500 lbs. Sul. Pot. (5)	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	19	2	14	9	17	4	4	11	1	3	0
4	3½ cwts. Superphosphate, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	5	2	1	2	14	4	3	18	12	16	3	2	28	13	5	16	26	3	3	15
5	3½ cwts. Superphosphate	5	12	1	1	(8) 12	18	3	10	5	14	2	16 (8)	10	7	3	9	11	16	3	2
6	3½ cwts. 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 cwts. Superphos., 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (2)	6	0	1	2	12	4	3	4	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	4	6	2	8	9	15	3	8	11	9	3	4
9	Farmyard Manure (14 tons), 3½ cwts. 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) "Ammonium-salts" 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. (4) 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. Series 3 and Series 4, one-half the Ammonium-salts = 200 lbs. only, applied at the time of sowing the seed, the other half sown broadcast, July 10.
(5) Applied for the first time in 1895. (6) 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. (7) The plant failed on these plots owing to drought. (8) 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.

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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. 64–5, 68–9, and 72–3, and for those in succeeding seasons, see pp. 80–1.

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. 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. 64. 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 of the determinations in the aqueous, and in the alcoholic extracts, which agreed very closely, calculated into their percentage 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.

Plots.	Abbreviated Description of Standard Manures. (For details, see pp. 74–5.)	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.			
		Manures, per Acre, per Annum.																			
		Sixteenth Season, 1891.																			
		Mean Per Cent. Total Dry Matter (Sugar 1895), Mineral Matter (Crude Ash), and Nitrogen in the Roots.																			
		Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
1	Farmyard Manure	13·32		0·792		12·99		0·845		13·04		0·768		11·97		0·823		13·24		0·807	
2	Farmyard Manure, & Super. ..	13·80		0·801		12·41		0·919		12·39		0·936		11·95		0·775		13·52		0·807	
3	Unmanured (1846, & since) ..	16·34		0·699		14·21		0·821		14·78		0·730		13·73		0·650		14·79		0·591	
4	Super., & Pot., Sod., & Mag. ..	15·39		0·764	0·108	11·75		0·903	0·174	13·48		0·852	0·135	12·03		0·901	0·155	13·78		0·784	0·129
5	Superphosphate	14·73		0·615	0·095	12·51		0.852	0·185	13·51		0·649	0·167	13·31		0·615	0·146	14·53		0·560	0·242
6	Super., & Potash	14·96		0·754	0·106	12·55		0·902	0·174	14·31		0·806	0·142	13·52		0·787	0·176	13·97		0·705	0·110
7	Super., Pot., & 36½ lb. Am.-slts.	15·15		0·745		..		..		..		..		..		..		..		..	
8	Unmanured (1853, & since) ..	..		..		..		..		..		..		..		..		..		..	
9	Farmyard Manure, & Super. ..	..		..	..	..		..	..	..		..	..	..		..	..	..		..	..
		Seventeenth Season, 1892.																			
1	Farmyard Manure	14·07		0·774		13·25		0·831		12·49		0·886		13·13		0·778		14·19		0·821	
2	Farmyard Manure, & Super. ..	13·53		0·753		12·78		0·855		12·77		0·815		12·94		0·872		13·25		0·829	
3	Unmanured (1846, & since) ..	15·80		0·666		13·25		0·841		14·70		0·678		12·89		0·708		14·48		0·658	
4	Super., & Pot., Sod., & Mag. ..	15·22		0·793	0·124	13·99		0·904	0·158	14·06		0·843	0·137	11·26		0·997	0·206	13·03		0·854	0·148
5	Superphosphate	15·03		0·625	0·122	12·13		0·741	0·182	14·31		0·639	0·185	13·48		0·633	0·251	13·43		0·620	0·214
6	Super., & Potash	14·70		0·757	0·120	13·78		0·866	0·161	14·35		0·819	0·126	13·35		0·905	0·206	13·85		0·784	0·172
7	Super., Pot., & 36½ lb. Am.-slts.	14·94		0·779		..		..		..		..		..		..		..		..	
8	Unmanured (1853, & since) ..	..		..		..		..		..		..		..		..		..		..	
9	Farmyard Manure, & Super. ..	..		..	..	..		..	..	..		..	..	..		..	..	..		..	..

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Eighteenth Season, 1893.

1	Farmyard Manure	12·88		0·871		11·50		1·004		12·18		0·952		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	11·45		1·128	0·266	11·53		1·135	0·265	11·12		1·186	0·287	11·91		1·032	0·201
5	Superphosphate	15·10		0·647	0·134	12·07		0·769	0·218	12·74		0·743	0·276	13·42		0·766	0·316	12·82		0·667	0·237
6	Super., & Potash	14·90		0·787	0·168	11·87		1·003	0·240	12·36		1·122	0·256	12·59		1·046	0·269	14·02		0·903	0·236
7	Super., Pot., & 36½ lb. Am.-slts.	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	13·03		0·939	0·146	13·37		0·918	0·140	12.30		0·946	0·177	13·10		0·878	0·134
5	Superphosphate	15·62		0·581	0·113	12·61		0·770	0·157	13·20		0·595	0·208	12·69		0·631	0·230	13·65		0·602	0·205
6	Super., & Potash	15·64		0·691	0·093	12·97		0·881	0·144	14·04		0·851	0·147	12·43		0·858	0·201	13·54		0·769	0·139
7	Super., Pot., & 36½ lb. Am.-slts.	15·40		0·724		..		..		..		..		..		..		..		..	
8	Unmanured (1853, & since) ..	..		..		..		..		..		..		..		..		..		..	
9	Farmyard Manure, & Super. ..	..		..		..		..		..		..		..		..		..		..	

Twentieth Season, 1895.

1	Farmyard Manure	11·68	7·16	0·834		10·21	5·81	0·906		9·69	5·28	0·811		10·01	5·24	0·828		10·76	6·27	0·767	
2	Farmyard Manure, Super., & Pot.	10·85	6·16	0·902		8·82	3·83	0·996		9·88	5·36	0·831		10·02	4·98	0·853		10·48	6·22	0·807	
3	Unmanured (1846, & since) ..	12·18	7·62	0·738										10·86	5·88	0·691		11·60	6·29	0·700	
4	Super., & Pot., Sod., & Mag. ..	11·66	6·98	0·970	0·117	(1)							(1)	9·66	4·87	0·981	0·144	10·49	5·43	0·928	0·112
5	Superphosphate	13·76	9·00	0·666	0·097									10·10	5·22	0·675	0·212	11·71	6·80	0·693	0·207
6	Super., & Potash	13·69	8·85	0·791	0·096									10·93	6·14	0·873	0·184	11·23	6·90	0·835	0·142
7	Super., Pot., & 36½ lb. Am.-slts.	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	(2) 12·56		0·969	0·186	13·11		0·937	0·169	(2) 11·27		1·002	0·194	12·46		0·895	0·145
5	Superphosphate	14·85		0·627	0·112	12·33		0·783	0·186	13·44		0·657	0·209	12·60		0·664	0·231	13·23		0·628	0·221
6	Super., & Potash	14 78		0·756	0·117	12·79		0·913	0·180	13·77		0·900	0·168	12·56		0·894	0·207	13·32		0·799	0·160
7	Super., Pot., & 36½ lb. Am.-slts.	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.

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

Below are given the particulars of the Manures and Produce, of the Twenty-first, Twenty-second, Twenty-third, Twenty-fourth, and Twenty-fifth Seasons, 1896, 1897, 1898, 1899, and 1900. For the Manures and Produce of the 20 preceding seasons, see pp. 62–3, 66–7, 70–1, and 74–5, and for those of succeeding seasons, see pp. 82–3.

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. 62–3, 66–7, 70–1, and 74–5), and also practically the same as previously for Sugar-beet (see pp. 58–9); excepting that Plot 9, which was unmanured for Sugar-beet, and also previously for Swedes, 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 in 1897 and previously, but 10 inches only in 1898 and since (²). 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.)

Plots.	Standard Manures.	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.
		Manures per Acre per Annum.				
	Twenty-first Season, 1896. Mineral Manures and Rape-cake sown April 25 to May 1. Seed drilled May 6 and 7; Plot 9, dibbled May 8. Ammonium-salts and Nitrate of Soda top-dressed July 7. Crop taken up, November 3–10.					
		Produce per Acre.				
		Roots. Tons. cwts. / Leaves. Tons. cwts.	Roots. Tons. cwts. / Leaves. Tons. cwts.	Roots. Tons. cwts. / Leaves. Tons. cwts.	Roots. Tons. cwts. / Leaves. Tons. cwts.	Roots. Tons. cwts. / Leaves. Tons. cwts.
1	Farmyard Manure (14 tons)	18 11 / 4 0	27 18 / 6 2	19 3 / 4 17	19 13 / 5 4	19 3 / 4 10
2	Farmyard Manure (14 tons), 450 lbs. Basic Slag, and 500 lbs. Sul. Pot.	21 7 / 4 3	31 0 / 7 0	24 4 / 6 0	23 18 / 6 5	22 5 / 4 17
3	Without Manure (1846, and since)	(7 12³) / (1 14³)	(20 11³) / (5 18³)	6 3 / 2 19	6 17 / 2 13	6 11 / 2 6
4	400 lbs. Basic Slag, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	7 2 / 1 9	22 1 / 5 15	16 19 / 3 0	23 12 / 3 14	20 13 / 2 16
5	400 lbs. Basic Slag	5 9 / 1 8	19 1 / 4 11	5 2 / 2 9	5 6 / 2 8	4 19 / 2 1
6	400 lbs. Basic Slag, 500 lbs. Sulphate Potash	5 8 / 1 3	19 5 / 4 8	15 17 / 3 8	20 17 / 4 19	18 9 / 3 7
7	400 lbs. Basic Slag, 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (¹)	6 8 / 1 9	17 19 / 4 10	16 13 / 3 11	21 13 / 4 18	18 2 / 3 13
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	3 12 / 1 4	11 9 / 4 8	5 0 / 2 15	6 19 / 2 14	6 1 / 2 6
9	Farmyard Manure (14 tons), 450 lbs. Basic Slag (²)	.. / ..	.. / ..	17 19 / 4 19	.. / ..	.. / ..
	Twenty-second Season, 1897. Mineral Manures and Rape-cake sown April 26–27. Seed drilled May 4 and 5; Plot 9, dibbled May 5 and 6. Ammonium-salts and Nitrate of Soda top-dressed July 20. Crop taken up, October 11–23.					
1	Farmyard Manure (14 tons)	15 16 / 4 4	25 6 / 8 7	19 5 / 7 9	20 4 / 8 7	20 6 / 7 10
2	Farmyard Manure (14 tons), 400 lbs. Basic Slag, and 500 lbs. Sul. Pot.	17 5 / 4 0	27 1 / 8 13	23 3 / 7 10	25 4 / 8 14	22 6 / 7 7
3	Without Manure (1846, and since)	(5 8³) / (1 12³)	(17 4³) / (7 11³)	7 8 / 5 1	8 17 / 5 9	8 13 / 4 18
4	400 lbs. Basic Slag, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	4 5 / 1 6	17 8 / 7 12	11 14 / 4 13	24 13 / 7 5	20 6 / 4 13
5	400 lbs Basic Slag	4 0 / 1 9	16 3 / 6 16	8 7 / 4 17	7 18 / 4 19	6 15 / 4 9
6	400 lbs. Basic Slag, 500 lbs. Sulphate Potash	3 2 / 1 3	14 4 / 6 12	11 4 / 4 14	18 16 / 6 18	16 2 / 4 1
7	400 lbs. Basic Slag, 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (¹)	3 17 / 1 12	14 4 / 7 0	10 17 / 4 15	19 7 / 6 15	16 11 / 4 13
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	1 13 / 1 2	7 10 / 5 4	3 12 / 3 1	5 16 / 4 10	6 6 / 4 7
9	Farmyard Manure (14 tons), 400 lbs. Basic Slag (²)	.. / ..	.. / ..	13 14 / 5 17	.. / ..	.. / ..

TWENTY-THIRD SEASON, 1898. Mineral Manures and Rape-cake sown April 5 and 6. Seed drilled April 13; Plot 9, dibbled April 14. Ammonium-salts and Nitrate of Soda top-dressed July 11. Crop taken up, October 12–28.

1	Farmyard Manure (14 tons)	18	4	2	15	27	15	4	8	20	0	3	11	20	3	2	19	23	11	3	13
2	Farmyard Manure (14 tons), 400 lbs. Basic Slag, and 500 lbs. Sul. Pot.	18	17	2	16	28	7	4	5	25	6	4	11	26	0	4	5	26	2	3	18
3	Without Manure (1846, and since)	(7	0[3])	(0	19[3])	(20	17[3])	(3	2[3])	7	6	2	3	7	4	1	17	9	13	1	16
4	400 lbs. Basic Slag, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	5	17	1	1	18	9	3	19	14	14	2	17	23	12	3	16	21	18	3	4
5	400 lbs. Basic Slag	5	18	1	0	16	2	3	5	7	7	2	6	8	0	2	9	9	15	2	5
6	400 lbs. Basic Slag, 500 lbs. Sulphate Potash	5	9	0	18	17	7	3	13	16	0	3	0	22	4	3	18	19	10	2	9
7	400 lbs. Basic Slag, 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (1)	6	19	1	3	17	7	3	10	15	18	2	12	23	6	4	7	20	15	2	14
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	6	19	1	6	15	8	3	9	8	18	2	6	10	14	3	0	10	8	2	8
9	Farmyard Manure (14 tons), 400 lbs. Basic Slag (2)	..		..		..		..		19	10	3	10	..		..		..		..	

TWENTY-FOURTH SEASON, 1899. Mineral Manures and Rape-cake sown April 6 and 12; Ammonium-salts and Nitrate of Soda sown April 20. Seed drilled April 28 and May 2; Plot 9, dibbled May 3; Crop taken up, October 31 to November 14. (The plant practically failed on all but the dunged plots, owing to drought.)

1	Farmyard Manure (14 tons)	9	5	2	2	12	2	2	8	9	1	2	9	14	15	3	14	17	16	3	11
2	Farmyard Manure (14 tons), 400 lbs. Basic Slag, and 500 lb. Sul. Pot.	9	7	1	14	12	0	2	9	10	6	2	2	15	11	3	7	17	12	3	2
3	Without Manure (1846, and since)	(2	3[3])	(1	4[3])	(2	18[3])	(1	0[3])	1	5	0	16	3	2	1	9	4	17	2	16
4	400 lbs. Basic Slag, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	1	5	0	11	3	15	1	8	2	9	0	13	6	2	1	10	6	16	1	9
5	400 lbs. Basic Slag	0	11	0	9	1	1	0	10	0	5	0	4	1	19	1	2	3	11	1	19
6	400 lbs. Basic Slag, 500 lbs. Sulphate Potash	0	18	0	10	1	15	0	15	2	2	0	13	4	4	1	2	6	14	1	10
7	400 lbs. Basic Slag, 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts (1)	1	3	0	10	2	3	0	18	2	5	0	13	3	16	1	2	6	2	1	10
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	0	5	0	5	0	9	0	7	0	11	0	9	4	10	2	4	3	9	1	17
9	Farmyard Manure (14 tons), 400 lbs. Basic Slag (2)	..		..		..		..		7	9	2	13	..		..		..		..	

TWENTY-FIFTH SEASON, 1900. Mineral Manures and Rape-cake sown April 21 and 23; Ammonium-salts and Nitrate of Soda sown July 18 and 19. Seed drilled May 11; Plot 9, dibbled May 11 and 12; Crop taken up, October 30 to November 24. Favourable Season, unusually even plant, and high produce.

1	Farmyard Manure (14 tons)	25	5	2	3	41	6	4	7	26	2	3	13	27	13	3	11	30	7	3	2
2	Farmyard Manure (14 tons), 400 lbs. Basic Slag, and 500 lbs. Sul. Pot.	28	1	2	12	41	17	5	0	35	14	5	12	38	8	6	0	35	11	3	11
3	Without Manure (1846, and since)	(9	10[3])	(1	4[3])	(29	14[3])	(4	4[3])	12	13	3	12	13	2	2	14	15	2	2	12
4	400 lbs. Basic Slag, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	8	15	1	2	33	2	4	19	28	19	3	5	43	4	6	6	34	11	3	16
5	400 lbs. Basic Slag	9	3	1	6	28	7	3	17	12	0	2	19	14	19	2	3	14	18	2	12
6	400 lbs. Basic Slag, 500 lbs. Sulphate Potash	7	1	0	19	29	13	3	12	28	4	3	12	37	11	5	13	29	8	2	19
7	400 lbs. Basic Slag, 500 lbs. Sulphate Potash, 36½ lbs. Am.-Salts (1)	10	16	1	7	28	14	4	17	28	14	5	2	36	19	7	4	29	4	4	4
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	7	15	1	3	22	11	4	17	12	17	3	13	15	13	3	7	15	8	3	8
9	Farmyard Manure (14 tons), 400 lbs. Basic Slag (2)	..		..		..		..		22	8	5	8	..		..		..		..	

AVERAGE OF 5 SEASONS, 1896, '97, '98, '99, and 1900.

1	Farmyard Manure (14 tons)	17	8	3	1	26	18	5	2	18	14	4	8	20	10	4	15	22	5	4	9
2	Farmyard Manure (14 tons), 400 lbs. Basic Slag, and 500 lbs. Sul. Pot.	18	19	3	1	28	1	5	9	23	15	5	3	25	16	5	14	24	15	4	11
3	Without Manure (1846, and since)	(6	7[3])	(1	7[3])	(18	5[3])	(4	7[3])	6	19	2	18	7	17	2	17	8	19	2	17
4	400 lbs. Basic Slag, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia	5	9	1	2	18	19	4	15	14	19	2	18	24	5	4	10	20	17	3	4
5	400 lbs. Basic Slag	5	0	1	2	16	3	3	16	6	12	2	11	7	12	2	12	8	0	2	13
6	400 lbs. Basic Slag, 500 lbs. Sulphate Potash	4	8	0	19	16	9	3	16	14	13	3	1	20	14	4	10	18	1	2	17
7	400 lbs. Basic Slag, 500 lbs. Sulphate Potash, 36½ lbs. Am.-Salts. (1)	5	17	1	4	16	1	4	3	14	17	3	7	21	0	4	17	18	3	3	7
8	Unmanured, 1853, and since; previously part Unman., part Superphos.	4	1	1	0	11	9	3	13	6	4	2	9	8	14	3	3	8	6	2	17
9	Farmyard Manure (14 tons). 400 lbs. Basic Slag (2)	..		..		..		..		16	4	4	9	..		..		..		..	

(1) "Ammonium-salts" equal parts Sulphate and Muriate of Ammonia of Commerce.
(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 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, and in a less degree on to Plot 3, Series 2, there is no doubt that these results (as those given in 1895) are too high.

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EXPERIMENTS ON **MANGEL WURZEL.**—BARN FIELD—*continued.*—SUMMARY OF THE COMPOSITION OF THE MANGEL ROOTS IN THE TWENTY-FIRST, TWENTY-SECOND, TWENTY-THIRD, TWENTY-FOURTH, AND TWENTY-FIFTH SEASONS, 1896, 1897, 1898, 1899, AND 1900.

For particulars of the composition in the first 20 Years, 1876–1895, see pp. 64–5, 68–9, 72–3, and 76–7.

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 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. 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. 64. In selected cases of the crops of the twentieth, twenty-second, twenty-third, twenty-fourth, and twenty-fifth seasons, 1895, 1897, 1898, 1899, and 1900, sugar was again determined. In each year both in an aqueous, and in an alcoholic extract of the pulp, and the results given in the Table are the means of these determinations, which agreed very closely, calculated into their percentage in the original root. In 1898 and 1899 determinations of sugar were also made in the expressed juice, but these results are not included in those given in the Table below.

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.

Plots.	Abbreviated Description of Standard Manures. — For details, see pp. 78–9.	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.			
		Mean Per Cent. Total Dry Matter, Sugar, Mineral Matter (Crude Ash), and Nitrogen in the Roots.																			
		Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.	Dry Matter.	Sugar.	Ash.	Nitrogen.
		Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
	Twenty-first Season, 1896.																				
1	Farmyard Manure	10·73		0.915		8·69		1·029		9·61		0·908		9·56		0·901		10·36		0·944	
2	Farmyard Manure, Slag, & Pot.	10·81		0·899		9·03		1·033		10·66		1·026		10·46		1·033		10·10		1·012	
3	Unmanured (1846, & since) ..	14·02		0·760		10·70		0·892		13·63		0·789		12·29		0·731		11·77		0·755	
4	Basic Slag, & Pot., Sod., & Mag.	12·42		0·905	0·119	9·52		1·066	0·169	11·02		1·005	0·160	9·38		1·056	0·200	10·15		0 986	0·165
5	Basic Slag	13·63		0·684	0·122	9·29		0·797	0·185	12·84		0·780	0·289	11·77		0·803	0·285	12·30		0·755	0·260
6	Basic Slag, & Potash	13·32		0·837	0·124	10·22		0·940	0·182	11·40		0·938	0·186	10·78		1·018	0·237	10·36		0·919	0·200
7	Slag, Pot., & 36½ lb. Am.-slts.	13·73		0·876		..		..		..		..		..		..		..		..	
8	Unmanured (1853, & since) ..	..		..		..		..		..		..		..		..		..		..	
9	Farmyard Manure, & Basic Slag	..		..		..		..		..		..		..		..		..		..	
	Twenty-second Season, 1897.																				
1	Farmyard Manure	14·91		0·834	0·187	13·79	8·87	0·886	0·222	12·98		0·819	0·227	13·64		0·821	0·259	13·29	8·19	0·850	0·256
2	Farmyard Manure, Slag, & Pot.	14·80		0 873	0·185	12·99	8·03	0·934	0·217	13·47		0·953	0·229	12·92		0·967	0·249	13·85	8·52	0·812	0·229
3	Unmanured (1846, & since) ..	16·65		0·670		14·32		0·793		15·48		0·589		14·26		0·634		14·54		0·609	
4	Basic Slag, & Pot., Sod., & Mag.	15·89	10·11	0·865	0·147	13·76	8·53	0·976	0·201	14·86	9·23	0·996	0·196	13·32	8·10	0·944	0·212	13·46	8·32	0·901	0·188
5	Basic Slag	15·91	10·08	0·671	0·142	14·23	9·03	0·826	0·214	14·76	8·88	0·606	0·254	14·03	8·10	0·608	0·299	14·51	8·77	0·629	0·264
6	Basic Slag, & Potash	15·23	9·56	0·785	0·132	13·17	8·05	0·952	0·191	14·94	9·12	0·958	0·179	13·47	8·22	0·947	0·227	14·72	9·37	0·834	0·206
7	Slag, Pot., & 36½ lb. Am.-slts.	15·95		0·856		..		..		..		..		..		..		13·82		0·838	
8	Unmanured (1853, & since) ..	..		..		..		..		..				..		..		..		..	
9	Farmyard Manure, & Basic Slag	..		..		..		..		13·61		0·795		..		..		..		..	

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	Twenty-third Season, 1898.																				
1	Farmyard Manure	14·02	8·85	0·809	0·154	11·53	5·18	1·011	0·225	12·39	6·50	0·929	0·267	12·26	5·93	0·894	0·285	13·21	8·07	0·825	0·244
2	Farmyard Manure, Slag, & Pot.	13·78	8·48	0·954	0·192	11·48	5·03	0·997	0·206	12·97	6·96	0·990	0·224	13·32	6·96	0·984	0·297	13·87	8·10	0·937	0·226
3	Unmanured (1846, & since) ..	14·93		0·702		10·77		0·873		12·33		0·793		11·53		0·797	0·281	12·33		0·695	
4	Basic Slag, & Pot., Sod., & Mag.	14·57	8·62	0·841	0·095	10·80	4·64	1·086	0·198	13·88	8·32	1·052	0·117	13·03	6·92	1·043	0·192	13·94	8·35	0·917	0·131
5	Basic Slag	14·13	8·67	0·676	0·101	10·98	3·86	0·924	0·175	11·94	5·80	0·776	0·174	10·78	4·47	0·896	0·261	11·41	5·66	0·659	0·237
6	Basic Slag, & Potash	14·66	9·09	0·795	0·109	11·90	5·37	0·972	0·188	13·60	8·03	1·002	0·118	13·83	7·68	1·038	0·243	14·57	9·35	0·835	0·194
7	Slag, Pot, & 36½ lb. Am.-slts.	14·25		0·839	0·097	12·21		0·999		13·49		0·912		13·33		0·990		13·38		0·904	
8	Unmanured (1853, & since) ..	14·98		0·729		11·84		0·867		13·43		0·774		10·94		0·864		12·44		0·669	
9	Farmyard Manure, & Basic Slag	..		..		..		..		13·07		0·965		..		..		..		..	
	Twenty-fourth Season, 1899.																				
1	Farmyard Manure	11·66	7·02	0·937	0·212	9·36	4·97	1·071	0·280	11·01	5·87	0·934	0·266	11·63	6·22	0·892	0·289	12·73	7·35	0·812	0·223
2	Farmyard Manure, Slag, & Pot.	11·34	6·85	0·956	0·217	9·49	4·86	1·067	0·251	10·30	5·31	1·102	0·243	11·61	6·75	1·050	0·278	11·93	7·02	0·941	0·224
3	Unmanured (1846, & since) ..	15·48		0·873		12·06		0·934		15·27		0·872		13·90		0·881		14·10		0·744	
4	Basic Slag, & Pot., Sod., & Mag.	11·79		1·196	0·243	10·96		1·129	0.201	10·16		1·206	0·270	10·89		1·237	0·263	10·66		1·215	0·271
5	Basic Slag	13·71		0·818	0·263	10·79		1·056	0·288	14·57		0·884	0·316	13·63		0·802	0·285	14·49		0·736	0·322
6	Basic Slag, & Potash	13·71		1·106	0·272	12·42		1·075	0·270	11·99		1·208	0.260	11·76		1·108	0·262	11·75		1·033	0·266
7	Slag, Pot., & 36½ lb. Am.-slts.	..		..		..		..		..		..		..		..		..		..	
8	Unmanured (1853, & since) ..	..		..		..		..		..		..		..		..		..		..	
9	Farmyard Manure, & Basic Slag	..		..		..		..		12·76		0·982	0·293	..		..		..		..	
	Twenty-fifth Season, 1900.																				
1	Farmyard Manure	12·77	8·13	0·793	0·136	11·57	6·38	0·881	0·180	11·04	6·08	0·856	0·223	10·83	5·68	0·878	0·232	11·21	6·55	0·794	0·193
2	Farmyard Manure, Slag, & Pot.	12·32	7·72	0·895	0·151	10·82	5·84	0·951	0·184	11·33	6·15	1·033	0·207	11·17	5·58	0·995	0·229	12·18	6·68	0·934	0·201
3	Unmanured (1846, & since) ..	15·42		0·706		11·63		0·832		13·26		0·716		11·87		0·768		13·39		0·648	
4	Basic Slag, & Pot., Sod., & Mag.	14·17	9·34	0·861	0·098	11·03	6·42	0·988	0·170	12·52	7·68	1·053	0·161	10·42	5·17	1·116	0·187	11·29	6·66	0·970	0·135
5	Basic Slag	14·93	10·20	0·685	0·114	11·77	6·65	0·832	0·174	11·86	6·64	0·786	0·258	11·27	5·58	0·855	0·291	12·42	7·04	0·702	0·238
6	Basic Slag, & Potash	14·90	10·14	0·824	0·111	11·92	6·74	0·937	0·182	13·41	8·77	1·012	0·152	11·09	5·98	1·061	0·200	12·26	7·24	0·924	0·173
7	Slag, Pot., & 36½ lb. Am.-slts.	..		..		..		..		..		..		..		..		..		..	
8	Unmanured (1853, & since) ..	..		..		..		..		..		..		..		..		..		..	
9	Farmyard Manure, & Basic Slag	..		..		..		..		12·09		0·907		..		..		..		..	
	Average of Five Seasons, 1896, '97, '98, '99, and 1900.																				
1	Farmyard Manure	12·82		0·858	0·172[1]	10·99		0·976	0·227[1]	11·41		0·889	0·246[1]	11·58		0·877	0·266[1]	12·16		0·845	0·229[1]
2	Farmyard Manure, Slag, & Pot.	12·61		0·915	0·186[1]	10·76		0·996	0·215[1]	11·75		1·021	0·226[1]	11·90		1·006	0·263[1]	12·39		0·927	0·220[1]
3	Unmanured (1846, & since) ..	15·30		0·742		11·90		0·865		13·99		0·752		12·77		0·762		13·23		0·690	
4	Basic Slag, & Pot., Sod., & Mag.	13·77		0·934	0·140	11·21		1·049	0·188	12·49		1·062	0·181	11·41		1·079	0·211	11·90		0·998	0·178
5	Basic Slag	14·46		0·707	0·148	11·41		0·887	0·207	13·19		0·766	0·258	12·30		0·793	0·284	13·03		0·696	0·264
6	Basic Slag, & Potash	14·36		0·869	0·150	11·93		0·975	0·203	13·07		1·024	0·179	12·19		1·034	0·234	12·73		0·909	0·208
7	Slag, Pot., & 36½ lb. Am.-slts.	..																			
8	Unmanured (1853, & since) ..	..																			
9	Farmyard Manure, & Basic Slag	..								12·88[1]		0·912[1]									

(1) Averages for 4 years only, 1897–1900.

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

Below are given the particulars of the Manures for the Twenty-sixth Season, 1901. For the Manures and Produce of the 25 preceding seasons, see pp. 62–3, 66–7, 70–1, 74–5, and 78–9.

The arrangement of the plots, and of the manures, is substantially the same as it was for the 25 preceding years of Mangels (see pp. 62–3, 66–7, 70–1, 74–5, and 78–9), and also practically the same as previously for Sugar-beet (see pp. 58–9); excepting that Plot 9, which was unmanured for Sugar-beet, and also previously for Swedes, 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 in 1897 and previously, but 10 inches only in 1898 and since (1). 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.)

Plots.	Standard Manures.	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." (2)	Series 4. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake and 400 lbs. "Ammonium-Salts." (2)	Series 5. Standard Manures, and Cross-dressed with 2000 lbs. Rape-cake.
		Manures per Acre per Annum.				
	Twenty-sixth Season, 1901. Mineral Manures and Rape-cake sown April 30, and May 1; Ammonium-salts and Nitrate of Soda sown . Seed drilled May 4 and 6; Plot 9, dibbled May 6; Crop taken up .					

Plots.	Standard Manures.	Series 1. Roots.	Series 1. Leaves.	Series 2. Roots.	Series 2. Leaves.	Series 3. Roots.	Series 3. Leaves.	Series 4. Roots.	Series 4. Leaves.	Series 5. Roots.	Series 5. Leaves.
		Produce per Acre.									
		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)										
2	Farmyard Manure (14 tons), 450 lbs. Basic Slag, and 500 lbs. Sul. Pot.										
3	Without Manure (1846, and since)										
4	{400 lbs. Basic Slag, 500 lbs. Sulphate Potash, 200 lbs. Chloride Sodium (common salt), 200 lbs. Sulphate Magnesia .. .. ..}										
5	400 lbs. Basic Slag										
6	400 lbs. Basic Slag, 500 lbs. Sulphate Potash										
	400 lbs. Basic Slag, 500 lbs. Sulphate Potash, 36½ lbs. Am.-salts ..										
	Unmanured, 1853, and since; previously part Unman., part Superphos.										
	Farmyard Manure (14 tons), 450 lbs. Basic Slag (1)										
1											
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(1) 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.
(2) "Ammonium-salts" equal parts Sulphate and Muriate of Ammonia of Commerce. In 1901, the north half of each plot of Series 2 and 3 received instead of "Ammonium-salts" as here stated, Bicarbonate of Ammonia containing an equivalent amount of Nitrogen.

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Experiments on SUGAR-BEET.—BARN FIELD, ROTHAMSTED.

New Series—commencing in 1898.

Experiments on the growth of Sugar-beet were made at Rothamsted during 5 consecutive years, 1871–5; for the particulars and results of which see pp. 58–61. For summary, and discussion thereof, see No. 92, pp. 27–41, No. 93, pp. 31–48, and No. 97, in the list of papers of Series I., given at p. 14.

Having regard to the renewed interest taken in the question of the growth of Sugar-beet, and the profitable production of sugar from it, in this country, it was decided in 1898 to make some new experiments at Rothamsted on the subject. A special object was, to obtain, in a greater degree than in the earlier experiments, both fair luxuriance, and at the same time adequate ripening; so as to ensure both high percentage of sugar, and high yield of sugar per acre. It was obviously essential to employ seed of the most approved description at the present time. Accordingly, we wrote to Messrs. Vilmorin & Co., of Paris, who sent us seed of their "*White Green Top Brabant.*" Two sets of experiments were made in Barn Field in 1898.

The First Set.—These were conducted on short lengths of land in the valley between Series I. and Series II. of the Mangel plots; and they received, respectively, the same mineral manures as the Mangels. One-third of the length had the mineral manures only; one-third the mineral manures and 2 cwts. of Sulphate of Ammonia per acre; and one-third the mineral manures and 272 lbs. Nitrate of Soda in addition (containing the same amount of Nitrogen as the Sulphate of Ammonia). The rows being in continuation of those of the Mangels, they were necessarily of the same distance apart—26 inches; and the Sugar-beet seed was, as was that of the Mangels, sown on ridges. The Sugar-beet seed was, however, dibbled, and at only 8 inches apart in the rows.

The seed was sown on April 19 and 20 (1898); and the nitrogenous manures were top-dressed on July 11, after which there was scarcely any rain until the 27th and 28th, when nearly an inch fell. In August there was less than half the average fall, and in September less than a quarter the average; whilst in August, and in each month to the end of the year, the temperature was over average. The result was, that the nitrogenous manures showed very little effect. In October, when the crops ought to have been ready to take up, there was a fair amount of rain, and, the weather being open and warm, the crops were allowed to stand, to see if there would be more effect from the nitrogenous manures. There proved to be some irregularity of the soils of this set of experiments; and, independently of this, on the one hand, the drought limited luxuriance, whilst on the other, the high temperatures favoured the formation of sugar. The result was, high percentage of sugar in the roots, but, with low amounts of produce, low produce of sugar per acre.

The summary of the results obtained on Plots 4 and 5, given in the Table below, will clearly illustrate the character of the crops, both as to quantity and quality.

In the case of Mangels, the sugar is determined in the roots with little more of trimming than is usual in the field for a feeding crop, and the sugar per acre is calculated on the weight of the crop as carted. In the case of Sugar-beet grown for the manufacture of sugar, however, the sugar is determined in the roots with the crowns trimmed off, and the sugar per acre is calculated on the weight of roots per acre in the cleaned and so trimmed condition. The three upper divisions of the Table show the produce of roots per acre as carted, the weight of leaf, and the proportion of leaf to 1,000 root. The subsequent divisions show the produce per acre of the cleaned and trimmed roots, the percentage of sugar in them, and the sugar per acre in the cleaned and trimmed roots.

The plots having received no nitrogenous manure for many years, the yield with the mineral manure alone was only between 6 and 7 tons per acre; and when trimmed as for sugar, little over 6 tons. With the very restricted action of the nitrogenous manures owing to drought, there was very little increase by the Ammonium-salts, and much less than there should have been by the Nitrate of Soda. It will be seen, however, that there was distinctly more effect from the nitrogenous manures when Basic Slag was used with Potash, Soda, and Magnesia, than with Basic Slag alone. With the restricted growth, but favourable temperature for sugar-formation, the percentage of sugar in the roots was fairly high, averaging more than 14. With the limited produce of roots, the produce of sugar per acre was, on Plot 4, with the full mineral manure alone, 2,031 lb.; with Sulphate of Ammonia added, 2,274 lb.; and with Nitrate of Soda added, 3,524 lb. Thus, therefore, with the plants so wide apart, and with such limited action of the nitrogenous manures owing to season, there was still, with the full mineral manure and Nitrate of Soda, rather more than 1½ ton of sugar per acre.

Plot.	Standard Manures.	Series 1. Standard Manures only.	Standard Manures, and— Series 2. 2 cwts. Sulphate of Ammonia, = 43 lbs. Nitrogen.	Series 3. 272 lbs. Nitrate of Soda, = 43 lbs. Nitrogen.
	Produce of Roots (as Carted) per Acre.			
		Tons cwts.	Tons cwts.	Tons cwts.
4	Basic Slag, and Potash, Soda, and Magnesia	6 15	7 13	11 18
5	Basic Slag only	6 9	6 6	10 4
	Produce of Leaf per Acre.			
4	Basic Slag, and Potash, Soda, and Magnesia	1 11	1 17	2 16
5	Basic Slag only	1 7	1 12	2 8
	Leaf to 1,000 Root.			
4	Basic Slag, and Potash, Soda, and Magnesia	229	245	237
5	Basic Slag only	210	251	234
	Produce of "Cleaned and Trimmed" Roots per Acre—Tons, Cwts.			
4	Basic Slag, and Potash, Soda, and Magnesia	6 5	7 2	11 1
5	Basic Slag only	6 0	5 18	9 10
	Sugar in "Cleaned and Trimmed" Roots—Per Cent.			
4	Basic Slag, and Potash, Soda, and Magnesia	14·47	14·26	14·22
5	Basic Slag only	14·02	13·99	14·63
	Sugar in "Cleaned and Trimmed" Roots per Acre—Lbs.			
4	Basic Slag, and Potash, Soda, and Magnesia	2,031	2,274	3,524
5	Basic Slag only	1,886	1,842	3,108

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Experiments on SUGAR-BEET.—BARN FIELD, ROTHAMSTED.

New Series—commencing in 1898.

The Second Set.—This set of experiments was carried out on a portion of Plot 9 of the Mangel-land, which had received Dung and Phosphate, and some Ammonium-salts, for 22 years in succession, 1876–97. Unlike the soil on which the first set was conducted, the soil of this set was, therefore, in high condition, so far as previous treatment was concerned. The land was subsoiled, and received a good deal of extra working, in order to secure a good tilth and seed bed. Mineral manure was applied over the whole on April 6, at the rate of 500 lbs. Sulphate of Potash, and 400 lbs. of Basic Slag per acre. Owing, however, to the additional mechanical operations, and the intervention of rain delaying the working of the land, the seed was not dibbled until May 12, or rather more than three weeks later than the first set. The seed was put in on the flat, in rows 15 inches apart, with 8 inches apart in the rows. One-third of the area had the mineral manures alone; one-third 2 cwts. per acre of Sulphate of Ammonia in addition; and the other third 272 lbs. Nitrate of Soda per acre in addition. As in the case of the first set, the nitrogenous manures were top-dressed on July 11; after which, as has already been explained, there was great deficiency of rain until October, when a fair amount fell; and, as the weather remained open and warm, the crops were allowed to stand, to see if there would be more effect from the nitrogenous manures. There was, in fact, considerable extension of growth of the leaves; but after a time it became a question whether the increased growth of leaf was not in part at the expense of the roots. The weather still remaining favourable, the crops were left standing until the middle of December; but sugar was determined in samples taken on November 22 and 23, and also on December 5 and 6. The results showed, in some cases, a rather lower percentage at the later date; indicating that the increase in the growth of leaves had been, at any rate to some extent, at the expense of the roots. The mean of the results at the two dates is adopted. The Table below gives a summary of the results.

It will be seen that, with the high condition of the land, the produce of roots in 1898 was with mineral manure alone more than 16 tons gross, and nearly 15 tons trimmed—that is about 2½ times as much as in the case of the first set; whilst, owing to the limited action of the nitrogenous manures from drought, there was very little increase of root, but more of leaf, by the addition of these manures. Under these circumstances, the proportion of leaf to 1,000 of root was more than it should be in favourably matured Sugar-beet, and this was the case notwithstanding that the plants were grown so close together. The percentage of sugar in the roots was, therefore, lower than it would have been if the roots had been taken up at their best stage of maturation, that is, before the second growth of leaf. Nevertheless, there was a produce of trimmed roots of about 15 tons per acre; and a yield of sugar per acre in the roots reckoned as cleaned and trimmed, of 4,292 lbs. with the mineral manure alone, 4,365 lbs. with the mineral manure and Sulphate of Ammonia, and 4,402 lbs. with the mineral manure and Nitrate of Soda; that is, nearly 2 tons of sugar per acre.

It was decided not to repeat the first set of experiments—those in the valley between Series I. and Series II. of the Mangels. But those of the second set, under more suitable circumstances as to the condition of the land, and as to distance apart of the plants, are continued. In 1898, the rows were 15 inches apart, but 17 inches in 1899 and since; in each year 8 inches from plant to plant in the rows. The same mineral manures as in 1898 have been applied in each year since.

In 1899, the condition of the land and of the weather being favourable, the same amounts of Sulphate of Ammonia and of Nitrate of Soda were sown, and harrowed in, on May 2, instead of being left for top-dressing later; and the seed was afterwards dibbled, also on May 2, as stated in the Table below. Owing, however, to drought, the plant to a great extent failed, and the blanks were filled in by transplanting; but the growth was restricted from continued deficiency of rain.

In 1900, the nitrogenous manures were top-dressed on July 19, and the season being throughout favourable, there was considerable increase both of roots and of sugar obtained by their use. The percentage of sugar in the roots is seen to be a good deal higher than in 1898, and the produce of sugar per acre was, with the mineral manure alone 4,096 lbs., with Sulphate of Ammonia in addition 5,631 lbs., and with Nitrate of Soda in addition 5,643 lbs.

Plot.	Manures per Acre.	Produce per Acre. Roots (as carted).		Produce per Acre. Leaf.		Proportion of Leaf to 1,000 of Root.	Produce of "Cleaned and Trimmed" Roots per Acre.		Sugar in "Cleaned and Trimmed" Roots. Per Cent.	Sugar in "Cleaned and Trimmed" Roots. Per Acre.
	Season 1898. Mineral Manures sown April 6; Seed dibbled May 12 and 13; Nitrogenous Manures top-dressed July 11; Crop taken up Dec. 16–19.									
		Tons	cwts.	Tons	cwts.		Tons	cwts.	Per cent.	lbs.
9–1	400 lbs. Basic Slag, and 500 lbs. Sul. Potash	16	3	4	16	293	14	14	13·03	4,292
9–2	400 lbs. Basic Slag, and 500 lbs. Sul Potash, and 2 cwts. Sul. Ammonia	16	19	5	14	335	15	9	12·62	4,365
9–3	400 lbs. Basic Slag, and 500 lbs. Sul. Potash, and 272 lbs. Nitrate of Soda	16	10	6	2	371	15	1	13·05	4,402
	Season 1899. Mineral Manures sown April 12; Nitrogenous Manures sown May 2; Seed dibbled May 2; Crop taken up, Oct. 21 and 23.									
9–1	400 lbs. Basic Slag, and 500 lbs. Sul. Potash	8	18	4	14	525				
9–2	400 lbs. Basic Slag, and 500 lbs. Sul. Potash, and 2 cwts. Sul. Ammonia	9	0	6	7	707				
9–3	400 lbs. Basic Slag, and 500 lbs. Sul. Potash, and 272 lbs. Nitrate of Soda	8	4	7	12	923				
	Season 1900. Mineral Manures sown April 23; Nitrogenous Manures sown July 19; Seed dibbled May 11; Crop taken up, Nov. 22–24.									
9–1	400 lbs. Basic Slag, and 500 lbs. Sul. Potash	13	7	3	16	284	12	9	14·69	4,096
9–2	400 lbs. Basic Slag, and 500 lbs. Sul. Potash, and 2 cwts. Sul. Ammonia	18	13	5	19	318	17	8	14·46	5,631
9–3	400 lbs. Basic Slag, and 500 lbs. Sul. Potash, and 272 lbs. Nitrate of Soda	18	13	6	2	326	17	7	14·50	5,643
	Season 1901. Mineral Manures sown May 1; Nitrogenous Manures sown ; Seed dibbled May 13; Crop taken up,									
9–1	400 lbs. Basic Slag, and 500 lbs. Sul. Potash									
9–2	400 lbs. Basic Slag, and 500 lbs. Sul. Potash, and 2 cwts. Sul. Ammonia									
9–3	400 lbs. Basic Slag, and 500 lbs. Sul. Potash, and 272 lbs. Nitrate of Soda									
9–1										
9–2										
9–3										

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