ROTHAMSTED RESEARCH

Report for 1934

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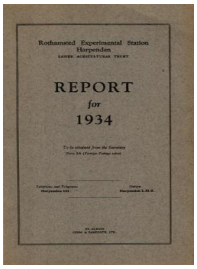

Organic Manures

Rothamsted Research

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The effect of superphosphate is as marked as that of nitrogen and the response continues even to the larger dressing. On the light peaty fen, potash also produces a marked increase but on the clay fen its effect is less. The early potatoes on the silt soil at Wisbech were less responsive but still gave definite responses to superphosphate and sulphate of ammonia.

At one fen centre, Wimblington, March, on a light fen soil, the effect of adding dung was tested. Sulphate of potash gave marked responses even in the presence of dung; sulphate of ammonia was less effective. The dressing of 2¼ cwt. each of sulphate of ammonia and sulphate of potash with superphosphate proved nearly as effective as 8 tons of dung per acre. The increases were :

	Mean Effect.	Dung Absent.	Dung Present.
Sulphate of ammonia, 2¼ cwt.	0.56 tons	0.29	0.83
Sulphate of potash, 2¼ cwt.	3.80 ,,	4.93	2.68
Dung 8 tons	5.00 ,,	—	—
Standard errors	±0.177	±0.250	

The investigations on the quality of potatoes begun in 1929 in association with Messrs. Lyons have now been transferred almost entirely to their laboratories, but a few key determinations continue to be made here so as to facilitate linking up with their work.

MINOR ELEMENTS IN PLANT NUTRITION

The investigations on boron are still being continued by Dr. Brenchley and Miss Warington.

Manganese is needed by plants, though only in small amounts; in its absence they become liable to certain diseases such as grey speck disease of oats. Chemical examination shows that the determining soil factor is not the actual amount of manganese present, but the proportion that exists in the exchangeable form and the tenacity with which it is held.

Molybdenum salts have been found to cause symptoms that look very much like those of Virus disease. This observation is being followed up in the Plant Pathological and Botanical Departments. Mr. W. A. Roach at East Malling has shown that some fruit tree stocks can take up molybdenum from the soil and others cannot.

ORGANIC MANURES

(1) *The Use of Straw as Manure.*

With the increasing tendency to break away from fixed rotations the systematic return of the straw to the land in the form of farmyard manure is becoming more and more difficult and two alternative methods are being compared with farmyard manure at Rothamsted : in one the straw is rotted artificially before being applied ; in the other it is ploughed direct into the land but artificials are added to furnish the necessary food for the micro-organisms effecting the decomposition. The effect is then observed in the year of application and in each of the four succeeding years. For each manure there are thus five plots under each crop in each year, one of which has received the manure during the year, another received it one year ago, while others had it two, three, and four years ago. The straw ploughed in with the appropriate artificials proved at least as useful as farmyard

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manure, excepting only for the hay crop, which in any case was abnormally low, as also was the yield of potatoes. The details are given later on ; averages of the various sets of plots are :

Average yield per acre of five treatments, 1934.

	Wheat grain.	Barley grain.	Potatoes.	Hay, Dry Matter.
	cwt.	cwt.	tons.	cwt.
Dung 1st year and 4 residuals	25.5	24.3	3.61	11.6
Straw (rotted) and 4 residuals..	25.0	23.5	2.98	10.5
Straw (unrotted) and 4 residuals	25.6	26.3	3.82	8.3
Super (annual N and P) ..	25.4	26.1	4.61	15.2
Rock phosphate (annual N and P)	24.7	22.5	3.54	14.1
Mean of all straw manures ..	25.4	24.7	3.47	10.1
Mean of all inorganic manures	25.0	24.3	4.08	14.6

It will be interesting to see whether similar results are obtained in future years : the question is of particular importance on mechanised farms. The equivalent mixture of artificials has been as good for wheat and barley as has the straw, and better for potatoes and hay : superphosphate also proved superior to mineral phosphate.

The residual effects are shown in the following figures, where the yields are expressed as a percentage of the average of the dung and the two straw treatments :

Average yields, 1932-34.

Treatment.	Crop.	Year of Application	Residual Years. First.	Second.	Third.	Fourth.
Farmyard Manure	Wheat	116(3)	96(3)	91(3)	95(2)	94(1)
	Barley	133(3)	98(3)	94(3)	76(2)	88(1)
	Potatoes	140(3)	102(3)	91(3)	96(2)	75(1)
Mean		130	99	92	89	86
Straw rotted artificially	Wheat	123(3)	99(3)	85(3)	97(2)	97(1)
	Barley	109(3)	97(3)	89(3)	93(2)	105(1)
	Potatoes	90(3)	79(3)	80(3)	104(2)	65(1)
Mean		107	92	85	98	90
Straw+artificials ploughed in	Wheat	112(3)	94(3)	102(3)	87(2)	100(1)
	Barley	121(3)	86(3)	96(3)	95(2)	106(1)
	Potatoes	123(3)	89(3)	114(3)	106(2)	122(1)
Mean		119	90	104	96	109

100=mean of the two straw and the farmyard manure results. Bracketed figures show the number of yields on which the figures are based.

The artificial rotting of the straw was not entirely satisfactory and we shall certainly improve it in future years.

(2) *Green Manure.*

As is well known the Woburn experiments on green manuring failed to show any benefit from either mustard or tares grown during the summer and ploughed in as preparation for winter wheat. This was quite unexpected, as the light soil at Woburn is the type of land that seems to need organic matter. The plant residues, however,

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have to undergo decomposition in the soil before they are of any manurial value to the crop and this decomposition is brought about by micro-organisms which themselves consume plant food. The process is complex and it is not difficult to imagine a train of processes in which the crop would gain nothing, and might easily lose, by the ploughing-in of green manure. Inspection of the plots indicates that the wheat suffers from nitrogen starvation in spite of the added plant residues. Drs. Crowther and Mann have shown that in conditions such as those of the Woburn green manure experiments, considerable loss or inactivation of nitrogen takes place in the soil during the period between the ploughing-in and the active assimilation of soil nitrates by the wheat plant.

The experiment has been repeated in such a way as to reduce this rather long period of waiting. Blue lupins were sown on May 16th : they grew vigorously and produced approximately 50 cwt. dry matter per acre of leaves, stems and roots : they were ploughed-in for kale sown on July 30th. The effect was very striking, the yield of kale being practically doubled. Only the leaves and stems of the lupins were effective, however : when these were removed and only the roots ploughed-in there was no benefit. The yield of kale was, in tons per acre :

Ploughed-in :—	Nitrogen contained in part ploughed-in, lb. per acre.	Kale, tons per acre.
1. Nothing (Lupin tops and roots removed) ..	0	3.53
2. Lupin roots only	11.3	3.17
3. Lupin whole plant roots and tops	133.6	6.68
4. Lupin whole plant plus tops from treatment 2	256	8.47

The Rothamsted soil is much heavier than that of Woburn and would be expected to behave rather differently to green manuring. Autumn sown vetches proved ineffective for the following spring sown crops while autumn sown rye was actually harmful to the barley and the sugar-beet : the results were :

Means of all manurial treatments, yields per acre, 1934.

	Potatoes.	Barley.		Sugar Beet.	
		Grain.	Straw.	Roots.	Tops.
	tons	cwt.	cwt.	tons.	tons.
No green manure ..	5.91	27.2	30.0	12.62	10.63
Vetches ploughed in	5.54	27.2	30.1	11.86	9.10
Rye ploughed in ..	6.14	20.4	25.0	11.59	5.96

Yield of green manures April 13th : rye, 5 tons green weight, 13 cwt. dry matter ; vetches, 0.6 tons green weight, 1.2 cwt. dry matter.

There is evidently a considerable amount to learn about green manuring, and it cannot be recommended generally without careful experiment to find out the conditions in which it is likely to succeed.

(3) *Poultry Manure.*

The marked increase in the number of poultry in this country has brought into prominence an old question which has never yet been thoroughly examined : how does poultry manure compare with equivalent amounts of artificials ? In 1933 the Ministry of Agriculture set up a small committee to study this question, the experimental work to be done under the supervision of the Rothamsted staff. The manure was dried and prepared in a form in which it could

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be transported easily as a commercial product : the analysis of the samples ranged between the following limits :

	1933.	1934.
Moisture	5.8	8.4
Nitrogen (N)	3.6-4.4	2.6-3.3
Phosphoric oxide (P_2O_5)	2.9-4.0	3.2-3.8
Potash (K_2O)	1.6-1.9	1.6

The experiments were made with market garden crops as it seems probable that gardeners would make more use of poultry manure than farmers.

Comparison was made at a number of centres with equivalent mixtures of sulphate of ammonia, and superphosphate : the crops included potatoes, savoys, peas, sprouts, onions, and carrots. Pot culture experiments have been made at Rothamsted with spinach beet.

The general result both in 1933 and 1934 is that poultry manure in its first year is less effective than sulphate of ammonia ; little evidence could be found that it is ever superior. At a number of centres neither manure was effective : apparently the ground was already in such high condition that even nitrogen failed to act.

The average results for potatoes at the 13 centres in which 3 cwt. per acre sulphate of ammonia was compared with the equivalent amount of poultry manure (approximately 1 ton) were as follows :

Potatoes, tons per acre. Mean of 13 experiments. 1934.

No Nitrogen	8.17
Poultry Manure 0.6 cwt. Nitrogen per acre	8.83
Sulphate of Ammonia, 0.6 cwt. Nitrogen per acre	9.53
Poultry Manure + Sulphate of Ammonia (1.2 cwt. N in all) ..	9.53
Mean	9.02
Standard error	±0.132

The return for the nitrogen is less than usual, being only about 9 cwt. potatoes per cwt. sulphate of ammonia. At some centres some crops gave more marked returns for nitrogen but again the sulphate of ammonia was never below and usually definitely superior to the poultry manure ; two examples are :

	No Nitrogen.	Poultry Manure.	Sulphate of Ammonia.	Standard Errors.
Newport, Salop, Savoys, tons	15.8	19.8	23.2	±0.896
Avoncroft, Worcester, Peas, cwt.	76.9	75.7	80.9	±1.66

There was no evidence that the poultry manure fortified the effect of the sulphate of ammonia ; indeed the average response to poultry manure was less in the presence than in the absence of sulphate of ammonia.

On the other hand there was some evidence of cumulative effect of poultry manure ; a dressing given in 1934 to land which had also received it in 1933 was more effective than sulphate of ammonia and the action seemed to be due to the nitrogen since phosphate caused but little increase :

Potatoes : 1934 (2nd Year of Application), tons per acre. Potton, Bedfordshire.

Mean Yield, 5.94.	
Average increase due to Sulphate of Ammonia	0.82
,, ,, ,, ,, Superphosphate	0.24
,, ,, ,, ,, Poultry Manure	1.30
Standard error of increase	±0.113

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