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Report for 1948

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Rothamsted Experimental Station
Harpenden

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REPORT
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Statistics Department

F. Yates

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STATISTICS DEPARTMENT

By F. Yates

During 1948 the department has chiefly been concerned in the design and analysis of experiments, both for Rothamsted and other research stations and for the National Agricultural Advisory Service, and in the organization, supervision and analysis of agricultural surveys.

Two major surveys were carried out in the course of the year; the first was the Rapid Survey of Fertilizer Practice, which was carried out in five counties. This was undertaken in order to investigate the extent of the reported shortages of fertilizer supplies which had developed as a result of the increased use of fertilizers and the exceptionally early season. The second was the Survey of Maincrop Potatoes. This was undertaken by all provinces with the object of obtaining detailed information on the agricultural practices followed in the growing of potatoes, and also to test out whether any method of estimation of the yield of the potato crop was practicable. A pilot survey of the conditions under which milk is produced on farms has also been commenced, and results from one county, Wiltshire, are at present being analysed.

Design and Analysis of Experiments

The volume of work on the design and analysis of experiments has been very considerable. The National Agricultural Advisory Services are now making considerable use of the department and Dr. Boyd has paid many visits to the various provincial centres in order to discuss various problems of experimental design on the spot. He is a member of a number of Provincial Field Experiments Committees and other Committees at National Agricultural Advisory Service Headquarters (46).

The design of the Rothamsted long-term experiment on the effects of various arable ley rotations was completed in conjunction with the other departments concerned, and the experiment has now been started. One part of this experiment will replace the Royal Agricultural Society of England Grazing Experiment which has now ended, and the other will be laid out on old arable land.

In addition to the design and analysis of the current year's experiments at Rothamsted, the work of summarizing the experimental results of the war years has been continued, and Mr. H. D. Patterson carried out an analysis of the results of the three-course rotation experiment.

Various pieces of work in experimental design and analysis have been carried out for the National Institute for Research in Dairying and for the Veterinary Laboratory, New Haw, Weybridge. Mr. Healy designed a series of experiments on minor element deficiencies in the Fen soils which were carried out by Mr. C. Barclay. The analysis of these experiments has also been carried out here. Mr. C. P. Cox, who was working on an agricultural research scholarship here last year, has now been appointed statistician at the National Institute for Research in Dairying and will be taking up his duties there as soon as their new building is completed.

Mr. P. M. Grundy has carried out some research into restricted types of randomization which allow the more unfavourable random

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patterns to be excluded without invalidating the estimation of error which can be derived from the experimental results. The problem first arose in connection with the types of design known as the "quasi-Latin square".

Dr. Yates prepared a paper on long-term rotation experiments for the Commonwealth Agricultural Bureaux Conference on Tropical and Sub-Tropical Soils (40).

Survey of Fertilizer Practice

A rapid survey was undertaken in the spring of 1948 in response to a request from the Ministry of Agriculture and the Agricultural Improvement Council to ascertain whether the reported shortages of fertilizer supplies were in fact serious, and to what extent they were likely to affect agricultural production. The survey was carried out in East Shropshire, West Warwickshire, the Taunton area of Somerset, the Hailsham area of East Sussex and the Vale of York. These areas were chosen partly because staff were there available for immediate execution of a survey, and partly in order to obtain as diverse a sample as possible of various types of farming in different parts of the country. The survey showed conclusively that although in certain small districts there were serious shortages at critical times, their extent was more limited than reports had indicated. The total effect on the agricultural production of the country as a whole is not likely to have been serious. The survey was noteworthy in that it proved possible to carry it out considerably more rapidly than any previous agricultural survey of a similar nature. The first request for the survey was made in April and a report was issued on the results in August (43).

This survey was not only valuable for its original purpose but also served to provide evidence on the changes of fertilizer practice that have occurred in the last two or three years. This information on current levels of use of fertilizers proved of considerable value in connection with the national plans for expanded agricultural production (see below). The current levels of nitrogenous manuring are shown in the following table. The large amount of nitrogen used on grass in East Shropshire is particularly noteworthy.

Use of Nitrogen on Farms in 1948

	Percentage of acreage dressed			Average rates of application on dressed acreage (cwt. N per acre)		
	Arable districts		Grassland districts	Arable districts		Grassland districts
	East Salop	West Riding	(mean)	East Salop	West Riding	(mean)
Cereals	60	40	43	·36	·23	·22
Potatoes	100	95	83	·84	·80	·68
Sugar Beet	97	100	—	1·06	·75	—
Mangolds	100	96	74	·96	·60	·56
Swedes	83	81	—	·60	·56	—
Hay: seeds	66	18	12	·42	·33	·29
meadow	68	25	9	·37	·20	·25
Pasture: ley	55	7	24	·35	·15	·35
permanent	27	8	8	·29	·25	·18

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During the year the field work of a routine survey was carried out in Berkshire, and the analyses were completed and reports issued on 7 further counties (48). 12 reports were also revised for reproduction by the Ministry.

Survey of Maincrop Potatoes

This survey was organized at the request of the Agricultural Improvement Council, and has been carried out by the officers of the National Agricultural Advisory Service. It has been designed to furnish comprehensive and precise information on the agricultural practices followed in growing maincrop potatoes, including cultivations, manuring, varieties, source of seed, pests, diseases, etc.

A further important feature of the survey is the testing of a simple and rapid method of estimating the yield of the potato crop. Work on the sampling of the potato crop by digging up and weighing short lengths of row as late as possible before lifting had been carried out by this department in conjunction with other departments and the farm in previous years, but no large-scale test under practical commercial conditions had been made.

Work was carried out by all the provinces in 1948. In some provinces the work was limited to certain counties, in others all the counties were covered, usually with a lower intensity of sampling. The farms were selected on the basis of their proposed potato acreages for 1948, a greater proportion of the farms with the larger acreages being taken. Within the acreage groups the selection was random. Two visits were made to all the selected farms and a third visit was also made to a sub-sample of these farms. At the first visit in June the agricultural particulars were obtained. At the second visit the selected fields were sampled for yield by taking 4 sample lengths of row (7 ft. each) randomly located in the field. At the third visit (to a sub-sample of the farms) samples were taken to determine the quantity of potatoes left in the ground after lifting. Particulars on date and method of lifting and the farmer's estimate of the total yield were obtained for all sampled fields. In a number of districts the sample fields were also examined for pests and diseases by the Advisory Staffs.

The results of the survey are at present being analysed. A preliminary report on yield was issued in October (44).

The experience of the 1948 survey has indicated that estimates of yield by sampling methods are likely to be practicable, and considerably more reliable than the estimates currently obtained. It is proposed to repeat the survey in 1949 and it is hoped that it will be possible to make the first test of methods of forecasting the yield a month or so before lifting time by taking weighed samples of the growing potatoes. Preliminary tests of this method of forecasting have already been made at Rothamsted and elsewhere with promising results, but the method must be tested on a larger scale over a number of years before any final conclusions as to its reliability and practicability can be drawn.

Survey of Methods of Milk Production

The main object of this Survey, which was planned by the Field Experiments Committee of the Agricultural Improvement Council, is to investigate the conditions under which milk is produced, so as to

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see in what directions improvement is required, and what advice should be given to farmers. The survey will also serve to provide an assessment of the equipment which is actually available on farms of various types for the production of milk.

The pilot survey referred to in the 1947 report has now been commenced, and results from one county, Wiltshire, are at present being analysed. The survey is being undertaken in three other counties, Hertfordshire, Caernarvon and Pembroke.

Textbook on Sampling Methods in Censuses and Surveys

The textbook on sampling methods for censuses and surveys was completed during the course of the year, and the printing was well advanced by the end of the year. The preparation of the book involved a good deal more research into methodology than had originally been anticipated. Opportunity was taken to review the whole of the subject and to develop the theory where this appeared to be required. It is hoped that the book will provide a standard textbook which will enable those who are not highly trained in mathematical statistics to plan sampling surveys with full efficiency (36).

Other Work on Sampling

Some work was carried out by Dr. Boyd on the sampling errors arising in the sampling of soils for chemical analysis to determine fertilizer requirements (47).

Mr. Read made an examination of the accumulated results of the sampling observations on the growth of wheat accumulated before the war under the Agricultural Meteorological Scheme.

Advice has been given to the East Midland Province on the design of a survey of poultry flocks. This survey is now in progress, and assistance may be required in the analysis.

A common method of sampling when samples are taken from the same universe on successive occasions is to replace part of the sample on each occasion by a fresh sample. The problems of estimation to which this method of sampling gives rise, have been investigated by Mr. H. D. Patterson (38).

Dr. Yates attended the 2nd Session of the United Nations Sub-Commission on Sampling which was held at Geneva.

National Plans for Increased Agricultural Productivity

A memorandum was prepared at the request of the Imports Substitution Panel on the best ways of utilizing limited supplies of additional nitrogenous fertilizer for increased agricultural productivity (49). This involved an analysis of the responses of grassland to nitrogenous manuring, similar to that already carried out for arable crops during the war. It was shown that very considerable increases in the productivity of grassland may be expected from the use of moderate dressings of nitrogenous fertilizer, and also that experimental results indicated that large responses might be expected to heavy dressings of nitrogen when grassland is used intensively for the production of dried grass and silage.

This work formed the basis of a paper presented at a meeting of the Agricultural Education Association on the relative yields of different crops in terms of food and their responses to fertilizers (41).

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Colonial Work

The department has continued to be consulted by many colonial research workers on problems arising in the design and analysis of experiments and on other experimental and sampling work. Mr. Healy carried out an analysis of a long-term coffee experiment from Tanganyika, and Mr. Church has been working on problems arising in the sampling of mealybugs—the vector of the virus causing "Swollen Shoot"—for the West African Cacao Research Station.

Assessment of Yields of Grass Pasture by Grass-cutting Techniques

No further field work was carried out at Rothamsted during 1948, but a paper has been prepared on the work of the previous three years (37). A further report was also prepared for the Joint Supervisory Committee on Ley Farming, which originated the work (46). The Committee has now been disbanded and further work on the same lines will be undertaken under the auspices of the Grassland Improvement Station.

Plant Breeding

Dr. Yates attended the 8th International Congress of Genetics at Stockholm and the Pre-Congress tour of the Plant Breeding Institute at South Sweden. He also gave a paper at the Conference of Plant Breeders held at the John Innes Horticultural Institute. He has been co-operating with the National Institute of Agricultural Botany in the planning of the future programme of variety trials.

Resazurin Research Scheme

The report on this work was completed in the course of the year by Mr. Eddison, working in conjunction with the National Institute for Research in Dairying. Statistical problems arising in any further investigations under the scheme will be handled by Mr. Cox.

Entomology and Parasitology

Mr. Dyke has succeeded Mr. Anscombe as statistical adviser to the Advisory Entomologists. The scheme of observations on certain important pest insects ("calendar insects") has continued and it is intended to undertake an analysis of the accumulated results during the coming year. Various items of work have also been undertaken for other departments at Rothamsted. Mr. D. R. Read has completed a paper in conjunction with Dr. P. H. Gregory on the spread of virus infection by aphids (39).

Hollerith Equipment

During the year the department has had the use of a sorter-counter and arrangements have been completed for the installation of a rolling total tabulator and the replacement of the sorter-counter by a sorter. Installation of this equipment is promised for June, 1949. This equipment should not only facilitate the analysis of all survey data but will also enable research to be carried out on the possibilities of handling more complicated analyses of experimental data—particularly experiments in which observations are made on a large number of variables—on punched card equipment.

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STAFF

The following appointments were made in the course of the year: Mr. G. M. Jolly (October, 1948), from Edinburgh University (Department of Agriculture Scholar); Miss E. P. Poulton (October, 1948), from Oxford University (Ministry of Agriculture Scholar); Miss M. A. Creasy (October, 1948), from University College, London.

The following members left to take up appointments: Dr. R. O. Cashen (September, 1948), Admiralty; Mr. R. T. Eddison (July, 1948), British Iron and Steel Research Association; Mr. D. R. Read (November, 1948), Research Department, Distillers Co. Ltd.