ROTHAMSTED RESEARCH

Modern Changes in the Treatment of Light Soils

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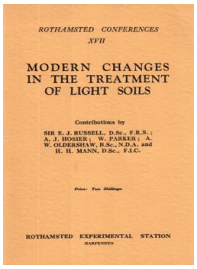

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H. H. Mann

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DANGERS OF DETERIORATION UNDER CONTINUOUS CROPPING

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The object of any form of agriculture is the obtaining of profitable returns from the land, while at the same time maintaining the capacity of the land for further production. Thus the question of the maintenance of the fertility of the soil is a fundamental consideration in any system of agriculture. And in England, on light land this has, in the past, been secured by two methods. In earlier days, the continuance of profitable agriculture was secured by frequent fallowing, and the old mediæval agriculture was based on a fallow every two or three years. Two hundred years ago, it was found possible to maintain the fertility, even of light land, without fallows, provided a suitable system of crop rotation was followed. The system of rotation usually adopted provided, on the one hand, a large amount of saleable produce, chiefly in the form of corn, and, at the same time, a sufficient amount of animal food to supply the material required by the animals employed to cultivate the land, as well as for the stock raised to sell as meat. The Norfolk four course rotation, either in the original or in modified form, did undoubtedly secure the maintenance of a high level of fertility even in light land, did provide the manure which was needed for the soil, and at the same time did enable the crops grown to remain normally in a healthy condition.

Recent developments in national economy have, however, made the old rotations no longer profitable and suitable over large areas, particularly in the light lands of the country. The demand for root crops for stock feeding has become reduced, and the rise of wages has led to a large increase of cost in producing them. The advent of the power driven machine in farming and of the motor on the roads has led to the decrease in the demand for fodders. The largely increased area under permanent grass has also added to the amount of fodder otherwise available. And, on the other hand, the supply of corn from other parts of the Empire and the World has removed the corn crops from the dominant position they formerly enjoyed, in the arable cultivation of light land in England.

The result is that over large areas, especially of light lands the old rotations have been perforce abandoned, and in hardly any region has any definite system of farming come to replace them. In some places, even, there has been a tendency to grow single crops year after year, with the application of artificial manures, or of other concentrated manures, either alone or in combination with farmyard manure. Thus, for instance, there are certain areas of

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light land, particulary suitable for potatoes, which have tended to be put under potatoes every year. Where things have not gone so far as this, there has been a tendency to use short rotations, consisting of marketable crops, and attempt again, to maintain the fertility by frequent and heavy manuring, with dung manures as well as artificials.

Such a policy is always dangerous, for if, for any reason, the supply of cheap manure fails, as has recently happened in areas which depended on London manure for their cultivation, the situation becomes very difficult, and the fertility may rapidly disappear, in spite of the use of artificial fertilisers. But even apart from such unforeseen circumstances, I want to show you to-day that all the evidence which is available seems to indicate that constant growing of one, or even of two, crops on light land, year after year, with marketing produce, leads to a falling off in the fertility, of light land at any rate, even when the amount of manure used is quite considerable. The experience of Woburn, where I am stationed, in this respect is very typical, and there may be advantage in calling attention to it.

The land at Woburn is a typical light loam, lying on the lower greensand, which furnishes so much of the light land areas in the Midlands and the South of England. For fifty years we have grown wheat and barley every year on such land, using large or medium doses of artificial fertilisers or of well-made cattle manure each year. The crops were grown every year from 1877 to 1926 and the manures were applied annually.The actual applications I shall consider to-day were those on five plots, as follows :

Plots 1 and 7.—No manure for the whole of fifty years. These show the falling off of the crops in the absence of any manure of any kind.

Plot 3.—Nitrate of Soda, at the rate of 2½ cwt. per acre from 1877 to 1906, and at half this rate from 1907 to 1926.

Plot 6.—Nitrate of Soda, at the rate of 2½ cwt. per acre from 1877 to 1906, and at half this rate from 1907 to 1926, with, in addition, Mineral Manures.

Plot 9.—Nitrate of Soda, at double the rates in Plots 3 and 6, with, in addition, Mineral Manures.

Plot 11.—Farmyard Manure, about 7 tons per acre from 1877 to 1906, and at half this rate from 1907 to 1926.

It will be seen that, on the whole, the amounts of both artificial and dung manures were high, at least during the first thirty years. The land was kept very clean, and yet in nearly all cases there has been a constant and almost steady decline in fertility, as judged by the crops obtained, during the course of the experiment. The following tables show this :

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Permanent Wheat

Plot	*Treatment per acre*	*Yield of Corn in Bushels per acre*				
		1877-1886	1887-1896	1897-1906	1907-1916	1917-1926
		bush.	*bush.*	*bush.*	*bush.*	*bush.*
1&7	No Manure	17.1	13.6	10.0	9.9	7.0
3	N.Soda, 2½ cwt. & 1¼ cwt.	24.1	23.2	17.0	15.1	13.3
6	N.Soda, 2½ cwt. & 1¼ cwt. with Mineral Manures..	32.4	30.1	23.6	17.5	16.1
9	N.Soda, 5 cwt. & 2½ cwt. with Mineral Manures..	37.2	30.8	29.2	18.1	15.2
11	Farmyard Manure. 7 tons & 4 tons	26.8	27.8	24.0	19.6	17.7

Permanent Barley

Plot	*Treatment per acre*	*Yield of Corn in Bushels per acre*				
		1877-1886	1887-1896	1897-1906	1907-1916	1917-1926
		bush.	*bush.*	*bush.*	*bush.*	*bush.*
1&7	No Manure	25.0	18.1	13.4	9.0	7.5
3	N.Soda, 2½ cwt. & 1¼ cwt.	40.4	30.9	23.7	15.2	11.3
6	N.Soda ,2½ cwt. & 1¼ cwt. with Mineral Manures..	46.0	41.1	35.3	19.7	16.8
9	N.Soda, 5 cwt. & 2½ cwt. with Mineral Manures..	53.3	45.3	42.9	25.4	20.0
11	Farmyard Manure. 7 tons & 4 tons	40.0	38.7	36.6	30.9	25.9

There are several points to which I wish to draw your attention in connection with the results shown in these tables. The first is that, whatever the manuring, in this light land, the yield of crop has gone off very greatly in continuous cropping. The loss of yield is much less where farmyard manure is used than where pure artificial manures are employed, as is shown by the following percentage losses, for the first twenty years, with heavier dressings, and in a second twenty years, with lighter dressings.

Percentage Reduction in Yield of Corn.

Plots	*Wheat*		*Barley*	
	In 20 yrs. *Per cent.*	*In 40 yrs.* *Per cent.*	*In 20 yrs.* *Per cent.*	*In 40 yrs.* *Per cent.*
1 & 7	42	59	45	64
3	29	45	41	78
6	27	50	23	63
9	22	59	21	62
11	10	34	8	35

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If these figures and the diagrams are examined, it will be seen that, in general, the percentage reduction in the yield of corn was not widely different with the artificial manures, whether mineral manures were added to the nitrate of soda or not, or whether the amount of nitrate of soda was doubled or not. In this case, it is clear that the falling off in yield is not due to a lack of manure but rather to something which prevents the manure added from having the expected effect. The effect is less in the case of farmyard manure than with any kind of artificial that has been used, and it is therefore, also clear that the use of dung has in part, but not entirely, avoided the influence which has destroyed the value of the manure added.

What is the cause of the loss of efficiency of the manures? I am afraid it is impossible to give an answer to this question at the present time. From our experience at Woburn, it would seem that some of the loss may be due to the increase of certain diseases as a result of constant cultivation. In the case of wheat, for instance, there is an extreme prevalence of the disease known as "take-all," especially on certain plots, The cause may, also, be partly found in the increasing difficulty of keeping the land free from weeds. This is always a great handicap under conditions where one crop is grown year after year, but in the present case, I do not think it has effected the matter much as up to 1926, very great efforts were made to keep these plots free from serious weeds. At the same time, certain treatments do encourage particular weeds, and the conditions of continuous cultivation prevent the cleaning of the land.

It is unfortunate that similar records do not exist for the long growing of other crops continuously on the same land, in the case of light land, for it is in some other cases that the temptation exists to carry on the practice. Thus, in one area of Bedfordshire, there has been a great temptation to grow potatoes year after year on land which is very similar to that at Woburn. In a few places the practice has been a success for a fairly long peroid, aided by the use of London dung and artificials. In other cases, the practice has led to very serious results. Eelworm disease has become prevalent, and the land has become incapable of growing a paying crop of potatoes. This has, I know, occurred at the same time as the supply of London manure has become smaller, and to this may be attributed some of the falling off of the health of this crop. But, in part, at any rate, it would seem to be the result of too frequent growing of potatoes on the same land. So far, in this case no-one has devised a method of getting over the damage done, except to leave the land free from potatoes for a number of years—for no available manurial treatment seems to be effective against the damage.

Other cases met with in practical farming might be multiplied. Perhaps one of the most striking is the case of sugar beet in Germany, where one of the limiting factors in sugar beet growing is again the

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eelworm which attacks this crop. It has not affected us yet in this country, but any attempt to grow sugar beet continuously or even too frequently on the same land, would be very liable to lead to serious results with this crop.

Disease and weeds are two of the causes of the falling off in the produce of land when a crop is grown continuously, but I do not think that this explanation covers more than a small part of the problem. In many cases these causes can be almost eliminated and yet the falling off with a continuously grown crop seems to occur, though, of course, not always to the same extent. The matter is obviously one for serious experiment, for if we could grow our valuable crops continuously on the same land, it would enable areas to be used much more efficiently than is the case at present. The problem is one which occurs on all land, but it is specially one which concerns the light lands of our country.

At present, the explanation evades us, and my object to-day is simply that of calling a warning against the idea that by the use of artificial manures or any other means, the falling off in value of continuously grown crops can be avoided. It is often, I know, a great temptation to grow a valuable crop very frequently, if not continuously, and trust to heavy artificial manuring to maintain the fertility of the land. This policy is definitely dangerous, and, if long continued, all the evidence available would indicate that the land will deteriorate in value.

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