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Summary of Fifty Year's Work at Woburn

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of the method, and the procedure of its correct execution, become better known.

The use of statistical methods in the design of experiments is, of course, applicable in laboratory as well as in field experiments, and the field technique developed is applicable to other than manurial problems; many voluntary workers are concerned with these other fields of work, at home or overseas. By applying statistical methods not only to the interpretation but also to the design of experiments it is not uncommon for the value of the experiment to be increased five or tenfold, a result which could not be obtained from improved methods of interpretation only, unless previous methods had been excessively inefficient.

THE WOBURN EXPERIMENTAL STATION

Soon after the first period of fifty years of the Woburn Experimental Station terminated in 1926, the Royal Agricultural Society made a grant to Rothamsted to provide a special assistant in the Statistical Department for the purpose of working out the results. This has been done, and the Report is now being prepared for publication.

The outstanding results are as follows:

(1) Green manuring is not an infallible method of improving sandy soils: in the Woburn experiment it failed completely.

Experiments are now in hand to discover the conditions for success.

(2) The residual values of farmyard manure and of cake and corn fed to animals on the farm appear on this sandy soil to be much less than indicated by the recognised Tables.

This problem urgently needs following up: there seems little doubt that many farmers entering new farms are called upon to pay compensation for something that may never benefit them.

(3) Lime is urgently needed on this light sandy soil, as indeed on a large number of other light soils, but it is easily applied wastefully. Certain conclusions can be drawn as to the best way of using lime for different crops, but new experiments are needed to test them before they could be generally recommended.

(4) When cropped continuously by wheat or by barley the yields suffer marked deterioration whatever the manuring. Farmyard manure or heavy dressings of artificial fertilisers delay the setting in of the deterioration, but do not prevent it. This deterioration of yield is accompanied by a serious loss of organic matter in the soil, no less than one-third of the initial supply having disappeared from the plots that receive no farmyard manure. There is also a loss of exchangeable calcium which was intensified by the use of sulphate of ammonia and reduced by nitrate of soda. Superphosphate had no appreciable effect on the soil reaction, and even after fifty years of annual dressings there was no sign that acidity was being produced. Several causes appear to contribute to the deterioration in yield when one and the same crop is thus grown year after year on the same land. Weeds become very troublesome and, as in other experiments at Rothamsted, they exercise a particularly baleful effect on yield. Certain plant diseases, especially those associated with the

soil, tend to accumulate. The loss of carbon and nitrogen from the soil probably depresses productiveness.

It is not yet clear whether other crops such as market garden crops would suffer the same kind of deterioration, though observations on certain market gardens on the same kind of soil and not far away from Woburn suggest that this may be so. No method of recuperation has yet been tested. This of course brings us back to the old problem of soil sickness, which formerly received much attention at Rothamsted. The earlier investigations were with horticultural soils and the treatment adopted was partial sterilisation, which has now become general. For farm land, however, this method is unsuitable.

It seems evident that the subject should be re-investigated. One special aspect, clover sickness, has been studied in conjunction with T. Goodey of the Institute of Helminthology, St. Albans; this work is still continuing.

(5) Although light soils are notoriously susceptible to drought we cannot find that either the wheat or the barley has suffered through lack of actual rainfall. A dry spell at a critical time may of course do harm, but over the fifty years there was no evidence of any uniform injury caused by dry weather. In 1933 in spite of the record drought, the annual rainfall being 17.8 inches only, we obtained on the light land at Woburn over 60 bushels of barley, 30 bushels of wheat, 14 tons of sugar beet and 8 tons of potatoes without excessive manurial treatment.

(6) The experiments show the conditions under which malting barley may be produced on a light soil.

(7) The acid plots have enabled us to study in detail the effects of acidity on plant growth, with the purpose of recognising the symptoms that appear before yields begin to suffer, and when therefore dressings of lime would be most advantageous and economical.

INSECT PESTS AT ROTHAMSTED AND WOBURN, 1932-3

H. C. F. NEWTON

GENERAL. The year was notable for very severe attacks: (1) on sugar beet by the Bean aphid, *Aphis rumicis* L. (plentiful also on the surrounding beans), (2) on kale by Flea-beetles (*Phyllotreta* spp.) in numbers sufficient to necessitate resowing, for the first time since 1930, (3) on barley by the Gout Fly, *Chlorops taeniopus* Meig. Damage by pigeons is increasing, and a large area of kale on Great Knott was stripped of its foliage when the plants were some six to eight inches high.

BROADBALK. *Wheat*. There was no winter attack by Frit Fly but some loss of plant by soil insects occurred during the winter months. Wheat Bulb Fly (*Hylemyia coarctata* Fall.) did not cause appreciable damage, though many tillers were destroyed; the attacked tillers on the fallowed plot were about twenty times more numerous than those on the unfallowed. Wheat Leaf Miner (*Agromyza (Domomyza) ambigua* Fall.) was rare; Wheat Midges (*Contarinia tritici* Kirby, *Sitodiplosis mosellana* Géhin) were notably less abundant, the figures for the last seven years being:

Year ..	..	..	1927	1928	1929	1930	1931	1932	1933
Percentage grain									
attack ..	..	..	3.2	6.5	7.7	17.6	21.4	15.4	2.1