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### Woburn Experimental Farm

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## WOBURN EXPERIMENTAL FARM

The season 1945–46 was a difficult one. After a mild but wet winter there followed a dry spring and a very wet summer with many thunderstorms. This rendered cultivations difficult, encouraged weeds, and lodged much of the corn. It was a very troublesome harvest. In August and September there was 6.5 in. of rain and 38 rainy days. Consequently most of the grain was not secured in the best condition. Potatoes were attacked by blight, though the experimental crops escaped entirely. Sugar beet grew well, but the sugar content was lower than usual.

### FIELD EXPERIMENTS

#### 1. *Continuous wheat and barley experiments*

The present interest of these experiments lies in the effect of the manuring for the 50 years 1877–1926 on the fertility of the land under various further treatments. The effect of fallowing in restoring the fertility of this exhausted land was tested over two five-year periods, and since 1943 the effect of nitrochalk has been studied. In 1946 the wheat results were vitiated by rabbit damage and by the weed *Holcus mollis*, which increased to such an extent that the yields were not recorded. The barley results were more reliable, though they were affected by the development of wild oats during the last five seasons, which, although observed on the plots for at least 40 years, had never before become a serious pest. A preliminary examination of the barley yields indicate that the effect of nitrochalk has been very much greater in plots formerly receiving phosphate and potash than on those without mineral manures. The action of nitrochalk on the farmyard manure plots has been about the same as on those treated previously with mineral manures only. The figures need further analysis and the matter is in hand.

#### 2. *The maintenance of the fertility of light land*

One of the purposes of the Woburn Station is to determine the best methods of maintaining the fertility of light land, especially at the present time when the amount of available farmyard manure is becoming less. This is the basis of the following three long-term experiments.

(a) *Alternate husbandry experiment*.—In recent years it has been contended that the best way of maintaining the fertility of land is to have an alternation of ley crops such as grass and clover or lucerne occupying the land for several years, followed by arable crops to utilise the accumulated fertility. How far this is more effective than a well planned arable rotation with proper use of fertilisers and small amounts of farmyard manure or compost has been tested at Woburn since 1938. The rotations compared are:—

- (i) Three years' ley, grazed.
- (ii) Three years' lucerne, cut for hay.
- (iii) Potatoes, wheat, and one year ley, cut for hay.
- (iv) Potatoes, wheat, kale.

Followed in each case by testing crops of potatoes and barley. As difficulty had occurred repeatedly with the kale crop it was decided

to replace this in 1946 with sugar beet. A similar amount of phosphates and potash is given in each case, but the amount of nitrogenous manure varies, being adapted to the crop. All the plots are divided, one half receiving 15 tons of farmyard manure per acre applied to the first test crop of potatoes.

We have now nine years' results from this experiment, giving five testing crops of potatoes and four of barley. The general results obtained are in very much the same direction as previously and may be stated as follows: (a) The potato crop following the three years' ley or the lucerne is definitely bigger than after the continuous arable rotation, but the second crop (barley) shows no significant advantage; (b) the effectiveness of a moderate dressing of farmyard manure for the potatoes following the grazed ley is much less than after either a lucerne ley hayed every year, or continuous arable cropping. The experiment is being continued and forms one of the most interesting areas of the farm.

(b) *Six course experiment with fertilisers only.*—This experiment, which has been carried on since 1930, receives no organic manures, but has varying amounts of nitrogen (in the form of sulphate of ammonia), potash (in the form of muriate of potash), and phosphoric acid (in the form of superphosphate) for each crop. The rotation consists of barley, clover, wheat, potatoes, rye, and sugar beet. It has been decided recently that the results should be worked up immediately, and it is hoped that the publication of these will be made during the coming year. One result is clear. There has been so far no indication of any general deterioration of the crops as a result of using fertilisers alone, though the crops of potatoes and sugar beet in 1946 were smaller than usual. On the land at Woburn there is no advantage in using superphosphate, and very rarely in using potash manures; while sulphate of ammonia usually gives very considerable increases with all crops except clover.

(c) *Green manuring experiment.*—The use of green manures for the maintenance of fertility has often been recommended, and experiments on the subject, using mustard and tares as green manures, have been in progress at Woburn since 1893. The present experiment, laid out in 1936, compares the effect on kale followed by barley of the following treatments: (1) two green manures grown in winter and spring, (2) ryegrass and clover undersown in the previous barley crop, (3) bare fallows. The green manures are ploughed-in about June. The technical difficulties of such an experiment are great, and the kale crop has so often failed that it was decided to replace it by a transplanted crop of winter cabbages of which the first crop was grown in 1946. Till 1945, inclusive, the green manures used were mustard and tares, but it was then decided to replace the mustard by rape sown where possible in the autumn, and the tares by lupins (for which crop the Woburn soil is specially suitable) sown in the spring. Additional variants in the experiment are the addition of straw to half the plots and of farmyard manure also to half of the plots.

So far as the experiment has gone it is clear that the crop of kale or its equivalent is smallest after the ryegrass, and that there has been little difference between the effects of the other green crops, of which clover is probably the best. In the case of the

second crop, barley, there has been little effect of any of the green manuring crops. Straw has uniformly reduced the kale crop.

### 3. *The making of a market garden soil*

In the year 1942 an experiment was undertaken to determine the relative value of farmyard manure, vegetable compost, sewage sludge, and a compost made from sewage sludge and straw, in converting a very exhausted area of the Woburn farm into land capable of growing market garden crops. The organic manures were also compared with fertilisers alone. The area chosen was one which was exceedingly poor, but which, by its character and texture, should make a good market garden soil, and each of the above materials was applied yearly at 15 and 30 tons per acre. A two-year rotation of vegetables was adopted, namely, first year: early green peas, followed by leeks; second year: globe beetroot followed by winter cabbage. The actual crops were only a measure of the condition of the soil and the interest of the experiment is rather in the change in the soil than in the nature of the crops. The year 1946 was the fifth year of the experiment.

The results are not yet ready for analysis, but it is clear that the effect of the different organic manures is distinct and that they differ according to the crop used. The fertilisers without the organic manures are clearly inferior.

### 4. *Experiment on take-all disease of wheat and barley*

In connection with the work on this very destructive disease of cereals, and especially of wheat and barley, conducted by Dr. S. D. Garrett at Rothamsted, an experiment was laid out at Woburn in 1943 to test several methods of counteracting the disease. The experiment, which will be fully reported on by Dr. Garrett, compares the amount of disease in a barley crop after early ploughing as against late ploughing, after an under-sown crop of trefoil as against keeping the land bare during the previous winter, and after early and late treatment with a nitrogenous fertiliser (sulphate of ammonia in this case). The crop in 1946 is the last of the series.

One result is the remarkable effect of the undersown trefoil on the barley in which it is grown, for in every case in 1946 the yield was very significantly greater than in the corresponding plots without trefoil.

### 5. *Other field experiments*

For a number of years the Woburn farm has taken a share in the study of certain foreign crops which it was thought might be suitable for cultivation in this country. For instance, we have now a type of soya bean which, after an experience of fifteen years, can be relied on to ripen in this part of England. Though it is a dwarf type it can, in good soil, produce about 11 cwt. of dry beans per acre. Even in a wet autumn like 1946 the crop has ripened without difficulty. The question has been to see whether this yield could be increased, especially since it was found that a dwarf type like this can be grown much closer than is usual, and there is no doubt that by this means the yield can be stepped up to a considerable extent. Other suggested varieties have been tested but none has so far been

found which will ripen as early and give as good a yield, while most of the seeds imported directly from America have been found to be infected with a virus disease which, under the difficult ripening conditions of England, have ruined the crop. This is a danger which has not been realised by most of those who have attempted to grow soya beans in England from foreign seed.

Experiments have again been made in 1946 with the type of early maize which, while giving good cobs for eating, yet will ripen seed satisfactorily in this part of England. Even in the wet and cold autumn of 1946 a good yield of seed was obtained.

We also tried again two varieties of sweet lupins with the intention of seeing how late in the season they could be sown so as to give a fodder crop late in the autumn. Under the conditions of 1946 it was found that both yellow and blue sweet lupins sown at the beginning of August were not suitable for this purpose. The yellow variety gave more growth than the blue, but neither produced a useful crop in the wet autumn of this year.

#### POT EXPERIMENTS

The pot culture station at Woburn is the oldest experimental pot station in Britain, and it has been used for carrying out special investigations which could not be done in the field. Four different subjects are being investigated in 1946.

##### 1. *Clover sickness*

In a paper published in 1938 it was shown that clover sickness is not necessarily connected with the presence of eelworms in the soil or with any recognised fungus attack. On the other hand, soil which has become clover sick by growing many crops of clover in succession can be made to grow healthy crops of clover by heating (moist) to a temperature of 70° F. for two hours, and also by adding to the soil a large dose of farmyard manure. Confirmation of these points has now been obtained. It has also been shown that healthy soil cannot be inoculated with the sickness, that washing of the soil with water makes very little difference to its virulence, that the washing water from the soil does not cause the disease in healthy soil, and that while dressings of charcoal reduce considerably the affection in a clover sick soil, the addition of colloid matter to the soil had no beneficial effect. The results have now been put together and are being offered for publication in the very near future.

Attempts are also being made to see how the advent of clover sickness in soil can be hastened. In 1946 certain factors on the onset of infection have been studied, namely the effect of temperature, of partial water-logging of the soil, or of an increase of the proportion of clover to soil. The results cannot be determined till a testing crop is grown in 1947, but this test will certainly be made in the coming year.

##### 2. *Competition of crop plants and certain weeds*

The study of the competition of barley and certain weeds under controlled conditions has continued. A paper on the competition between one of the forms of twitch common at Woburn (*Holcus mollis*) is now in the press and will come out in the "Annals of Applied Biology" in 1947. In the last year a similar study of the

competition between barley and chickweed (*Stellaria media*) has been conducted, and the results are now being worked up.

3. *The nutrition of barley under very acid soil conditions*

This study, which has now continued for a number of years and in connection with which two papers have already been published, has been continued in an attempt to find out why barley will not grow under conditions more acid than that represented by a pH value of 4.7 to 5.0. This year for the first time we have succeeded in getting a healthy crop of barley at a pH value of 4.3, by large additions of a soluble phosphate to the soil coupled with a small addition of calcium nitrate. Increase in the colloid contents of the soil by the addition of bentonite made very little difference to the growth. Other points have come out of this intensive study, and the whole of the work to date is now being worked up for publication.

4. *How far is a growing plant efficient as a user of the nitrogen in the soil?*

This is a matter which has been under investigation in the last three years, using barley as the test plant. It is a continuation of work done for a number of years on the effect of green manures as sources of nitrogen and what happens to their nitrogen when they are buried in the soil.

STAFF

The Woburn Experimental Station has been under the charge of Dr. H. H. Mann during the whole of the period under report, Mr. T. W. Barnes has been chemist to the Station since 1929, and has remained during 1945-46. The farm foreman, Mr. W. A. McCallum, has continued in general charge of the farm while we have been assisted by various members of the Rothamsted staff as occasion arose.

From 1st October, 1946, the management of the Woburn farm has been turned over to Mr. J. R. Moffatt, the Farm Manager at Rothamsted; Dr. Mann will continue to be responsible for the control of the station as a whole.

Publications (including Summaries), page 114.