ROTHAMSTED RESEARCH

Report for 1935

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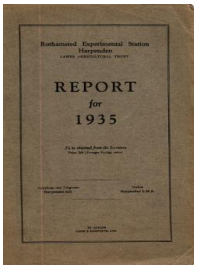

Insecticides

Rothamsted Research

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ENTOMOLOGY

The Entomological Department is concentrating on a study of the factors that determine the changes in number and the movements of insect populations. Observations show that all the ordinary harmful insects occur on our farm but in general their numbers are so small that they do little damage. Occasionally, however, one or more species multiplies with extraordinary rapidity and devastates the crop. The spring of 1935, for example, was not favourable for insects in general, yet one species, the Pygmy Mangold Beetle, multiplied so inordinately that it completely ruined the mangolds on Barnfield, on which mangolds have been grown every year since 1876 (with two exceptions) and where the insect has certainly been living for a long time. In certain investigations, the general procedure is to take systematically frequent " samples " of the insect population of the farm. Methods have been devised for making sample censuses that can be subjected to statistical examination and these are continuously improved to facilitate their use in practice. Approximately four times as many insects were caught from March to October in 1935 as in the corresponding period of the previous years, the difference being mainly in the Lepidoptera and the Diptera. Full meteorological observations are taken, and relations are sought between these and the census figures. The numbers of nocturnal insects caught in a light trap show a definite lunar periodicity, with low numbers at full moon and high numbers at new moon. The effect is more marked for some groups of insects than for others and is most significant in the *Noctuidae*.

A higher proportion of females was obtained in the *Noctuidae* in a trap at a height of 35 feet above the ground, than in one about 3-4 feet above the ground.

A mechanical trap for insects, designed and tested during the year has been found valuable for estimating the activity of small slow-flying insects, such as green fly. It has already been adopted for use in studying the transmission of potato virus disease by insects.

Dr. Barnes has completed the first series of his studies on variation in population of certain insects, which include nine years' observations in the case of the wheat midges. The figures for 1935 for the latter insect show an increase over the previous two years and so fit very closely to the periodic curve which was suggested three years ago.

The analysis of records of insect migration has thrown light on two important problems. Considerable evidence has been found that some British migrant butterflies and moths make a return flight to the south in the autumn, also that one of the migrant Hawk moths which occurs in both Europe and America, at times as a pest, shows a tendency to occur simultaneously in both Continents. This indicates that the causes of migration in this species must be sought for in factors that are either very widely spread or are positively correlated in the two Continents.

INSECTICIDES.

Dr. Tattersfield and Dr. Martin investigate the direct attack on harmful insects by means of insecticides. Certain vegetable

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products are found to be extremely effective and have the further advantage that they are harmless to farm animals and to man. Among them the most important are products from the tropical plants, Cubé, Derris, Haiari and others, and the non-tropical Pyrethrum. Methods of chemically evaluating these are investigated, and experiments are made to test the effect of manures on pyrethrum. Dr. Tattersfield's work has created so much interest in the United States that one of the large manufacturing firms there invited him over in May, 1935, to discuss problems with their experts and those of the United States Department of Agriculture.

During 1935 work has been concentrated on the differentiation of the species and varieties of derris root. Henderson's valuable studies in Malaya of the botanical characters of members of this genus give no indication of their potential value as insecticides nor whether the constitution of the resins is determined by genetical or environmental factors. We have had specimens of *Derris elliptica* possessing little or no toxicity to insects, and samples of *Tephrosia vogellii* and of *Mundulea suberosa* vary widely in activity, despite the fact that they appear to be true to type. From these plants a number of crystalline derivatives have been isolated by various investigators. Only one, " rotenone," is highly toxic to insects, the others appear to be either altered in the process of extraction or derived from precursors of greater insecticidal power. Three samples of derris, *D. elliptica*, *D. malaccensis*, and the " Sumatra-type," all contained about the same amount of extractives, but the resins differed markedly in properties. The rotenone content was highest in *D. elliptica* and lowest in the "Sumatra-type." *D. malaccensis* and the "Sumatra-type" resins yielded an optically active resin from which was isolated optically inactive " toxicarol," a compound closely related to rotenone, but with relatively little insecticidal power. The resins derived from these three types of root when dissolved in benzene were optically active and laevorotatory, and although their rotations were in the same order as their insecticidal powers the relationship was not quantitative. When a solution of caustic potash in methyl alcohol was added to the benzene solutions of the resins, those derived from *D. malaccensis* and the " Sumatra-type " changed instantaneously in sign and became dextrorotatory, while those from *D. elliptica* became less laevorotatory but did not change sign. The resin extracted by caustic potash from the " Sumatra-type " resin gave the change-over from laevo- to dextrorotation, but the residue reacted like the resin from *D. elliptica*. The induced dextrorotation declined with time at a rate depending on the amount of methyl alcohol added with the potash.

Direct insecticidal tests showed that no single method, including the estimation of the dehydro-compounds derived from the resins by suitable oxidation and dehydration processes, truly assessed the relative potencies of these three roots, and our chemical work shows that the toxicity of the resins is determined not only by rotenone, but by the precursors of deguelin and toxicarol also.

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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. Bocock, J. C. F. Fryer, Cragg and W. Herrod-Hempsall, with Sir John Russell as Chairman

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