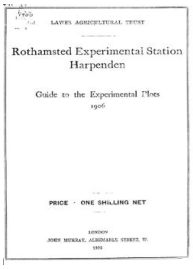
Rothamsted Experimental Station - Guide to the Experimental Plots 1906



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Rothamsted Research

Rothamsted Research (1906) *Barn Field - Mangel Wurzel ;* Rothamsted Experimental Station - Guide To The Experimental Plots 1906, pp 9 - 16 **- DOI: https://doi.org/10.23637/ERADOC-1-140**

The diagram, Fig. 2, shows in a graphic form the benefit the whole rotation receives from the growth of clover, even when the root crop receives nitrogenous manures.

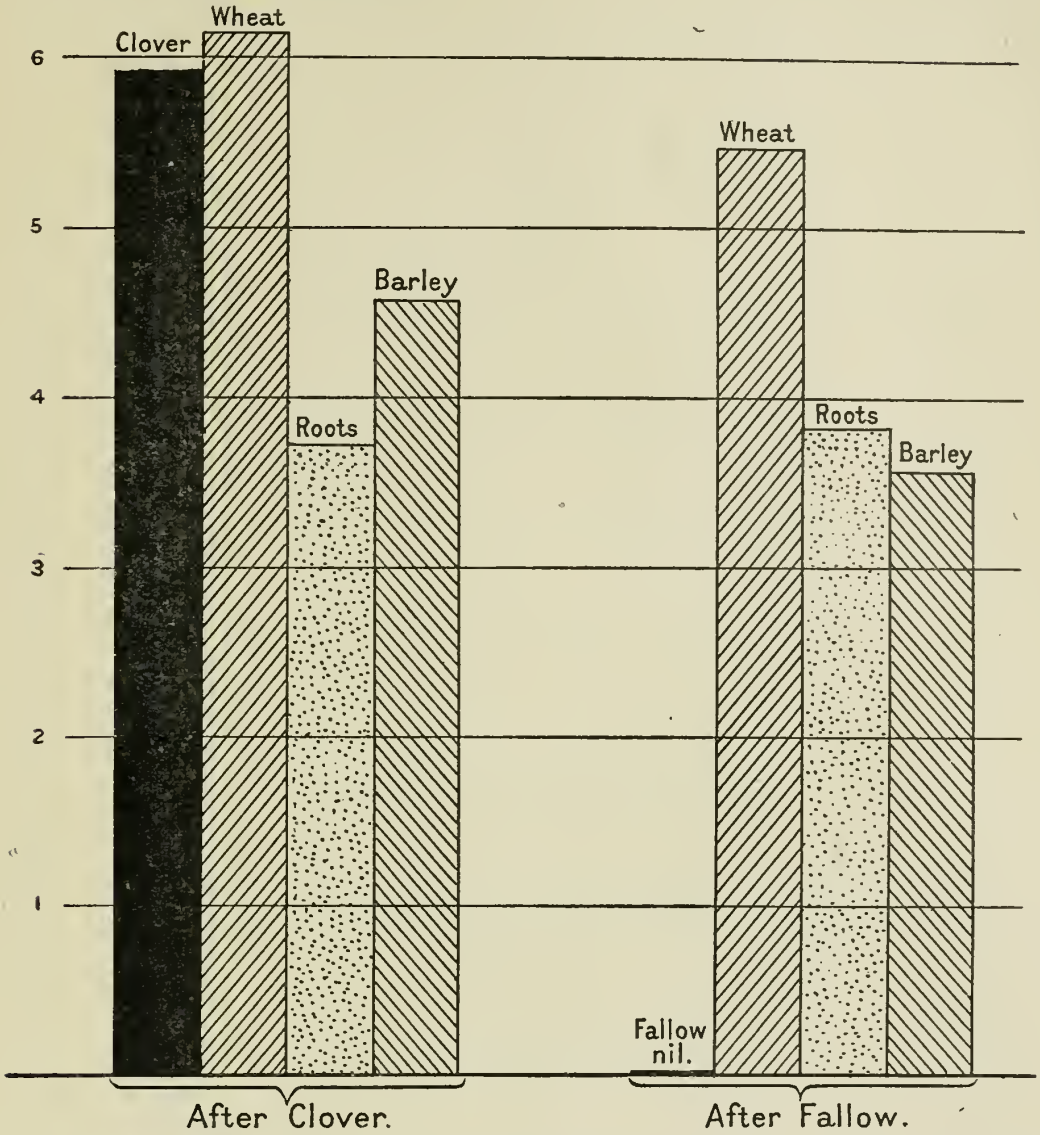

Fig. 2.—Comparative Effect of Clover or Bare Fallow on the succeeding Crops in the Rotation. Total Produce—In 1000 lb. for Clover, Wheat, and Barley, and in 100 cwt. for Roots.

BARN FIELD

Mangel Wurzel

The experiments upon mangels began in 1876, but the land had been receiving similar manures for other root crops since 1856.

The field is divided longitudinally into eight strips running the whole length of the field; each of these strips receives one manure throughout its length; farmyard manure alone on Strip 1, and in combination with superphosphate and sulphate of potash on Strip 2, nothing on Strip 8, superphosphate alone on Strip 5, superphosphate and sulphate of potash on Strip 6, and complete minerals, including sulphate of magnesia and

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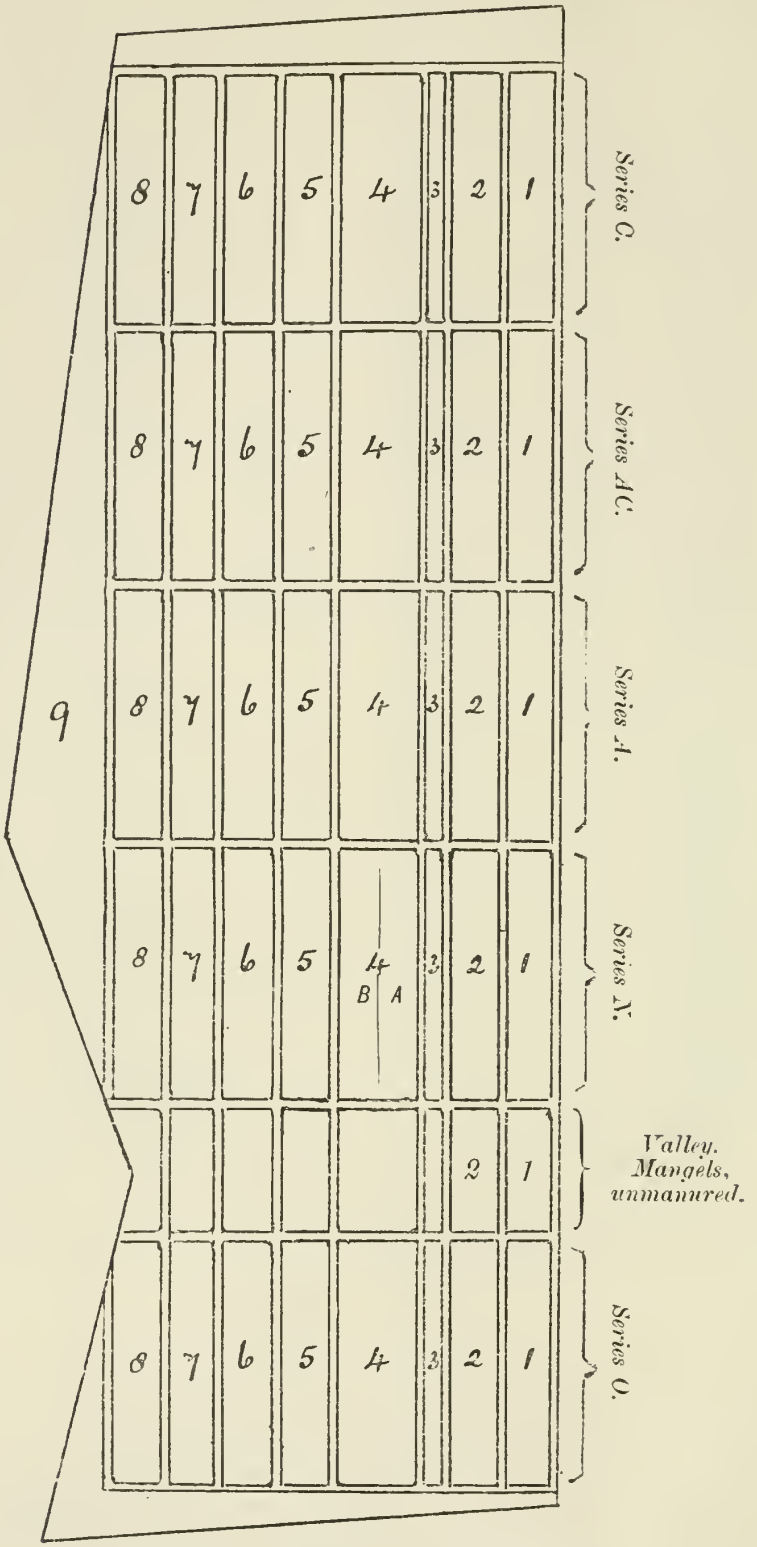
B.—*Plan of the Plots in Barn Field on which Experiments have been made with Root Crops.*

1843 and onwards.



Total area of ploughed land, about 8 acres.

Area of Plots { 1, 2, 5, 6, 7, and 8, of each Series, rather over $\frac{1}{7}$ acre.
3, of each Series, about $\frac{1}{27}$ acre.
4, of each Series, about $\frac{1}{5}$ acre.
9, rather over $\frac{4}{10}$ acre.

The double lines indicate division paths between plot and plot.

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common salt, on Strip 4. The strips are then subdivided into plots by cross-dressings of nitrogenous manures; nothing on the O Series, nitrate of soda on Series N, ammonium-salts on Series A, rape cake on Series C, and a combination of ammonium-salts and rape cake on Series AC.

TABLE V.—*Experiments on Mangel Wurzel, Barn Field, beginning* 1876. *Quantities of Manures per acre per annum.*

Strip.	Strip Manures					Nitrogenous Manures running across all the Strips.					
						Series O.	N.	A.	AC.		C.
	Farmyard Manure.	Superphosphate.	Sulphate of Potash.	Sulphate of Magnesia.	Chloride of Soda. (Salt.)	None.	Nitrate of Soda.	Ammonium-salts.*	Rape Cake.	Ammonium-salts.*	Rape Cake.
	Tons	Cwt.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.	Lb.
1	14	...	...	...	...	...	550	400	2000	400	2000
2	14	3·5	500†	...	...	...	550	400	2000	400	2000
4	...	3·5	500	200	200	...	550	400	2000	400	2000
5	...	3·5	...	...	...	...	550	400	2000	400	2000
6	...	3·5	500	...	...	...	550	400	2000	400	2000
7‡	...	3·5	...	200	200	...	550	400	2000	400	2000
8	...	...	...	...	...	...	550	400	2000	400	2000

* Equal parts Sulphate and Muriate Ammonia of Commerce.
† The addition of Potash to Plot 2 began in 1895. ‡ Commenced in 1903 only.

TABLE VI.—*Barn Field Mangel Wurzel. Produce of Roots and Leaves per acre. Season* 1905.

Strip.	Strip Manures.	Cross-Dressings.				
		O.	N.	A.	AC.	C.
		None.	Nitrate of Soda.	Ammonium-salts.	Rape Cake and Ammonium-salts.	Rape Cake.
		Tons.	Tons.	Tons.	Tons.	Tons.
1	Dung only	R. 21·04 L. 4·05	33·52 5·61	24·80 5·50	25·93 5·91	24·12 5·61
2	Dung, Super., Potash	R. 21·83 L. 4·06	33·75 5·76	30·27 6·68	31·59 7·36	29·54 5·83
4	Complete Minerals	R. 3·23 L. 1·07	22·30 * 24·69 4·42 * 5·43	17·96 3·30	31·62 7·06	23·86 3·88
5	Superphosphate only	R. 3·75 L. 1·34	17·49 4·27	6·74 3·54	8·88 3·96	11·13 3·80
6	Super. and Potash	R. 3·07 L. 1·06	20·42 3·80	18·02 3·82	25·47 7·23	20·91 3·76
7	Super., Sulph. Mag., and Chloride Sodium	R. 3·47 L. 1·23	22·69 4·65	19·43 3·96	28·53 7·60	22·45 4·41
8	None	R. 2·68 L. 1·21	9·55 4·55	5·29 3·89	8·60 4·36	8·02 3·52

* Received an equivalent amount of Phosphoric Acid, Nitrogen, and Potash, but without any Soda Salts.

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The value of farmyard manure in growing mangels is evident, especially when they are grown continuously on the same land. In favourable seasons it is possible to obtain good crops by the aid of manures containing no organic matter, as seen in 1905; but in ordinary years the bad texture of the soil which results, and its tendency to lose water on account of the lack of humus, affect both the germination of the seed and the growth of the plant in its early stages.

TABLE VII.—*Barn Field Mangel Wurzel. Average produce of Roots per acre over 27 years (1876 to 1902).*

Strip.	Strip Manures.	Cross-Dressings.				
		O.	N.	A.	AC.	C.
		None.	Nitrate of Soda.	Ammonium-salts.	Rape Cake and Ammonium-salts.	Rape Cake.
		Tons.	Tons.	Tons.	Tons.	Tons.
1	Dung only . . .	17·44	24·74	21·73	24·05	23·96
2	Dung, Super., Potash* .	17·95	25·19	22·35	24·91	24·43
4	Complete Minerals .	5·36	18·01	14·86	25·49	21·33
5	Superphosphate only .	5·21	15·40	7·66	10·38	11·13
6	Super. and Potash .	4·55	15·38	14·03	22·48	18·63
8	None	3·91	10·24	5·89	9·84	10·00

* The addition of Potash to Plot 2 only began in 1895.

Effect of Nitrogen

To ascertain the effects of nitrogen, it is best to examine Strip 4, which receives a complete mineral manure with different compounds of nitrogen. Series A, which receive ammonium-salts, should also be compared with Series N, receiving nitrate of soda. The general superiority of nitrate of soda as a nitrogenous manure for mangels is most strikingly seen on Plots 5, where potash is omitted.

The diagram, Fig. 3, shows on the left hand the average results obtained with the varying amounts and compounds of nitrogen on the Plots 4 in question, where there is an abundant supply of mineral manure. The right-hand half of the diagram shows the effect of the same nitrogenous manures when used in conjunction with dung instead of complete minerals.

The injurious effects of the very large amounts of nitrogen added to some of the plots is very manifest wherever there is more nitrogen than the plant can properly deal with. The leaves have a dark green appearance, are much curled and crinkled, and show an increased tendency to variegation, the chlorophyll collecting into dark green or almost black blotches on the lighter background of the leaf. The leaf stalks are often much more coloured, and become a bright orange yellow.

On these plots the leaves do not ripen off and obtain the general yellow flaccid appearance presented on the more healthy plots when the crop is ready to lift; instead, the outer leaves begin to die and shrivel up quite early in October; in some places they show numbers of dead spots and burnt-looking patches round the edges of the leaf.

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Thus, towards the end of October, the plots receiving the excess of nitrogen present a very unhealthy appearance; a large proportion of the plants seem scorched and withered as regards the outer leaves, and only show a cluster of small dark green active leaves at the heart.

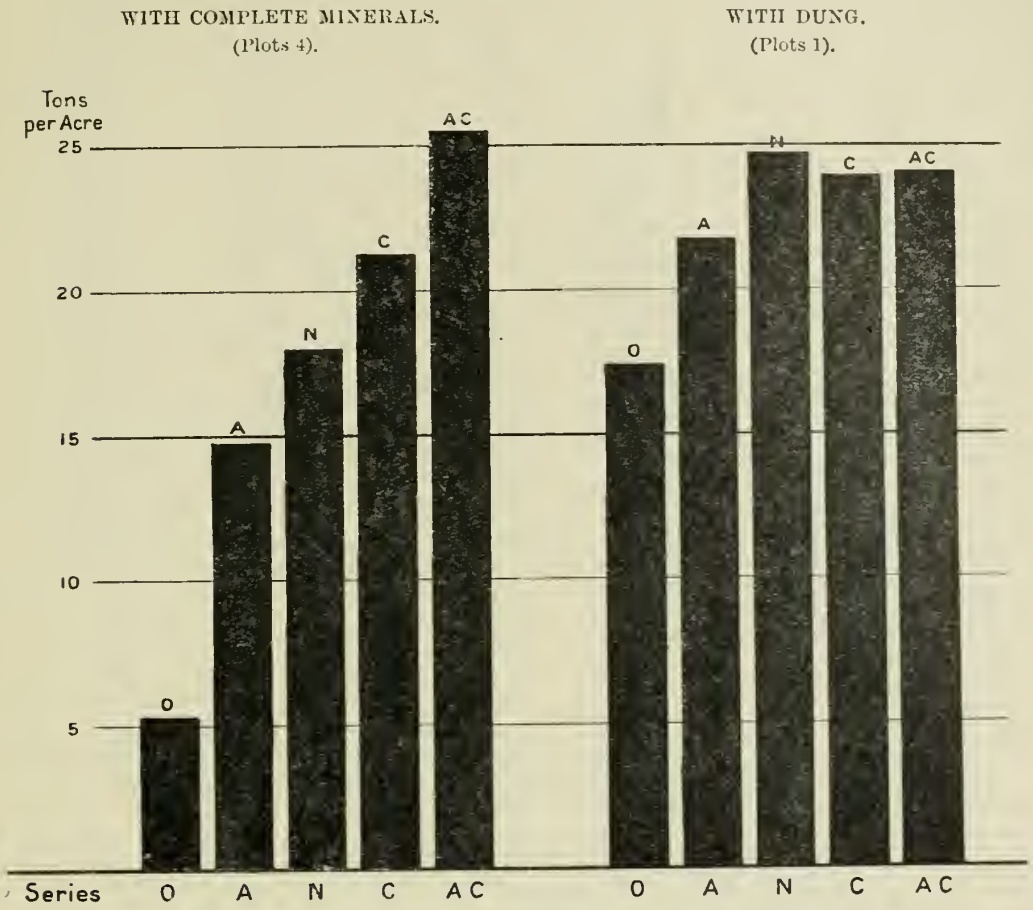

FIG. 3.—Mangel Wurzel. Effect of increasing amounts of Nitrogen. Average Produce of Roots per acre, 1876-1902.

O = No Nitrogenous Manure.
A = 86 lb. Nitrogen as Ammonium-salts.
N = 86 lb. Nitrogen as Nitrate of Soda.
C = 98 lb. Nitrogen as Rape Cake.
AC = 98 lb. Nitrogen as Rape Cake, and 86 lb. Nitrogen as Ammonium-salts.

Effect of Mineral Manures

The effect of the different mineral constituents of a manure upon the mangel crop can be seen by an examination of Plots 4, 5, and 6.

The great increase of crop comes as a rule when potash is added to the superphosphate, and is to be correlated with the fact that the mangel is essentially a sugar-producing plant, and that large supplies of potash seem to be essential to the processes in the plant which result in the formation of sugar and similar carbohydrates.

The effect of potash and of the other saline manures is plainly visible in the appearance of the plants themselves. On the plots receiving potash the plant begins to ripen early, the leaves turn yellow and become flaccid, so that in October these plots may be seen outlined from the rest by their lighter tint.

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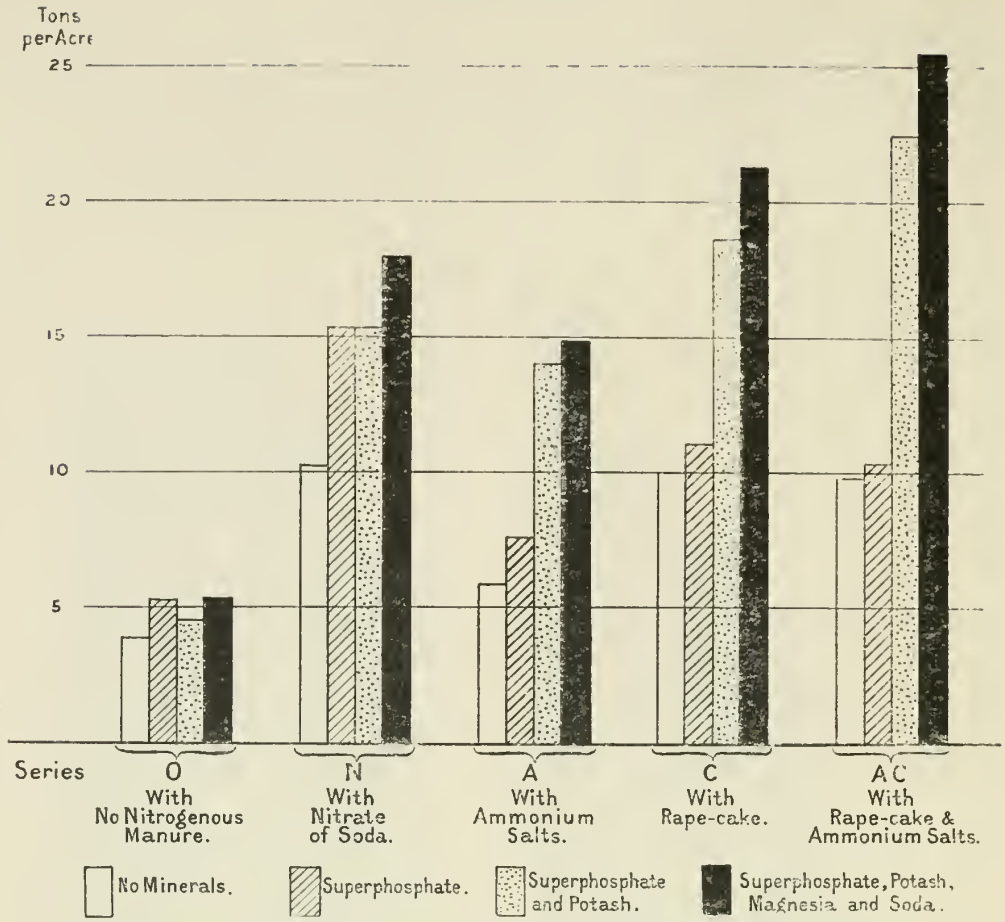

FIG. 4.—Mangel Wurzel. Effect of various Mineral Manures. Average Produce of Roots per acre, 1876-1902.

Effect of Artificial Manures with Dung

A comparison of Strip 2 with Strip 1 shows the effect of adding superphosphate and sulphate of potash to the dung and nitrogenous manures applied to Strip 1. A heavier crop and a healthier plant is obtained, especially where a large amount of nitrogenous manure is used. Since in the earlier experiments it was found that superphosphate had no beneficial effect when used with dung we can put down the superiority of Strip 2 over Strip 1 to the sulphate of potash which is now used.

Effect of Manures upon the Texture of the Soil

On the strong Rothamsted soil several of the manures employed have an injurious action upon the texture of the soil and often prevent a satisfactory tilth being obtained in the spring, to the great injury of the crop. This is particularly seen where no organic manure is used, both dung and rape cake tend to keep the land in good condition. Of the artificial manures nitrate of soda and sulphate of potash have the worst effect upon the land, making it very sticky when wet, and hard and caked when dry. Superphosphate on the contrary promotes a friable tilth.

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METEOROLOGICAL OBSERVATIONS

The rainfall has been measured at Rothamsted since February 1853 in a 5-inch funnel gauge, and in a rectangular gauge (7 feet 3·12 inches by 6 feet), having an area of one-thousandth acre.

In addition to these gauges, an 8-inch Board of Trade gauge has been employed since January 1881. The ground on which the gauges are situated is 420 feet above sea-level.

The amount of water percolating through bare soil has been measured since 1870 by means of three drain-gauges, each having an area of one-thousandth acre. These were constructed by undermining the soil at the desired depths—20, 40, and 60 inches respectively—and inserting perforated iron plates to support the soil. When this was completed, trenches were cut round the blocks of soil, and these were then isolated by means of brick and cement walls. The external soil was then returned. The percolating water falls on to zinc funnels, from which it passes to the measuring cylinders.

Barometric and temperature records have been kept since 1873, and since July 1891 daily observations of the bright sunshine have been made by means of a Campbell-Stokes recorder.

The average yearly rainfall as measured at Rothamsted during the fifty-one years, 1853-1903, is 28·21 inches.

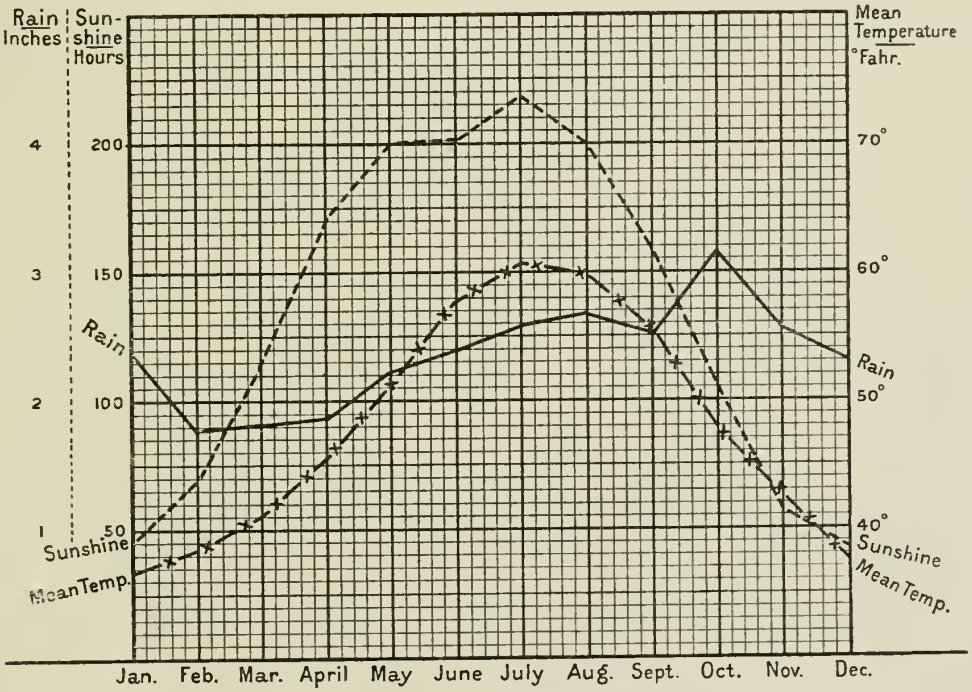

FIG. 5.—Rainfall: Average of 51 years (1853-1903).
Sunshine: Average of 11 years (1892, 1893, and 1895-1903).
Mean Temperature: Average of 26 years (1878-1903).

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TABLE VIII.—*Meteorological Summary.*

	Rainfall.			Bright Sunshine.				Temperature.		
	Average, 51 years (1853-1903).			Average, 11 years (1892, 1893, and 1895-1903).				Average, 26 years (1878-1903).		
	Total Fall.	Rainy Days.		Total.	Per cent.	Days with 0·1 hour, or more.		Means.		Min. and Max. combined.
		Actual.	Per cent.			Actual.	Per cent.	Minimum.	Maximum.	
	Inches.	No.		Hours.		No.		°F.	°F.	°F.
January .	2·35	16	52	46·4	19	16	51	31·5	41·6	36·6
February .	1·78	13	47	69·2	25	19	66	32·5	43·9	38·2
March .	1·81	13	42	114·6	32	26	85	33·5	48·3	40·9
April .	1·86	13	43	170·3	42	27	91	36·8	54·2	45·5
May .	2·22	13	42	199·9	41	29	93	42·2	60·2	51·2
June .	2·39	12	41	201·9	41	27	91	48·4	66·6	57·5
July .	2·58	13	43	217·5	44	29	95	51·7	69·7	60·7
August .	2·67	14	44	201·1	45	30	96	51·4	68·5	59·9
September .	2·51	13	44	158·3	43	27	92	47·6	64·1	55·9
October .	3·16	18	57	106·1	32	25	79	41·1	54·8	48·0
November .	2·57	17	55	57·0	22	18	58	36·8	48·3	42·6
December .	2·31	16	52	43·2	18	16	51	32·4	42·9	37·7
Whole year	28·21	171	47	1585·5	36	289	79	40·5	55·3	47·9

TABLE IX.—*Rainfall and Drainage, etc., at Rothamsted*, 1905.

	Rain.			Drainage.			Bright Sunshine.	Temperature.	
	Total Fall.		Number of Rainy Days.	Soil 20 ins. deep.	Soil 40 ins. deep.	Soil 60 ins. deep.		Max.	Min.
	5-inch Funnel Gauge.	$\frac{1}{1000}$th Acre Gauge.	$\frac{1}{1000}$th Acre Gauge.						
	Inches.	Inches.	No.	Inches.	Inches.	Inches.	Hours.	°F.	°F.
January .	1·292	1·339	10	0·703	0·772	0·755	83·6	43·1	31·7
February .	0·944	0·951	11	0·225	0·234	0·218	78·4	46·3	36·1
March .	3·487	3·573	22	2·422	2·540	2·482	125·9	51·3	36·9
April .	2·155	2·215	22	0·558	0·549	0·588	100·5	52·6	38·7
May .	1·082	1·125	8	0·069	0·073	0·104	244·1	61·3	41·5
June .	3·893	4·054	15	1·259	1·382	1·382	169·1	66·2	50·7
July .	1·402	1·473	10	0·232	0·310	0·352	264·8	73·4	55·0
August .	3·342	3·459	20	0·976	0·919	0·918	180·1	67·0	50·3
September .	2·143	2·248	12	0·713	0·739	0·702	129·2	61·5	47·9
October .	1·583	1·665	16	0·393	0·320	0·306	113·8	51·3	37·7
November .	3·127	3·231	20	2·664	2·753	2·644	60·0	46·6	33·6
December .	1·057	1·103	13	0·836	0·990	0·963	30·4	43·9	34·5
Total or Mean	25·507	26·436	179	11·050	11·581	11·414	1579·9	55·4	41·2

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