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Rothamsted Report for 1947

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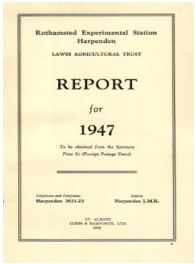
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C. B. Williams

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DEPARTMENT OF ENTOMOLOGY

By C. B. Williams

Investigations

Dr. Williams has continued his studies of insect migration, insect populations, and of the effect of weather conditions on the activity and abundance of insects.

The work on migration has consisted chiefly in the collection of a large number of records of the occurrence of immigrant insects into England during the last few years; and particularly of the Cabbage-White Butterfly and the Silver-Y Moth, both of which have come in from abroad in very large numbers recently and have done extensive damage. Co-operation has been established with workers on the Continent and a very much wider knowledge is now obtainable of the distribution of these migrants in Europe in different years. Some evidence of mass movement was obtained for the Antler Moth, a serious pest of upland pastures, which we have suspected for many years as a possible migrant.

In the study of the structure of insect populations progress has been made in the application of statistical methods to the relative abundance of different species of insects in a mixed population, which gives a new conception of the "balance" in such conditions. Also a study has been made of the importance of competition in preventing the development of two closely related species in a single ecological community. In a paper (128) evidence is brought forward that the advantages of close relationship (e.g., species in the same genus) may outweigh the disadvantages of competition, so that small communities contain fewer genera than would be expected in a community of the same size in which the species were selected without reference to generic relationships.

Before the war considerable work was carried out on the effect of weather conditions on the activity and abundance of insects by means of regular captures in a light trap; this work was a wide study on the effect on "insects" as a whole. In the last two years the study has been resumed, with the assistance of Mr. Banerjee, to test the possibility of working with single species of insects. About twenty abundant species of Lepidoptera have been chosen for study and the results are promising. The main difficulties have been: (1) the relatively short period over which any single species appears, (2) the rapid natural rise and fall of numbers during the brood, and (3) the relatively small numbers of any one species obtained in a trap. To overcome this last difficulty the number of traps has been increased to three, but it would be better still if this could be again increased to six.

The opportunity was taken of the Presidential Address to the Association of Applied Biologists (127), to show how the past activities of the Entomological Department fit into a general scheme of research in Applied Insect Ecology; with its object the study of the causes of insect outbreaks and their prevention, rather than continual expenditure on direct control methods.

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The scheme is as follows:—

FACTORS AFFECTING THE TOTAL POPULATION

The Physical Environment

*Geology and Geography

*Weather and climate

The Biological Environment

Food supply

*Parasites and Predators

*Competition

FACTORS AFFECTING THE DISTRIBUTION OF THE POPULATION

*Migration, or deliberate movement

*Drift, or accidental movement by natural causes

Accidental distribution by human agency.

Work in those sections marked * is already being carried out, and it is hoped that the scope might be extended to the other fields.

Dr. Barnes reports that owing to the part-time availability of an untrained assistant he was able to extend both the wheat blossom midges study as well as the slug investigations. He also states that his attendance at the Conference of Advisory Entomologists' meeting at Aberdeen during September was of immediate and direct use in establishing contacts and interchange of views concerning gall midge and slug problems in the field.

The progress of Dr. Barnes' investigations is as follows:—

1. The long-term study of the incidence of the wheat blossom midges on Broadbalk was successfully carried out for the twenty-first year in succession. While the numbers of *Contarinia tritici* remained high (21,094 per 500 ears compared with 29,638 in 1946) those of *Sitodiplosis mosellana* fell very considerably (599 per 500 ears compared with 3,853 in 1946). This drop is probably local and not general throughout the country. The percentage grain infestation on Broadbalk remained at 13 in the case of *C. tritici* but for *S. mosellana* it fell from 13 to 2. Since *S. mosellana* does more damage than *C. tritici* this drop is important. One may expect both species to decrease generally for the next year or two.

In 1947 the wheat blossom midges apparently responded to the abnormally hot weather at the end of May and early in June more than the wheat did. The result was that *Contarinia tritici* started emerging before the wheat plant was available for oviposition. This was observed both on Broadbalk and on a farm at Bedford. Consequently these early midges laid their eggs on a weed, Couch grass, both on Broadbalk and at Bedford.

The emergence of the midges on Broadbalk field was again studied and checked against that in the new insectary at Rothamsted Lodge. The correspondence was surprisingly high.

The study of the longevity of viable larvae in the soil showed that some *S. mosellana* gathered in July, 1939, emerged successfully during 1947; they had thus survived 8 winters in the soil. It is of more than passing interest to note that this survival in the soil has now been partly confirmed by Mr. Cohen, Advisory Entomologist in the Northern Province, and his colleagues who have found large numbers of living *S. mosellana* larvae in fields which have not been under wheat since 1945 and 1944 respectively.

2. As a direct result of the observations on the wild host plants of the wheat blossom midges, a *Stenodiplosis* gall midge was recorded

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for the first time from Couch grass both at Bedford and Harpenden. Superficial examination leads one to suppose this species of midge has come from Foxtail grass. This possible change of host plant may be of importance and it has already aroused the interest of Mr. W. Cottier, Senior Entomologist, of the Plant Disease Division in New Zealand.

3. Short biological studies were made on other gall midges including *Wachtliella ericina* on ornamental Heather, *Wachtliella rosarum* and *Macrolabis luceti* on Rose, *Contarinia solani* on Woody Nightshade (in an attempt to see whether this species would live on Deadly Nightshade or Tomato) and *Therodiplosis persicae* which lives on red spider on Peach and other plants grown under glass, e.g., Raspberry at Dundee.

4. The slug investigation was largely a comparison of slug activity at Bedford compared with that in Harpenden.

5. The appearance of further volumes of "*Gall Midges of Economic Importance*" was again delayed. But the final proofing and indexing of Vols. 3 and 4 was completed in August. Publication has been held up owing to shortages of binding cloth and paper, but now publication of Vol. 3 is promised for 24th March, 1948, but there is still (January, 1948) no news of Vol. 4.

Owing to this delay Dr. Barnes shelved the completion of further volumes, but intended to complete two further volumes in the year ending 30th September, 1948.

6. Identification of gall midges sent in has been almost entirely restricted to those sent in by Advisory Entomologists and others in this country. Time, however, will soon have to be made to deal with overseas consignments which have been accumulating.

Dr. Evans reports as follows on his work with Dr. Guild on the relations between earthworms and soil fertility.

The studies on the life-cycles of the common species have been continued.

Field studies

Annual fluctuations, the results of the three years' work, suggest that, in permanent pasture, large scale fluctuations do not occur.

In leys, after arable, there is a rapid build up of the population.

In arable, after permanent grass, there is but little decrease in population during the first year but a rapid diminution thereafter

Soil structure

The weight of wormcasts produced per acre per annum on pastures of varying age varied from 1–25 tons and it was calculated that from 4–36 tons of soil pass through the alimentary tracts of the total population present. The percentage pore space of a soil containing a high population of casting species is much greater than that of one containing a high population of non-casting species, i.e., 67 per cent. as against 40 per cent. The amount of coarse sand relative to silt and clay increases appreciably with depth in two old pastures and this distribution is probably the result of the long continued activity of earthworms.

Effects on soil fertility

A large scale pot experiment showed that the presence of earthworms in numbers approximating to those found in the field gave a significant increase in yield of the test crop, mustard. As a

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result of the four large scale pot experiments carried out during these investigations we have reached the conclusion that this method is not suitable and that, if the investigations are to be continued, experiments should be carried out in cylinders, at least 3 ft. in diameter, sunk into the soil and exposed to natural weather conditions. The tentative conclusion that we have reached is that earthworms are not of any great importance under arable conditions but that they are of great importance in soil uncultivated by man, i.e., permanent pasture, heaths and broad-leaved forests.

Dr. Johnson reports as follows in connection with his work on the distribution of aphididae in relation to weather conditions and field outbreaks.

A. Sampling Aphids on the bean crop

A sampling technique has been developed which enables the number of aphids, predators and parasites on the bean crop to be estimated on a satisfactory statistical basis. The method depends on selecting sample plants at random, removing all aphids from them and estimating the numbers by cliquot samples from a suspension in water. A rapid assessment of numbers, growth of populations, changes in proportions of instars, alatae, etc., can now be made and provides for the first time, with this insect on beans, a basis on which to compare infestations between plots or to study quantitatively the growth and decline of the populations themsilver. The results of last year's work are now being analysed.

B. Local Flighting

Hitherto local flighting has been studied mainly by means of nets or sticky traps which have the disadvantage of sampling relatively more insects as the wind-speed increases. Since the number of aphids in the air is itself dependent on wind-speed the use of these traps introduces an undesirable complication.

Experiments have, therefore, been made with two types of suction trap, which, by sucking a known and constant quantity of air through a vertical duct, gathers insects from known volumes of air.

Continuous records of aphids in these traps have been made throughout June-December, 1947, in two localities—one in an open field and one over a small bean patch. Identification of the aphids and analysis of their numbers in relation to times of day and weather and degree of infestation of the crop are now in progress.

C. Trapping of higher altitudes

Throughout the season trapping has been in progress at the R.D.E., Cardington, where nets have been flown almost daily from a barrage balloon cable at the following heights: 50, 250, 500, 1,000, 1,500, 2,000, 3,000, and 4,000 ft. The material gathered in these nets amounts to several thousands of aphids, which are now being identified. A quantitative analysis of numbers of aphids in relation to meteorological conditions is in progress.

D. Collection of Black Aphis for Biometrical Study

A collection of Bean Aphis from beans in different localities all over the country and black aphids from other hosts at Kew and near Rothamsted have been made. The intention was to study the limits of morphological variation of the bean aphid and its relations and to see if local differences occurred. A start has been made on the measurement of some characters but pressure of other work has put it in abeyance.