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Report for 1937

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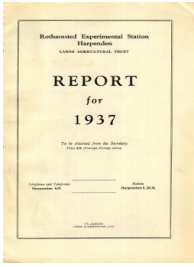

Organic Manures

Rothamsted Research

Rothamsted Research (1938) *Organic Manures ;* Report For 1937, pp 29 - 35 **- DOI: https://doi.org/10.23637/ERADOC-1-69**

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recorded. The oats were undersown with a seeds mixture, which constitutes the 1935 crop, while mangolds were grown in 1936.

TABLE VI

Chalk : cwt. per acre (1933)	1935 Hay : cwt. per acre Yield	Increase for each dressing	1936 Mangolds roots : tons per acre Yield	Increase for each dressing
None	25.5		17.22	
35	46.0	+20.5	24.92	+7.70
70	59.2	+13.2	29.12	+4.20
140	66.0	+6.8	31.49	+2.37
210	67.3	+1.3	31.57	+0.08
Standard Error	±2.70	±3.82	±1.42	±2.01

The effects of acidity are clearly much less marked than at Tunstall, moderate crops being obtained in both years even in the absence of chalk. The successive increases per 35 cwt. of chalk were 20.5, 13.2, 3.4 and 0.6 cwt. hay in 1935 and 7.70, 4.20, 1.18 and 0.04 tons mangolds in 1936. Thus the residual response falls off steadily at the higher levels of application; in particular, the highest dressing would not have proved economically efficient.

In a second experiment by Mr. Gardner, started in 1934, the residual effects on hay of chalk, potash salt, slag and Gafsa phosphate are studied alone and in combination. The phosphatic treatments have so far had no beneficial effect, while potash salt has produced only small increases which were not significant. The responses to 75 cwt. chalk applied in 1934 are shown in Table VII.

TABLE VII

Responses to 75 cwt. chalk applied in 1934, Barnet, Herts

Hay cwt.peracre	Mean response	Potash: (applied in 1934) Absent	Present	Standard error	Mean yield
1934	+1.7	+1.6	+1.8	±0.806	16.1
1935	+5.4	+5.2	+5.6	±1.17	28.8
1936	+8.6	+4.4	+12.8	±1.55	35.7
1937	+5.9	+6.3	+5.5	±1.38	25.7

As in the other experiments there is no sign that the effects of chalk are dying away, good responses being obtained in each of the last three seasons. In 1936 the effectiveness of chalk was increased by the presence of potash, the increase to chalk being 12.8 cwt. with potash present as against 4.4 cwt. with no potash. In the other years, however, the response to chalk has not been affected by potash.

Organic Manures

The growing shortage of stable manure has seriously curtailed the supply of organic manure for the soil and alternative sources are being studied. More and more there is a tendency to divert waste products to other purposes but certain products, particularly sewage sludge and town refuse, still offer some possibilities. The manurial value of town refuse treated by a new process is being tested.

The experiments on the making of artificial farmyard manure from straw have been much facilitated and improved as a result of the erection of the new building at the farm.

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Early Results with Farmyard Manure at Rothamsted

On the Classical fields farmyard manure has been compared with artificial fertilisers for a long series of years under continuous cropping conditions.

TABLE VIII

Field	Crop	Period	Average Yield: No manure	Farmyard manure	Best artificial treatment
Broadbalk ..	Wheat	1852–1925	*Plot* 3. Grain 6.7 cwt. Straw 9.8 ,,	*Plot* 2*B*. Grain 19.4 cwt. Straw 34.2 ,,	*Plot* 8. Grain 20.1 cwt Straw 39.8 ,,
Hoosfield ..	Barley	1852–1928	*Plot* 1*O*. Grain 6.2 cwt. Straw 7.8 ,,	*Plot* 7-2. Grain 20.7 cwt. Straw 28.1 ,,	*Plot* 4*A*. Grain 18.2 cwt. Straw 23.6 ,,
Barnfield ..	Mangolds	1876–1935	*Plot* 8*O*. Roots 3.39 tons Tops 0.98 tons	*Plot* 1*O*. Roots 17.59tons Tops 3.06tons	*Plot* 4*N*. Roots 17.79tons Tops 3.86tons

Farmyard manure used annually maintains a satisfactory level of yield, which is equalled in the case of wheat grain and mangolds roots and approached in the case of barley grain by a heavy complete annual dose of artificials.

Other classical plots showed that the cumulative effects of repeated dressings of farmyard manure were considerable and persisted for a long period after the manuring was stopped. Thus on Hoosfield the following yields were recorded in the past three seasons some 65 years since the dung on Plot 7-1 was discontinued :—

Plot		Barley, cwt. per acre: 1935 Grain	1935 Straw	1936 Grain	1936 Straw	1937 Grain	1937 Straw
1-0	Unmanured since 1852	5.2	11.1	5.9	12.4	2.3	6.1
7-1	14 tons dung 1852-71 then unmanured ..	20.0	23.7	12.8	18.9	3.6	13.3
7-2	14 tons dung annually since 1852	33.9	59.3	28.1	42.2	15.2	31.7

Similar results appeared on Hoosfield when the permanent potato plots, which for 26 years (1876-1901) had received annual dressings of 14 tons of farmyard manure, were discontinued and cropped with cereals without further manure. In the last four crops for which yields were recorded the figures were :—

TABLE IX

	Plot 1: Unmanured since 1876		Plot 3: Dung 14 tons per acre annually for 26 years 1876-1901, afterwards unmanured	
	Grain	Straw	Grain	Straw
	bush.	cwt.	bush.	cwt.
1918 Barley	8.4	4.0	16.2	8.6
1919 Barley	4.7	3.2	11.5	6.4
1921 Wheat	10.5	9.1	24.3	24.6
1922 Barley	13.0	7.4	21.6	11.3

The manner of storage of farmyard manure was studied in field experiments in 1915-16. The results showed the increase in crop producing power caused by keeping the dung heaps compact, and in particular by providing them with some shelter. *

* E. J. Russell and E. H. Richards, J. A. S. 1917, Vol. 8. pp. 495-563, and J. R. A. S. E. 1916, Vol. 77, pp. 1-36.

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Although dung is so widely used, its effects have seldom been measured in replicated experiments owing to the difficulty of applying this bulky material to scattered small plots.

Modern Replicated Experiments on Farmyard Manure

The material available consists of eleven experiments each on sugar beet and potatoes, four on beans (summarised on p. 49), five on mangolds (summarised on p. 43), two each on swedes and kale and one on wheat. The residual effects of the manure on the succeeding crop have also been studied in several experiments.

Direct effects

TABLE X

Direct Effects of Farmyard Manure
Potatoes tons per acre

Year	Centre	Mean yield	Increase for dung	Quantity of dung tons/acre
1915	Rothamsted	6.71	+3.19	10
1916	Rothamsted	3.19	+1.12	20
1920	Rothamsted	9.21	+1.98	15
1932	Rothamsted	11.54	+1.10	15
1934	Rothamsted	9.95	+2.23	20
1935	Rothamsted	5.24	+2.36	15
1936	Rothamsted	5.21	+2.18	15
1937	Rothamsted	6.16	+2.46	15
1934	Wimblington	7.81	+5.00	8
1935	Wimblington	7.14	+2.47	8½
1936	Wimblington	8.25	+1.18	6½
	Sugar Beet Roots (tons per acre)			
1933	Rothamsted	6.46	+2.34	20
1934	Rothamsted	14.03	+1.26	10
1935	Rothamsted	11.57	+1.23	10
1936	Rothamsted	14.84	+1.68	10
1937	Rothamsted	14.14	+1.04	10
1937	Woburn	16.06	+0.74	10
1936	Gainsborough	12.76	+0.08	10
1936	Wragby	12.21	+0.74	10
1937	Wragby	13.45	+0.74	10
1937	Market Rasen	10.63	+0.11	10
	Mangolds Roots (tons per acre)			
1936	Rothamsted	25.50	+4.20	10
1937	Rothamsted	21.40	+2.04	10
1932	Oakerthorpe	31.20	+8.13	15
1933	Oakerthorpe	20.58	+4.21	15
1934	Oakerthorpe	19.56	+9.75	15
	Beans Grain (cwt. per acre)			
1934	Rothamsted	18.7	+1.9	10
1935	Rothamsted	21.0	+5.6	10
1936	Rothamsted	16.8	−0.1	10
1937	Rothamsted	29.0	+2.0	10
	Swedes Roots (tons per acre)			
1922	Rothamsted	29.74	+3.71	10
1923	Rothamsted	15.0	+1.1	10
	Kale (tons per acre)			
1932	Woburn	20.99	+4.44	15
1936	Woburn	13.11	+2.42	10
	Wheat Grain (bushels per acre)			
1916	Rothamsted	34.8	+3.1	10

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At Rothamsted the responses in potatoes varied from 1.1 to 3.2 tons per acre, the average response to a dressing of 15 tons being 2.1 tons per acre. At Wimblington, on a light fenland soil, dressings of about 8 tons proved very effective.

A dressing of 10 tons increased the yields of sugar beet roots by 1.3 tons per acre in the Rothamsted experiments ; elsewhere the responses in roots were smaller. In most experiments dung produced a small decrease in sugar percentage.

The direct effect of 10 tons of farmyard manure is usually about equivalent to that of 2 cwt. of sulphate of ammonia. Calculated on a nitrogen basis one part of ammoniacal nitrogen is about equal to 3 parts of farmyard manure in the year of application.

In order to study the rate of exhaustion of the effects of normal dressings of dung in rotation practice an experiment on residual values was laid down in Little Hoosfield in 1904 and continued till 1926. The results showed that the dung made by cattle having a good cake ration was considerably more effective in its first year than dung made by animals on a store ration, but in the subsequent three seasons the effects of the two types of manure were very similar. The residual effects of dung of any kind were much more pronounced than those of commercial organic manures such as shoddy, guano and rape cake ; but in the fourth season after application the residues of dung only increased production some 20 per cent. above the level of the continuously unmanured control plot. The design of the Little Hoos experiment was improved in the present Four-Course Rotation experiment commenced in Hoosfield in 1930. The results of the first three years of the complete cycle were summarised in the Station Report for 1936, p. 53. Dung, Adco compost, and straw with supplementary artificials are compared in direct effects and in residual action over a 5 year period. The three forms of straw manure behave in a similar manner and their residual effects are apparent at least three years after application. As the experiment proceeds the measurement of manurial effects will gain in precision.

Methods of applying farmyard manure

In the Rothamsted potato experiments in 1932 and 1934, dung ploughed in in autumn was compared with dung ploughed in shortly before planting in spring. In the 1934 experiment there was no appreciable difference between the effects of the two times of application, while in 1932 the spring application gave an extra increase of about one ton per acre, which was, however, not significant

In the later Rothamsted potato experiments dung ploughed in during December or January was compared with dung applied in the bouts.

TABLE XI
Potatoes : tons per acre
Farmyard Manure (15 tons per acre)

	No dung	Ploughed in	In the bouts	Mean response	Advantage for application in bouts
1935	5.24	7.15	8.06	+2.36	+0.91
1936	5.21	6.45	8.33	+2.18	+1.88
1937	6.16	7.64	9.60	+2.46	+1.96

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Application in the bouts proved definitely superior each year, giving an increase of between 1 and 2 tons per acre over the earlier application.

In the 1936 and 1937 experiments the effect of adding 2 tons of chaffed straw to the dung was also tested. With the earlier application of dung the straw was ploughed in, while with the later application the straw was mixed with the dung and stored until bouting. In both years the addition of straw produced small but not significant decreases in yield. In 1936, however, straw increased the yields on plots which also received sulphate of ammonia (applied in the bouts).

The addition of straw ($1\frac{1}{2}$ tons) to dung is also included in the new Woburn green manuring experiment. On plots receiving dung and 2 cwt. sulphate of ammonia, straw decreased the yield of kale by 1.0 tons per acre, while on plots receiving dung and 4 cwt. sulphate of ammonia the decrease was only 0.1 tons per acre. The difference between these figures is not significant, but it is in the same direction as in the 1936 potato experiment. In 1937 the kale crop was a very poor one and straw had no appreciable effect.

Only one experiment is available on the method of applying dung to sugar beet. At Rothamsted in 1931 dung was applied and spread three weeks before ploughing under or immediately before ploughing. The later application gave a significant increase of 0.7 tons roots over the earlier application.

TABLE XII

Responses to Artificials

Potatoes (tons per acre)

		Amount of sulphate of ammonia	Dung: Absent	Dung: Present	Difference Pres. minus Abs.	S.E. of difference
		Responses to Sulphate of Ammonia				
1932	Rothamsted ..	0.4 cwt. N	+1.85	+2.34	+0.49	±0.471
		0.8 cwt. N	+3.17	+3.22	+0.05	±0.471
1934	Rothamsted ..	0.4 cwt. N	+1.35	+1.59	+0.24	±0.476
		0.8 cwt. N	+1.65	+1.88	+0.23	±0.476
1935	Rothamsted ..	0.8 cwt. N	+1.03	+1.89	+0.86	±0.329
1936	Rothamsted ..	0.4 cwt. N	+1.52	+0.99	−0.53	±0.612
1937	Rothamsted ..	0.4 cwt. N	+1.85	+1.90	+0.05	±0.366
		0.8 cwt. N	+2.87	+3.46	+0.59	±0.366
1934	Wimblington	0.45 cwt. N	+0.29	+0.83	+0.54	±0.354
1935	Wimblington	0.5 cwt. N	+0.65	+1.26	+0.61	±0.404
1936	Wimblington	0.5 cwt. N	−0.01	+0.88	+0.89	±0.891
		Responses to Sulphate of Potash				
		Amount of sulphate of potash				
1932	Rothamsted ..	0.8 cwt. K_2O	−0.15	+0.16	+0.31	±0.471
		1.6 cwt. K_2O	+0.15	−0.10	−0.25	±0.471
1937	Rothamsted ..	1.6 cwt. K_2O	+0.73	+0.32	−0.41	±0.423
1934	Wimblington	1.12cwt. K_2O	+4.93	+2.68	−2.25	±0.354
1935	Wimblington	1.25cwt. K_2O	+2.43	−0.03	−2.46	±0.404
1936	Wimblington	1.25cwt. K_2O	+0.93	−0.03	−0.96	±0.891
		Responses to Superphosphate				
		Amount of superphosphate				
1937	Rothamsted ..	0.8 cwt. P_2O_5	+1.52	+0.85	−0.67	±0.423
1935	Wimblington	1.0 cwt. P_2O_5	+0.49	+0.45	−0.04	±0.404
1936	Wimblington	1.0 cwt. P_2O_5	+0.03	−0.80	−0.83	±0.891

For mean yields see Table X.

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Effects of dung on the responses to artificials

The question whether artificials may be profitably applied on land which is also being dunged has been studied in several experiments, see Table XII on previous page. These show the responses to sulphate of ammonia and minerals in the absence and in the presence of dung.

With potatoes the responses to sulphate of ammonia were increased in presence of dung in seven out of eight experiments, the increase being significant at Rothamsted in **1935**. These increases are presumably due to the minerals contained in the dung, since sulphate of ammonia produced no increase when applied without dung or minerals.

The responses to sulphate of potash were decreased by the addition of dung in four experiments out of five, the decrease being significant at Wimblington in **1934** and **1935**. In the remaining experiment, potash had no appreciable effect.

The response to superphosphate was decreased in presence of dung at Rothamsted in **1937**, though not significantly. At Wimblington in **1935**, the response was unaltered, while in the remaining experiment the effects of superphosphate were not significant.

TABLE XIII

Responses to Artificials

Sugar Beet Roots (tons per acre)

		Dung		Difference Pres. minus Abs.
		Absent	Present	
Responses to Sulphate of Ammonia (0.6 cwt. N)				
1933	Rothamsted ..	+0.15	+0.05	−0.10[1]
1934	Rothamsted ..	+1.38	+1.83	+0.45[2]
1937	Wragby ..	+1.89	+0.68	−1.21
1937	Market Rasen	+3.00	+2.28	−0.72
Responses to Muriate of Potash (1.0 cwt. K_2O)				
1936	Rothamsted ..	−0.39	−0.25	+0.14
1937	Rothamsted ..	+0.74	+0.12	−0.62
1937	Woburn ..	+1.48	+0.74	−0.74
Responses to 5 cwt. Superphosphate + 3 cwt. 30% Potash Salt				
1936	Gainsborough	+0.78	−0.23	−1.01
1936	Wragby ..	+0.98	+0.57	−0.41
1937	Wragby ..	+1.31	+1.30	−0.01
1937	Market Rasen	+2.32	+0.68	−1.64

S.E. of differences (1) ±0.674. (2) ±0.636.

With sugar beet roots the responses to sulphate of ammonia were not significantly affected by the addition of dung in any of the three experiments in which sulphate of ammonia produced a clear response in roots. The responses to muriate of potash were somewhat decreased by dung in two experiments; in the third, potash produced small but not significant depressions in yield both in

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presence and absence of dung. In the further experiments containing minerals (superphosphate and potash salt), the responses to minerals were slightly decreased by the addition of dung.

TABLE XIV

Kale (tons per acre)

	Woburn 1932 Sulphate of ammonia : cwt. N				Woburn 1936 Sulphate of ammonia	
	None	0.2	0.4	0.8	0.4 cwt. N	0.8 cwt. N
No dung	13.29	17.76	19.67	24.36	10.14	13.67
Dung	19.19	21.24	23.67	28.74	13.14	15.49
Standard errors			±0.713		±0.357	

With kale, the responses to sulphate of ammonia were smaller in presence of dung in both experiments, though not significantly so.

TABLE XV

Residual effects of Dung on the Succeeding crop (cwt. per acre)

Dung applied to		Amount of dung	Succeeding crop	Mean yield	Increase for dung
		tons			
Potatoes	1916	10	Wheat grain	11.9	+2.4
Potatoes	1920	15	Wheat grain	17.8	+3.6
Potatoes	1936	15	Spring oats grain	20.2	+2.7
Kale	1932	15	Barley total produce	95.1	+12.2
Kale	1936	15	Barley grain	12.0	+2.2
Barley	1921	14	Clover 1921 green weight	9.2	+6.7
			Clover 1922 hay	45.5	+8.2
			Clover 1923 hay	13.0	+2.3

The residual effects are striking. Dung applied to potatoes or kale increased the succeeding cereal crops by over 2 cwt. grain per acre in every case. In an experiment in which dung was applied to barley, clover sown under the barley continued to benefit from the dung for at least three seasons, the green weights being doubled by the dung in the first season.

POULTRY MANURE

The consignments of dried poultry manure for the 1933-36 experiments were obtained from Suffolk, but for the 1937 experiments the supply was from Hampshire : the percentages of nitrogen, phosphoric acid and potash were very similar :—

		Percentage in dried manure				
		Nitrogen	P_2O_5	K_2O	Ash	Dry matter
1936	Suffolk	3.90	3.53	1.70	35.3	88.7
1937	Hampshire	3.75	3.43	1.76	22.2	85.1

In the first three years in which the manures were applied the poultry manure was distinctly inferior to the sulphate of ammonia. The direct effect of poultry manure, based on 29 experiments, only amounted to 64 per cent. of the direct effect of sulphate of ammonia.