ROTHAMSTED RESEARCH

Details of the Classical and Long-term Experiments Up to 1967

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Barnfield - Formerly Mangolds and Sugar Beet

Rothamsted Research

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BARNFIELD, ROOT CROPS 1843–1959 (EXCEPT 1853–55, BARLEY), AND INTERIM TREATMENTS 1960–67

The early experimental crops on the Barnfield plots were: white turnips 1843–48, swedes 1849–52, barley 1853–55, swedes 1856–70, sugar beet 1871–75. The layout of the field and the manures applied for these crops were similar to those adopted for the mangolds, but there were some important changes. For details of dressings and yields obtained in these early years see (1). From 1876 to 1959 mangolds were grown on all plots. From 1946 four rows of sugar beet were drilled on each plot, occupying about one-third of the area. All roots were carted and all leaves and tops were spread on their respective plots and ploughed in except as mentioned under 'Yields' below. For the complete history of cropping and manuring 1843–1959 see (2).

The field is manured on a cross dressing system similar to that on Hoos Barley but with the important addition that the nitrogen treatments cross the two FYM strips. P, K, Na, Mg together with FYM are laid in various combinations on strips running north and south, the various nitrogenous manures are applied across these strips at right angles. The actual rates of manuring are given in Table 8 below:

TABLE 8

Manures applied annually 1876–1959

(Unless otherwise stated—see note 1)

(i) *Arrangement*

The main part of the experiment comprises 35 plots arranged in seven 'strips' running roughly north–south and five 'series' running at right-angles. Plot 9 lies outside this scheme. The plots of each strip receive one of certain combinations of farmyard manure and minerals; the plots of each series receive one of certain combinations of castor meal, sulphate of ammonia and nitrate of soda.

The individual plots are defined by their strip number and their series letter.

(ii) *Treatments to series*

O	None
N	Nitrate of soda to supply 86 lb N (2)
A	Sulphate of ammonia to supply 86 lb N (3)
AC	Sulphate of ammonia as series A and castor meal as series C
C	Castor meal to supply 86 lb N (4)

(iii) *Treatments to strips*

Strip		
1	D	
2	DPK	(5)
4	PKNaMg	(2)
5	P	
6	PK	
7	PNaMg	(6)
8	None	

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(iv) *Symbols, materials and rates of application*

P	363 lb superphosphate (18% P_2O_5) to supply 65 lb P_2O_5 (about 30 lb P) (7)
K	500 lb sulphate of potash (49% K_2O) supplying 245 lb K_2O (about 200 lb K)
Na	200 lb agricultural salt (sodium chloride 39·3% Na) supplying about 80 lb Na
Mg	200 lb sulphate of magnesia supplying about 20 lb Mg
D	14 tons farmyard manure

(v) Plot 9 has received treatment NKNaMg since 1903 (8)

Notes

(1) Many of the treatments were continuous from 1845. For details 1843–75 see References (2) and (5).

(2) In 1903 plot 4N was halved to test Na v. K. 4Na carried the original manures; 4Nb received superphosphate 392 lb but no sodium, N and K being given as potassium nitrate 570 lb, calcium nitrate 100 lb and calcium chloride at 190 lb to balance chloride in the sodium chloride on 4Na.

(3) Until 1916 equal parts of ammonium sulphate and chloride. (1887 ammonium sulphate only.)

(4) Until 1939 rape cake at 2000 lb (none 1917–20); 1940–54 2000 lb castor bean meal; since 1955 86 lb N as castor bean meal. Castor meal was discontinued after 1961.

(5) Until 1894 farmyard manure and superphosphate.

(6) Since 1903. Until 1902 the whole of strip 7 received 65 lb P_2O_5, 245 lb K_2O and ammonium salts providing 8 lb N.

(7) Basic slag was used in place of superphosphate from 1896–1902.

(8) 1876–1902 14 tons farmyard manure, 65 lb P_2O_5, 86 lb N as ammonium salts per acre.

Application of manures. Farmyard manure was ploughed down in winter; P, K, Mg, salt and castor bean meal and one-third of the sulphate of ammonia and nitrate of soda were applied after the first cultivation but before the seed was drilled. The remaining two-thirds of the nitrogenous fertilisers was applied as a top dressing about the time of singling.

Husbandry

Mangolds. Variety, Yellow Globe. In 1908 and 1927 swedes were grown when mangolds failed. In 1931 a crop of mixed mangolds and swedes was grown. In 1935 the mangolds failed and the field was bare fallowed.

Since 1954 a space equal to four rows of mangolds has been kept free from crop along the west side of strip 1 because the plot boundary is very near to the field boundary. This area receives the same manure as the adjacent cropped area.

Sugar beet (1949–59). From 1946 to 1959 four rows of sugar beet (Kleinwanzleben E) were drilled on the east side of every strip except strip 8 which had the sugar beet on the west side.

Weed control. In 1955 certain plots badly infested with twitch (*Agropyron repens*) were divided into two parts, one part being sprayed with sodium trichloroacetate (TCA). In 1956 the other half of these plots was similarly treated.

Liming. In spring 1956 a corrective dressing of 5 tons of ground chalk was applied to the A and AC series. After the crop had been removed a

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maintenance dressing was applied to balance the sulphate of ammonia and castor meal given over a five-year period on series A, AC and C, the rate being 100 lb calcium carbonate per 14 lb N as sulphate of ammonia and 50 lb calcium carbonate per 14 lb N as castor meal.

In December 1962 ground chalk was applied at 2 tons to series A, AC and C.

Yields

Mangolds. Yields of roots and of leaves were taken from the whole area of each plot till 1941. From 1942 the yields of leaves were calculated from the weights of leaves on two rows per plot chosen at random. From 1955, on plots 4-0, 5-0, 6-0, 7-0 and 8-0, where the plants were very small, leaves and roots were weighed separately for the two chosen rows only; for the remainder the total crop was weighed without separation. Yields of roots and leaves were calculated by applying the appropriate ratio to the total yield of the whole plot. The whole crop was carted off these plots.

Sugar beet. Yields of roots were taken from the whole area of each plot until 1954 and yields of leaves were taken from one row per plot chosen at random. From 1955, on plots 4-0, 5-0, 6-0, 7-0 and 8-0 leaves and tops were weighed separately on the one chosen row and the ratio so determined was applied to the total produce of the whole plot. The whole crop was carted off these plots. Top weights were estimated from one random row per plot and the tops were spread on their plots and ploughed in except on the O series (less FYM plots).

Period 1960–67. In 1960 and 1961 the field was fallowed, farmyard manure and castor meal and minerals were applied.

In 1962 plots were divided lengthways for comparison of potatoes and mangolds. Farmyard manure and minerals were applied as in the past but the application of castor meal was discontinued. The division of 4N was discontinued and the plot reverted to standard strip manuring. For each crop plots were divided into four for a test of nitrogen (except series O which continued to receive no nitrogen). Rates 0, 0·6, 1·2, 1·8 cwt N as sulphate of ammonia on series C, AC and A; as nitrate of soda on series N and plot 9; all in the seedbed.

In 1963 farmyard manure and minerals were applied and the field was fallowed, except for three rows of potatoes on the east side of strip 4, series N, A, AC and C for observations on *Oospora pustulans*. Potatoes received 1·2 cwt N as sulphate of ammonia on A, AC and C, nitrate of soda on N.

In 1964 plots were again divided lengthways for comparison of potatoes and mangolds (crop positions in reverse of those in 1962). The rate of P was increased to 122·5 lb P_2O_5 to allow use of compound fertiliser (0: 14: 28) on strips 2, 4 and 6. Granular superphosphate was applied (at 122·5 lb P_2O_5) to strips 5 and 7. Nitrogen rates and forms were as in 1962, cumulative on 1962 treatments.

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In 1965 and 1966 the field was fallowed. Farmyard manure and minerals (P at customary rate) were applied but not nitrogen.

In 1967 spring beans were grown, farmyard manure and minerals were applied but not nitrogen. All plots were sprayed with simazine weedkiller at 1 lb per acre.

References

1. *Memoranda of the Field Experiments, Rothamsted, 1901*, 56–63.
2. *Rep. Rothamsted exp. Stn for 1961*, 227.
3. For a summary of Barnfield results up to 1940 see:
   Watson, D. J. & Russell, E. J. (1943–46). The Rothamsted experiments on mangolds 1872–1940.
   Part 1. Effect of manures on yields of roots. *Emp. J. exp. Agric.* **11**, 49–64.
   Part 2. Effect of manures on the growth of the plant. *ibid.* **11**, 65–77.
   Part 3. Causes of variation of yields. *ibid.* **13**, 61–79.
   Part 4. The composition of the mangolds grown on Barnfield. (I) The dry matter content of leaves and roots. *ibid.* **14**, 49–56. (II) The nitrogen content of leaves and roots. *ibid.* **14**, 57–70.
4. See also Kalamkar, H. J. (1933). A statistical examination of the yield of mangolds from Barnfield at Rothamsted. *J. agric. Sci.* **23**, 161–175.
5. For an account of the yields of mangolds and sugar beet 1941–59 and analyses of crops and soils from Barnfield, see Warren, R. G. & Johnston, A. E., *Rep. Rothamsted exp. Stn for 1961*, 227–247.

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TABLE 9

Mangolds, Barnfield 1876–1959

Roots: tons, means over 19, 37 and 19 years

Series	O			A			N			C			AC		
	No nitrogen			Ammonium sulphate			Sodium nitrate			Rape cake			Rape cake + ammonium sulphate		
Strip	1876–1894	1904–1940	1941–1959	1876–1894	1904–1940	1941–1959	1876–1894	1904–1940	1941–1959	1876–1894	1904–1940	1941–1959	1876–1894	1904–1940	1941–1959
8 None	3·8	3·0	1·5	6·0	5·6	5·8	10·2	10·6	8·1	10·2	8·3	8·4	10·1	7·5	8·1
5 P	5·0	4·0	2·2	8·3	6·8	7·4	15·7	16·1	11·7	12·0	9·4	9·8	11·2	8·8	9·3
6 PK	4·5	3·8	2·1	13·7	14·5	11·7	15·5	16·8	12·3	18·0	17·6	14·4	22·1	22·0	18·9
7 PNaMg	(5·9)	4·0	2·2	(15·0)	16·1	12·2	(15·9)	18·4	12·4	(18·9)	19·2	15·1	(22·0)	21·5	17·0
4 PKNaMg	5·3	4·2	2·7	15·5	15·5	12·8	18·3	19·0	14·4	20·7	20·7	15·8	25·0	26·4	19·1
1 D	16·8	17·4	8·9	22·1	22·0	18·1	23·2	28·0	20·0	23·6	23·0	17·9	24·5	23·2	19·9
2 DPK	(17·0)	19·9	11·3	(21·4)	26·9	19·6	(24·2)	29·4	21·7	(23·3)	27·8	20·7	(23·5)	29·4	23·5

The figures in brackets are means for the period, but the treatments differed from those given later.

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TABLE 10

Sugar beet, Barnfield

Roots and tops: tons, means over 14 years 1946–59

Series	O		A		N		C		AC	
	No nitrogen		Ammonium sulphate		Sodium nitrate		Rape cake		Rape cake + ammonium sulphate	
Strip	Tops	Roots	Tops	Roots	Tops	Roots	Tops	Roots	Tops	Roots
8 None	2·0	1·5	4·9	4·2	6·1	5·0	7·5	5·6	9·0	6·4
5 P	2·1	1·9	4·8	5·0	7·4	6·7	6·6	6·9	9·3	7·2
6 PK	1·9	1·6	5·3	6·6	6·6	6·2	6·8	8·2	10·4	9·5
7 PNaMg	2·1	1·8	6·4	7·2	7·8	7·2	8·4	7·7	11·7	9·0
4 PKNaMg	2·0	1·8	5·8	7·2	7·5	8·0*	7·5	9·1	10·2	10·3
1 D	5·2	6·2	12·2	11·5	10·6	11·1	10·3	11·4	12·1	11·4
2 DPK	5·5	5·9	9·0	8·6	11·0	9·9	9·8	9·8	11·2	10·3

* Sodium nitrate replaced by a mixture of potassium and calcium nitrates.

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