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ROTHAMSTED
RESEARCH

Report for 1935

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Bee-keeping Research Section : 1922-1935

Rothamsted Research

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In the field experiments on pyrethrum at Woburn manuring had no significant effect on yield.

Soil Insecticides. The possibility of finding a chemical substance effective for soil sterilisation and as a soil insecticide has recently been revived. Some years ago it was shown at Rothamsted that certain benzene derivatives were very promising, but they were then unobtainable on the large scale. They are now, however, available in quantity and at relatively low cost. The subject has therefore been re-opened and Major Ladell appointed to discover how best to find out the effects of these substances against wireworm and eel-worm in actual field conditions; these two pests being chosen because they are already doing much damage, and the eel-worm is threatening to do more.

This work has been greatly facilitated by Major Ladell's new method for the rapid separation of insects and other arthropods from soil. The sample is stirred in a heavy non-toxic solution (magnesium sulphate, sp. gr. 1.1) through which a stream of fine air is bubbled to assist in floating the insects to the surface. The froth containing the insects is drawn off over a sedimentation tank and the insects finally separated by filtration.

Over 95 per cent. of the soil fauna can thus be separated from a sample of about 5 lb. of soil in about 20 minutes. Two field experiments on the use of insecticides against soil insects were carried out in 1935, one against wireworm and the other against root eelworm, four insecticides in single and double doses being used. Significant differences were observed between the numbers of eelworm cysts in the control and some of the treated plots. There was also a noticeable decrease in the number of wireworms on some of the plots. Both experiments are being continued.

BEE-KEEPING RESEARCH SECTION : 1922-1935.

Organisation and Equipment. Shortly after the war the Development Commissioners made a grant to the University of Cambridge for investigations on problems of bee-keeping to supplement the work on Bee Diseases they were financing at the University of Aberdeen.

In 1921 the investigations were by mutual agreement transferred to Rothamsted along with the equipment and the stocks of bees. In 1922 Mr. D. M. T. Morland came from the Ministry of Agriculture to take charge. He has been assisted throughout by Arthur Rolt, while B. A. Young was a voluntary worker for about one year and others for shorter periods. In 1934 the beekeepers asked that the work should be extended to deal with bee diseases, and the British Bee-Keepers' Association generously undertook to collect one half of the money required, if the Ministry of Agriculture would provide the rest. This was done, and Dr. H. L. A. Tarr was appointed as Bacteriologist to investigate brood diseases.

The section forms part of the Department of Entomology.

At the inception of the work at Rothamsted an Advisory Committee was appointed consisting of Messrs. Boccock, J. C. F. Fryer, Cragg and W. Herrod-Hempsall, with Sir John Russell as Chairman

and Dr. Imms (Head of the Department of Entomology) as Secretary. Meetings have been held once or twice a year to discuss the progress made and to advise on future investigations.

The present Committee consists of Mr. J. C. F. Fryer, Mr. W. Herrod-Hempsall (Ministry of Agriculture), Miss A. Betts (Apis Club), Dr. Gregg, Mr. J. Herrod-Hempsall, Rev. W. H. Richardson (British Bee Keepers Association), Dr. H. Schütze, Dr. J. C. G. Ledingham (Lister Institute), Brother Adam, Dr. F. Thompson, Mr. B. C. Berkeley, Mr. Gilbert Barratt. Two of the members representing the B.B.K.A. were appointed by that body when they took over the responsibility for the collection of the Beekeepers' share in the fund for Foul Brood disease research: the two members representing the Lister Institute were appointed at the same time to advise on the bacteriological side of the work.

The experimental apiary (4)⁽¹⁾ is situated on the Rothamsted Farm in a sheltered position protected by trees and hedges. It usually contains thirty to forty colonies mostly on British Standard Frames, about half being in W.B.C. hives and the rest in "National" single walled hives. These are arranged regularly, but in such a way as to avoid excessive drifting of the bees. The field laboratory contains store room, extracting room, and workshop and has water and electricity laid on.

Two or three out-apiaries are usually maintained for special investigations and for work on brood diseases.

The main sources of nectar are white clover, the lime trees of the adjacent avenue and, in spring, wild cherry and holly. Willows of both pollen- and nectar-bearing varieties have been planted at the apiary and a small orchard stands opposite. The spraying experiments carried out on these trees are watched with some anxiety, but up to the present there has been no evidence of poisoning of the bees.

For the more technical investigations there is a large laboratory in the Entomological Department.

Hive Temperatures. Observations on hive temperatures by means of thermocouples were commenced by Mr. Bullamore while the apiary was still at Cambridge; they were continued at Rothamsted with improved instruments embedded in the foundation wax. Interference with the brood was thus avoided but the temperatures recorded were of course those of the brood and not of the air in the hive.

Daily readings, winter and summer, were carried out for a number of years in hives with different comb arrangements. Once a month readings were taken every three hours for a period of 24 hours or more. The statistical analysis of the data was made under the supervision of Mr. Irwin, but was never published. The results tended to confirm those obtained by Phillips and Demuth in North America and were summarised at the 5th International Entomological Congress in Paris in 1933⁽¹⁵⁾.

Feeding Experiments. Two feeding investigations were undertaken in 1929⁽¹⁰⁾, these were:—

(a) *Comparison of Cane and Beet Sugar.* Some beekeepers had

(1) The numbers in brackets refer to the Bibliography on pp. 64—66.

been accustomed to attribute their winter losses to the use of beet sugar as food. Two series of hives were deprived of most of their natural stores, one was given cane sugar first as syrup then as candy, and the other beet sugar in similar form. No difference in wintering attributable to the sugar could be detected. This experiment was repeated over a series of winters.

- (b) *Ripening of Syrup.* A mild organic acid such as tartaric acid or vinegar is sometimes used in preparing syrup for autumn so as to invert the cane sugar and prevent granulation in the comb. Experiments showed that boiling syrup with acetic acid for 30 minutes inverted only 15 per cent. of the sugar, while merely bringing the syrup to the boil was almost ineffective. Syrup to which acid has been added was not so readily inverted by the salivary juices of the bees as was the plain sugar, so that samples of the sealed stores taken from the hive after feeding showed an advantage in favour of the untreated sugar. The inhibiting action of the acetic acid on the invertase of the bees' saliva had defeated the object of adding it.

Weighing Hives. Even in a commercial apiary it is most desirable to have a hive on scales, and in an experimental apiary this is a necessity. Three sensitive self-recording balances are used to record continuously the changes of weight of the stocks kept on them⁽⁸⁾. One of these has been in continuous use for nine years and the records show a marked similarity in the dates of the onset, peak and cessation of honeyflow in different seasons.

The relation between the daily fluctuations, which give a measure of the bees' activity, and the weather records (sunshine, temperature, rain, wind, in decreasing order of importance) have been studied by P. V. Sukhatme.

Study of Swarming. Swarms are undesirable as they not only cause trouble and loss of time, but also they divide the working force of the bees at the season when it is most important to keep it intact. The brood food theory of Gerstung seems to offer a reasonable explanation of swarming and it has received some confirmation from Rösch's work on the division of labour in the hive⁽¹²⁾.

Experiments with bees marked on emerging from the cell and then introduced into observation and other hives, tend to corroborate Rösch's work. As they become older bees are promoted from the various grades of nursing duty to household work, such as wax building and the ripening and storing of honey, and finally to field work.

According to the brood food theory it is a surplus of nurse bees over the requirements of the brood that causes the building of queen cells. A surplus occurs in every normal stock immediately after the peak of brood rearing is reached; its magnitude varies according to a number of factors and it is largely this which determines whether swarming occurs or not.

The introduction of marked bees into a colony induced swarming: indeed in one year the only swarms in the experimental apiary came from such colonies. The withdrawal of brood from

other strong colonies to provide bees for marking and transfer to the experimental hives had lowered the proportion of nurse bees to brood in the one lot and considerably augmented it in the other. Removal of much of the sealed brood from the nest and keeping the resulting bees away until they are past nursing age forms the basis of several systems of swarm control.

A Conference on swarming was held at Rothamsted in 1935 and was largely attended by beekeepers. A report on this Conference was published⁽³⁸⁾.

BEE DISEASES

Acarine or "Isle of Wight" Disease. In 1927 Mr. Allen experimented on the treatment of Acarine disease by vapours introduced into the hive. Oil of wintergreen and sulphur dioxide were the only ones that killed the mite without at the same time killing the bee. The Frow treatment had not at that time been devised and nitrobenzene was not tried; when Mr. Allen left the work was discontinued; it will, however, be resumed during the coming season.

Brood Diseases. Dr. Tarr finds that American foul brood is a definite disease due to *Bacillus larvae*, but the so-called European foul brood is more complex and appears to be associated with at least two organisms. A third disease generally called "addled brood" may be due to some trouble in the queen and is not due to a pathogenic organism.

American foul brood and addled brood are more common than European foul brood.

American foul brood appears to attack quite strong bees, but there is distinct evidence that European foul brood is more prevalent in weak stocks and in neglected apiaries.

A Conference to discuss problems of brood disease was held at Rothamsted in May, 1934⁽³⁷⁾.

Senses and Sense Organs of Bees. H. C. F. Newton investigated the so-called olfactory organs or "campaniform sensillæ" scattered over the bodies of bees, dealing particularly with the structure and development of the sensillæ occurring in the wing bases of adult worker bees. He finds no evidence that the actual termination of the nerve fibre is exposed to the outside air.⁽²³⁾

J. Marshall⁽²⁾ has made a preliminary study of other sensory organs, the contact chemoreceptors on the antenna and fore-tarsus of the honey bee. He found that the bee responds when a solution of saccharose of an average strength of M/12 comes into contact with the antenna, whereas a strength of M/1 is required to elicit a response from the fore-tarsus. Amputation of the antenna did not affect the gustatory reactions of the bee but resulted in a complete loss of olfactory recognition of wax comb. It was concluded that the antenna are the seat of all the olfactory organs which perceive mild odours.

HONEY PROBLEMS

"Frosting" of Granulated Honey. Preliminary observations suggest that this phenomenon, due to the formation of an irregular air space between the dextrose crystals and the jar, is aggravated by the large quantities of air that the modern centrifugal extractor incorporates into the honey and which is not removed in subsequent operations. It can be got rid of by incubating for two days at 40°C, but this involves loss of both colour and aroma of the honey. Placing the honey in a vacuum was not effective as on re-admitting air the bubbles were re-absorbed.

Heather Honey. Thixotropy. Heather honey is popularly supposed to be able to hold more moisture than other honeys without fermentation, and it was therefore desirable to draw up for the National Mark Scheme a special schedule for heather honeys, allowing a reasonable excess of moisture. The special water-holding powers are associated with the capacity to form a gelatinous structure on standing which is reversibly destroyed by stirring, a property well-known in other materials under the name of "thixotropy" (page 47).

G. W. Scott Blair has investigated this problem and has described a simple semi-quantitative test for thixotropy by which honeys can be classified⁽²⁴⁾.

Very few of the many plants from which honey can be obtained yield this thixotropic honey. *Calluna vulgaris* and *Leptospermum scoparium*, the latter from New Zealand, are the only authenticated cases to date (Apr., 1936), except that heated honey from Buckwheat (*Polygonum fagopyrum*) is also reported by Pryce-Jones as thixotropic.

Honeys produced from *Erica* spp. however, are not thixotropic, and should not contain any excess of moisture.

LIBRARY

A library of bee-keeping books is being built up and now includes long series of some of the more important bee journals and a number of books and pamphlets on beekeeping. Additions to the collection will be welcomed.

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CROP ESTIMATION AND FORECASTING

SAMPLING OBSERVATIONS ON THE GROWTH OF WHEAT

In 1924 the Agricultural Meteorological Committee was formed by the Ministry of Agriculture and Fisheries, the Department of Agriculture for Scotland, the Meteorological Office and the Forestry Commission, to investigate the effects of the weather on agricultural and horticultural crops. The programme includes sampling observations on the growth of wheat on a plan developed by the Statistical and Plant Physiological Departments at Rothamsted. Ten stations collaborate; at nine of them full meteorological observations are taken. The work is supervised by the Statistical Department, and 1935 was the third year of the full scheme.